Appendix 8A. Tables

Table 8-1. Maximum Loads to be Supplied from One of the Redundant Essential Auxiliary Power System

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
SEQ 1:	Centrifugal Charging Pump	600 HP	500 HP	11 sec.	680 HP (18)	11 sec.	4160V	1ETA, 1ETB, 2ETA, 2ETB	One per diesel
	Motor Operated Valves	112 KW(1)	112 KW(1)	11 sec.	112 KW(1)	11 sec.	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	Estimated
	1500 KVA, 600 VAC Essential Aux. Power Sys. Load Center	(2)	(2)	11 sec.	(2)	11 sec.	575V	1ELXA, 1ELXB, 2ELXA, 2ELXB	Additional load center in Sequence 2
	600/120 V Power Panelboard	15 KVA	14.8 KVA	11 sec.	14.8 KVA	11 sec.	575V	1EMXH, 2EMXH	Two per station
	Vital AC-DC Sys. Batt. Chgrs.	100 KVA	60 KVA	11 sec.	60 KVA	11 sec.	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	Two per diesel
	VC/YC System Control Room Air Handling Unit Fans	50 HP	40 HP	11 sec.	40 HP	11 sec.	575V	1EMXH, 2EMXH	Two per station
	VC/YC System Pressure Filter Fan	10 HP	5 HP	11 sec.	5 HP	11 sec.	575V	1EMXH, 2EMXH	Two per station

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	VC/YC System Pressure Filter Heater	10 KW	10 KW	11 sec.	10 KW	11 sec.	575V	1EMXH, 2EMXH	Two per station
	VC/YC Sys. Swgr. Rm. Air Handling Unit Fans	15 HP	15 HP	11 sec.	15 HP	11 sec.	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	Two 7.5 HP fans per diesel
	Diesel Jacket/Interco oler Pump	20 HP	19 HP	11 sec.	19 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Generator Battery Charger	5 KVA	5 KVA	11 sec.	5 KVA	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
SEQ 1: (cont'd)	Diesel Air Compressors	30 HP	30 HP	11 sec.	30 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	Two 15 HP comps. per diesel
	Diesel Lube Oil Before & After Pump	10 HP	9.5 HP	11 sec.	9.5 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel 600/120V Panelboard	5 KVA	3.7 KVA	11 sec.	3.7 KVA	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	Diesel Lube Oil Heater Pump	5 HP	5 HP	11 sec.	5 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Bldg. General Vent. Supply Fans	40 HP	40 HP	11 sec.	40 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	Two 20 HP fans per diesel
	Diesel Fuel Oil Transfer Pump	1 HP	1.5 HP	11 sec.	1.5 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Crank Case Vacuum Blower	0.5 HP	0.5 HP	11 sec.	0.5 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
SEQ 1: (cont'd)	Diesel Fuel Oil Drip Tank Pump	(15)	0.1 HP	11 sec.	0.1 HP	11 sec.	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Trace Heating Panelboard	30 KVA	10 KVA	11 sec.	---	---	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	Tech Support Center MCC SMXE	130 KVA	130 KVA	11 sec.	---	---	575V	1EMXA, 2EMXA	One per station. Used during blackout on both units.
	Radiation Monitoring	0.25 HP	0.25 HP	11 sec.	0.25 HP	11 sec.	575V	1EMXH	One per station
	R.H.R. & CS Sump Rm. Sump Pump	7.5 HP	4.5 HP	11 sec.(14)	4.5 HP	11 sec.(14)	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel
	Diesel Generator Rm. Sump Pump	30 HP	26 HP	11 sec.(14)	26 HP	11 sec.(14)	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	Two 15 HP pumps per diesel
	SSFARC Control Power Transformers	0.75 KVA	0.75 KVA	11 sec.	0.75 KVA	11 sec.	575V	1EMXA-4, 1EMXH-1, 2EMXA-4	Two per station
	Hydrogen Analyzer	1.4 KVA	1.4 KVA	11 sec.	1.4 KVA	11 sec.	575V	1EMXA, 1EMXB-3, 2EMXA, 2EMXB-3	One per diesel
	Hydrogen Mitigation Pnlbd.	7.5 KVA(3)	---	---	6 KVA(3)	11 sec.(3)	575V	1EMXA-4, 1EMXB, 2EMXA-4, 2EMXB	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
SEQ 2:	Safety Injection Pump	400 HP	---	---	440 HP (18)	16 sec.	4160V	1ETA, 1ETB, 2ETA, 2ETB	One per diesel
	1500 KVA, 600 VAC Essential Aux. Power Sys. Load Center	(2)	(2)	16 sec.	(2)	16 sec.	575V	1ELXC, 1ELXD, 2ELXC, 2ELXD	
	Emerg. AC Lighting Panel	30 KVA	30 KVA	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
	Annulus Ventilation System Fan	30 HP	---	---	24 HP	16 sec.	575V	1EMXC, 1EMXD,	One per diesel
	Annulus Ventilation System Fan	30 HP	--	--	30 HP	16 sec.	575V	2EMXC, 2EMXD	One per diesel
	Annulus Ventilation System Moisture Separator Heaters	43 KW	---	---	43 KW	16 sec.	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
	Radiation Monitoring	(6)	(6)	16 sec.	(6)	16 sec.	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	(6)

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	Pipe Tunnel Booster Fans	15 HP	15.5 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
	Control Rod Drive Ventilation Fans	100 HP	100 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	Two 50 HP fans per diesel
	Lower Containment Cooling Units	275 HP	266.5 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	(20)
	Upper Containment Air Handling Units	20 HP	12.8 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	Two 10 HP fans per diesel
	Upper Containment Return Air Fans	2 HP	2 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	Two 1 HP fans per diesel
	Incore Instrumentatio n Rm. Air Hdlg. Unit	3 HP	1.7 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
	Press Booster Fan	20 HP	8.6 HP	16 sec.	---	---	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
SEQ 3:	Residual Heat Removal Pump	400 HP	---	---	455 HP (18)	20 sec.	4160V	1ETA, 1ETB, 2ETA, 2ETB	One per diesel
SEQ 4:	Deleted Per 2012 Update								
SEQ 5:	Component Cooling Water Pumps	400 HP	380 HP	30 sec.	350 HP	30 sec.	4160V	1ETA, 1ETB, 2ETA, 2ETB	Two 200 HP pumps per diesel
SEQ 6:	Nuclear Service Water Pump	1000 HP(4)	650 HP	35 sec.	700 HP	35 sec.	4160V	1ETA, 1ETB, 2ETA, 2ETB	One per diesel
	RN Strainer Backwash Pump	15HP	15HP	36 sec. (22)	15 HP	36 sec. (22)	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
SEQ 7:	Auxiliary Feedwater Pump (Motor Driven)	500 HP	510 HP	40 sec.	580 HP (18)	40 sec.	4160V	4160V 1ETA, 1ETB, 2ETA, 2ETB	One per diesel
SEQ 8:	Containment Air Return Fan	30 HP	---	---	28 HP	10 min.	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
	Hydrogen Skimmer Fan	40 HP	---	---	44 HP	10 min.	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	Inverter KS Backup Transf.	15 KVA	15 KVA	10 min	---	---	575V	1EMXG, 2EMXG	Two per station
	VC/YC System Battery Rm. Exhaust Fans	1 HP	1 HP	10 min.	1 HP	10 min.	575V	1EMXG, 2EMXG	Two per station
	VC/YC System Control Rm. & Control Rm. Area Chilled Water Pump	40 HP	36 HP	10 min.	36 HP	10 min.	575V	1EMXG, 2EMXG	Two per station
	VC/YC System Control Room Area AHU Fans	75 HP	70 HP	10 min.	70 HP	10 min.	575V	1EMXG, 2EMXG	Two per station
	VC/YC Sys. Comp. Oil Pump	1.5 HP	1.5 HP	10 min.	1.5 HP	10 min.	575V	1EMXG, 2EMXG	Two per station
SEQ 9:	VC/YC System Compressor	495 HP	353 HP	11 min.(13)	353 HP (18)	12 min.(13)	4160V	1ETA, 1ETB, 2ETA, 2ETB	Two per station
SEQ 10:	Back-up Pressurizer Heaters	416 KW (16)	416 KW (16)	(7) (16)	---	---	575V	1ELXA, 1ELXB, 2ELXA, 2ELXB	One group per diesel
	Boric Acid Transfer Pump	15.5 KW	11.25 KW	60 min.(7)	---	---	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	Fuel Pool Cooling Pump	200 HP	200 HP	60 min.(7)	200 HP (18)	(7) (18)	4160V	1ETA, 1ETB, 2ETA, 2ETB	One per diesel
	Hydrogen Recombiner	64 KW	---	---	64 KW	24 hrs.(7)	575V	1EMXC, 1EMXD, 2EMXC, 2EMXD	One per diesel
OTHER:	Containment Spray Pump	400 HP	---	---	420 HP (18)	(23)	4160V	1ETA, 1ETB, 2ETA, 2ETB	One per diesel
	Nuclear Service Water Strainer Backflush Drum	3 HP(8)	3 HP (8)	(8)	3 HP(8)	(8)	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel
	Residual Heat Removal Pump Air Handling Unit	1.5 HP	1.2 HP	(9)	1.2 HP	(9)	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel
	Containment Spray Pump Air Handling Unit	1.5 HP	1.2 HP	(9)	1.2 HP	(9)	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel
OTHER: (cont'd)	Fuel Pool Cooling Pump Air Handling Unit	1.5 HP	1.3 HP	(9)	1.3 HP	(9)	575V	1EMXA, 1EMXB, 2EMXA, 2EMXB	One per diesel

