

19 RELIABILITY AND MAINTAINABILITY

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19 RELIABILITY AND MAINTAINABILITY

19.1 RELIABILITY ASSURANCE

19.1.1 Purpose

The objective of the Reliability Assurance Program is to ensure assumptions made in the Probabilistic Risk Assessment during the design phase, regarding component reliability and availability, are maintained valid throughout the life of the plant. The program is discussed in DCD Tier 2 Section 17.4.

In accordance with the objective of the program, Table 19-1 provides an example of the scope and frequency of on-going testing and maintenance activities expected to be performed on RTNSS equipment to achieve the objective discussed above. Specifics cannot be known until manufacturer and model information becomes available; therefore, this is provided for information only.

ACSR references in the Basis refer to the Availability Controls Manual Surveillance Requirements detailed in DCD Tier 2 Section 19ACM.

Table 19-1
Reliability and Maintainability of Important Components

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
ARI	Automatically depressurize scram header on ATWS signal.	C12-F038, F039, F042, F043A/B, F044A/B These represent the actuated devices only; refer to the DPS System to address the actuating device(s).	Fail to Energize	Verify each dump valve vents on receipt of actuation signal Replace	C12-SOV-FE- F038, F039, F042, F043A/B, F044A/B (1E-03)	24 months on a staggered test basis 20 Years	ACSR 3.3.1.2 Normally deenergized solenoids physically mounted in mild environment are not subjected to the failure mechanisms normally considered to lead to the identified failure mode; however, it is unreasonable to assume that they will provide reliable performance for the life of the plant. Therefore, preemptive replacement at the specified interval is considered prudent.
BiMAC	Provide core debris cooling in LDW through deluge valves.	BiMac structure E50-F009A/B/C/D/E/F/G/H/J/K/L/M	Fail to remain intact Fail to open	Inspect structure Verify Continuity of Explosive Charges Verify valves actuate Verify flow	Point Estimate (1E-02) E50-SQV-FA1/2/3, FB1/2/3, FC1/2/3, FD1/2/3 (3E-03)	24 months 31 days 24 months 10 years	Inspect each time available seems prudent ACSR 3.5.1.1 ACSR 3.5.1.2 ACSR 3.5.1.4

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Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
				through each flow path from pool to LDW Replace pyrotechnic charge Perform Logic Functional Test	Channel A and B PLCs	24 months 24 months on a staggered test basis	The pyrotechnic charge is susceptible to age and environmental degradation and the only maintenance possible is replacement; the frequency of replacement is based on industry experience. ACSR 3.5.1.3
CB HVAC	Provide post 72-hour cooling for DCIS and Control Room habitability.	CB HVAC The design is intended to be direct drive variable speed fans requiring no modulating or controlling dampers; therefore, only the fan/motor unit is included in this analysis.	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	FAN FR (1E-05) FAN FS (6E-04)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience

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System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
Chilled Water System	Provide post 72-hour cooling for HVAC. Provide cooling support for FAPCS.	Chiller units	Fail to run Fail to start	Refrigerant Analysis Glycol Analysis Oil Analysis Vibration Analysis External Visual Inspection Internal Inspection Overhaul System Performance Test System Functional Test	CHU FR (1E-05) CHU FS (6E-03)	12 months 6 months 6 months 6 months 3 months 24 months as needed 24 months 24 months	Industry experience has shown that general cleanliness of external/accessible parts and appropriate action based on analysis and test results will provide a reliable unit.
Control Room Area Ventilation	Portable Generator for post 72-hour battery charging	CR HVAC The design is intended to be direct drive variable speed fans requiring no modulating or controlling dampers; therefore, only the fan/motor unit is included in this analysis.	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	FAN FR (1E-05) FAN FS (6E-04)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience
Diesel Fire Pump	Provide post 72-hour refill	U43-P1A/P2A	Fail to Start Fail to Run	Fire Pump Monthly Test	U43-EDP-FS-G1 (2.2E-02)	1 month	Primarily required by NEIL, specific tests and frequency

