20 REGULATORY TREATMENT OF NON-SAFETY SYSTEMS (RTNSS)

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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.

20.2 PROBABILISTIC ASSESSMENT OF RTNSS – CRITERION C

RTNSS Criterion C requires an assessment of safety functions that are relied upon at-power and during shutdown conditions to meet the NRC's 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 tech-spec allowed leakage, designated as “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 (T-H) uncertainty issues in a systematic process that identifies potential uncertainties in passive components or T-H phenomena and then applies an appropriate treatment to the component to ensure that the uncertainties are treated conservatively.

Passive system T-H 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 T-H 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, diesel generators, PIP buses, Fuel Building HVAC, 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.

The BiMAC device provides an engineered method to assure heat transfer between a core debris bed and cooling water in the lower drywell during some severe accident scenarios. Waiting to flood the lower drywell until after the introduction of core material minimizes the potential for energetic fuel-coolant interaction. Covering core debris with water provides scrubbing of fission products released from the debris and cools the corium, thus limiting off-site dose and potential core-concrete interaction. The BiMAC device provides additional assurance of debris bed cooling by providing engineered pathways for water flow through the debris bed. BiMAC failure could occur if no water is supplied. The BiMAC device is not safety-related. It is a first of a kind design that is added to the ESBWR to reduce the uncertainties involved with severe accident phenomenology. As such, it is a candidate for RTNSS.

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.

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.

At-Power Inadvertent Opening of a Relief Valve

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

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 considered a transient, which 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.

At-Power Loss of Preferred Power

Loss of Preferred Power (LOPP) occurs as a result of severe weather, grid disturbances, transformer 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, 2, and 3 are answered "Yes." 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. Those components, controlled by the site organization, that prevent a loss of offsite power, such as substations, breakers, motor control centers, and protective relays, are much less risk-significant and below the threshold for RTNSS consideration. 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.

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.

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.

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.

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.

In addition, the level 2 analysis includes assumptions on the design and performance of the BiMAC device, which is in the process of being analyzed and tested. Therefore, the BiMAC device is also a RTNSS candidate.

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

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.

Systems identified as RTNSS are evaluated in the focused PRA sensitivity study to ensure that the combination of safety-related and non-safety related systems meets the safety goal guidelines. PRA importance studies are then performed to determine the risk-significance of these systems. If an individual system is determined to have a significant effect on the safety goals, it is designated as High Regulatory Oversight. Table 20.2-1 shows that the combination of safety-related and RTNSS systems is adequate to meet the safety goals. The importance studies take the results of the safety-related plus RTNSS configuration and then exclude one RTNSS system at a time. A Risk Achievement Worth (RAW) value is calculated because the importance of the system is its availability to perform its function. For example, a RAW value is calculated for the case where all safety-related and RTNSS systems are available except DPS. The corresponding CDF value of 2.8 E-4/year is greater than the CDF safety goal of 1 E-4/year. Thus, the safety goals are not met if DPS is not credited. The only case where an individual system importance study did not meet the safety goals was for DPS.

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

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

Table 20.3-1

RTNSS Systems

Table System	Function	RTNSS Criterion	Regulatory Treatment
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
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

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.

20.4.2 Reliability Assurance

All RTNSS systems shall be in the scope of the Design Reliability Assurance Program, as directed by DCD Tier 2 Chapter 17, which will be incorporated into the Maintenance Rule program.

20.4.3 Augmented Design Standards

Systems that meet RTNSS Criterion B (that is, for actions required beyond 72 hours) require augmented design standards to assure reliable performance in the event of hazards, such as seismic events, high winds, and flooding. These standards are applied to High and Low Regulatory Oversight systems that meet Criterion B.

A RTNSS system classified as B1 or B2 that is required to function following a seismic event requires an augmented seismic design criterion. For B1 SSCs, the design is performed in accordance with Seismic Category II. B2 SSCs are designed for seismic requirements consistent with the International Building Code (IBC) – 2003 by International Code Council, Inc. (300-214-4321). The building structures are classified as Category IV (Power Generating Stations) with an Occupancy Importance Factor of 1.5. Either of the methods permitted by the IBC, simplified analysis or dynamic analysis, is acceptable for determination of seismic loads on NS structures and equipment including those designated as RTNSS. Because these systems are designated to perform their function post 72 hours, the equipment does not need to be able to perform their functions during the seismic event, but must be available following the event.