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks
	Ground Water Drainage System Pumps	30 HP	30 HP	(10)	30 HP	(10)	575V	(10)	Three 10 HP per diesel
	Aux. Bldg. Filtered Exhaust Fans	90 HP	90 HP	(11)	90 HP	(11)	575V	(11)	One per diesel
	Diesel Jacket Water Heater Pump	1 HP	(12)	---	(12)	---	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Jacket Water Heater	30 KW	(12)	---	(12)	---	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Barring Gear Motor	3 HP	(12)	---	(12)	---	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Lube Oil Heater	15 KW	(12)	---	(12)	---	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
	Diesel Generator Space Heater	4.6 KW	(12)	---	(12)	---	575V	1EMXE, 1EMXF, 2EMXE, 2EMXF	One per diesel
SOURCE SIZE (Per Diesel)		4000 KW	5000 KVA Continuous						
		4400 KW	5500 KVA 2 Hrs/Day (without affecting life of the unit)						

Note: Loads will be started automatically according to sequence number.

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C. Number	Remarks

1. This load will not exist after first 5 minutes and hence is not included in total load.
2. Transformers magnetizing inrush KVA 6 to 10 times its rating.
3. Intermittent load used during LOCA on an as needed basis. MCC energized after 11 sec. However, load requires manual operator action to energize.
4. Equipment rating is larger than load required during LOCA or Blackout.
5. Deleted Per 2018 Update
6. One 0.25 HP and one 0.5 HP fans connected to 1EMXC; two 0.25 HP and one 0.75 HP fans connected to 1EMXD for Unit 1; and one 0.5 HP fan connected to 2EMXC; one 0.25 HP and one 0.75 HP fans connected to 2EMXD for Unit 2.
7. Loads can be started after 12 minutes, if desired.
8. Nuclear service water strainer backflush drum motor will start at the same time as the respective RN pump motor to which it serves starts.
9. ES Air Handling Unit loads will start at the same time the respective pump motor to which it serves starts. (See FSAR Figure 8-3).
10. Two 10 HP pumps connected to 1EMXH-1, Seq. 1 (11 sec.) and one 10 HP pump connected to 1EMXG, Seq. 8 (10 min.) for Unit 1. Three 10 HP pumps connected to 2EMXG, Seq. 8 (10 min.) for Unit 2.
11. 90 HP req'd for LOCA and BLACKOUT per unit; one 50 HP (50 HP req'd) fed from 1EMXH, Seq. 1 (11 sec.); one 40 HP (40 HP req'd) fed from 1EMXG, Seq. 8 (10 min.) for Unit 1 and one 50 HP (50 HP req'd) fed from 2EMXG, Seq. 8 (10 min.); one 40 HP (40 HP req'd) fed from 2EMXH, Seq. 1 (11 sec.) for Unit 2.
12. The diesel loads categorized under "OTHER" are not connected when the diesel is operating.
13. Upon LOCA compressor receives immediate start permissive, upon BLACKOUT compressor receives start permissive after 8.5 second delay. Breaker closes following BLACKOUT after 11 minute delay (Sequence 9). Compressor receives sequencer start signal upon a BLACKOUT or LOCA following a 12 minute delay (Sequence 10). Additional delays for compressor pre-lube and motor short cycle protection are engineered in the chiller controls. These will not affect the operation of the sequencer timer as described.
14. These loads are sequenced on but do not auto-start. Level controls start/stop loads as required.
15. One 0.33 HP pump connected to 1EMXE; one 0.33 HP pump connected to 1EMXF for Unit 1 and one 0.25 HP pump connected to 2EMXE; one 0.25 HP pump connected to 2EMXF for Unit 2.
16. Nominal, initial capacity. Minimum capacity of 150 KW is required within four hours in order to establish and maintain natural circulation in hot standby.
17. Deleted Per 2012 Update
18. The Motor Driven Auxiliary Feedwater Pump (MDCAP) must be throttled to minimum flow prior to starting the Fuel Pool Cooling Pump to provide diesel generator load margin. Alternatives to throttling the MDCAP are securing the MDCAP, any ECCS pump, or YC chiller, which maybe more desirable and provide more margin than throttling the MDCAP. Also, the YC chiller maybe aligned to the opposite unit as another alternative. Cumulative load on diesel is actually less than noted in loading calculation (Reference MCC-1381.05-00-0260 & 0266).
19. Once Safety Injection Signal is Reset, management of diesel load to manually start and/or secure equipment is assumed by Operations.
20. One 125 HP and one 150 HP fans are connected to 1EMXC and 1EMXD for Unit 1. One 125 HP and one 150 HP fans are connected to

Sequence Number	Equipment Or Application	Connected Per Diesel	Required During Blackout	Reqd. Load Init Time After Blackout Signal	Required During LOCA	Reqd. Load Init Time After LOCA Safety Signal	Voltage	SWGR. GR./ L.C./M.C.C . Number	Remarks

2EMXC and 2EMXD for Unit 2.

21. Deleted Per 2018 Update.
22. If the pump control switch is in the auto position (normal operating position) during a BLACKOUT, the RN Strainer Backwash Pump will start approximately one-second after the Nuclear Service Water Pump start in load sequence 6. If the pump control switch is in the manual position (used during testing) during a BLACKOUT, the RN Strainer Backwash Pump will start in load sequence 2 when power is restored to the associated motor control center. During a SI only, the RN Strainer Backwash Pump will remain running if it was previously running or it will start approximately one-second after the Nuclear Service Water Pump start in load sequence 6.
23. The Containment Spray Pump's start is blocked when the load sequencer is actuated. The Containment Spray Pumps can be started following load sequencer reset and initiation of ECCS recirculation mode.

Table 8-2. Single Failure Analysis for the Offsite Power Systems

Component	Malfunction	Resulting Consequences
1. Duke Energy Transmission System	Loss of power due to blackout	a. The switchyard PCBs connecting the unit to the system (switchyard) trip automatically.
		b. The onsite diesel generators start and blackout loads are sequenced on automatically. The Essential Systems continue to receive an uninterrupted flow of power.
2. Switchyard red or yellow bus	Loss of one	a. No consequence. The red or yellow bus power circuit breakers (as applicable) trip. The unit is still connected to the system through two independent circuits from the remaining switchyard bus.
3. Switchyard power circuit breakers connecting the stepup transformers to switchyard or Circuit from switchyard to either main transformer or Main transformer	Loss of one due to a fault	a. The faulted equipment is isolated by protective relaying and protective equipment.
		b. The other independent offsite circuit remains unaffected.
		c. The two auxiliary switchgears normally supplied from the faulted circuit are connected in a rapid bus transfer to the other auxiliary transformer in the second independent circuit of that unit within a maximum of 8 cycles dead time and all unit and essential auxiliaries continue to receive uninterrupted offsite power.
		d. The unit generator automatically runs back to 56 percent rated output, or generator trips.
		e. One of the two independent offsite circuits to each unit is available.
4. Busline circuits from 230 kV switchyard to main transformer or Unit 1.	Collaspe of Rock Springs Line onto both busline circuits.	a. The faulted lines are isolated by protective relaying and protective equipment..
		b. An alternate offsite power source which is completely independent of the two Unit 1 overhead transmission circuits is provided through an intertie with the Unit 2 offsite power system

Table 8-3. Protective Relaying Breakdown - By Relay Zones

Relaying Zones	Protective Relays
1	Generator Differential, generator neutral overvoltage, generator neutral overcurrent, loss of excitation, voltage restrained overcurrent, negative sequence, overfrequency, volts/hertz, reverse power, breaker failure, out-of-step, inadvertent energization.
Deleted Per 2011 Update	
2, 5	Transformer differential, transformer neutral overcurrent, transformer fault pressure, transformer loss of cooler power, transformer overcurrent.
3, 6	Phase directional distance, ground directional distance, phase overcurrent, ground overcurrent.
4, 7	Transformer differential, transformer neutral overvoltage, breaker failure, transformer fault pressure.
8, 9, 11, 12	Transformer differential, phase and ground fault overcurrent.
10, 13	Generator differential, voltage controlled overcurrent.

