20 REGULATORY TREATMENT OF NON-SAFETY SYSTEMS

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20.1 INTRODUCTION

The ESBWR plant design uses passive safety systems to supply safety injection water and provide core and containment cooling. As the ESBWR relies on passive safety systems to perform the design-basis, safety-related functions of reactor inventory control and decay heat removal, different portions of active and passive systems also provide certain defense-in-depth backup to the primary passive features. For example, the Fuel and Auxiliary Pools Cooling System (FAPCS) Low Pressure Coolant Injection mode provides a nonsafety-related backup to the Gravity Driven Cooling System (GDCS). All active systems requiring AC power to operate are designated as non-safety related.

The ALWR Utility Requirements Document (URD) for passive plants, issued by the Electric Power Research Institute, recommends that the plant designer specifically define the active systems relied upon for defense-in-depth. Passive systems are able to perform their safety functions for 72 hours after an initiating event. After 72 hours, non-safety or active systems may be required to replenish the passive systems or to perform core and containment heat removal duties directly. The ESBWR includes active systems that provide defense-in-depth capabilities for reactor coolant system makeup and decay heat removal. These active systems provide backup capability and reduce challenges to the passive systems in the event of transients or plant upsets. In general, these systems are designated as non-safety related.

SECY-94-084, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs,” outlines a process that includes the use of both probabilistic and deterministic criteria to achieve the following objectives:

- Determine whether regulatory oversight for certain non-safety related systems is needed;
- Identify risk important SSCs for regulatory oversight (if it is determined that regulatory oversight is needed);
- Decide on an appropriate level of regulatory oversight for the various identified SSCs commensurate with their risk importance.

The SECY-94-084 criteria are applied to the ESBWR design to determine the systems that are candidates for RTNSS consideration in DCD Chapter 19A.

The purpose of Section 20 is to provide additional details, only in certain subsections, to support the information on RTNSS that is provided in DCD Tier 2 Appendix 19A. Section 20 is not intended to duplicate Appendix 19A material.

20.2 PROBABILISTIC ASSESSMENT OF RTNSS – CRITERION C

RTNSS Criterion C requires an assessment of safety functions relied upon at-power and during shutdown conditions to meet NRC safety goal guidelines. A comprehensive assessment to identify RTNSS candidates includes focused PRA sensitivity studies for internal events, evaluations of external events, an assessment of the effects of nonsafety-related systems on initiating event frequencies, and an assessment of uncertainties in these analyses and uncertainties that may be introduced by passive components.

20.2.1 Focused PRA Sensitivity Study

A focused PRA sensitivity study evaluates whether passive systems alone are adequate to meet the NRC safety goals of CDF less than 1.0 E-4 per year and LRF less than 1.0 E-6 per year. The focused PRA retains the same initiating event frequencies as the baseline PRA, and sets the status of nonsafety-related systems to failed, while safety-related systems remain unchanged in the model. Additional nonsafety-related systems are included if CDF or LRF values are above the goals. The additional nonsafety-related systems required to meet the CDF and LRF goals are candidates for RTNSS.

The intent of the focused analyses is to determine the impact to core damage frequency (CDF) and large release frequency (LRF) that is caused by removing credit for non-safety systems. The results are compared to the following NRC criteria to determine whether systems should be considered for regulatory treatment of non-safety systems (RTNSS):

- CDF < 1.0E-04/yr
- LRF < 1.0E-06/yr

Focused PRA analyses were performed for all the following PRA models:

(1) Core Damage Frequency

  a) Baseline
  b) Fire
  c) Flood
  d) High Winds

(2) Large Release Frequency

  a) Baseline
  b) Fire
  c) Flood
  d) High Winds

(3) Shutdown Core Damage Frequency

  a) Baseline
  b) Fire
  c) Flood

d) High Winds

The shutdown analyses do not require evaluation of LRF because the containment is assumed to be open. For the remaining analyses LRF is represented by releases other than allowed containment leakage, designated as variable “nTSL.”

The following systems are assumed to be unavailable for the focused analyses: Diesels (R21), Condenser (N37), Condensate and Feedwater, (N21), CRD Injection & FMCRD (C12), FAPCS (G21), RWCU/SDC (G31), FPS Injection (U43), DPS (C72), MSIV (B21), RCCW (P21), TCCW (P22), Plant Air (P51),Nitrogen (P54), Plant Service Water (P41), FMCRD groups' power (R12), PIP buses A3 and B3 (R11). A flag file is used to effectively fail these systems, by setting key representative components to TRUE.

Table 20.2-1, PRA Focus Results, shows the results of the focused PRA analyses with and without RTNSS. The focus internal events, fire, and flooding Level 1 or Level 2 PRA models currently do not meet at least one of the NRC criteria (CDF/LRF) without RTNSS systems. However, the CDF and LRF criteria are met if the RTNSS systems are credited as shown in the table referenced above.

20.2.2 Assessment of Uncertainties

The ESBWR PRA addresses passive system thermal-hydraulic uncertainty issues in a systematic process that identifies potential uncertainties in passive components or thermal-hydraulic phenomena and then applies an appropriate treatment to the component to ensure that the uncertainties are treated conservatively.

Passive system thermal-hydraulic uncertainties manifest themselves in the PRA model within failure probabilities and success criteria. Passive components that must rely on natural forces, such as gravity, have lower driving forces than conventional pumped systems so additional margin is incorporated into the design. Some passive functions are based on new engineering design, with limited operating experience to establish confidence in the failure rate estimates. The PRA models the effectiveness of passive safety functions in the failure rate estimated and success criteria that are factored into the event trees. Therefore, assessing the event tree success criteria in the PRA model identifies thermal-hydraulic uncertainties.

There are also uncertainties associated with the manual alignment and operation of long-term decay heat removal systems identified under RTNSS Criterion B. These uncertainties can influence the results such that there is a challenge to the CDF and LRF goals in transient sequences. This is not an issue for low frequency scenarios, such as large LOCA or seismic events.

In order to address these uncertainties, the FAPCS system is added as a RTNSS candidate. This system has the capability to provide a core injection function and to provide a decay heat removal function. The support systems needed to use this system are RCCWS, Standby Diesel Generators, PIP buses, Electrical Building HVAC, Fuel Building HVAC, Nuclear Island Chilled Water System, and PSWS. These are all considered to be covered by RTNSS for Criterion C.

The function of FAPCS is provided as a two train system. The trains are physically and electrically separated such that no single active component failure can fail the function. This provides the CDF and LRF reduction needed to address the PRA uncertainty concerns.

20.2.3 PRA Initiating Events Assessment

The At-Power and Shutdown PRA models are reviewed to determine whether non-safety SSCs could have a significant effect on the estimated frequency of initiating events. The following screening criteria are imposed on the at-power and shutdown initiating events:

(1) Are nonsafety related SSCs considered in the calculation of the initiating event frequency?

(2) Does the unavailability of the nonsafety-related SSCs significantly affect the calculation of the initiating event frequency?

(3) Does the initiating event significantly affect CDF or LRF for the baseline PRA?

If the answer to all three of these questions is "Yes", then the non-safety SSC is a RTNSS candidate. The results are discussed below.

20.2.3.1 At-Power Generic Transients

Initiating events that are considered Generic Transients are described in DCD subsection 19.2.3.1. Because several initiating events in this group are caused by the failures of non-safety-related SSCs, screening questions 1, 2, and 3 are answered "Yes." However, this category of transient initiating events includes various failures of components or operator errors. No specific non-safety-related systems have a significant effect on risk, and there are no RTNSS candidates from this category.

20.2.3.2 At-Power Inadvertent Opening of a Relief Valve

Safety/Relief Valves are safety-related. Therefore, they are not RTNSS candidates.

20.2.3.3 At-Power Transient with Loss of Feedwater

The initiating events in this group begin with a prompt and total loss of feedwater and require the success of other mitigating systems for reactor vessel level control. The SSCs related to feedwater and condensate are nonsafety-related, and thus Questions 1, 2, and 3 are answered "Yes." The loss of feedwater is a significant contributor to CDF, so the feedwater and condensate systems are RTNSS candidates. However, several features in the advanced design of the new generation feedwater level control system add significant reliability and, thus, a lower failure probability for loss of feedwater initiating events. The feedwater level control system is implemented on a triplicate, fault-tolerant digital controller. Therefore, a control failure is much less likely to occur in the ESBWR than in the design of current generation of reactors.