In addition to seismic standards, all Criterion B systems must meet design standards to withstand winds and missiles generated from category 5 hurricanes. As with seismic, the systems do not need to perform their functions during the high wind event, but must be available following the event. Fire events are sufficiently addressed with the current regulatory standards, so no additional controls are applied.

The plant design for protection of SSCs from the effects of flooding considers the relevant requirements of General Design Criterion 2, “Design Bases for Protection Against Natural Phenomena,” and 10 CFR Part 100, Appendix A, “Seismic and Geologic Siting Criteria for Nuclear Power Plants,” Section IV.C as related to protecting safety-related SSC from the effects of floods, tsunamis and seiches. The design meets the guidelines of Regulatory Guide 1.59 with regard to the methods utilized for establishing the probable maximum flood (PMF), probable maximum precipitation (PMP), seiche and other pertinent hydrologic considerations; and the guidelines of Regulatory Guide 1.102 regarding the means utilized for protection of safety-related SSC from the effects of the PMF and PMP.

Systems that meet RTNSS Criteria A, C, D, or E do not require augmented design standards described above, but must incorporate the defense-in-depth principles of redundancy and physical separation to ensure adequate reliability and availability.

Figure 20.4-1
RTNSS Functional Relationships Supporting Post Accident Monitoring

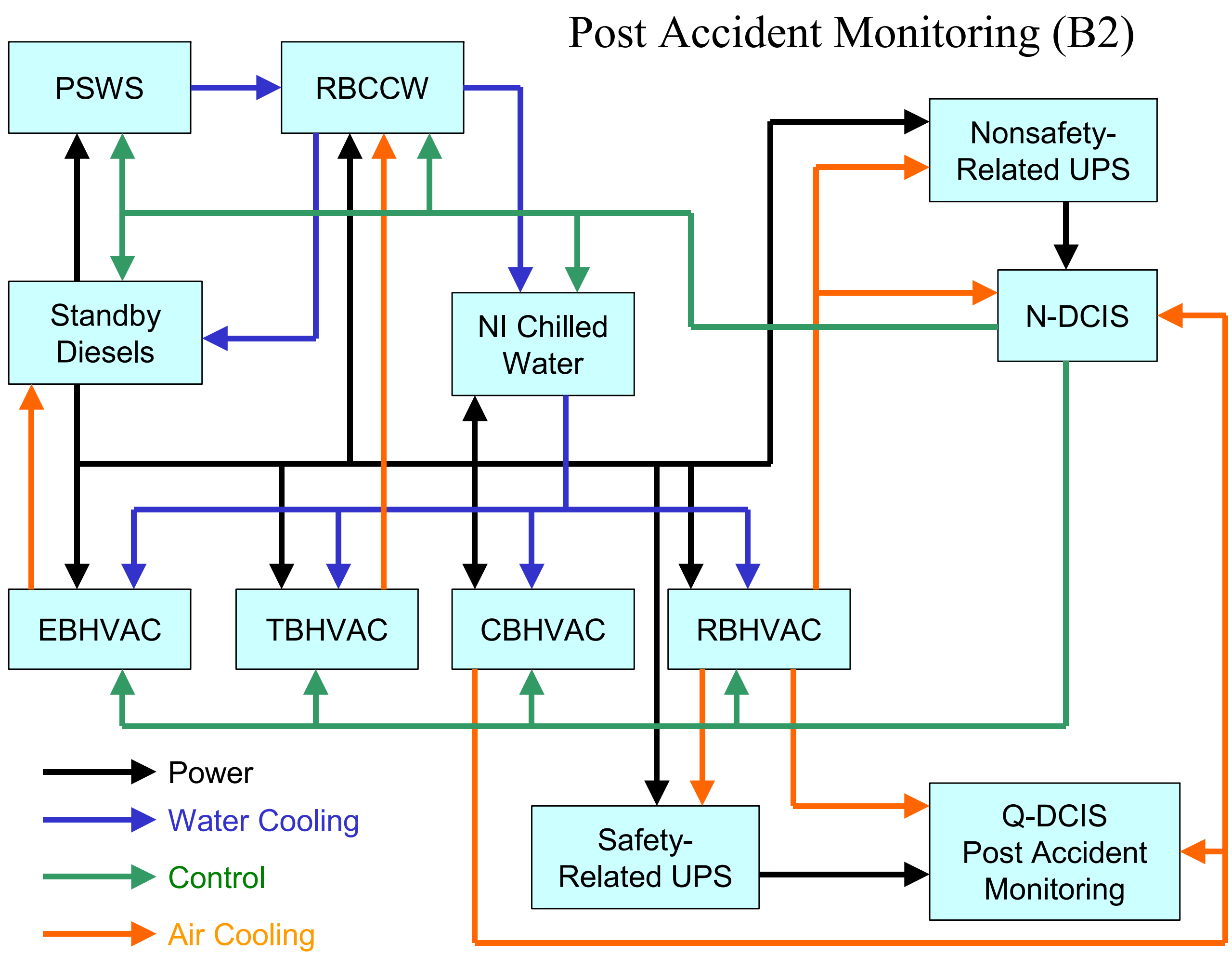


Figure 20.4-2
RTNSS Functional Relationships Supporting Post 72 hour Cooling & Control Room Habitability

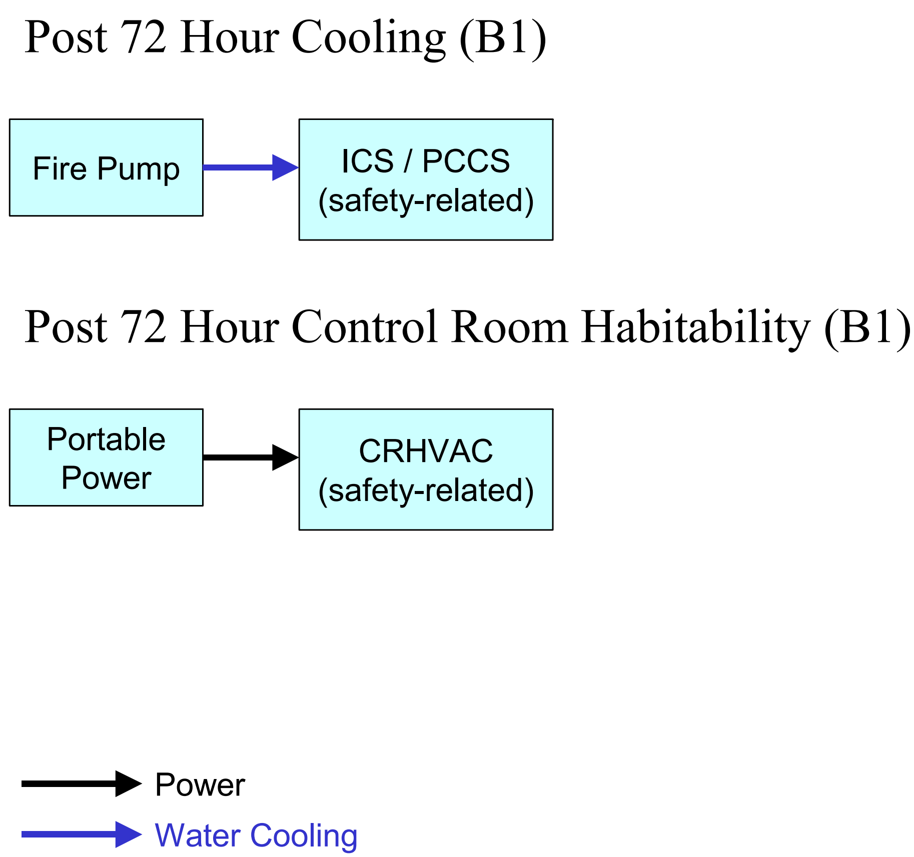
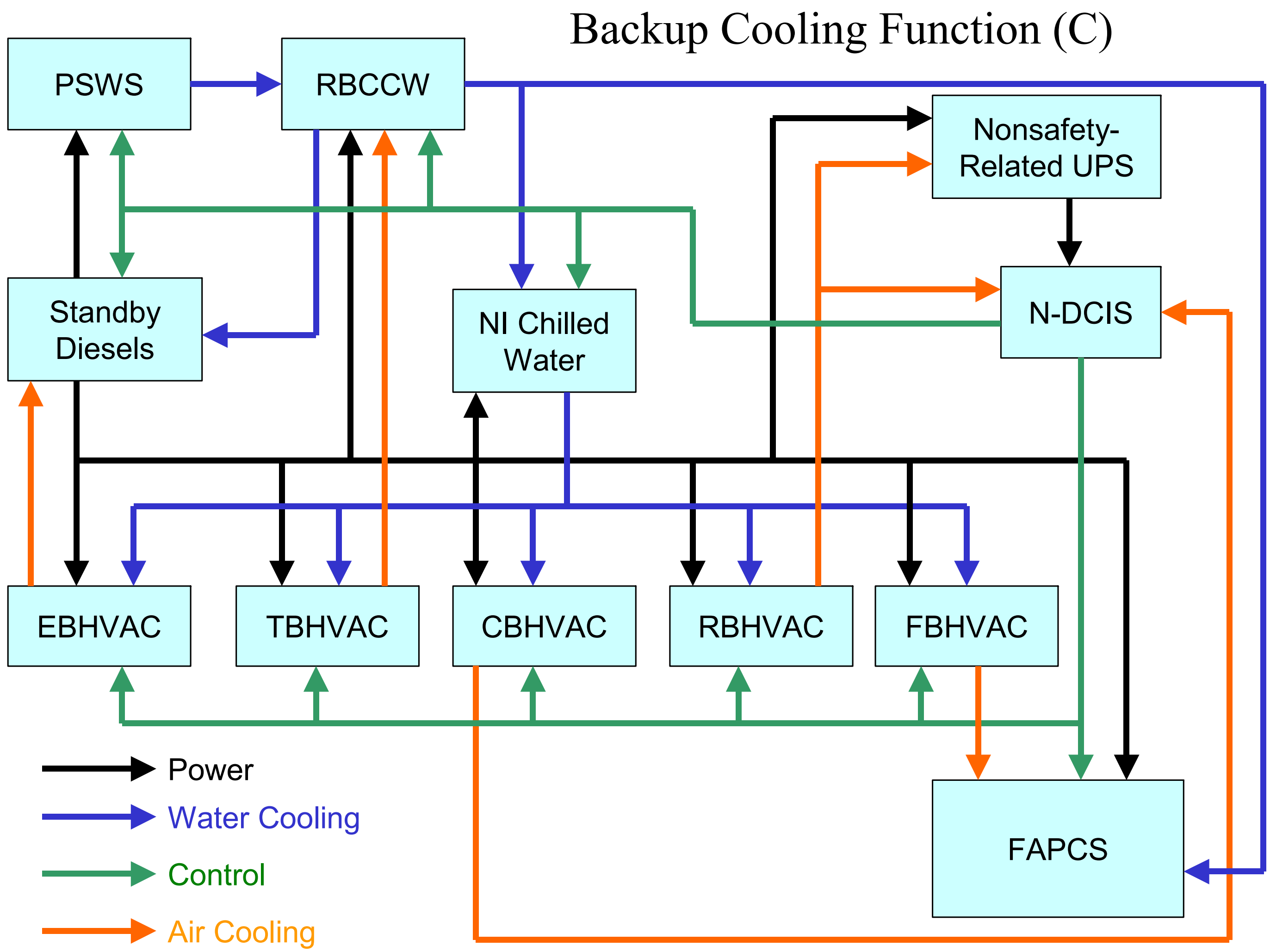