Table 8-4. Monitoring Systems Analysis

		Action Taken		
System Monitored	**Description of Monitor Operation**	**Automatically**	**By Operator**	**Consequence of Monitoring System Failure**
I - Generator PCB's				
1. Low Air Pressure System	Separate pressure switches monitor for the minimum air pressure for closing and tripping the circuit breaker	On falling air pressure the breaker is either tripped or locked out from oper- ating pressures. Actions are alarmed.	None	Loss of alarm and possible damage of breaker.
2. High Air Pressure System	Pressure switch monitors the High pressure storage tank for low pressure	Alarm is initiated	None	No alarm is initiated. However, Low Air Pressure is unaffected.
3. Pole position	If all poles of all bkr. do not agree, then the alarm relay is energized.	Trips the breaker and alarms	None	Does not trip breaker and no alarm is initiated.
Deleted Per 2009 Update				
II - Main Step-up Transformer				
1. Hot spot (winding temp.)	Alarm initiated when temp. reaches 120°C (except 1A, 2A & 2B, which alarm at 100°C)	Alarm initiated	None	No alarm, however, redundant alarm (item 2) available

System Monitored	Description of Monitor Operation	Action Taken: Automatically	Action Taken: By Operator	Consequence of Monitoring System Failure
2. Hot spot temp. (analog)	RTD input to computer to reach pre-set limit (except 1A, 2A & 2B, which have 6 channels of direct contact fiber optic temperature probes and no RTD)	Alarm initiated	None	No alarm, however, redundant alarm (item 1) available The above two systems are backup for each other.
3. Oil temp. (1A, 2A & 2B - two channels)	Alarm initiated when oil temp. reaches 90°C (except 1A, 2A & 2B, which have alarms at 75°C for one channel and 80°C for other channel)	Alarm initiated	None	No alarm, (except 1A, 2A & 2B, which have two independent instruments)
4. Oil temp. (analog) (1A, 2A & 2B, three channels)	RTD input to computer to reach pre-set limit	Alarm initiated,	None	No alarm, except 1A, 2A & 2B, which have three independent instrument strings
5. Cooler power (Group 1 or 2)	Undervoltage Relays monitor the power Loss of power to either one initiates alarm	Alarm initiated except 2A & 2B, which also runs unit back to 55% and isolates generator	None	No alarm, however, oil flow alarm provides back up except 1A, 2A & 2B, which also have cooler AC current alarms to detect loss of power or failed cooler components

System Monitored	Description of Monitor Operation	Action Taken: Automatically	Action Taken: By Operator	Consequence of Monitoring System Failure
6. Cooler power (total loss)	Alarm initiated upon loss of power to both	Alarm initiated except 2A & 2B, which has the same runback/trip response as item 5	None	No alarm, however, oil flow alarm provides back up except 1A, 2A & 2B, which also have cooler AC current alarms to detect loss of power or failed cooler components
7. Mech pressure relief	Alarm initiated due to excess pressure	Alarm initiated	None	No alarm, however, item 10 provides alarm except: 1A, which has two devices with alarms and 2A & 2B, which have three devices with alarms
8. Oil flow	Alarm initiated upon failure of one or more oil pumps.	Alarm initiated	None	No alarm, however, items 3 and 4 provide alarm except 1A, 2A & 2B, which also have cooler AC current alarms to detect pump failures or obstructions
9. Gas accumulation	Accumulated gas forces oil down to initiate relay	Alarm initiated	None	No alarm, however, covered under maintenance procedures except 1A which has one channel of detection and 2A & 2B, which have two channels of detection. Item 12 also provides backup.
10. Fault Pressure	Contact closure upon sudden rise of transformer internal pressure	Trip the transformer off and initiate alarm	None	No trip from fault pressure relay, however, items 7 and 9 provide alarm. 1A, 2A & 2B, have three alarming sensors, with 2 out of 3 logic to operate trip.
11. Oil level	Contact closure when the oil level reaches the lowest safe level	Trip the transformer off and initiate alarm	None	No trip from oil level switch. 1A, 2A & 2B, each have three alarming sensors, with 2 out of 3 logic to operate trip.

		Action Taken		
System Monitored	**Description of Monitor Operation**	**Automatically**	**By Operator**	**Consequence of Monitoring System Failure**
12. Gas generation	Contact closure when any of 8 monitored gasses exceeds alarm levels	Alarm initiated	None	No alarm on gas generation. Item 9 provides backup alarm.

Table 8-5. Deleted Per 1999 Update

Table 8-6. Equipment Shared by Both Units

No.	Equipment Identification
1	*Air Conditioning Equipment and Cable Room Pressurizing Fans No. A & B
2	*Air Conditioning System Control Room Pressurizing Fans No. A & B
3	*Control Room Air Conditioning Fans No. A & B
4	*Air Conditioning System Chiller Water Pumps No. A & B
5	*Air Conditioning System Compressors No. A & B
6	*Equipment and Cable Room A/C Fans No. A & B
7	Selected Trace Heating
8	Auxiliary Control Power System Chargers # CXA, CXB, CXS (Spare)
9	Regulated Dist. Centers 1KRP and 2KRP
10	*Vital AC - DC System Battery Chargers, EVCA, EVCB, EVCC, EVCD, EVCS (Spare)
11	600 Volt Load Centers No. 1SLXA, 1SLXB, 1SLXC, 1SLXD, 1SLXF, 1SLXG, 1SLXH 2SLXA, 2SLXB, 2SLXC, 2SLXD, 2SLXF, 2SLXG, 2SLXH, 2SLXI
12	600 Volt Motor Control Centers 1EMXG, 1EMXH, 1EMXH1, 2EMXG, 2EMXH
13	Electrical Computer Support System Uninterruptible Power Supply SKDCS (Spare)
14	Nuclear Service Water System valve 1RN1 and valves with 'ORN' designators

Note:

1. The majority of the equipment identified is installed with Unit 1 and is fed power by Unit 1 at the time of startup. Alternate feeds with manual transfer capability are provided, as appropriate, to the shared systems, such that either Unit 1 or Unit 2 can be used to feed power to the shared loads.
2. Asterisk (*) indicates Engineered Safety Features load.
3. SKDCS Uninterruptible Power Supply (UPS) functions as an installed spare for the replacement of either 1KDCS UPS or 2KDCS UPS in supplying assigned Unit 1 or Unit 2 Control System Infrastructure loads.

Table 8-7. Single Failure Analysis for the Onsite Power Systems

Component	Malfunction	Resulting Consequences
1. Isolated phase bus from main transformer to the generator breaker or to the auxiliary transformer or Auxiliary transformer	Loss of one due to a fault	a. The faulted equipment is isolated by protective relaying and protective equipment..
		b. The other independent offsite circuit remains unaffected
		c. The two auxiliary switchgears normally supplied from the faulted circuit are connected in a rapid bus transfer to the other auxiliary transformer in the second independent circuit of that unit within a maximum of 8 cycles dead time and all unit and essential auxiliaries continue to receive uninterrupted offsite power.
		d. The unit generator automatically runs back to 56 percent rated output, or generator trips.
		e. One of the two independent offsite circuits to the affected unit is available
2. Isolated phase bus connecting the generator circuit breakers and the unit generator or Unit generator	Loss of one	a. Both generator breakers trip.
		b. The unit generator trips automatically.
		c. The reactor trips automatically.
		d. All unit and essential auxiliaries continue to receive uninterrupted offsite power from the two independent offsite circuits.
3. Generator breaker	Loss of one pole of one breaker coincident with a malfunction described in 4 or 5	a. The other two poles of the affected breaker, the other generator breaker and the respective switchyard power circuit breakers trip.
		b. The two auxiliary switchgears normally supplied from the faulted circuit are connected to the auxiliary transformer in the second independent circuit of that unit within a maximum of 8 cycles deadtime and all unit and essential auxiliaries continue to receive uninterrupted power through one offsite circuit.
		c. The unit generator trips automatically.
		d. The reactor trips automatically.
4. Isolated Phase Bus Cooling System	Loss of Cooling Water	a. Within 15 minutes the operator must open the bus dampers to utilize the once-through system feature..
		b. No reduction in unit output is required