The dominant contributors to a total loss of feedwater are a loss of control power to the feedwater controllers and loss of AC power to the pumps. Only a total and immediate loss of all feedwater flow is included in the Loss of Feedwater initiating event category. A controller failure that results in reduced feedwater flow is much less significant than a complete loss of feedwater.

Therefore, due to the conservative treatment of the condensate and feedwater systems in the PRA, their risk significance does not warrant additional regulatory oversight.

20.2.3.4 At-Power Loss of Preferred Power

Loss of Preferred Power (LOPP) occurs as a result of severe weather, grid disturbances, plant-centered failures, or switchyard faults. Loss of preferred power is assumed to cause a plant trip and a loss of feedwater, with longer-term effects on other mitigating systems requiring AC power. The associated systems that comprise the onsite AC power distribution system are nonsafety-related, and thus, Questions 1 and 2 are answered "Yes." Plant-centered components such as substations, breakers, motor control centers, and protective relays are much less risk-significant and below the threshold for RTNSS consideration (less than1% contribution to CDF) so Question 3 is answered "No". The cumulative effects of Loss of preferred power are a significant contributor to CDF and LRF for at-power and shutdown risk. However, the dominant risk contributions are from the loss of incoming AC power from the utility grid and weather related faults. These types of faults are caused by components that are not controlled by the site organization. , Therefore, the SSCs within the ESBWR design scope for preventing a loss of offsite power initiating event are not risk significant and do not warrant additional regulatory oversight.

Note that the onsite power generation does have RTNSS controls due to other criteria.

20.2.3.5 At-Power LOCA

Loss of coolant accidents are initiated by piping leaks, valve leaks, or breaks. LOCAs are postulated to initiate in systems, such as RWCU/SDC and Main Steam. However, general design considerations require that all piping and components within the reactor coolant pressure boundary be safety-related. The RWCU/SDC and Main Steam piping have redundant safety-related isolation valves that automatically close on a LOCA signal. Questions 1, 2, and 3 are answered "No."

In addition, Safety/Relief Valves are safety-related. Therefore, there are no RTNSS candidates from this category.

20.2.3.6 Shutdown Loss of Preferred Power

The causes and effects of loss of preferred (that is, offsite) power initiating event during shutdown are similar to at-power conditions, which were discussed previously.

20.2.3.7 Loss of Shutdown Cooling

The decay heat removal function during shutdown modes of operation is provided by the Reactor Water Cleanup/Shutdown Cooling System (RWCU/SDCS) System operating in shutdown cooling mode. With the reactor well flooded, FAPCS may be used as an alternative.

If the reactor well is flooded, the risk associated with loss of decay heat removal is negligible because the large amount of water stored above the core assures long-term core cooling.

With the reactor well unflooded, it is assumed that both RWCU/SDC trains are in service and that one train is sufficient to remove decay heat while maintaining stable reactor coolant temperature. Therefore, if one RWCU pump were to trip in this configuration, it would not initiate a loss of shutdown cooling event, and Questions 1, 2, and 3 are answered "No."

There are no RTNSS candidates for regulatory oversight.

20.2.3.8 Shutdown LOCA

The frequency of Shutdown LOCA events is lower than at full power, due to the reduced vessel pressure and temperature. Also, the fact that control rods are fully inserted, the reduced pressure and temperature of the reactor coolant, and the lower decay heat level allow for longer times available for recovery actions.

Breaks outside containment can be originated only in ICS, RWCU/SDC or FAPCS piping, or instrument lines, because these are the only systems that remove reactor coolant from the containment during shutdown. The rest of the RPV vessel piping is isolated. The RWCU/SDC and FAPCS containment penetrations have redundant and automatic power-operated safety-related containment isolation valves that close on signals from the leak detection and isolation system and the reactor protection system. The ICS lines have redundant power operated safety-related isolation valves inside containment to terminate a loss of inventory in the event of an ICS line break outside of containment. Questions 1, 2, and 3 are answered "No."

There are no RTNSS candidates from this category, although availability controls on the lower drywell hatches are provided.

20.2.4 Summary of RTNSS Candidates from Criterion C

The focused PRA sensitivity study requires certain portions of DPS being designated as RTNSS. The portions that provide capability for a manual backup of safety-related automatic actuation of ECCS provides the level of protection necessary to meet both the CDF and LRF goals.

The assessment of uncertainties concludes that the defense-in-depth role of FAPCS in providing a backup source of low pressure injection and suppression pool cooling is within the requirements for RTNSS.

20.3 SELECTION OF IMPORTANT NON-SAFETY SYSTEMS

The selection of RTNSS systems considers nonsafety-related SSCs that are necessary to meet NRC regulations, safety goal guidelines, and containment performance goal objectives. RTNSS systems needed to meet the NRC regulations specified in Criteria A, B, D and E are based on deterministic analyses. RTNSS systems needed to meet Criterion C are based on PRA insights.

Results of the regulatory treatment assessment are summarized in Table 20.3-1.

20.4 PROPOSED REGULATORY OVERSIGHT

20.4.1 Regulatory Oversight

Regulatory oversight is applied to each system designated as RTNSS to ensure that it has sufficient reliability and availability to perform its RTNSS function, as defined by the focused PRA, or deterministic criteria. The extent of oversight is commensurate with the safety significance of the RTNSS function, and is categorized as either High Regulatory Oversight (HRO), Low Regulatory Oversight (LRO), or Support.

HRO - If the focused PRA analysis determines that a RTNSS system is significant to public health and safety (that is, necessary to meet the NRC safety goals) then it is classified as HRO. Technical Specification Limiting Condition for Operation should be established for the system/component, in accordance with 10 CFR 50.36.

LRO - If a RTNSS system is not significant, as described above, then the proposed level of regulatory oversight is Low Regulatory Oversight (LRO), which is addressed in regulatory availability specifications, which are described in the Availability Control Manual.

Support – These systems have low risk significance and they provide support (generally component and room cooling) for RTNSS systems that provide active mitigation functions. Treatment of support systems relative to the systems they support is described in the Availability Control Manual. The relationship between RTNSS support systems is illustrated in Figures 20.4-1 through 20.4-3.

20.5 ADDITIONAL INFORMATION

20.5.1 RTNSS Functions, Fault Tree Logic, and Components

Table 20.5-1, Example RTNSS Functions, Fault Tree Logic, and Components, provides insight as to the gate(s) representing the RTNSS function and the components working to fulfill those functions along with the specific basic events with which they are associated. This is provided as information only and not intended to duplicate the full scope and detail contained in the current model depicted in the various detailed sections of this document.

Table 20.2-1

PRA Focus Results

Mode	Model[1]	CDF (/yr)	LRF (/yr)	CDF (/yr)	LRF (/yr)
		FOCUS	**FOCUS**	**RTNSS**	**RTNSS**
At Power					
	Baseline	3.22E-04	3.05E-04 / 1.18E-04[2]	4.91E-06	9.06E-08
	Fire	1.15E-04	1.15E-04	2.40E-07	4.72E-08
	Flood[3]	1.15E-05	4.49E-06	9.06E-09	1.23E-09
	Total High Wind	1.94E-06	3.26E-07	1.76E-09	7.75E-11
Shutdown					
	Total SD Baseline	1.99E-06	1.99E-06	1.33E-07	1.33E-07
	Total SD Fire	2.54E-06	2.54E-06	2.68E-07	2.68E-07
	Total SD Flood	9.69E-07	9.69E-07	1.02E-07	1.02E-07
	Total SD High Winds	2.52E-07	2.52E-07	2.77E-09	2.77E-09

1 All analyses performed at 1E-15/yr truncation except as indicated below

2 Without / with Level 2 flag subsuming

3 The flood analyses use a truncation of 1E-14/yr

Table 20.3-1

RTNSS Systems

Table System	Function	RTNSS Criterion	Regulatory Treatment
ARI	Automatically depressurize scram header on ATWS signal.	A	LRO
BiMAC	Provide core debris cooling in LDW through deluge valves.	C	LRO
CB HVAC	Provide post 72-hour cooling for DCIS and Control Room habitability.	B2	Support
Chilled Water System	Provide post 72-hour cooling for HVAC. Provide cooling support for FAPCS.	B2 C	Support Support
Control Room Area Ventilation	Portable Generator for post 72-hour ventilation	B1	LRO
Diesel Fire Pump	Provide post 72-hour refill to PC/ICC and Spent Fuel pools.	B1	LRO
Diesel Generators	Provide power for post accident monitoring Provide power for FAPCS and support systems. (Non-seismic PRA sequences.)	B2 C	LRO LRO
DPS	Diverse actuation of ECCS functions.	C	HRO
Drywell Hatches	Provide boundary for recovering vessel level following a Shutdown LOCA below top of fuel event	C	LRO
EB HVAC	Provide post 72-hour cooling for DGs and 1E Electrical Distribution. Provide support for electrical power to FAPCS.	B2 C	Support Support
External Connection	Provide post 7-day refill to PC/ICC and Spent Fuel pools.	B1	LRO
FAPCS	Suppression pool cooling and low pressure coolant injection modes. (Non-seismic PRA sequences.)	C	LRO
FB HVAC	Provide cooling support for FAPCS.	C	Support
Feedwater Runback	Run FW demand to minimum on ATWS signal.	A	LRO
PAM Instruments (DCIS)	Provide post accident monitoring (use RG 1.97 to determine scope.)	B2	LRO