Figure 20.4-3
RTNSS Functional Relationships Supporting Backup Cooling Functions



20.5 ADDITIONAL INFORMATION

20.5.1 RTNSS Functions, Fault Tree Logic, and Components

Table 20.2-1, 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 20.5-1

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-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	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
		C72-ARIDPSD1PR, HIGH RPV PRESSURE SIGNAL TO DPS DIV I CONTROLLER C72-ARIDPSD2PR, HIGH RPV PRESSURE SIGNAL TO DPS DIV II CONTROLLER	C72-ATM-FC-DPSPRA C72-ATM-FC-DPSPRB C72-ATM-FC-DPSPRC C72-ATM-FC-DPSPRD C62-ISIG8-PT1A C62-ISIG8-PT1B C62-ISIG8-PT1C C62-ISIG8-PT1D	ANALOG TRIP MODULE SIGNAL FOR HIGH 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

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
ARI (continued)		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) 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 E50-RE_-FD-FC2-1	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 ELECTROMECHANICAL RELAY SQUIB VALVE FB3 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FC1 ELECTROMECHANICAL RELAY ELECTROMECHANICAL RELAY SQUIB VALVE FC2 ELECTROMECHANICAL RELAY

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
BiMAC (continued)			E50-RE_-FD-FC2-2	ELECTROMECHANICAL RELAY
			E50-SQV-CC-F3-C3	SQUIB VALVE FC3
			E50-RE_-FD-FC3-1	ELECTROMECHANICAL RELAY
			E50-RE_-FD-FC3-2	ELECTROMECHANICAL RELAY
			E50-SQV-CC-F1-D1	SQUIB VALVE FD1
			E50-RE_-FD-FD1-1	ELECTROMECHANICAL RELAY
			E50-RE_-FD-FD1-2	ELECTROMECHANICAL RELAY
			E50-SQV-CC-F2-D2	SQUIB VALVE FD2
			E50-RE_-FD-FD2-1	ELECTROMECHANICAL RELAY
			E50-RE_-FD-FD2-2	ELECTROMECHANICAL RELAY
			E50-SQV-CC-F3-D3	SQUIB VALVE FD3
			E50-RE_-FD-FD3-1	ELECTROMECHANICAL RELAY
			E50-RE_-FD-FD3-2	ELECTROMECHANICAL RELAY
		E50-DELUGE-ACT, ACTUATION FAILURES	E50-BT_-LP-SQUIBS-TR1	TRAIN 1 SQUIB-FIRING BATTERY
			E50-TT_-NO-PRI-A-TR1	TRAIN 1 PRIMARY THERMOCOUPLE A
			E50-TT_-NO-ADJ-1A-TR1	TRAIN 1 ADJACENT THERMOCOUPLE 1A
			E50-TT_-NO-ADJ-2A-TR1	TRAIN 1ADJACENT THERMOCOUPLE 2A
			E50-LOG-FC-THERM-A-TR1	TRAIN 1 LOGIC UNIT
			E50-BT_-LP-PLCA-TR1	TRAIN 1 DEDICATED PLC A BATTERY
			E50-TS_-CC-CHA-TR1	TRAIN 1 TEMPERATURE SWITCH
			E50-RE_-FO-CH1A-S-TR1	TRAIN 1 OUTPUT RELAY 1A-S
			E50-TT_-NO-PRI-B-TR1	TRAIN 1 PRIMARY THERMOCOUPLE B
			E50-TT_-NO-ADJ-1B-TR1	TRAIN 1 ADJACENT THERMOCOUPLE 1B
			E50-TT_-NO-ADJ-2B-TR1	TRAIN 1 ADJACENT THERMOCOUPLE 2B
			E50-LOG-FC-THERM-B-TR1	TRAIN 1 LOGIC UNIT
			E50-BT_-LP-PLCB-TR1	TRAIN 1 DEDICATED PLC B BATTERY
			E50-TS_-CC-CHB-TR1	TRAIN 1 TEMPERATURE SWITCH
			E50-RE_-FO-CH1B-S-TR1	TRAIN 1 OUTPUT RELAY 1B-S
			E50-BT_-LP-SQUIBS-TR2	TRAIN 2 SQUIB-FIRING BATTERY
			E50-TT_-NO-PRI-A-TR2	TRAIN 2 PRIMARY THERMOCOUPLE A
			E50-TT_-NO-ADJ-1A-TR2	TRAIN 2 ADJACENT THERMOCOUPLE 1A
			E50-TT_-NO-ADJ-2A-TR2	TRAIN 2 ADJACENT THERMOCOUPLE 2A

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
BiMAC (continued)		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-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 LOGIC UNIT TRAIN 2 DEDICATED PLC A BATTERY TRAIN 2 TEMPERATURE SWITCH TRAIN 2 OUTPUT RELAY 1A-S TRAIN 2 PRIMARY THERMOCOUPLE B 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 R13-BAC-LP-R13TBC	NSR R13 TURBINE/SWGR BLDG LOAD GROUP A NSR R13 TURBINE/SWGR BLDG LOAD GROUP B NSR R13 TURBINE/SWGR BLDG LOAD GROUP C
	CF-TOPRB, FEEDWATER RUN BACK FAILURE	C72-FWRBLDD1, LOAD DRIVER FAILS TO ENERGIZE CIRCUIT	C72-LDD-FC-FWRB1	LOAD DRIVER