**Table 19-1
Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
	to ICS/PCCS and Spent Fuel pools.			Fire Pump Battery Monthly Test Verify flow path* Start and Operate Manually* Fire Pump Battery 18 Mo. Test Fire Pump Flow Test Fire Pump Engine Inspection Fire Service Water Flow Test	U43-EDP-FR-G1 (2.5E-02)	1 month 31 days* 92 days* 18 months 18 months 2 years 3 years	will be dictated by the plant specific Fire Program to meet NEIL as well as federal and state fire code requirements. *ACSR 3.7.1.2 and ACSR 3.7.1.3 respectively.
AC Power PIP Buses	Provide power for post accident monitoring Provide power for FAPCS and support systems. (Non-seismic PRA sequences.)	480V Motor Control Center R12-FB-A R12-FB-B 6.9KV Switchgear R11-1000A3 R11-1000B3	Fail to provide power Fail to provide power	Thermographic scan (buckets and housing) Clean and Inspect (buckets and housing) Test circuit breakers Thermography Breaker – Detailed Inspection Breaker – Overhaul Cubicle – Detailed	R12-FB-A-0000 (1.05E-03) R12-FB-B-0000 (1.05E-03) R11-1000B3 (1.73E- 05) R11-1000A3 (1.73E- 05)	1 year 5 years 10 years 1 year 6 years 12 years 6 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience

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System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
				Inspection Cubicle – Overhaul		12 years	Industry Experience
Diesel Generators	Provide power for post accident monitoring	DG A	Failure to Start and Run	Start and Operate	R21-DGA (1.53E-01) R21-DGA-0080 (3.22E-03)	92 days 24 Months	ACSR 3.8.1.2/3.8.2.2 Industry Experience
		Jacket Cooling AOV P21- F023A	Failure to Cool Failure to Close	Clean and Inspect Inspect and Replace Elastomers	P21-ACV-OO-F023A (2E-03)	12 Years	Industry Experience
	Provide power for FAPCS and support systems. (Non-seismic PRA sequences.)	Room Cooling Normal Room Venting	System Failure to Cool Failure to Start and Run	See following items Clean, Inspect, and Lubricate	R21-DGA-0050 (2.98E-02) R21-NORMVENTA (2.53E-04)	See below 24 Months	See below Industry Experience
		Supplemental Venting	Failure to Start and Run	Clean, Inspect, and Lubricate	R21-SUPPVENTA (2.08E-02)	24 Months	Industry Experience
		DG Electronic Equipment Room Cooling Nuclear Island Chill Water	Failure to Start and Run See Chilled Water System	Clean, Inspect, and Lubricate See Chilled Water System	R21-COOLINGA (7.9E-03) NICWSA-SYS-FAILS (Transfer) R12-A2-01A-LL (Transfer)	24 Months See Chilled Water System	Industry Experience See Chilled Water System
	Bus A2-01A	See AC Power PIP Buses	See AC Power PIP Buses	R21-DGA-0060 (4.9E-03)	See AC Power PIP Buses	See AC Power PIP Buses	

Table 19-1
Reliability and Maintainability of Important Components

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
		Fuel Oil Storage & Transfer Day Tank	System Failure Failure to Supply Fuel	See following items Verify volume	R21-DAYTANKA (2.7E-05) R21-FLT-PG-DGA (3.6E-03)	See below 31 days	See below ACSR 3.8.1.1/3.8.2.1
		Filter	Plugged	Replace	R21-DGA-0060 (4.9E-03)	18 Months	NEIL
		Fuel Oil Transfer Tank Train (typical of two available) Check Valve	System Failure Rupture Sub-system failure	Inspect See following items	R21-TNK-RP-1A (2.4E-06) R21-TRANSFER1A (1.05E-02)	10 Years See below	NEIL See below
			Fails to open/remain open	Disassemble and Inspect	R21-UV_-CC-FO-G1 (1.11E-04) R21-UV_-OC-F3A (7.2E-05)	10 Years	SOER 86-03
		Pump	Fails to Start and Run	Perform vibration monitoring	R21-MP_-FS- FOPUMP-G1 (2.22E- 03) R21-MP_-FR- FOPUMP-G1 (6.3E- 04)	1 Quarter	Industry Experience
		Manual valves	Plugs/transfers closed	None	R21-BV_-OC-F1A (1.08E-05) R21-BV_-OC-F5A (1.08E-05)		Low probability occurrence
		DG B	Same as DG A	Same as DG A	Same as DG A	Same as DG A	Same as DG A