Table 20.3-1

RTNSS Systems

Table System	Function	RTNSS Criterion	Regulatory Treatment
PIP Buses	Provides post 72-hour AC power from standby diesel generators to support Post-Accident Monitoring, and FAPCS.	B2 C	Support Support
PSW	Provide post 72-hour cooling for RCCWS. Provide cooling support for FAPCS.	B2 C	Support Support
RB HVAC	Provide post 72-hour cooling for DCIS.	B2	Support
RCCWS	Provide post 72-hour cooling for Chillers and DGs. Provide cooling support for FAPCS.	B2 C	Support Support
SLCS Actuation	Backup actuation logic to initiate SLCS and isolate RWCU/SDC.	A	LRO
TB HVAC	Provide post 72-hour cooling for DCIS in Turbine Building. Provide room cooling for RCCW pumps.	B2 C	Support Support

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
ARI	Automatically depressurize scram header on ATWS signal. C72-ARIRXSCRAM, ARI VALVES FAIL TO VENT AIR HEADER	C72-ARIX, ARI VALVEs FAIL TO OPEN OR DPS FAILS TO GENERATE ACTUATION SIGNAL C72-ARIDPSD1PR, HIGH RPV PRESSURE SIGNAL TO DPS DIV I CONTROLLER C72-ARIDPSD2PR, HIGH RPV PRESSURE SIGNAL TO DPS DIV II CONTROLLER	C72-LOG-FC-D1DPS C72-LOG-FC-D2DPS C72-LOG-FC-D3DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC C12-SOV-FE-F043A C12-SOV-FE-F043B C12-SOV-FE-F044A C12-SOV-FE-F044B C12-SOV-FE-F038 C12-SOV-FE-F039 C12-SOV-FE-F042 R13-BAC-LP-R13RBA R13-BAC-LP-R13RBB R13-BAC-LP-R13RBC C72-ATM-FC-DPSPRA C72-ATM-FC-DPSPRB C72-ATM-FC-	DIVISION 1 LOGIC UNIT DIVISION 2 LOGIC UNIT DIVISION 3 LOGIC UNIT NSR R13 CONTROL BLDG LOAD GROUP A NSR R13 CONTROL BLDG LOAD GROUP B NSR R13 CONTROL BLDG LOAD GROUP C SOLENOID VALVE F043A SOLENOID VALVE F043B SOLENOID VALVE F044A SOLENOID VALVE F044B SOLENOID VALVE F038 SOLENOID VALVE F039 SOLENOID VALVE F042 NSR R13 REACTOR BLDG LOAD GROUP A NSR R13 REACTOR BLDG LOAD GROUP B NSR R13 REACTOR BLDG LOAD GROUP C ANALOG TRIP MODULE SIGNAL FOR HIGH

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			DPSPRC C72-ATM-FC-DPSPRD C62-ISIG8-PT1A C62-ISIG8-PT1B C62-ISIG8-PT1C C62-ISIG8-PT1D	PRESSURE A ANALOG TRIP MODULE SIGNAL FOR HIGH PRESSURE B ANALOG TRIP MODULE SIGNAL FOR HIGH PRESSURE C ANALOG TRIP MODULE SIGNAL FOR HIGH PRESSURE D RCSPRESS from PT1A RCSPRESS from PT1B RCSPRESS from PT1C RCSPRESS from PT1D
ARI		C72-ARIDPSD1LL, LOW LEVEL SIGNAL TO DPS DIV I CONTROLLER C72-ARIDPSD2LL, LOW LEVEL SIGNAL TO DPS DIV II CONTROLLER	C62-ISIG9-LTA C62-ISIG9-LTB C62-ISIG9-LTC C62-ISIG9-LTD C72-ATM-FC-DPSLLA C72-ATM-FC-DPSLLB C72-ATM-FC-DPSLLC C72-ATM-FC-DPSLLD	RCSLEVEL from LTA RCSLEVEL from LTB RCSLEVEL from LTC RCSLEVEL from LTD ANALOG TRIP MODULE SIGNAL FOR LOW LEVEL A (L2) ANALOG TRIP MODULE SIGNAL FOR LOW LEVEL B (L2) ANALOG TRIP MODULE SIGNAL FOR LOW LEVEL C (L2)

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
				ANALOG TRIP MODULE SIGNAL FOR LOW LEVEL D (L2)
BiMAC	Provide core debris cooling in LDW through deluge valves. BI_SP, GDCS DELUGE SUPPLY FAILS TO OPEN Modeled in Level 2 only.	POINT ESTIMATE E50-DELUGE-MECH, MECHANICAL FAILURES	L2-BI_FN-ESTIMATE E50-SQV-CC-F1-A1 E50-RE_-FD-FA1-1 E50-RE_-FD-FA1-2 E50-SQV-CC-F2-A2 E50-RE_-FD-FA2-1 E50-RE_-FD-FA2-2 E50-SQV-CC-F3-A3 E50-RE_-FD-FA3-1 E50-RE_-FD-FA3-2 E50-SQV-CC-F1-B1 E50-RE_-FD-FB1-1 E50-RE_-FD-FB1-2 E50-SQV-CC-F2-B2 E50-RE_-FD-FB2-1 E50-RE_-FD-FB2-2 E50-SQV-CC-F3-B3 E50-RE_-FD-FB3-1 E50-RE_-FD-FB3-2 E50-SQV-CC-F1-C1 E50-RE_-FD-FC1-1 E50-RE_-FD-FC1-2 E50-SQV-CC-F2-C2	CORE NOT COOLED BY DELUGE FLOW SQUIB VALVE FA1 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FA3 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FA3 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FB1 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FB2 ELECTROMECHANICAL RELAY

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			E50-RE_-FD-FC2-1	ELECTROMECHANICAL RELAY SQUIB VALVE FB3 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FC1 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FC2 ELECTROMECHANICAL RELAY
BiMAC		E50-DELUGE-ACT, ACTUATION FAILURES	E50-RE_-FD-FC2-2 E50-SQV-CC-F3-C3 E50-RE_-FD-FC3-1 E50-RE_-FD-FC3-2 E50-SQV-CC-F1-D1 E50-RE_-FD-FD1-1 E50-RE_-FD-FD1-2 E50-SQV-CC-F2-D2 E50-RE_-FD-FD2-1 E50-RE_-FD-FD2-2 E50-SQV-CC-F3-D3 E50-RE_-FD-FD3-1 E50-RE_-FD-FD3-2	ELECTROMECHANICAL RELAY SQUIB VALVE FC3 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FD1 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FD2 ELECTROMECHANICAL

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			 E50-BT_-LP-SQUIBS-TR1 E50-TT_-NO-PRI-A-TR1 E50-TT_-NO-ADJ-1A-TR1 E50-TT_-NO-ADJ-2A-TR1 E50-LOG-FC-THERM-A-TR1 E50-BT_-LP-PLCA-TR1 E50-TS_-CC-CHA-TR1 E50-RE_-FO-CH1A-S-TR1 E50-TT_-NO-PRI-B-TR1 E50-TT_-NO-ADJ-1B-TR1 E50-TT_-NO-ADJ-2B-TR1 E50-LOG-FC-THERM-B-TR1 E50-BT_-LP-PLCB-TR1 E50-TS_-CC-CHB-TR1 E50-RE_-FO-CH1B-	RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FD3 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY TRAIN 1 SQUIB-FIRING BATTERY TRAIN 1 PRIMARY THERMOCOUPLE A TRAIN 1 ADJACENT THERMOCOUPLE 1A TRAIN 1ADJACENT THERMOCOUPLE 2A TRAIN 1 LOGIC UNIT TRAIN 1 DEDICATED PLC A BATTERY TRAIN 1 TEMPERATURE SWITCH TRAIN 1 OUTPUT RELAY 1A-S TRAIN 1 PRIMARY THERMOCOUPLE B TRAIN 1 ADJACENT THERMOCOUPLE 1B