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
Feedwater Runback (Continued)		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	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
		C72-FWRBCONTROL2, DPS DIV II FW RUN BACK SIGNAL	C72-LOG-FC-D2DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC	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
		C72-FWRBCONTROL3, DPS DIV III FW RUN BACK SIGNAL	C72-LOG-FC-D3DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC	DIV 3 DPS LOGIC UNIT NSR R13 CONTROL BLDG LOAD GROUP A NSR R13 CONTROL BLDG LOAD GROUP B NSR R13 CONTROL BLDG LOAD GROUP C
		C72-FWRBLDD2, LOAD DRIVER FAILS TO ENERGIZE CIRCUIT	C72-LDD-FC-FWRB2	LOAD DRIVER
		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	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
		C72-FWRBCONTROL2, DPS DIV II FW RUN BACK SIGNAL	C72-LOG-FC-D2DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC	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
		C72-FWRBCONTROL3, DPS DIV III FW RUN BACK SIGNAL	C72-LOG-FC-D3DPS R13-BAC-LP-R13CBA R13-BAC-LP-R13CBB R13-BAC-LP-R13CBC	DIV 3 DPS LOGIC UNIT NSR R13 CONTROL BLDG LOAD GROUP A NSR R13 CONTROL BLDG LOAD GROUP B NSR R13 CONTROL BLDG LOAD GROUP C

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
SLCS 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	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	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
		T10-RWCU-F044A-OO, NONSAFETY-RELATED MOTOR OPERATED VALVE F044A FAILS TO CLOSE	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	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 BLDG LOAD GROUP B DIVISION 1 LOGIC UNIT DIVISION 2 LOGIC UNIT DIVISION 3 LOGIC UNIT
		T10-RWCU-F004B-OO, NONSAFETY-RELATED AIR OPERATED VALVE F004B FAILS TO CLOSE	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	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

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
SLCS Actuation (continued)		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 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		

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
RB HVAC	Provide post 72-hour cooling for DCIS.	Not modeled		
RCCWS	Provide post 72-hour cooling for Chillers and DGs.	Not modeled		
		FAPCS		
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-DGA-0060, DG-A FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE** **R21-DGA-0080, DG-A JACKET COOLING FAILURE**	**R21-DG_-FR-DGA** **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** **P21-ACV-OO-F023A**	**DIESEL GENERATOR "A"** **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** **AIR OPERATED VALVE F023A**

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
Diesel Generator (continued)		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 P41-ACV-CC-F009A P41-MOV-OC-F003A P21-ACV-OO-F016A P21-ACV-OC-F012A	MOV P21-F034A FROM RCCWS TO RWCU/SDC HX-A MOTOR OPERATED VALVE F0010A1 HEAT EXCHANGER B001A AIR OPERATED VALVE MV-F002A AIR OPERATED VALVE F009A MOTOR OPERATED VALVE F003A AIR OPERATED VALVE F016A AIR OPERATED VALVE F012A
		P21-0016-_3-LL, HEAT EXCHANGER 0002A FAILURES (RCCW HX 0002A IN STANDBY)	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	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
		P21-0016-_5-LL, HEAT EXCHANGER 0003A FAILURES (RCCW HX 0003A IN STANDBY)	P21-MOV-CC-F0010A3 P21-HX_-LK-B003A P41-ACV-OC-F002A P41-ACV-CC-F006A P41-MOV-OC-F007A	MOTOR OPERATED VALVE F0010A3 HEAT EXCHANGER B003A AIR OPERATED VALVE MV-F002A AIR OPERATED VALVE MV-F006A MOTOR OPERATED VALVE MV-F007A
		R21-DGA-0050, DG-A 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	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