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Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
DPS	Diverse actuation of ECCS functions:	Two of four low level or pressure sensor combined with the ATWS SRNM permissive and two of four ATWS Logic Processors (SSLC) actuate load drivers. The two load drivers are in series and both must be actuated to allow current to the squib valve actuators.	Failure to provide appropriate actuation signal(s)	Perform Logic System Functional Test	C72-C41-F003A-DPS C72-C41-F003B-DPS C72-C41-F003C-DPS C72-C41-F003D-DPS (Each failure rate 5.3E-04)	24 months on a staggered test basis	ACSR 3.3.2.2
	SLCS Actuation						
	ARI Actuation	One of three ARI air header vent path exhaust to atmosphere.	Failure to provide appropriate actuation signal(s)	Perform Logic System Functional Test	C72-C71-ARI (1.88E-04) C72-FWRUNBACK (6.45E-04)	24 months on a staggered test basis 24 months on a staggered test basis	ACSR 3.3.1.3 ACSR 3.3.3.2

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System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
	FW Runback Actuation	Two of four high RPV sensors and SRNM flux (>6%) divisional signal and two of four ATWS logic processors combined with two of three DPS processors actuate load drivers for feedwater control system.	Failure to provide appropriate actuation signal(s)				
EB HVAC	Provide post 72-hour cooling for DGs and 1E Electrical Distribution. Provide support for electrical power to FAPCS.	EB HVAC The design is intended to be direct drive variable speed fans requiring no modulating or controlling dampers; therefore, only the fan/motor unit is included in this	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	FAN FR (1E-05) FAN FS (6E-04)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience

**Table 19-1
Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
		analysis.					
External Connection	Provide post 7-day refill to ICS/PCCS and Spent Fuel pools.	U43-MKUP	Insufficient volume Fails catastrophically	Verify volume Perform structural inspection	TNK RP (1E-07)	31 days 4 years	ACSR 3.7.1.1 Any structural degradation would be expected to be slow; an overall structure inspection program to meet 10CFR65 (a)(3) reporting requirements should dictate performance interval. This is a conservative frequency.
FAPCS	Suppression pool cooling and low pressure coolant injection modes. (Non-seismic PRA sequences.)	G21-C001A/B	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect Verify Flowpath	WS-TOPSPC (1.6E-02) VL-TOPINJ (9.7E-02)	6 months 6 months 6 months 4 years 2 years 31 days	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience ACSRs 3.7.2.1 and 3.7.3.1
FB HVAC	Provide cooling support for FAPCS.	FB HVAC The design is intended to be direct drive variable speed fans requiring no modulating or controlling	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	FAN FR (1E-05) FAN FS (6E-04)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience

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Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
		dampers; therefore, only the fan/motor unit is included in this analysis.					
Feedwater Runback	Run FW demand to minimum on ATWS signal.	N21-F060 (LFCV)	Fail to open (AOV)	Clean and Inspect Inspect and Replace Elastomers	ACV CC (2E-03)	24 Months	Industry Experience
		G31-F025A/B, F028 (RWCU/SDC Overboard Flow)	Fail to open (MOV)	Inspect and lubricate (Mechanical Grooming)	MOV CC (4E-03)	12 Years	Industry Experience
						4 years	Industry Experience
		Inspect and Lubricate (Electrical Inspection)	8 years	Industry Experience			
		These represent the actuated devices only; refer to the DPS System to address the actuating	Fail to Actuate	Perform FWRB function actuation	NLU FC (5E-06)	24 months	ACSR 3.3.3.1
					None of these are modeled; therefore, the generic failure rate for the		