Component	Malfunction	Resulting Consequences
	Loss of the Normal Cooling Fan	a. Within 15 minutes the operator must reduce unit output to 2000 amps. The unit and essential auxiliaries continue to receive uninterrupted power from the two offsite circuits.
5. Auxiliary Transformer Cooling System	Loss of one of the two cooler banks	a. No consequence. Each auxiliary transformer is normally loaded to half of its self-cooled rating with the unit at rated 100 percent MVA output. The unit receive uninterrupted flow of power from the two independent offsite circuits.
6. Main Transformer Cooling System (Unit 2)	Loss of one of the two cooler banks	a. 28 min. 45 sec after failure, turbine will automatically be run back to half load. 30 minutes after failure, associated generator breaker will be tripped. Transformer will remain energized from switchyard. The unit and the essential auxiliaries continue to receive uninterrupted flow of power from the two independent offsite circuits.
7. Auxiliary transformer or Non-segregated bus from the auxiliary transformer to the 6900V Normal Auxiliary System switchgear	Loss of one due to a fault	a. The faulted equipment is isolated by protective relaying and protective equipment.
		b. The two 6.9 kV Normal Auxiliary System switchgear normally supplied from the faulted circuit is connected in a rapid bus transfer to the other auxiliary power transformer of that unit within a maximum of 8 cycles dead time and all unit and essential auxiliaries continue to receive uninterrupted offsite power..
		c. The unit generator automatically runs back to 56 percent MVA rated output.
8. 6900V Normal Auxiliary System switchgear source breakers	Breaker fault or failure to open during a fault	a. The alternate source breaker locks open.
		b. The applicable generator PCB trips isolating the unit generator from the fault.
		c. The two applicable switchyard PCBs trip isolating the system from the fault.
		d. The unit generator automatically runs back to 56 percent rated output.
		e. The other 6900V Normal Auxiliary Power System switchgear supplied from the faulted circuit is connected in a rapid bus transfer to the other unit auxiliary power transformer in the second independent circuit of that unit within a maximum of 8 cycles dead time.

Component	Malfunction	Resulting Consequences
		f. If the generator unit is above approximately 48 percent power, the generator and the reactor trip due to the loss of one reactor coolant pump. The other generator PCB trips maintaining uninterrupted offsite power to the unit and essential auxiliaries through one independent circuit.
		g. If the unit generator is below approximately 48 percent power, the unit generator is not tripped.
		h. Assuming that one 4160V Essential Auxiliary Power System switchgear is connected to the affected 6900V Normal Auxiliary Power System switchgear, then it is deenergized. Sufficient redundant Engineered Safety Features loads remain operable from the redundant 4160V Essential Auxiliary Power System switchgear for the safe operation of the reactor. An onsite diesel generator starts and is automatically connected to the de-energized Essential Auxiliary Power System switchgear and the required loads are sequenced on automatically.
9. 6900V Normal Auxiliary System switchgear bus or	Bus shorted or	a. The 6900V Normal Auxiliary System switch gear source breaker trips. The alternate source breaker locks open.
6900V Normal Auxiliary System switchgear feeder breakers	Breaker fault or failure to open during a fault	b. If the generator unit is above approximately 48 percent power, the generator and the reactor trip due to the loss of one reactor coolant pump. Both generator PCBs trip maintaining power to the unit and essential auxiliaries through two independent circuits.
		c. If the generator unit is below approximately 48 percent power, the unit generator is not tripped.

Component	Malfunction	Resulting Consequences
		d. Assuming that one 4kV Essential Auxiliary Power System switchgear is connected to the faulted 6900V Normal Auxiliary Power switchgear, then it is de-energized. Sufficient redundant Engineered Safety Feature loads remain operable from the redundant 4160V Essential Auxiliary Power System bus, for the safe operation of the reactor. The onsite diesel generator dedicated to the de-energized switchgear starts and blackout loads are sequenced on that switchgear automatically.
10. Feeder cable to the 4160V Essential Auxiliary Power switchgear or 6.9/4kV auxiliary power transformer	Fault	a. The affected 6900V Normal Auxiliary Power System switchgear and 4160V switchgear breakers trip. Sufficient redundant auxiliaries remain operable from the redundant essential bus for the safe operation of the reactor.
		b. The diesel generator dedicated to the affected 4kV Essential Auxiliary Power System switchgear starts and blackout loads are sequenced on that switchgear automatically.
11. 4kV Essential Auxiliary Power (EAP) System switchgear source breaker	Fault	a. The affected 4kV EAP switchgear is deenergized. The feeder breaker in the 6900V auxiliary switchgear trips and the diesel generator breaker locks out. Sufficient redundant auxiliaries remain operable from the redundant essential switchgear bus for the safe operation of the reactor.
12. 4kV Essential Auxiliary Power (EAP) System switchgear bus or 4kV EAP switchgear feeder breaker	Fault	a. The affected 4kV EAP switchgear is deenergized. The 4kV EAP switchgear normal source breaker and the diesel generator breaker lock out. Sufficient redundant auxiliaries remain operable from the redundant essential bus for the safe operation of the reactor.

Component	Malfunction	Resulting Consequences
13. 4kV Essential Auxiliary Power (EAP) System Switchgear feeder cables or 4160/600 Volt EAP load center transformer or 600V EAP load center source breakers	Fault on one	a. The associated load feeder breaker trips and isolates the fault from the system. Sufficient redundant auxiliaries remain operable from the redundant Essential Power System for safe operation of the reactor.
14. 600 volt EAP load center bus or 600V EAP load center feeder breaker	Fault	a. The 600 Volt EAP load center source circuit breaker trips. Sufficient redundant auxiliaries remain operable from the redundant Essential Auxiliary Power System for the safe operation of the reactor.
15. 600 volt EAP load center feeder cable or 600 Volt EAP motor control center bus	Fault	a. The 600 volt EAP load center feeder breaker trips. Sufficient redundant auxiliaries remain operable from the redundant Essential Auxiliary Power System for the safe operation of the reactor.
16. 600 Volt EAP motor control center feeder cable	Fault	a. The 600 Volt EAP motor control center feeder breaker trips. Sufficient redundant auxiliaries remain operable from the redundant system for the safe operation of the unit.

Table 8-8. Major Loads Connected to the Diesel

	Time Required				Length of Time Each Load is Required	
Equipment	**Blackout**	**LOCA**	**Size of Load**	**Inrush Current**	**Blackout**	**LOCA**
Safety injection pump	Not Required	16 sec	400 HP	345 Amps	-	3 days
Centrifugal charging pump	11 sec	11 sec	600 HP	472 Amps	7 days	7 days
Residual heat removal pump	Manual Start	20 sec	400 HP	397 Amps	year	year
Containment spray pump	When Required	(2)	400 HP	403 Amps	-	3 days
Component cooling water pump	30 sec	30 sec	200 HP	148 Amps	year	year
Nuclear service water pump	35 sec	35 sec	700 HP	665 Amps	year	year
Auxiliary feedwater pump (Unit 1)	40 sec	40 sec	500 HP	430 Amps	254 min.	254 min.
Auxiliary feedwater pump (Unit 2)	40 sec	40 sec	500 HP	393 Amps	254 Min.	254 Min.
Fuel pool cooling pump	60 min	60 min	200 HP	158 Amps	3 months	3 months
A/C system compressor	12 min	12 min	495 HP	308 Amps	year	year

1. Deleted Per 2018 Update.
2. The Containment Spray Pump's start is blocked when the load sequencer is actuated. The Containment Spray Pumps can be started following load sequencer reset and initiation of ECCS recirculation mode.

Table 8-9. Diesel-Generator Modeling Program Verification Data

		Voltage Dip Volts			Frequency Dip Hertz		
Time Seconds	Motor Start HP & KW Load	DGMP	Test	Percent Difference	DGMP	Test	Percent Difference
t[1]	2000 HP 2480 KW	3211	3300	-2.70	57.56	57.24	0.56
t + 5	1000 HP 900 KW	3636	3785	-3.94	58.97	59.32	-0.59
t + 10	800 HP 1400 KW	3771	4100	-8.02	58.89	59.41	-0.88
t + 15	300 HP 950 KW	4022	4075	-1.30	59.97	59.28	1.16

Note:

1. t is the time when the machine reaches rated voltage and frequency. t is not a pre-set time.