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
Diesel Generator (continued)			R21-MOD-CC-6A	MOTOR OPERATED DAMPER 6A
			R12-BAC-LP-A2-01A	480 VAC BUS A2-01A
		R21-DGB-0020, DG-B FAILS TO RUN	R21-DG_-FR-DGB	DIESEL GENERATOR "B"
		R21-TRANSFERB, FUEL OIL TRANSFER FAILURE FOR DG-B	R21-FLT-PG-DGB	FILTER
			R21-BV_-OC-F1B	MANUAL VALVE
			R21-MP_-FR-P1B	MOTOR-DRIVEN PUMP
			R21-UV_-CC-F3B	CHECK VALVE
			R21-BV_-OC-F5B	MANUAL VALVE
			R21-BV_-OC-F2B	MANUAL VALVE
			R21-MP_-FR-P2B	MOTOR DRIVEN PUMP
			R21-UV_-CC-F4B	CHECK VALVE
			R21-BV_-OC-F6B	MANUAL VALVE
			R12-BAC-LP-B2-01B	480 VAC BUS B2-01B
			R21-TNK-RP-1B	TANK
			R21-TNK-RP-2B	TANK
			R21-BV_-OC-F7B	MANUAL VALVE
			R21-LT_-NO-DGB	LEVEL TRANSMITTER
		R21-DGB-0080, DG-B JACKET COOLING FAILURE	P21-ACV-OO-F023B	AIR OPERATED VALVE
			P21-MPC-FR-C001B	MOTOR DRIVEN PUMP C001B
			P21-AHU-FR-RCCWB	AIR HANDLING UNIT RCCWS ROOM TRAIN B
			NICWSB-SYS-FAILS	NUCLEAR ISLAND CHILLED WATER SUBSYSTEM TRAIN B
			P21-UV_-CC-0001B1	CHECK VALVE 0001B1
			P21-MPC-FR-C002B	MOTOR-DRIVEN PUMP C002B
			P21-UV_-CC-0001B2	CHECK VALVE 0001B2
			P21-MPC-FR-C003B	MOTOR-DRIVEN PUMP C003B
			P21-UV_-CC-0001B3	CHECK VALVE 0001B3
			P21-ACV-CC-F0023B	AIR OPERATED VALVE F0023B
			P21-TNK-RP-0001B	RCCW SURGE TANK 0001B
			P21-ACV-OO-F0004	AIR OPERATED VALVE F0004
			P21-ACV-OO-F0007	AIR OPERATED VALVE F0007

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
Diesel Generator (continued)			P21-ACV-OO-F0020	AIR OPERATED VALVE F0020
			P21-ACV-OO-F0027	AIR OPERATED VALVE F0027
			P21-ACV-OO-F0061	AIR OPERATED VALVE F0061
		R21-DGB-0050, DG-B ROOM COOLING FAILURE	R21-FAN-FR-AHU2B	BLOWER/VENTILATION FAN
			R21-FAN-FR-10B	BLOWER/VENTILATION FAN
			R21-FAN-FR-11B	BLOWER/VENTILATION FAN
			R21-FAN-FR-12B	BLOWER/VENTILATION FAN
			R21-MOD-CC-1B	MOTOR-OPERATED DAMPER
			R21-MOD-CC-2B	MOTOR-OPERATED DAMPER
			R21-MOD-CC-3B	MOTOR-OPERATED DAMPER
			R21-MOD-CC-4B	MOTOR-OPERATED DAMPER
			R21-MOD-CC-5B	MOTOR-OPERATED DAMPER
			R21-MOD-CC-6B	MOTOR-OPERATED DAMPER
			R21-AHU-FR-3B	AIR HANDLING UNIT
			R12-BAC-LP-B2-01B	480 VAC BUS B2-01B
EB HVAC	Provide support for electrical power to FAPCS.	R21-DGA-0050, DG-A ROOM COOLING FAILURE	R21-FAN-FR-AHU2A	DG-A NORMAL VENTILATION FAN
			R21-AHU-FR-3A	AIR HANDLING UNIT
			R21-FAN-FR-10A	BLOWER/VENTILATION FAN
			R21-FAN-FR-11A	BLOWER/VENTILATION FAN
			R21-FAN-FR-12A	BLOWER/VENTILATION FAN
			R21-MOD-CC-1A	MOTOR OPERATED DAMPER 1A
			R21-MOD-CC-2A	MOTOR OPERATED DAMPER 2A
			R21-MOD-CC-3A	MOTOR OPERATED DAMPER 3A
			R21-MOD-CC-4A	MOTOR OPERATED DAMPER 4A
			R21-MOD-CC-5A	MOTOR OPERATED DAMPER 5A
			R21-MOD-CC-6A	MOTOR OPERATED DAMPER 6A
			R12-BAC-LP-A2-01A	480 VAC BUS A2-01A
		R21-DGB-0050, DG-B ROOM COOLING FAILURE	R21-FAN-FR-AHU2B	BLOWER/VENTILATION FAN
			R21-FAN-FR-10B	BLOWER/VENTILATION FAN
			R21-FAN-FR-11B	BLOWER/VENTILATION FAN
			R21-FAN-FR-12B	BLOWER/VENTILATION FAN
			R21-MOD-CC-1B	MOTOR-OPERATED DAMPER 1B