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			S-TR1 E50-BT_-LP-SQUIBS-TR2 E50-TT_-NO-PRI-A-TR2 E50-TT_-NO-ADJ-1A-TR2 E50-TT_-NO-ADJ-2A-TR2	TRAIN 1 ADJACENT THERMOCOUPLE 2B TRAIN 1 LOGIC UNIT TRAIN 1 DEDICATED PLC B BATTERY TRAIN 1 TEMPERATURE SWITCH TRAIN 1 OUTPUT RELAY 1B-S TRAIN 2 SQUIB-FIRING BATTERY TRAIN 2 PRIMARY THERMOCOUPLE A TRAIN 2 ADJACENT THERMOCOUPLE 1A TRAIN 2 ADJACENT THERMOCOUPLE 2A
BiMAC		E50-DELUGE-ACT, ACTUATION FAILURES (continued)	E50-LOG-FC-THERM-A-TR2 E50-BT_-LP-PLCA-TR2 E50-TS_-CC-CHA-TR2 E50-RE_-FO-CH1A-S-TR2 E50-TT_-NO-PRI-B-TR2 E50-TT_-NO-ADJ-	TRAIN 2 LOGIC UNIT TRAIN 2 DEDICATED PLC A BATTERY TRAIN 2 TEMPERATURE SWITCH TRAIN 2 OUTPUT RELAY 1A-S TRAIN 2 PRIMARY THERMOCOUPLE B

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			1B-TR2 E50-TT_-NO-ADJ-2B-TR2 E50-LOG-FC-THERM-B-TR2 E50-BT_-LP-PLCB-TR2 E50-TS_-CC-CHB-TR2 E50-RE_-FO-CH1B-S-TR2	TRAIN 2 ADJACENT THERMOCOUPLE 1B TRAIN 2 ADJACENT THERMOCOUPLE 2B TRAIN 2 LOGIC UNIT TRAIN 2 DEDICATED PLC B BATTERY TRAIN 2 TEMPERATURE SWITCH TRAIN 2 OUTPUT RELAY 1B-S
Control Room Area Ventilation	Portable Generator for post 72-hour ventilation	Not modeled		
DPS	Diverse actuation of ECCS functions.	Not specifically modeled, contained within several other modeled functions		
Drywell Hatches	Provide boundary for recovering vessel level following a Shutdown LOCA below top of fuel event	OPERATOR ACTIONS	DWH-1 DWH-2	Lower Drywell Hatches
Feedwater Runback	Run FW demand to minimum on ATWS signal.		R13-BAC-LP-R13TBA R13-BAC-LP-R13TBB	NSR R13 TURBINE/SWGR BLDG LOAD GROUP A NSR R13 TURBINE/SWGR BLDG

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
	CF-TOPRB, FEEDWATER RUN BACK FAILURE	C72-FWRBLDD1, LOAD DRIVER FAILS TO ENERGIZE CIRCUIT	R13-BAC-LP-R13TBC C72-LDD-FC-FWRB1	LOAD GROUP B NSR R13 TURBINE/SWGR BLDG LOAD GROUP C LOAD DRIVER
Feedwater Runback		C72-FWRBCONTROL1, DPS DIV I FW RUN BACK SIGNAL C72-FWRBCONTROL2, DPS DIV II FW RUN BACK SIGNAL C72-FWRBCONTROL3, DPS DIV III FW RUN BACK SIGNAL C72-FWRBLDD2, LOAD DRIVER FAILS TO ENERGIZE CIRCUIT C72-FWRBCONTROL1, DPS DIV I FW RUN BACK SIGNAL	C72-LOG-FC-D1DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC C72-LOG-FC-D2DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC C72-LOG-FC-D3DPS R13-BAC-LP-R13CBA R13-BAC-LP-	DIV 1 DPS LOGIC UNIT NSR R13 CONTROL BLDG LOAD GROUP A NSR R13 CONTROL BLDG LOAD GROUP B NSR R13 CONTROL BLDG LOAD GROUP C DIV 2 DPS LOGIC UNIT NSR R13 CONTROL BLDG LOAD GROUP A NSR R13 CONTROL BLDG LOAD GROUP B NSR R13 CONTROL BLDG LOAD GROUP C DIV 3 DPS LOGIC UNIT NSR R13 CONTROL BLDG LOAD GROUP A NSR R13 CONTROL

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			R13CBB	BLDG LOAD GROUP B
			R13-BAC-LP-R13CBC	NSR R13 CONTROL BLDG LOAD GROUP C
		C72-FWRBCONTROL2, DPS DIV II FW RUN BACK SIGNAL	C72-LDD-FC-FWRB2	LOAD DRIVER
		C72-FWRBCONTROL3, DPS DIV III FW RUN BACK SIGNAL	C72-LOG-FC-D1DPS	DIV 1 DPS LOGIC UNIT
			R13-BAC-LP-R13CBA	NSR R13 CONTROL BLDG LOAD GROUP A
			R13-BAC-LP-R13CBB	NSR R13 CONTROL BLDG LOAD GROUP B
			R13-BAC-LP-R13CBC	NSR R13 CONTROL BLDG LOAD GROUP C
			C72-LOG-FC-D2DPS	DIV 2 DPS LOGIC UNIT
			R13-BAC-LP-R13CBA	NSR R13 CONTROL BLDG LOAD GROUP A
			R13-BAC-LP-R13CBB	NSR R13 CONTROL BLDG LOAD GROUP B
			R13-BAC-LP-R13CBC	NSR R13 CONTROL BLDG LOAD GROUP C
			C72-LOG-FC-D3DPS	DIV 3 DPS LOGIC UNIT
			R13-BAC-LP-R13CBA	NSR R13 CONTROL BLDG LOAD GROUP A
			R13-BAC-LP-R13CBB	NSR R13 CONTROL BLDG LOAD GROUP B
				NSR R13 CONTROL

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			R13-BAC-LP-R13CBC	BLDG LOAD GROUP C
LCS Actuation	Backup actuation logic to initiate SLCS and isolate RWCU/SDC. BC-TOPRWCU, FAILURE TO ISOLATE BREAK OUTSIDE CONTAINMENT IN RWCU LINE	T10-RWCU-F004A-OO, NONSAFETY-RELATED AIR OPERATED VALVE F004A FAILS TO CLOSE T10-RWCU-F044A-OO, NONSAFETY-RELATED MOTOR OPERATED VALVE F044A FAILS TO CLOSE T10-RWCU-F004B-OO, NONSAFETY-RELATED AIR OPERATED VALVE F004B FAILS TO CLOSE	G31-ACV-OO-F004A C72-LDD-FC-S1G31F3A C72-LDD-FC-S2G31F3A R13-BAC-LP-R13RBA R13-BAC-LP-R13RBB C72-LOG-FC-D1DPS C72-LOG-FC-D2DPS C72-LOG-FC-D3DPS G31-MOV-OO-F044A C72-LDD-FC-S1G31F8A C72-LDD-FC-S2G31F8A R12-BAC-LP-A2-02A R13-BAC-LP-R13RBA R13-BAC-LP-R13RBB C72-LOG-FC-D1DPS C72-LOG-FC-D2DPS C72-LOG-FC-D3DPS	NSR ACV F004A RWCU/SDC F003A FIRST SERIES LOAD DRIVER RWCU/SDC F003A SECOND SERIES LOAD DRIVER NSR R13 REACTOR BLDG LOAD GROUP A NSR R13 REACTOR BLDG LOAD GROUP B DIVISION 1 LOGIC UNIT DIVISION 2 LOGIC UNIT DIVISION 3 LOGIC UNIT MOTOR OPERATED VALVE F044A RWCU/SDC F008A FIRST SERIES LOAD DRIVER RWCU/SDC F008A SECOND SERIES LOAD DRIVER 480 VAC BUS A2-02A NSR R13 REACTOR BLDG LOAD GROUP A NSR R13 REACTOR