Table 8-10. Single Failure Analysis of the Switchyard 125 VDC System

Component	Malfunction	Comments and Consequences
1. 600 AC power supply to charger	Loss of power to one	No consequence - power from battery is available to supply power without interruption.
2. Battery charger	Loss of power from one	a. The 125 volt DC bus does continue to receive power from its respective battery without interruption except as in (2c).
		b. Standby battery charger is available.
		c. Several internal faults may cause high short circuit currents to flow with the resulting voltage reduction on the 125 volt DC bus until the fault is cleared by the isolating circuit breakers. Complete loss of voltage on the 125 volt DC bus may result if the battery circuit breakers open. However, redundant protective relaying and panelboards are provided and are supplied from the other redundant 125 volt DC bus.
3. 125V DC battery	Loss of power from one	Only those 125 volt DC control panelboards supplied from the affected bus are lost. However, the redundant paneboards supplied from the other 125 volt DC bus is unaffected and continue to provide power for protection and control.
4. DC switchgear busses P-N	Bus shorted	Same comment as 3.
5. 125V DC bus SY-1, SY-2	Grounding a single bus	a. The 125 volt DC system is an ungrounded electrical system. Ground detector equipment monitors and alarms a ground anywhere on the 125 volt DC system. A single ground does not cause any malfunction or prevent operation of any safety feature.
6. 125V DC bus SY-1, SY-2	Gradual decay voltage on one bus	a. Each 125 volt bus is monitored to detect the voltage decay on the bus and initiate an alarm at a voltage setting where the battery can still deliver power for safe and orderly shutdown of the station. Upon detection, power is restored by correcting the deficiency.
7. DC switchgear load feeder cables	Cables shorted	Same comments as 3.

Component	Malfunction	Comments and Consequences
8. 125V DC primary or backup panelboards	Bus shorted in one	a. Voltage on associated 125 volt DC bus decays until isolated by isolating circuit breakers.
		b. Protective relaying connected to the affected panelboards are lost; however, redundant protective relaying supplied from the other 125 volt DC bus provide protection.
		c. One source of control power is lost to the switching station power circuit breakers; however, a redundant source of control power is provided from the other 125 volt DC bus.

Table 8-11. 250 VDC Auxiliary Power System Loads Used for Battery Sizing[1]

Load	Rating of Load	Total Amperes Inrush/Continuous
Turbine emergency bearing oil pump motor	75 HP	783/261
Deleted per 2015 update		
Unit 1 (only) Generator air side seal oil backup pump motor	25 HP	270/90
Unit 2 (only) Seal oil pump motor	15 HP	202.7/51.2
Feedwater pump turbine No. 1A emergency oil pump motor	7.5 HP	87/29
Feedwater pump turbine No 1B emergency oil pump motor	7.5 HP	87/29
Lighting (U1&U2) and seal oil starter motor monitoring (Unit 2 only)		203.4/203.4
Bus Voltage & System Failure Circuits		2/2
Turbine Backup Vapor Extractor	1.5 HP	17.25/5.75

Note:

1. Batteries are sized to supply seal oil pump, vapor extractor and remaining DC lights for four hours along with the FWPT Emergency Oil (backup) Pumps (EOPs) which run for three hours, provided the Reactor Bldg. and Admin. Bldg. DC lights are removed within two hours. Loads on Unit 1 and 2 are similar except as noted.

Table 8-12. 125 VDC Auxiliary Control Power System Loads Used for Battery Sizing

Load	Total Amperes Inrush[1]/Continuous
Inverter (computer)	139.5/139.5
Inverter (auxiliary power panelboard)	435.5/379.9
600V load centers	12.2/12.2
6.9 kV switchgear	11/1.4
Cond Sys Controls	32.7/2.9
H_2 Recomb Cnt Pnl	12/12
Feed water pump controls	5.8/5.7
Protective relaying	61.8/61.8
Sub Panel DCA-1	155.2/67.1
Annunicators	17.3/17.3
Event recorder	5/5
Generator breaker control	51.6/1.2
Miscellaneous Controls	68.9/56.1

Note:

1. Inrush upon loss of AC power.

Table 8-13. Single Failure Analysis of the 125 VDC Vital Instrumentation and Control Power System

Component	Malfunction	Comments and Consequences
1. 600V AC power supply to chargers EVCA, EVCB, EVCC and EVCD	Loss of power to one	No consequence - power from battery is available to supply power without interruption.
2. Battery chargers EVCA, EVCB, EVCC and EVCD	Loss of power from one	a. Several internal faults may cause high short circuit currents to flow with the resulting voltage reduction on the 125 volt DC bus until the fault is cleared by the isolating circuit breakers.
		b. the 125 volt DC bus continues to receive power from its respective battery without interruption
		c. A spare charger is available to replace the non-functioning charger.
3. 125V DC batteries EVCA, EVCB, EVCC EVCD	Short circuit on one	Power is lost to the instrumentation and control channel serviced by the battery.
4. 125 DC distribution centers EVDA, EVDB, EVDC, EVDD	P and N Buses shorted on one distribution center	Power is lost to the instrumentation and Control channel serviced by the distribution center.
5. 125V DC distribution centers EVDA, EVDB, EVDC, EVDD	Grounding of single bus	The 125 volt DC system is an ungrounded electrical system. Ground detector equipment monitors and alarms a ground anywhere on the 125 volt DC system. A single ground will not cause any malfunction or prevent operation of any safety feature.
6. 125V DC distribution centers EVDA, EVDB, EVDC, EVDD	Gradual decay of voltage on one bus	Each 125 volt bus is monitored to detect the voltage decay on the bus and initiate an alarm at a voltage setting where the battery can still deliver power for safe and orderly shutdown of the station. Upon detection, power is restored either by correcting the deficiency by switching to a redundant source or by employing one of the redundant circuits.
7. DC distribution center incoming feeder cables	Cables shorted	Charger incoming cables - a. Voltage on one of the 125 Volt DC Bus Systems Decays until isolated by an over current protective device.

Component	Malfunction	Comments and Consequences
		b. The 125 Volt DC Bus continues to receive power from its respective battery. Battery incoming cables - Same comments as item 3 of this table.
8. 125V DC instrumentation and control power panelboards 1EVDA, 1EVDB, 1EVDC, 1EVDD	Bus shorted on one panelboard	a. Voltage on one of the 125 volt DC bus systems decays until isolated by the isolating circuit breakers.
		b. For a short in panelboard 1EVDA or 1EVDD, for Unit 1, one-half of the 4160 volt switchgear control power is lost. The remaining redundant switchgear is adequate and is supplied control from the other DC panelboard.
		c. For Unit 1, one-half of the 600 Volt Essential Auxiliary Power System load centers lose DC control power
9. 125VDC Instrumentation and control power paneboards 2EVDA, 2EVDB, 2EVDC, and 2EVDD	Bus shorted on one panelboard	a. Voltage on one of the 125 volt DC bus systems decays until isolated by the isolating circuit breakers.
		b. For a short in panelboard 2EVDA or 2EVDD, for Unit 2 one-half of the 4160 volt switchgear closing control power is lost. The remaining redundant switchgear is adequate and is supplied control power from the other DC panelboard.
		c. For Unit 2, one-half of the 600 Volt Essential Auxiliary Power System load centers lose DC control power.

Table 8-14. Deleted Per 1991 Update. The information is available in **Figure 8-39**

Table 8-15. Single Failure Analysis of the 120 Volt AC Vital Instrumentation and Control Power System

Component	Malfunction	Comments and Consequences
1. 125V DC distribution centers EVDA, EVDB, EVDC, EVDD	P and N buses shorted on one	One static inverter per unit is lost and power to one instrument is lost temporarily until a manual transfer could be made to a regulated instrument bus. The temporary loss of one vital instrument bus per unit results in the temporary loss of one channel per unit of reactor protection and instrument systems and engineered safety systems. Other remaining channels receive vital instrument control power from the other panelboards.
2. Static inverter feeder cable	Failure	One static inverter is lost and power to one instrument bus is lost temporarily until a manual transfer could be made to a regulated instrument bus. The temporary loss of one vital instrument bus results in the temporary loss of one channel of reactor protection and instrument systems and engineered safety systems. Other remaining channels receive vital instrument control power from the other panelboards.
3. Static inverter	Failure	Same as comment 2.
4. Vital instrumentation and control power panelboards, 1EKVA, 1EKVB, 1EKVC, 1EKVD	Failure of one	For any one bus failure, only one channel of any system associated with reactor protective systems or engineered safety features actuation system is lost. Sufficient redundant channels supplied from other vital instrument buses provided adequate protection.
5. Vital instrumentation and control power panelboards, 2EKVA, 2EKVB, 2EKVC and 2EKVD	Failure of one	Same as 4.