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
EB HVAC (continued)			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-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	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 F013A MOTOR OPER. VALVE F014A CHECK VALVE F004A MOTOR-DRIVEN PUMP C001A
		G21-FDSPB, FAPCS SPC INJECTION TRAIN B G21-BRUN, TRAIN B	G21-UV_-CC-F307B 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	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

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
FAPCS (continued)	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** **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**	**CHECK VALVE F102A IN FEEDWATER LINE A** **CHECK VALVE F103A IN 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 support for FAPCS P41-0002-_2, INSUFFICIENT FLOW FROM PSW PUMPS	**P41-0070-_1, PSW PUMP 1A**	**P41-SYS-FC-HVACPSW-A** **P41-0074-_1** **P41-MOV-OC-PMPF002A** **P41-0077-_1** **R11-BAC-LP-100A3** **P41-0075-_1**	**PSW-A ROOM COOLING** **MOTOR DRIVEN PUMP C001A** **MOTOR OPERATED VALVE MV-F002A** **STRAINER P41-D001A** **6.9 KV AC PIP-A LOADS BUS 1000A3** **CHECK VALVE F001A**

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
PSW (continued)		P41-0091-_2, PSW PUMP 2A	P41-SYS-FC-HVACPSW-A	PSW-A ROOM COOLING
			P41-0074-_2	MOTOR DRIVEN PUMP C002A
			P41-MOV-OC-PMPF004A	MOTOR OPERATED VALVE MV-F004A
			P41-0077-_2	STRAINER P41-D002A
			R11-BAC-LP-100A3	6.9 KV AC PIP-A LOADS BUS 1000A3
			P41-0075-_2	CHECK VALVE F003A
		P41-0070-_3, PSW PUMP 1B	P41-SYS-FC-HVACPSW-B	PSW-B ROOM COOLING
			P41-0074-_3	MOTOR DRIVEN PUMP C001B
			P41-MOV-OC-PMPF002B	MOTOR OPERATED VALVE MV-F002B
			P41-0077-_3	STRAINER P41-D001B
			R11-BAC-LP-100B3	6.9 KV AC PIP-A LOADS BUS 1000B3
			P41-0075-_3	CHECK VALVE F001B
		P41-0091-_4, PSW PUMP 2B	P41-SYS-FC-HVACPSW-B	PSW-B ROOM COOLING
			P41-0074-_4	MOTOR-DRIVEN PUMP C002B
			P41-MOV-OC-PMPF004B	MOTOR OPERATED VALVE MV-F004B
			P41-0077-_4	STRAINER P41-D002B
			R11-BAC-LP-100B3	6.9 KV AC PIP-A LOADS BUS 1000B3
			P41-0075-_4	CHECK VALVE F003B
RCCWS	Provide cooling support for FAPCS.	G21_P21-ARUN, RCCWS FAIL TO COOL FAPCS	G21-HX_-LK-B001A	HEAT EXCHANGER B001A
			G21-MOV-OC-F046A	MOTOR OPERATED VALVE P21-F046A
			G21-MOV-OC-F047A	MOTOR OPERATED VALVE P21-F047A
			G21-MOV-CO-F048A	MOTOR OPERATED VALVE P21-N048A
			P21-MOV-OC-F0010A1	MOTOR OPERATED VALVE F0010A1
			P41-ACV-OC-F002A	AIR OPERATED VALVE MV-F002A
			P41-MOV-OC-F003A	MOTOR OPERATED VALVE F003A
			P41-ACV-OC-F009A	AIR OPERATED VALVE MV-F009A
			P21-ACV-CO-F016A	AIR OPERATED VALVE F016A
			P21-ACV-OC-F012A	AIR OPERATED VALVE F012A

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
RCCWS (continued)		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 P21-ACV-CO-F016B P21-ACV-OC-F012B	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-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 cooling for Chillers and DGs.	Not modeled		

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
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 U43-BV_-CC-FU435B	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 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		

System/ Subsystem	RTNSS FUNCTIONS	Fault Tree Logic ID	Basic Event(s)	Component(s)
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**		