**Table 19-1
Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis	
		device(s).			component type and failure mode is specified.			
PAM Instruments (DCIS)	Provide post accident monitoring (use RG 1.97 to determine scope.)	PAM Instrument Channels (Reference FSAR Subsection 7.5.1)	Fail to provide accurate signal	Perform Channel Check	Post Accident Monitoring Instrument Channels are not modeled.	31 days	ACSR 3.3.4.1	
				Perform Channel Calibration		24 months	ACSR 3.3.4.2	
PSW	Provide post 72-hour cooling for RCCWS. Provide cooling support for FAPCS.	P41-C001A/B P41-C002A/B	Fail to Run	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	P41-0001-_1 (1.22E-03)	6 months	Industry Experience	
			Fail to Start			6 months	Industry Experience	
		P41-FAN-001A/B, 2A/B	Fail to Run	Thermography Vibration Monitoring Clean and Inspect	P41-FAN-FR-000 (2.4E-04) P41-FAN-FS-000 (6.0E-04)	6 months	Industry Experience	
			Fail to Start			3 months	Industry Experience	
		RCCW/TCCW Heat Exchangers	Fails to function Leaks Plugged	Performance Monitoring NDE Inspection	Internal Inspection Clean	HX_FC 1.00E-06	1 month to 2 years	Variable times specified based on quality of PSW; the lower the water quality, the more frequent the specified activities are required.
						HX_LK 1.00E-06	4 to 6 years, if req'd	
				HX_PG 1.00E-06	2-4 years, if req'd			
					2 years, only in			

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Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
				Leak Test		harshest circumstances 2 to 4 years in harshest circumstances	
RB HVAC	Provide post 72-hour cooling for DCIS.	RB HVAC The design is intended to be direct drive variable speed fans requiring no modulating or controlling dampers; therefore, only the fan/motor unit is included in this analysis.	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	FAN FR (1E-05) FAN FS (6E-04)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience
RCCWS	Provide post 72-hour cooling for Chillers and DGs. Provide cooling support for FAPCS.	P21-P- 0001A1/2/3 P21-P- 0001B1/2/3	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	P21-0001-_1A (4.3E- 03) P21-0001-_1B (4.3E- 03)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience
SLCS Actuation	Backup actuation logic to	C41- F003A/B/C/D	Fail to Operate	Verify SLC actuation on actuation signal	C41-SQV-CC-F003A C41-SQV-CC-F003B		

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Reliability and Maintainability of Important Components**

System	Function	System/Train/ Component	Failure Mode(s)	Recommended Maintenance	PRA Unavailability/ Failure Rate	Test or Maintenance Interval	Basis
	initiate SLCS and isolate RWCU/SDC.	These represent the actuated devices only; refer to the DPS System to address the actuating device(s).		Replace pyrotechnic charge	C41-SQV-CC-F003C C41-SQV-CC-F003D (Each is 3E-03)	24 months 24 months	ACSR 3.3.2.1 The pyrotechnic charge is susceptible to age and environmental degradation and the only maintenance possible is replacement; the frequency of replacement is based on industry experience.
TB HVAC	Provide post 72-hour cooling for DCIS in Turbine Building. Provide room cooling for RCCW pumps.	TB HVAC The design is intended to be direct drive variable speed fans requiring no modulating or controlling dampers; therefore, only the fan/motor unit is included in this analysis.	Fail to Run Fail to Start	Thermography Vibration Monitoring Oil Analysis Electrical Tests Clean and Inspect	FAN FR (1E-05) FAN FS (6E-04)	6 months 6 months 6 months 4 years 2 years	Industry Experience Industry Experience Industry Experience Industry Experience Industry Experience