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			G31-ACV-OO-F004B C72-LDD-FC-S1G31F3B C72-LDD-FC-S2G31F3B R13-BAC-LP-R13RBA R13-BAC-LP-R13RBB C72-LOG-FC-D1DPS C72-LOG-FC-D2DPS C72-LOG-FC-D3DPS	BLDG LOAD GROUP B DIVISION 1 LOGIC UNIT DIVISION 2 LOGIC UNIT DIVISION 3 LOGIC UNIT NSR ACV F004B RWCU/SDC F003B FIRST SERIES LOAD DRIVER RWCU/SDC F003B SECOND SERIES LOAD DRIVER NSR R13 REACTOR BLDG LOAD GROUP A NSR R13 REACTOR BLDG LOAD GROUP B DIVISION 1 LOGIC UNIT DIVISION 2 LOGIC UNIT DIVISION 3 LOGIC UNIT
SLCS Actuation		T10-RWCU-F044B-OO, NONSAFETY-RELATED MOTOR OPERATED VALVE F044B FAILS TO CLOSE	G31-MOV-OO-F044B C72-LDD-FC-S1G31F8B C72-LDD-FC-S2G31F8B R12-BAC-LP-B2-02B R13-BAC-LP-R13RBA R13-BAC-LP-R13RBB C72-LOG-FC-D1DPS C72-LOG-FC-D2DPS C72-LOG-FC-D3DPS	MOTOR OPERATED VALVE F044B RWCU/SDC F008B FIRST SERIES LOAD DRIVER RWCU/SDC F008B SECOND SERIES LOAD DRIVER 480 VAC BUS B2-02B NSR R13 REACTOR BLDG LOAD GROUP A NSR R13 REACTOR BLDG

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
				LOAD GROUP B DIVISION 1 LOGIC UNIT DIVISION 2 LOGIC UNIT DIVISION 3 LOGIC UNIT
DCIS				
TB HVAC	Provide post 72-hour cooling for DCIS in Turbine Building.	Not modeled		
TB HVAC	Provide room cooling for RCCW pumps.	Not specifically modeled, contained within several other modeled functions		
CB HVAC	Provide post 72-hour cooling for DCIS and Control Room habitability.	Not modeled		
Chilled Water System	Provide post 72-hour cooling for HVAC.	Not modeled		
EB HVAC	Provide post 72-hour cooling for DGs and 1E Electrical Distribution.	Not modeled		
PSW	Provide post 72-hour cooling for RCCWS.	Not modeled		
RB HVAC	Provide post 72-hour cooling for DCIS.	Not modeled		
RCCWS	Provide post 72-hour cooling for Chillers and DGs.	Not modeled		
FAPCS				

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
Chilled Water System	Provide cooling support for FAPCS.		NICWSA-SYS-FAILS NICWSB-SYS-FAILS	NUCLEAR ISLAND CHILLED WATER SUBSYSTEM TRAIN A NUCLEAR ISLAND CHILLED WATER SUBSYSTEM TRAIN B
Diesel Generator	Provide power for FAPCS and support systems. (Non-seismic PRA sequences.) G102, LOSS OF ELECTRICAL POWER WHICH WOULD LEAD TO TRAIN SEPARATION	R21-DGA-0020, DG-A FAILS TO RUN	R21-DG_-FR-DGA	DIESEL GENERATOR "A"
		R21-DGA-0060, DG-A FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE	R21-TNK-RP-1A R12-BAC-LP-A2-01A R21-BV_-OC-F1A R21-MP_-FR-P1A R21-UV_-CC-F3A R21-BV_-OC-F5A R21-BV_-OC-F2A R21-MP_-FR-P2A R21-UV_-CC-F4A R21-BV_-OC-F6A R21-FLT-PG-DGA R21-TNK-RP-2A R21-BV_-OC-F7A R21-LT_-NO-DGA	TANK 1A 480 VAC BUS A2-01A MANUAL VALVE MOTOR DRIVEN PUMP CHECK VALVE MANUAL VALVE MANUAL VALVE MOTOR DRIVEN PUMP CHECK VALVE MANUAL VALVE FILTER TANK MANUAL VALVE LEVEL TRANSMITTER
		R21-DGA-0080, DG-A JACKET COOLING FAILURE	P21-ACV-OO-F023A	AIR OPERATED VALVE F023A
Diesel Generator		P21-0016-_1-LL, HEAT EXCHANGER 0001A FAILURES (RCCW HX 0001A IN STANDBY)	P21-MOV-CC-F034A P21-MOV-OC-F0010A1 P21-HX_-LK-B001A P41-ACV-OC-F002A	MOV P21-F034A FROM RCCWS TO RWCU/SDC HX-A MOTOR OPERATED VALVE F0010A1 HEAT EXCHANGER B001A

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
		P21-0016-_3-LL, HEAT EXCHANGER 0002A FAILURES (RCCW HX 0002A IN STANDBY) P21-0016-_5-LL, HEAT EXCHANGER 0003A FAILURES (RCCW HX 0003A IN STANDBY) R21-DGA-0050, DG-A ROOM COOLING FAILURE	P41-ACV-CC-F009A P41-MOV-OC-F003A P21-ACV-OO-F016A P21-ACV-OC-F012A P21-MOV-CC-F034B P21-MOV-OC-F0010A2 P21-HX_-LK-B002A P41-ACV-OC-F002A P41-ACV-OC-F004A P41-MOV-OC-F005A P21-ACV-OO-F016A P21-ACV-OC-F012A P21-MOV-CC-F0010A3 P21-HX_-LK-B003A P41-ACV-OC-F002A P41-ACV-CC-F006A P41-MOV-OC-F007A R21-FAN-FR-AHU2A R21-AHU-FR-3A R21-FAN-FR-10A R21-FAN-FR-11A R21-FAN-FR-12A R21-MOD-CC-1A R21-MOD-CC-2A R21-MOD-CC-3A R21-MOD-CC-4A R21-MOD-CC-5A	AIR OPERATED VALVE MV-F002A AIR OPERATED VALVE F009A MOTOR OPERATED VALVE F003A AIR OPERATED VALVE F016A AIR OPERATED VALVE F012A MOV P21-F034B FROM RCCWS TO RWCU/SDC HX-B MOTOR OPERATED VALVE F0010A2 HEAT EXCHANGER B002A AIR OPERATED VALVE MV-F002A AIR OPERATED VALVE MV-F004A MOTOR OPERATED VALVE MV-F005A AIR OPERATED VALVE F016A AIR OPERATED VALVE F012A MOTOR OPERATED VALVE F0010A3 HEAT EXCHANGER B003A AIR OPERATED VALVE MV-F002A AIR OPERATED VALVE MV-F006A MOTOR OPERATED VALVE MV-F007A

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
				DG-A NORMAL VENTILATION FAN AIR HANDLING UNIT BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN MOTOR OPERATED DAMPER 1A MOTOR OPERATED DAMPER 2A MOTOR OPERATED DAMPER 3A MOTOR OPERATED DAMPER 4A MOTOR OPERATED DAMPER 5A
Diesel Generator		R21-DGB-0020, DG-B FAILS TO RUN R21-TRANSFERB, FUEL OIL TRANSFER FAILURE FOR DG-B	R21-MOD-CC-6A R12-BAC-LP-A2-01A R21-DG_-FR-DGB R21-FLT-PG-DGB R21-BV_-OC-F1B R21-MP_-FR-P1B R21-UV_-CC-F3B R21-BV_-OC-F5B R21-BV_-OC-F2B R21-MP_-FR-P2B R21-UV_-CC-F4B R21-BV_-OC-F6B R12-BAC-LP-B2-01B	MOTOR OPERATED DAMPER 6A 480 VAC BUS A2-01A DIESEL GENERATOR "B" FILTER MANUAL VALVE MOTOR-DRIVEN PUMP CHECK VALVE MANUAL VALVE MANUAL VALVE MOTOR DRIVEN PUMP CHECK VALVE MANUAL VALVE