Table 8-16. Load Sequencing Times

LOAD GROUP NUMBER	SEQUENCE TIME (Seconds)
Initiate Timer (T_o)	9.7 ± 0.3
1 (T_1)	T_o + 0.9 ± 0.1
2 (T_2)	T_o + 5.6 ± 0.4
3 (T_3)	T_o + 9.4 ± 0.6
4 (T_4)	T_o + 14.1 ± 0.9
5 (T_5)	T_o + 18.4 ± 1.2
6 (T_6)	T_o + 23.1 ± 1.4
7 (T_7)	T_o + 28.3 ± 1.7
8 (T_8)	T_o + 530.0 ± 60.0
9 (T_9)	T_8 + 56.0 ± 4.0
10 (T_{10})	T_8 + 112.3 ± 7.0

Table 8-17. Exception to Regulatory Guide 1.9, Rev. 3 and IEEE Std 387-1984

Regulatory Position or IEEE Std. Guidance	Exception
IEEE Std 387-1984 Exclusion 1.3: The following item is outside of the scope of this standard: (3) The fuel oil storage system (day tank, storage tank, transfer pumps and filters, and strainers between the storage tank and the day tank)	MNS takes exception to this exclusion. MNS includes the entire fuel oil system as part of the EDG super system. This configuration follows the methodology set forth in RG 1.9 Rev.3.
IEEE Std 387-1984 Exclusion 1.3: The following item is outside of the scope of this standard: (4) The auxiliary power system beyond the generator terminals of the diesel-generator unit, including: (a) The conductors for transmitting power from the generator (b) The diesel-generator unit main disconnecting and protective device (c) The generator circuit instrument transformers, whether furnished with the diesel-generator unit or not (d) The generator protective relays	MNS takes exception to this exclusion. MNS includes the listed portions of the auxiliary power system, as part of the EDG super system. These portions are considered vital to EDG functionality. This configuration follows the methodology set forth in RG 1.9 Rev.3.
RG 1.9 Rev. 3 Regulatory Position 1.2: When the characteristics of the required emergency diesel generator loads are not accurately known, such as during the construction permit state of design, each emergency diesel generator unit of an onsite power supply system should be selected to have a continuous load rating (as defined in Section 3.7.1 of IEEE Std 387-1984) equal to the sum of the conservatively estimated loads (nameplate) needed to be powered by that unit at any one time plus a 10 to 15 percent margin. In the absence of fully substantiated performance characteristics for mechanical equipment such as pumps, the electric motor drive ratings should be calculated using conservative estimates of these characteristics, e.g., pump runout conditions and motor efficiencies of 90 percent or less, and power factors of 85 percent or lower.	MNS used 92% motor effeciency at licensing (UFSAR 8.3.1.2.4). Today, the station does not have the recommended 10 to 15 percent margin indicated in RG 1.9 Rev. 3, but is able to carry its designed loads as previously recommended by IEEE Std 387-1972.
IEEE Std 387-1984 Design Criterion 5.1.2(1): The unit shall be capable of operating during and after any design basis event without support from the preferred power supply. The following design condition, including appropriate margins as required by IEEE Std 323-1983, 6.3.1.5 shall be specified by those individuals responsible for the system application and, as a minimum, shall include: (a) Operational cycles (4000 starts over a period of 40 years, unless otherwise specified	No purchase specification describing the engine's capabilities was prepared. MNS takes exception, per former Nordberg engineers. EDGs designed for life of station.

Regulatory Position or IEEE Std. Guidance	Exception
IEEE Std 387-1984 Design Criterion 5.1.2(1): The unit shall be capable of operating during and after any design basis event without support from the preferred power supply. The following design condition, including appropriate margins as required by IEEE Std 323-1983, 6.3.1.5 shall be specified by those individuals responsible for the system application and, as a minimum, shall include: (b) Operating hours (4000 hours over a period of 40 years, unless otherwise specified	No purchase specification describing the engine's capabilities was prepared. MNS takes exception, per former Nordberg engineers. EDGs designed for life of station.
IEEE Std 387-1984 Design Criterion 5.1.2(1): The unit shall be capable of operating during and after any design basis event without support from the preferred power supply. The following design condition, including appropriate margins as required by IEEE Std 323-1983, 6.3.1.5 shall be specified by those individuals responsible for the system application and, as a minimum, shall include: include (g) Load profile (including allowable voltage and frequency variations) see 3.5	MNS takes exception to specifying a load profile with allowable voltage and frequency variations. The MNS design criteria complied with IEEE Std 387-1972. Additionally, a diesel generator dynamic loading computer program was developed and the results compared to actual sequential loading test data. The comparison demonstrated the acceptability of the computer program as an aid in dynamic diesel generator analysis.
IEEE Std 387-1984 Design Criterion 5.1.2(1): The unit shall be capable of operating during and after any design basis event without support from the preferred power supply. The following design condition, including appropriate margins as required by IEEE Std 323-1983, 6.3.1.5 shall be specified by those individuals responsible for the system application and, as a minimum, shall include: (h) Absolute barometric pressure (altitude and tornado depressurization, duration, and magnitude)	No purchase specification describing the engine's capabilities was prepared. MNS takes exception due to lack of manufacturer design information.
IEEE Std 387-1984 Design Criterion 5.1.2(1): The unit shall be capable of operating during and after any design basis event without support from the preferred power supply. The following design condition, including appropriate margins as required by IEEE Std 323-1983, 6.3.1.5 shall be specified by those individuals responsible for the system application and, as a minimum, shall include: (i) Combustion air contaminant (salt, sand, etc)	No purchase specification describing the engine's capabilities was prepared. MNS takes exception, no specification from manufacturer.
IEEE Std 387-1984 Design Criterion 5.1.2(1): The unit shall be capable of operating during and after any design basis event without support from the preferred power supply. The following design condition, including appropriate margins as required by IEEE Std 323-1983, 6.3.1.5 shall be specified by those individuals responsible for the system application and, as a minimum, shall include: (m) Service water quality	No purchase specification describing the engine's capabilities was prepared. MNS takes exception to specifying quality of service water because appropriate water filtration and monitoring of EDG heat exchanger DP ensures sufficient heat transfer.

Regulatory Position or IEEE Std. Guidance	Exception
IEEE Std 387-1984 Design Criterion 5.1.2(3): The unit shall be capable of accepting design load following operation at light load or no load for the time required by the equipment specification.	Quality Report MCS 1301.00-1 documents successful testing by operating an EDG for 18 hours at no load followed by a step loading of > 50% load (with the water rheostat). MNS takes exception to this test because it is detrimental to the EDG.
RG 1.9 Rev. 3 Regulatory Position 1.8: Section 5.5.4(2) of IEEE Std 387-1984, on retaining all protective devices during emergency diesel generator testing, does not apply to a periodic test that demonstrates diesel generator system response under simulated accident conditions per Regulatory Positions 2.2.5, 2.2.6, and 2.2-12.	MNS takes exception to this paragraph. The "simulated accident conditions test" should not be allowed to cause unnecessary damage to an EDG if that EDG has an unforeseen problem. UFSAR Section 8.3.1.1.7 identifies 4 trips that are provided to protect the diesel at all times, and are not bypassed during starting of the diesel generator by an engineered safeguards signal. It is also recommended that the "trips bypass test" be used to verify the EDG does not trip on the bypass trip signals.
RG 1.9 Rev. 3 Regulatory Position 2.2.6: Demonstrate that the emergency diesel generator can satisfactorily respond to a LOOP in conjunction with SIAS in whatever sequence they might occur (e.g., loss-of-coolant accident (LOCA) followed by delayed LOOP or LOOP followed by LOCA). A simultaneous LOOP/LOCA event would be demonstrated by simulating a LOOP and SIAS and verifying that (1) the emergency buses are deenergized and loads are shed from the emergency buses, and (2) the emergency diesel generator starts on the autostart signal from its standby conditions, attains the required voltage and frequency and energizes permanently connected loads within acceptable limits and time, energizes autoconnected loads through the load sequencer, and, operates for greater than or equal to 5 minutes.	MNS takes exception to performing this test in any order that the event can occur. This test is typically performed with the simultaneous LOOP and SIAS signal given. Additional testing beyond the simultaneous signal test is not required per the station Tech. Specs.and unnecessarily puts the plant through unnecessary transients.

Regulatory Position or IEEE Std. Guidance	Exception
RG 1.9 Rev. 3 Regulatory Position 2.2.7: Demonstrate the emergency diesel generator's capability to reject a loss of the largest single load while operating at power factor between 0.8 and 0.9 and verify that the voltage and frequency requirements are met and that the unit will not trip on overspeed.	MNS takes exceptions to performing this test at a specified power factor. This Surveillance is performed with the DG connected to its bus in parallel with offsite power supply. The DG is tested under maximum kVAR loading, which is defined as being as close to design basis conditions as practical subject to offsite power conditions. Design basis conditions have been calculated to be greater than 0.9 power factor. During DG testing, equipment ratings are not to be exceeded (i.e., without creating an overvoltage condition on the DG or 4 kV emergency buses, over-excitation in the generator, or overloading the DG emergency feeder while maintaining the power factor greater than or equal to 0.9).
RG 1.9 Rev. 3 Regulatory Position 2.2.8: Demonstrate the emergency diesel generator’s capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor between 0.8 and 0.9, and verify that the voltage requirements are met and that the emergency diesel generator will not trip on overspeed.	MNS takes exception to performing this test utilizing a specified power factor. This test is typically performed with a power factor close to unity. Performing this test at a 0.9 power factor is considered destructive testing due to excessively high voltage fluctuations in the generator. Although not representative of the design basis inductive loading that the DG would experience, a power factor of approximately unity (1.0) is used for testing. This power factor is chosen in accordance with manufacturer's recommendations to minimize DG overvoltage during testing.

Regulatory Position or IEEE Std. Guidance	Exception
RG 1.9 Rev. 3 Regulatory Position 2.2.9: Demonstrate full-load carrying capability at a power factor between 0.8 and 0.9 for an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the emergency diesel generator, and 22 hours are at a load equal to 90 to 100 percent of its continuous rating. Verify that voltage and frequency requirements are maintained.	MNS takes exception to performing this test utilizing a specified power factor. This test is typically performed with a power factor close to unity. Performing this test at a 0.9 power factor is considered destructive testing due to excessively high voltage fluctuations in the generator. This Surveillance is performed with the DG connected to its bus in parallel with offsite power supply. The DG is tested under maximum kVAR loading, which is defined as being as close to design basis conditions as practical subject to offsite power conditions. Design basis conditions have been calculated to be greater than 0.9 power factor. During DG testing, equipment ratings are not to be exceeded (i.e., without creating an overvoltage condition on the DG or 4 kV emergency buses, over-excitation in the generator, or overloading the DG emergency feeder while maintaining the power factor greater than or equal to 0.9). The load band is provided to avoid routine overloading of the DG. Routine overloading may result in more frequent teardown inspections in accordance with vendor recommendations in order to maintain DG OPERABILITY.
IEEE 387-1984 Qualification Requirement 7.3.2: Further classification of the safety-related components identified in 7.3.1(1) is required to address the potential for age-related failures. The categories in Table 2 illustrate this classification.	MNS takes exception to the aging program as described in Table 2 and Appendix B. The aging of components is addressed at MNS by the component preventive/predictive maintenance programs, the material shelf life program, the parts stocking program and component testing programs. These programs are a primary responsibility of the System Engineers and meet the intent of Table 2.

Regulatory Position or IEEE Std. Guidance	Exception
RG 1.9 Rev. 3 Table 1: Preoperational and Surveillance Testing.	MNS takes exception to the test intervals listed in this table for the following: 2.2.9 Endurance and Margin Test: The table specifies Refueling Outage, MNS performs this testing with the unit online, at a frequency equal to the refueling outage interval. 2.2.10 Hot Restart Test: The table specifies Refueling Outage, MNS performs this testing with the unit online, at a frequency equal to the refueling outage interval. The surveillance test frequencies were initially based on RG 1.9; however, the current surveillance test frequency is controlled by the Surveillance Frequency Control Program.
RG 1.9 Rev. 3 Regulatory Position 2.3.2.4: Ten Year Testing.	MNS takes exception to the requirement this test be performed during a plant shutdown.

Table 8-18. Exception to Regulatory Guide 1.137, Rev 1 and ANSI N195-1976

Regulatory Position	Duke Position/Exception
C. REGULATORY POSITION 1. The requirements for the design of fuel-oil systems for diesel generators that provide standby electrical power for a nuclear power plant that are included in ANSI N195-1976, "Fuel Oil Systems for Standby Diesel-Generators," provide a method acceptable to the NRC staff for complying with the pertinent requirements of General Design Criterion 17 of Appendix A to 10 CFR Part 50, subject to the following:	The McGuire diesel generator fuel oil system was designed and installed prior to the writing of ANSI N195-1976. The following information provides the McGuire design positions for differences from ANSI N195-1976: 5.2 & 5.3) Each McGuire reactor unit is supported by 2 independent diesel generator units. The capacity of each fuel storage system of each diesel generator unit is sufficient to operate its associated diesel generator for a period of 5 days at 100% design load plus margin. The fuel system allows for cross connection between the two diesel generators such that either diesel engine can be aligned fuel from either storage tank. Using this capability, a quantity of fuel in excess of 7 days supply can be made available for one diesel generator. 5.4) Each McGuire diesel fuel storage tank contains a supply of fuel for its diesel generator to support operating at 100% rated capacity for a 5 day period. Together, both fuel storage tanks provide more than 7 days capacity plus additional margin for one diesel generator. 6.1) The day tank for each diesel engine contains at least 30 minutes of fuel for engine operation at 100% load. The day tank overflow is not connected to the storage tank. 6.3) There is a duplex filter arrangement in the fuel line from the transfer pump to the day tank. 7.1 & 7.2) Portions of the fuel system are designated Safety Class 3 (reference paragraph 3.2.3.3.1.e and Table 3-4). Refer to Table 3-4 for identification of components which were not built to applicable codes and standards, but have been qualified seismically. 7.3) The safety class 3 portion of the fuel system which is required for diesel engine operation is protected from tornados, floods, missiles and other natural phenomena. The recirculation portion of the fuel system is not safety class 3 and therefore is not protected from these events. 7.4) Refer to Table 3-4 for summary of criteria for the diesel fuel system. 7.5) A fill line strainer is not provided. The underground storage tank does not have a flame arrestor. 8.2.d) The underground storage tank is not

	equipped with a high level alarm.
a. Throughout ANSI N195-1976, other documents required to be included as part of the standard are either identified at the point of reference or described in Section 7.4, "Applicable Codes, Standards, and Regulations," or in Section 11, "References," of the standard. The specific acceptability of these listed documents has been or will be addressed separately in other regulatory guides or in Commission regulations, where appropriate.	The McGuire diesel generator fuel oill system was designed and installed prior to the writing of ANSI N195-1976. Portions of the fuel system are designated Safety Class 3 (reference paragraph 3.2.3.3.1.e and Table 3-4). Refer to Table 3-4 for identification of components which were not built to applicable codes and standards, but have been qualified seismically.
b. Section 1, "Scope," of ANSI N195-1976 states that the standard provides the design requirements for the fuel-oil system for standby diesel generators and that it sets forth other specific design requirements such as safety class, materials, physical arrangement, and applicable codes and regulations. The standard does not specifically address quality assurance, and in this regard ANSI N195-1976 should be used in conjunction with Regulatory Guide 1.28, "Quality Assurance Program Requirements (Design and Construction)," which endorses ANSI N45.2-1977, "Quality Assurance Program Requirements for Nuclear Power Plants," for the design, construction, and maintenance of the fuel-oil system.	Reference Table 1-4 for McGuire Nuclear Station's Regulatory Guide Disposition of Regulatory Guide 1.28 "Quality Assurance Program Requirements"
c. Section 5.4, "Calculation of Fuel Oil Storage Requirements," of the standard sets forth two methods for the calculation of fuel-oil storage requirements. These two methods are (1) calculations based on the assumption that the diesel generator operates continuously for 7 days at its rated capacity, and (2) calculations based on the time-dependent loads of the diesel generator. For the time-dependent load method, the minimum required capacity should include the capacity to power the engineered safety features.	The McGuire diesel generator fuel oill system was designed and installed prior to the writing of ANSI N195-1976. The calculation for determining the minimum fuel storage requirements is based on method (1) with the exception that the time interval for continuous operation without refueling of the storage tank is 5 days at rated capacity.
d. Section 7.3, "Physical Arrangement," of ANSI N195-1976 states that "the location of day tanks shall be as required by the diesel-engine manufacturer." In addition to this requirement, the physical location of the day tank relative to the engine and design of the engine fuel system should take into account such items as net positive suction head requirements and the potential need for electric fuel pumps powered from a reliable power supply to ensure that the diesel-generator unit can start automatically and attain the required voltage and frequency within acceptable limits and time.	The McGuire diesel generator fuel oill system was designed and installed prior to the writing of ANSI N195-1976. The day tank is located in such a way that net positive suction head requirements are met with installed equipment. A DC powered fuel oil booster pump is provided for initial pressurization of the fuel system on the engine if needed. This pump is automatically secured once the engine driven booster pump begins supplying the fuel needs of the engine. This pump will automatically start in the event the engine driven fuel booster pump fails to maintain minimum fuel pressure.
e. Section 7.3 of ANSI N195-1976 states that the arrangement of the fuel-oil system "shall provide for inservice inspection and testing in accordance with ASME Boiler and Pressure Vessel Code, Section XI, 'Rules for Inservice Inspection of Nuclear Power Plant Components.' "	The McGuire diesel generator fuel oill system was designed and installed prior to the writing of ANSI N195-1976.