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
		R21-DGB-0080, DG-B JACKET COOLING FAILURE	R21-TNK-RP-1B R21-TNK-RP-2B R21-BV_-OC-F7B R21-LT_-NO-DGB P21-ACV-OO-F023B P21-MPC-FR-C001B P21-AHU-FR-RCCWB NICWSB-SYS-FAILS P21-UV_-CC-0001B1 P21-MPC-FR-C002B P21-UV_-CC-0001B2 P21-MPC-FR-C003B P21-UV_-CC-0001B3 P21-ACV-CC-F0023B P21-TNK-RP-0001B P21-ACV-OO-F0004 P21-ACV-OO-F0007	480 VAC BUS B2-01B TANK TANK MANUAL VALVE LEVEL TRANSMITTER AIR OPERATED VALVE MOTOR DRIVEN PUMP C001B AIR HANDLING UNIT RCCWS ROOM TRAIN B NUCLEAR ISLAND CHILLED WATER SUBSYSTEM TRAIN B CHECK VALVE 0001B1 MOTOR-DRIVEN PUMP C002B CHECK VALVE 0001B2 MOTOR-DRIVEN PUMP C003B CHECK VALVE 0001B3 AIR OPERATED VALVE F0023B RCCW SURGE TANK 0001B AIR OPERATED VALVE F0004 AIR OPERATED VALVE F0007
Diesel Generator		R21-DGB-0050, DG-B ROOM COOLING FAILURE	P21-ACV-OO-F0020 P21-ACV-OO-F0027 P21-ACV-OO-F0061 R21-FAN-FR-AHU2B R21-FAN-FR-10B R21-FAN-FR-11B	AIR OPERATED VALVE F0020 AIR OPERATED VALVE F0027 AIR OPERATED VALVE F0061 BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			R21-FAN-FR-12B R21-MOD-CC-1B R21-MOD-CC-2B R21-MOD-CC-3B R21-MOD-CC-4B R21-MOD-CC-5B R21-MOD-CC-6B R21-AHU-FR-3B R12-BAC-LP-B2-01B	BLOWER/VENTILATION FAN MOTOR-OPERATED DAMPER MOTOR-OPERATED DAMPER MOTOR-OPERATED DAMPER MOTOR-OPERATED DAMPER MOTOR-OPERATED DAMPER MOTOR-OPERATED DAMPER AIR HANDLING UNIT 480 VAC BUS B2-01B
EB HVAC	Provide support for electrical power to FAPCS.	R21-DGA-0050, DG-A ROOM COOLING FAILURE R21-DGB-0050, DG-B ROOM COOLING FAILURE	R21-FAN-FR-AHU2A R21-AHU-FR-3A R21-FAN-FR-10A R21-FAN-FR-11A R21-FAN-FR-12A R21-MOD-CC-1A R21-MOD-CC-2A R21-MOD-CC-3A R21-MOD-CC-4A R21-MOD-CC-5A R21-MOD-CC-6A R12-BAC-LP-A2-01A R21-FAN-FR-AHU2B R21-FAN-FR-10B R21-FAN-FR-11B R21-FAN-FR-12B R21-MOD-CC-1B	DG-A NORMAL VENTILATION FAN AIR HANDLING UNIT BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN MOTOR OPERATED DAMPER 1A MOTOR OPERATED DAMPER 2A MOTOR OPERATED DAMPER 3A MOTOR OPERATED DAMPER 4A MOTOR OPERATED DAMPER 5A MOTOR OPERATED DAMPER 6A 480 VAC BUS A2-01A

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
				BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN BLOWER/VENTILATION FAN MOTOR-OPERATED DAMPER 1B
EB HVAC			R21-MOD-CC-2B R21-MOD-CC-3B R21-MOD-CC-4B R21-MOD-CC-5B R21-MOD-CC-6B R21-AHU-FR-3B R12-BAC-LP-B2-01B	MOTOR-OPERATED DAMPER 2B MOTOR-OPERATED DAMPER 3B MOTOR-OPERATED DAMPER 4B MOTOR-OPERATED DAMPER 5B MOTOR-OPERATED DAMPER 6B AIR HANDLING UNIT 480 VAC BUS B2-01B
FAPCS	Suppression pool cooling and low pressure coolant injection modes. (Non-seismic PRA sequences.) WS-TOPSPC, FAPCS SUPPRESSION POOL COOLING	G21-FDSPA, FAPCS SPC INJECTION TRAIN A G21-TRA-RUNN, TRAIN A G21-FDSPB, FAPCS SPC INJECTION TRAIN B	G21-UV_-CC-F307A G21-NMO-CC-F306A G21_P21-ARUN G21-FT_-NO-N014A G21-PT_-NO-N002A G21-MOV-OO-F008A G21-MOV-OO-F003A G21-MOV-CC-F011A G21-MOV-CC-F013A G21-MOV-CC-F014A G21-UV_-OC-F004A G21-MP_-FR-C001A G21-UV_-CC-F307B	CHECK VALVE F307A NITROGEN MOTOR OPERATED VALVE F306A SEE RCCWS SECTION BELOW DISCHARGE FLOW TRANSMITTER SUCTION PRESSURE TRANSMITTER MOTOR OPER. VALVE F008A MOTOR OPERATED VALVE F003A MOTOR OPER. VALVE F011A MOTOR OPER. VALVE

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
		G21-BRUN, TRAIN B	G21-NMO-CC-F306B G21_P21-BRUN G21-FT_-NO-N014B G21-PT_-NO-N002B G21-MOV-OO-F008B G21-MOV-OO-F003B G21-MOV-CC-F011B G21-MOV-CC-F013B G21-MOV-CC-F014B G21-UV_-OC-F004B G21-MP_-FR-C001B	F013A MOTOR OPER. VALVE F014A CHECK VALVE F004A MOTOR-DRIVEN PUMP C001A CHECK VALVE F307B NITROGEN MOTOR OPERATED VALVE F306B SEE RCCWS SECTION BELOW DISCHARGE FLOW TRANSMITTER SUCTION PRESSURE TRANSMITTER MOTOR OPER. VALVE F008B MOTOR OPERATED VALVE F003B MOTOR OPER. VALVE F011B MOTOR OPER. VALVE F013B MOTOR OPER. VALVE F014B CHECK VALVE F004B MOTOR-DRIVEN PUMP C001B
FAPCS	VL-TOPINJL, FAPCS LPCI OP. MODE	In addition to G21-TRA-RUNN and G21-BRUN above G21-RPV-INJ, FLOW DISCHARGE INTOTHE RPV (VIA FW ANDRWCU LINES) FAILS	B21-UV_-CC-F102A B21-UV_-CC-F103A G21-NMO-CC-F332A	CHECK VALVE F102A IN FEEDWATER LINE A CHECK VALVE F103A IN

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			G21-NMO-CC-F332B G21-UV_-CC-F333A G21-UV_-CC-F333B G21-UV_-CC-F331A G21-UV_-CC-F331B G21-UV_-CC-F348A G21-UV_-CC-F348B T23-POL-RP-SP G21-NMO-CC-F321A G21-NMO-CC-F321B G21-NMO-CC-F3222A G21-NMO-CC-F322B B21-LT_-NO-N001A B21-LT_-NO-N001B B21-LT_-NO-N001C B21-LT_-NO-N001D G21-BV_-OC-F320	FEEDWATER LINE A NITROGEN MOTOR OPERATED VALVE F332A NITROGEN MOTOR OPERATED VALVE F332B CHECK VALVE F333A CHECK VALVE F333B CHECK VALVE F331A CHECK VALVE F331B CHECK VALVE F348A CHECK VALVE F348B SUPPRESSION POOL NITROGEN MOTOR OPERATED VALVE F321A NITROGEN MOTOR OPERATED VALVE F321B NITROGEN MOTOR OPERATED VALVE F322A NITROGEN MOTOR OPERATED VALVE F322B SP LEVEL TRANSMITTER NOO1A SP LEVEL TRANSMITTER NOO1B SP LEVEL TRANSMITTER NOO1C SP LEVEL TRANSMITTER NOO1D MANUAL VALVE F320
FB HVAC	Provide cooling support for FAPCS.			
PSW	Provide cooling	P41-0070-_1, PSW PUMP 1A	P41-SYS-FC-HVACPSW-A	PSW-A ROOM COOLING MOTOR DRIVEN PUMP

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
	support for FAPCS P41-0002-_2, INSUFFICIENT FLOW FROM PSW PUMPS		P41-0074-_1 P41-MOV-OC-PMPF002A P41-0077-_1 R11-BAC-LP-100A3 P41-0075-_1	C001A MOTOR OPERATED VALVE MV-F002A STRAINER P41-D001A 6.9 KV AC PIP-A LOADS BUS 1000A3 CHECK VALVE F001A
PSW		P41-0091-_2, PSW PUMP 2A P41-0070-_3, PSW PUMP 1B P41-0091-_4, PSW PUMP 2B	P41-SYS-FC-HVACPSW-A P41-0074-_2 P41-MOV-OC-PMPF004A P41-0077-_2 R11-BAC-LP-100A3 P41-0075-_2 P41-SYS-FC-HVACPSW-B P41-0074-_3 P41-MOV-OC-PMPF002B P41-0077-_3 R11-BAC-LP-100B3 P41-0075-_3 P41-SYS-FC-HVACPSW-B P41-0074-_4 P41-MOV-OC-PMPF004B P41-0077-_4 R11-BAC-LP-100B3 P41-0075-_4	PSW-A ROOM COOLING MOTOR DRIVEN PUMP C002A MOTOR OPERATED VALVE MV-F004A STRAINER P41-D002A 6.9 KV AC PIP-A LOADS BUS 1000A3 CHECK VALVE F003A PSW-B ROOM COOLING MOTOR DRIVEN PUMP C001B MOTOR OPERATED VALVE MV-F002B STRAINER P41-D001B 6.9 KV AC PIP-A LOADS BUS 1000B3 CHECK VALVE F001B PSW-B ROOM COOLING MOTOR-DRIVEN PUMP C002B