For those portions of the fuel-oil systems for standby diesel generators that are designed to Section III, Subsection ND of the Code, an acceptable method of meeting the requirements of Section 7.3 is to ensure that the system arrangement would allow: (1) Pressure testing of the fuel-oil system to a pressure 1.10 times the system design pressure at 10-year intervals. In the case of storage. tanks, recommendations of the tank vendor should be taken into account when establishing the test pressure. (2) A visual examination to be conducted during the pressure test for evidence of component leakages, structural distress, or corrosion. In the case of buried components, a loss of system pressure during the test constitutes evidence of component leakage.	The diesel fuel system is tested in accordance with ASME Boiler and Pressure Vessel Code, Section XI, 'Rules for Inservice Inspection of Nuclear Power Plant Components.'
f. Section 7.3 of ANSI N195-1976 requires that adequate heating be provided for the fuel-oil system. Assurance should be provided that the fuel oil can be supplied and ignited at all times under the most severe environmental conditions expected at the facility. This may be accomplished by use of an oil with a "cloud point" lower than the 3-hour minimum soak temperature expected at the site during the seasonal periods in which the oil is to be used, and/or by maintenance of the onsite fuel oil above the "cloud point" temperature.	The McGuire diesel generator fuel oill system was designed and installed prior to the writing of ANSI N195-1976. Diesel fuel parameters including “cloud point” are tested and verified to be within the acceptance criteria of the Diesel Fuel Oil Testing Program.
g. Section 7.5, "Other Requirements," of the standard states that "protection against external and internal corrosion shall be provided" for the fuel-oil system. To amplify this requirement for buried supply tanks not located within a vault and other buried portions of the system, a protective coating and an impressed current-type cathodic protection system should be provided in accordance with NACE Standard RP-01-69 (1972 Revision), "Recommended Practice-Control of External Corrosion on Underground or Submerged Metallic Piping Systems." In addition, the impressed current-type cathodic protection system should be designed to prevent the ignition of combustible vapors or fuel oil present in the fuel-oil systems for standby diesel generators.	The McGuire diesel generator fuel oill system was designed and installed prior to the writing of ANSI N195-1976. The underground fuel oil storage tanks were externally coated for corrosion protection. Corrosion protection for the fuel oil storage tank adheres to the Procedures of the National Association of Corrosion Engineer’s Recommended Practice-Control of External Corrosion on Underground or Submerged Metallic Piping System, RP-01-69 (1972 revision). There is no cathodic protection installed on the underground fuel oil storage tanks.
h. Section 7.5 of the standard includes requirements for fire protection for the diesel-generator fuel-oil system. The requirements of Section 7.5 are not considered a part of this regulatory guide since this subject is addressed separately in more detail in other NRC documents. Thus a commitment to follow this regulatory guide does not imply a commitment to follow the requirements of Section 7.5 concerning fire protection.	Acceptable as written.
2. Appendix B to ANSI N195-1976 should be used as a basis for a program to ensure the initial and continuing quality of fuel oil as supplemented by the following: a. The oil stored in the fuel-oil supply tank, and the oil to be used for filling or refilling the supply tank, should meet the requirements of Federal Fuel Oil Specification VV-F-800b	Diesel fuel parameters (including “cloud point”) are tested and verified to be within the acceptance criteria of the Diesel Fuel Oil Testing Program as outlined in Tech Spec 5.5.13. If test results for viscosity or for water and sediment for fuel oil contained in the supply tanks exceed the limits

(April 2, 1975); ASTM D975-77, "Standard Specification for Diesel Fuel Oils;" or the requirements of the diesel-generator manufacturer, if they are more restrictive, as well as the fuel-oil total insolubles level specified in Appendix B to the standard. The "cloud point" should be less than or equal to the 3-hour minimum soak temperature or the minimum temperature at which the fuel oil will be maintained during the period of time that it will be stored. If test results for viscosity or for water and sediment for fuel oil contained in the supply tanks exceed the limits specified in the applicable specification, the diesel should be considered inoperable. Fuel oil contained in the supply tank not meeting remaining applicable specification requirements should be replaced in a short period of time (about a week).	specified in the applicable specification, the actions of Tech Spec 3.8.3 are applied and the condition is evaluated under the McGuire Corrective Action Program. Fuel oil contained in the supply tank not meeting applicable specification requirements is corrected through reconditioning or replacement as determined by the Corrective Action Program.
b. Prior to adding new fuel oil to the supply tanks, onsite samples of the fuel oil should be taken. As a minimum, prior to the addition of new fuel, tests for the following properties should be conducted: (1) Specific or API gravity (2) Water and sediment (3) Viscosity. Test results for the latter two tests should not exceed the limits specified in the applicable specification. Analysis of the other properties of the fuel oil listed in the applicable specification should be completed within 2 weeks of the addition.	McGuire complies with this requirement with the exception that analysis of the other properties of the fuel oil listed in the applicable specification are completed within 31 days of the addition.
c. The periodic sampling procedure for the fuel oil should be in accordance with ASTM D270-1975, "Standard Method of Sampling Petroleum and Petroleum Products."	Periodic sampling is performed in accordance with the Diesel Fuel Oil Testing Program.
d. Accumulated condensate should be removed from storage tanks on a quarterly basis or on a monthly basis when it is suspected or known that the groundwater table is equal to or higher than the bottom of buried storage tanks.	Acceptable as written.
e. Day tanks and integral tanks should be checked for water monthly, as a minimum, and after each operation of the diesel where the period of operation was 1 hour or longer. Accumulated water should be removed immediately. If it is suspected that water has entered the suction piping from the day or integral tank, the entire fuel-oil system between the day or integral tank and the injectors should be flushed.	Acceptable as written.
f. As a minimum, the fuel oil stored in the supply tanks should be removed, the accumulated sediment removed, and the tanks cleaned at 10-year intervals. To preclude the introduction of surfactants in the fuel system, this cleaning should be accomplished using sodium hypochlorite solutions or their equivalent rather than soap or detergents.	Acceptable as written.
g. If an event should occur that would require replenishment of fuel oil without the interruption of operation of the diesel generators, the method of adding fuel oil should be such as to minimize the creation of turbulence of the accumulated residual sediment in the bottom of the supply tank since stirring up this sediment during the addition of acceptable new incoming fuel has the potential of causing the overall quality of the fuel oil in the storage tank to become unacceptable.	Acceptable as written.
h. For those facilities having an impressed current-type	Not applicable to McGuire, no cathodic protection

cathodic protection system, cathodic protection surveillance should be conducted according to the following procedures: (1) At intervals not exceeding 12 months, tests should be conducted on each underground cathodic protection system to determine whether the protection is adequate. (2) The test leads required for cathodic protection should be maintained in such a condition that electrical measurements can be obtained to ensure the system is adequately protected. (3) At intervals not exceeding 2 months, each of the cathodic protection rectifiers should be inspected. (4) Records of each inspection and test should be maintained over the life of the facility to assist in evaluating the extent of degradation of the corrosion protection systems.	exists on the underground tanks.

Table 8-19. Exception to IEEE Standard 450-1995

IEEE Standard Guidance	Exception
IEEE 450-1995 6.4 - **Acceptance, modified performance, and performance tests**: 6.4e) If earlier in the test an individual cell is approaching reversal of its polarity (+1 V or less) but the terminal voltage has not yet reached its test limit, the test should be stopped, and the weak cell should be disconnected from the battery string and bypassed with a jumper of adequate conductor ampacity. The new minimum terminal voltage should be determined based on the remaining cells. The test should then be continued in order to determine the capacity of the remaining cells. The time required to disconnect the cell, install the jumper, and restart the test shall not exceed 10% of the total test duration or 6 minutes, whichever is shorter. This "downtime" shall not be included in the test discharge period (i.e., the capacity determination shall be based on the actual test time).	MNS takes exception with "restart the test shall not exceed 10% of the total test duration or 6 minutes, whichever is shorter". Six (6) minutes is not sufficient time to safely remove four (4) straps from the eight (8) posts and re-connect. MNS will not remove the bad cell during the test. MNS will continue the test is completed and jumper out or replace the bad cell prior to returning to service.