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
				MOTOR OPERATED VALVE MV-F004B STRAINER P41-D002B 6.9 KV AC PIP-A LOADS BUS 1000B3 CHECK VALVE F003B
RCCWS	Provide cooling support for FAPCS.	G21_P21-ARUN, RCCWS FAIL TO COOL FAPCS	G21-HX_-LK-B001A G21-MOV-OC-F046A G21-MOV-OC-F047A G21-MOV-CO-F048A P21-MOV-OC-F0010A1 P41-ACV-OC-F002A P41-MOV-OC-F003A P41-ACV-OC-F009A P21-ACV-CO-F016A P21-ACV-OC-F012A	HEAT EXCHANGER B001A MOTOR OPERATED VALVE P21-F046A MOTOR OPERATED VALVE P21-F047A MOTOR OPERATED VALVE P21-N048A MOTOR OPERATED VALVE F0010A1 AIR OPERATED VALVE MV-F002A MOTOR OPERATED VALVE F003A AIR OPERATED VALVE MV-F009A AIR OPERATED VALVE F016A AIR OPERATED VALVE F012A
RCCWS		G21_P21-RUNN, RCCWS FAIL TO COOL FAPCS	P21-HX_-LK-B001B G21-MOV-OC-F046B G21-MOV-OC-F047B G21-MOV-CO-F048B P21-MOV-OC-F0010B1 P41-ACV-OC-F002B P41-MOV-OC-F003B P41-ACV-OC-F009B	HEAT EXCHANGER B001B MOTOR OPERATED VALVE P21-F046B MOTOR OPERATED VALVE P21-F047B MOTOR OPERATED VALVE P21-N048B MOTOR OPERATED VALVE F0010B1 AIR OPERATED VALVE MV-

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			P21-ACV-CO-F016B P21-ACV-OC-F012B	F002B MOTOR OPERATED VALVE MV-F003B AIR OPERATED VALVE MV-F009B AIR OPERATED VALVE F016B AIR OPERATED VALVE F012B
TB HVAC	Provide room cooling for RCCW pumps.	P21-HVACRCCWAFTR, FAILURE OF RCCW ROOM A FCU TO RUN P21-HVACRCCWBFTR, FAILURE OF RCCW ROOM B FCU TO RUN	P21-AHU-FR-RCCWA R12-BAC-LP-TB1-A NICWSA-SYS-FAILS P21-AHU-FR-RCCWB R12-BAC-LP-TB1-B NICWSB-SYS-FAILS	AIR HANDLING UNIT RCCWS ROOM A 480 VAC TURBINE BLDG POWER CENTER 1-A NUCLEAR ISLAND CHILLED WATER SUBSYSTEM TRAIN A AIR HANDLING UNIT RCCWS ROOM TRAIN B 480 VAC TURBINE BLDG POWER CENTER 1-B NUCLEAR ISLAND CHILLED WATER SUBSYSTEM TRAIN B
PIP Buses	Provide post 72-hour AC power from standby diesel generators to support Post-Accident Monitoring, and FAPCS.	Not modeled		
RCCWS	Provide post 72-hour	Not modeled		

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
	cooling for Chillers and DGs.			
PCS/ICCS				
Diesel Makeup Pump	Provide post 72-hour refill to PC/ICC and Spent Fuel pools. FPS-MKUP, MAKEUP FROM FPS FAILS	FPS-P1A, MAKE UP FROM PRIMARY FPS DIESEL PUMP TRAIN FAILS FPS-P2A, MAKE UP FROM SECONDARY FPS DIESEL DRIVEN PUMP FAILS	U43-EDP-FR-P1A U43-TNK-RP-TNK3 U43-UV_-CC-FU432A U43-UV_-CC-FU431A U43-TNK-RP-T1A U43-EDP-FR-P2A U43-TNK-RP-TNK4 U43-UV_-CC-FU43TB U43-UV_-CC-FU433A U43-TNK-RP-MKUP	DIESEL-DRIVEN PUMP P1A PRIMARY DIESEL FUEL TANK P1A FIRE HEADER CHECK VALVE PUMP P1A DISCHARGE CHECK VALVE PRIMARY TANK 1A DIESEL-DRIVEN PUMP 2A SECONDARY DIESEL FUEL TANK SECONDARY FPS HEADER CHECK VALVE PUMP DISCHARGE CHECK VALVE MAKEUP WATER
External Connection	Provide post 7-day refill to PC/ICC and Spent Fuel pools. U43-ICPCCS, INJECTION INTO IC/PCCS POOL FAILS	FPS-2ND, SECONDARY LINE TO REACTOR BUILDING FAILS FPS-PCCSA, TRAIN A FPS TO IC/PCCS FAILURE FPS-PCCSB, TRAIN B FPS TO IC/PCCS FAILURE	U43-UV_-CC-FU436 U43-BV_-CC-FU437 U43-UV_-CC-FU434A G21-UV_-CC-F427A U43-BV_-CC-F426A U43-BV_-CC-FU435A U43-UV_-CC-FU434B G21-UV_-CC-F427B U43-BV_-CC-F426B	CHECK VALVE MANUAL VALVE CHECK VALVE F434A CHECK VALVE F427A MANUAL VALVE F426A MANUAL VALVE F435A CHECK VALVE F434B CHECK VALVE F427B MANUAL VALVE F426B

Table 20.5-1

Example RTNSS Functions, Fault Tree Logic, and Components

System/ Subsystem	RTNSS Functions	Fault Tree Logic ID	Basic Event(s)	Component(s)
			U43-BV_-CC-FU435B	MANUAL VALVE F435B
Post Accident Monitoring				
Diesel Generator	Provide power for post accident monitoring	Not modeled		
PAM Instruments (DCIS)	Provide post accident monitoring	Not modeled		
PIP Buses	Provide post 72-hour AC power from standby diesel generators to support Post-Accident Monitoring, and FAPCS.	Not modeled		
RCCWS	Provide post 72-hour cooling for Chillers and DGs.	Not modeled		

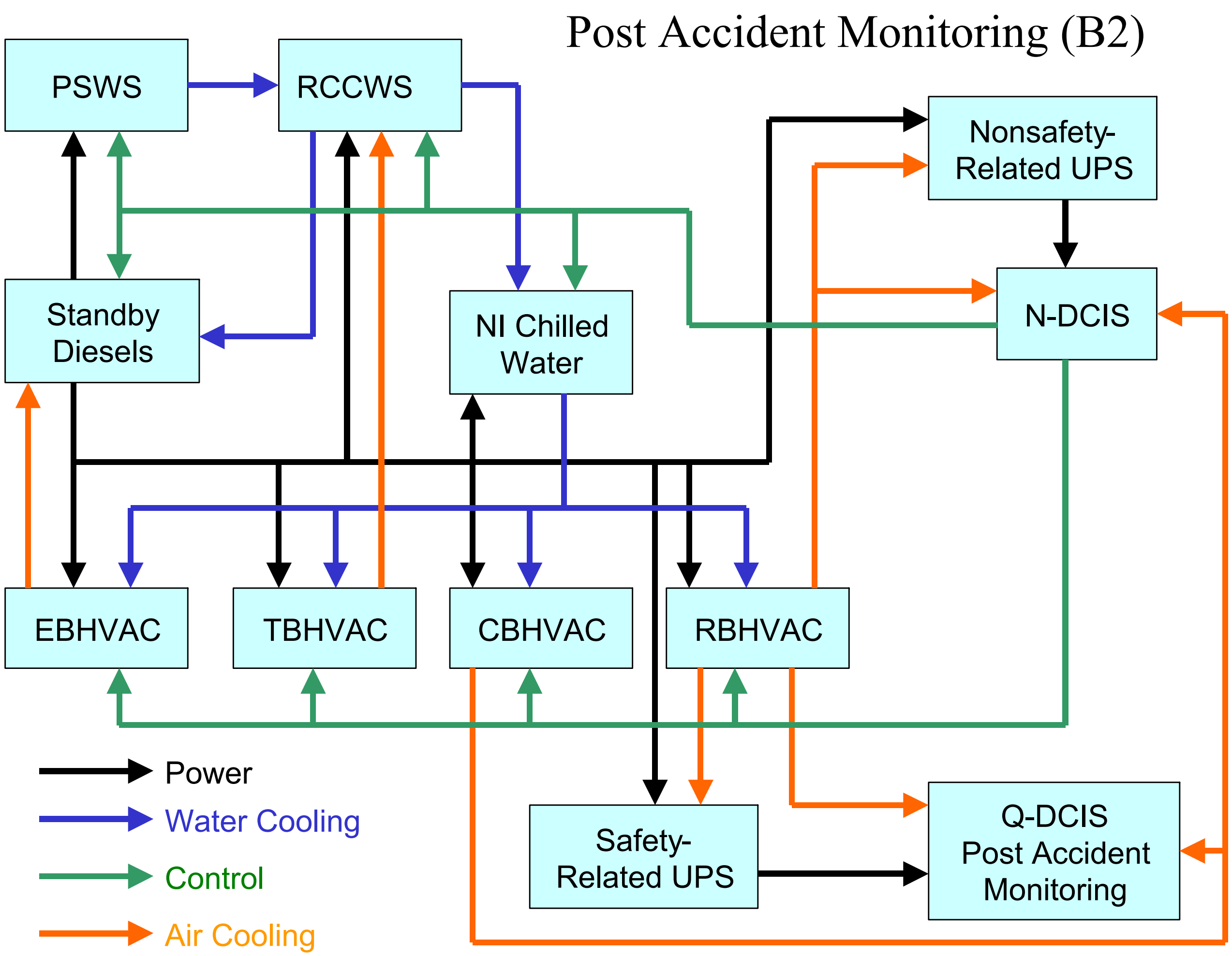

Figure 20.4-1
RTNSS Functional Relationships Supporting Post Accident Monitoring

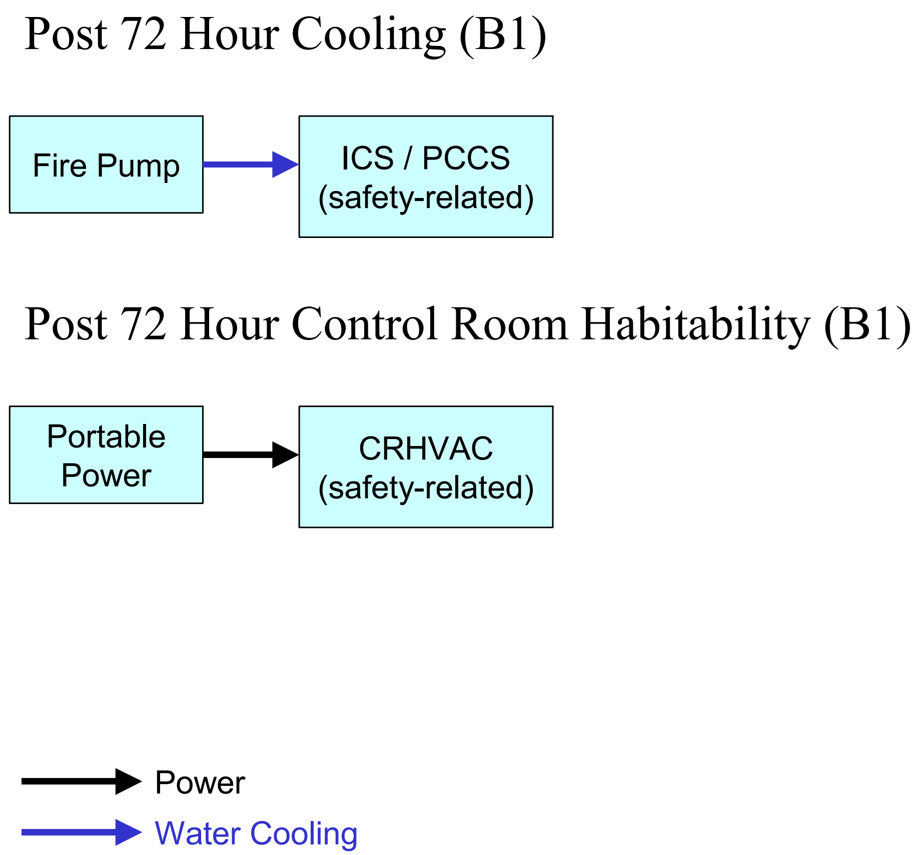

Figure 20.4-2
RTNSS Functional Relationships Supporting Post 72 hour Cooling & Control Room Habitability

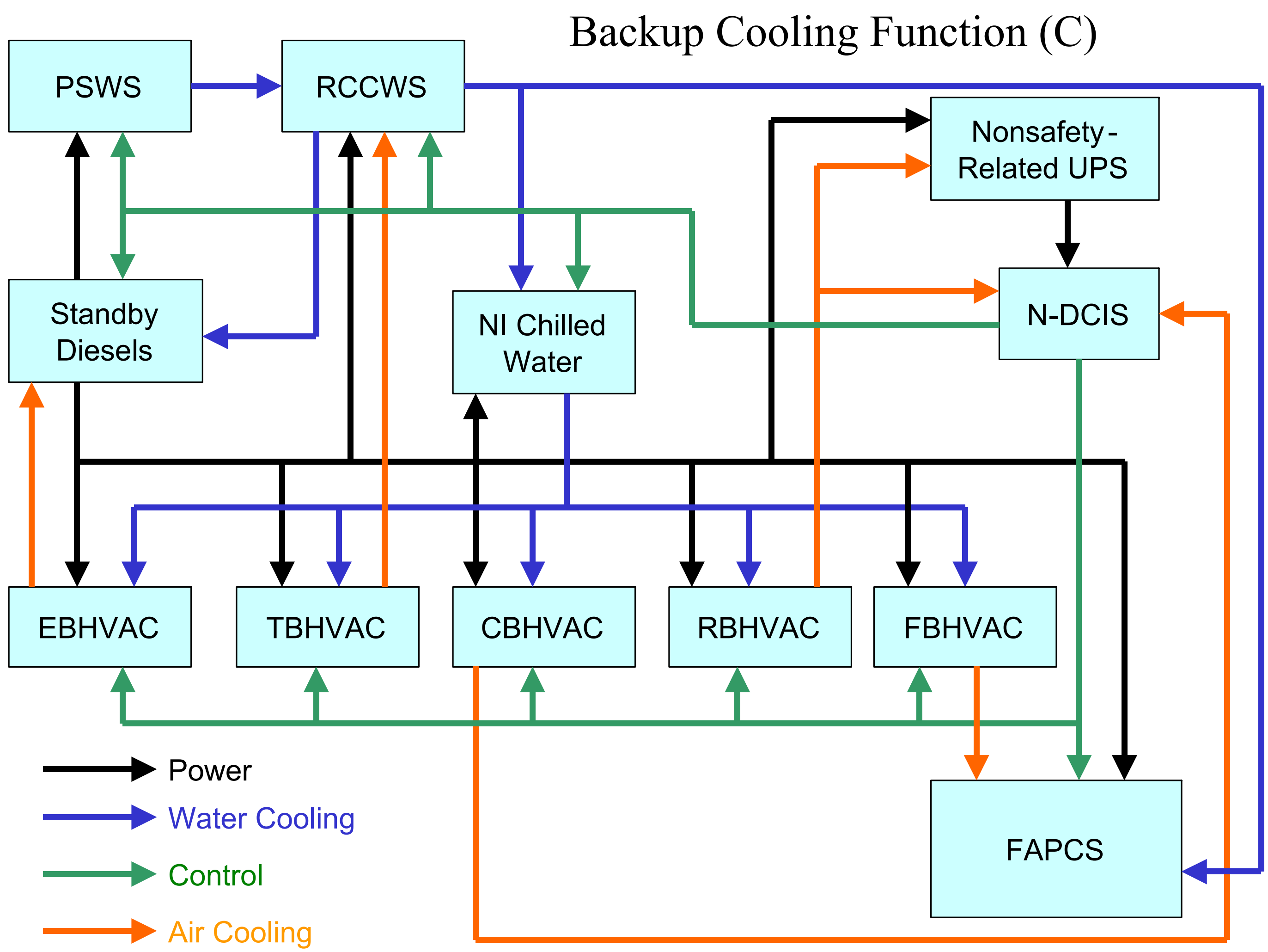

Figure 20.4-3
RTNSS Functional Relationships Supporting Backup Cooling Functions