Appendix 8A. Tables

Table 8-1. Class 1E Loads

Safety Loads	Function	Power
Component Cooling Pumps	Equipment Cooling	4160VAC
Containment Spray Pumps	Containment Cooling	4160VAC
Residual Heat Removal Pumps	Emergency Core Cooling	4160VAC
Safety Injection Pumps	Emergency Core Cooling	4160VAC
Centrifugal Charging Pumps	Emergency Core Cooling	4160VAC
Auxiliary Feedwater Pumps	Steam Generator Makeup for Emergency Core Cooling	4160VAC
Nuclear Service Water Pumps	Environmental Control and Equipment Cooling	4160VAC
Fuel Pool Cooling pumps	Fuel Pool Cooling	4160VAC
HVAC Compressors	Environmental Control	4160VAC
Essential Motor Control Centers[1]	Supply Emergency Power	600VAC
Vital Battery Chargers	Supply Vital DC Power and Maintain Vital Battery Charge	600VAC
Diesel Battery Chargers	Supply DC Power for Diesel Control and Maintain Charge on Diesel Battery	600VAC
Diesel Generator Fuel Oil Booster Pumps	Diesel Generator Operation	125VDC
Vital I&C DC Distribution Centers	Supply Vital DC Power	125VDC
Auxiliary Relay Racks (Process Instrumentation and Control System)	Process Control	120VAC

Note:

1. See Table 8-6 for a listing of Essential Motor Control Center Loads.

Table 8-2. Transmission Structures Design Specifications

A.	General Loading: 0.5" radial ice, 0°F, 4 pounds wind		
	Overload factors:	vertical	1.50
		transverse wind	2.50
		wire tension, suspension	1.10
		wire tension, strain	1.25
	Application:	one or both circuits intact	
B.	Extreme wind loading: no ice, 60°F, 9 pounds wind		
	Overload factors:	Same as A, above	
	Application:	Same as A, above	
C.	Heavy ice loading: 1.25" radial ice, 0°F, no wind		
	Overload factors:	1.0 on all loads	
	Application:	Same as A, above	
D.	Construction loading:		
	Lattice Towers:		
	a) Suspension structures:	Same as A (above) with any one wire broken.	
	b) Strain structures:	Same as A (above) with any three wires broken on one side.	
	Steel Poles:		
	a) Suspension structures:	Same as A (above) with any one wire broken.	
	b) Strain structures:	Same as A (above) with any one wire broken.	

Table 8-3. Description of Transmission Lines

Transmission Line Identification	Line Voltage	First Major Substation	Distance to Substation	Conductor Type	Figure Reference	Comments
Newport	230kV	Newport Tie Station	5.2 miles	(Bundled) 2-1272 KCM 54/19 ACSR	Figure 8-5	Shares common R/W with Allison Creek Line; has one crossover point
Allison Creek	230kV	Newport Tie Station	5.2 miles	(Single) 1-1272 KCM 54/19 ACSR	Figure 8-6	Shares common R/W with Newport Line; has one crossover point
Roddey	230kV	Pacolet Tie Station	41.4 miles	(Bundled) 1-954 KCM 54/19 ACSR	Figure 8-7	Shares common R/W with Clay Hill Line; has one crossover point
Clay Hill	230kV	Ripp Sub-station	24.5 miles	(Single) 1-1272 KCM 54/19 ACSR	Figure 8-8	Shares common R/W with Roddey Line; has one crossover point
Moser	230kV	Allen Steam Station Switchyard	10.9 miles	(Bundled) 2-1272 KCM 54/19 ACSR	Figure 8-9	Shares common R/W with a 525kV Line; has no crossovers
Peacock	230kV	Peacock Tie Station	14.8 miles	(Bundled) 2-1272 KCM 54/19 ACSR	Figure 8-28	Shares common R/W with Roddey and Clay Hill Lines; has 1 crossover point

Notes:

1. R/W is an abbreviation for Right of Way.
2. Crossover point refers to a 500 kV line crossing above a 230 kV line.
3. Conductor area units "KCM" are equivalent to conductor area units "MCM", reference National Electrical Safety Code - 1996, section 110-6.

Table 8-4. Grid Frequency Decay Analysis

Case	Assumptions	Results
Case A	Duke generation was reduced by more than 2100 MW by the loss of all Marshall generation and associated transmission. In addition to this loss of generation and transmission, two additional interconnections were assumed to be out of service -- the 500 kV line between Jackson Ferry of Appalachain Power Company and Duke's Antioch Station and the 230 kV douible circuit line between Roxboro Steam Plant of Carolina Power and Light Company and Eno Tie Station. The remaining interconnections mitigated substantially the disturbance to the Duke system.	Insignificant Decay - The interconnected network supports frequency.
Case B	Duke generation was reduced by more than 2200 MW by the loss of all Belews Creek generation and associated transmission. In addition the 230 kV Roxboro to Eno interconnection was assumed to be out of service. The remaining interconnections mitigated substantially the disturbance to the Duke system.	Insignificant Decay - The interconnected network supports frequency.
Case C	Duke generation was reduced by more than 2700 MW by the loss of all Oconee generation and associated transmission. This loss of transmission eliminated the 500 kV line between Oconee and Norcross of the Georgia Power Company system. In addition, the 500 kV interconnection between Jackson Ferry of Appalachian Power Company and Duke's Antioch station was assumed out of service. The remaining interconnections mitigated substantially the disturbance to the Duke system.	Insignificant Decay - The interconnected network supports frequency.
Since the above three disturbances did not cause undue strain on the Duke system, another highly improbable disturbance was investigated. For the remaining cases (D, E, & F), it was assumed that all interconnections from surrounding power systems into the Duke system were removed from service, leaving the Duke system isolated.		
Case D	Duke generation was reduced by more than 2200MW by the loss of Belews Creek generation and associated transmission.	Maximum frequency decay rate of approximately 0.38 hertz per second.
Case E	Duke generation was reduced by more than 3000MW by the loss of Belews Creek generation and associated transmission and Oconee 2 generation.	
Case F	Duke generation was reduced by more than 3500MW by the loss of Belews Creek generation and associated transmission, Oconee 2 generation and McGuire 1 generation.	Maximum frequency decay rate of approximately 1.06 hertz per second, still well below the max 4 Hz/sec.

Table 8-5. Transmission System Availability

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

500 kV Facilities	***1986***	***1987***	***1988***	***1989***	***1990***
Line Miles	*549*	*549*	*549*	*549*	*558*
Line Tripouts	*8*	*16*	*41*	*12*	*8*
Tripouts per 100 Miles	*1.46*	*2.91*	*7.47*	*2.19*	*1.43*
Line Lockouts	*1*	*0*	*1*	*1*	*0*
Lockouts per 100 Miles	*0.18*	*0*	*0.18*	*0.18*	*0*
Total Outage Time (hours)	*0.02*	*12*	*13*	*3*	*1*
Availability Factor (per 100 Miles)	*0.99999*	*0.9951*	*0.9947*	*0.9989*	*0.9999*
Average Availability Factor for 5-Year Period: 0.9977 (per 100 Miles)					
230 kV Facilities	***1986***	***1987***	***1988***	***1989***	***1990***
Line Miles	*2483*	*2483*	*2526*	*2526*	*2579*
Line Tripouts	*69*	*116*	*133*	*89*	*70*
Tripouts per 100 Miles	*2.78*	*4.67*	*5.27*	*3.52*	*2.71*
Line Lockouts	*3*	*0*	*3*	*1*	*3*
Lockouts per 100 Miles	*0.12*	*0*	*0.12*	*0.04*	*0.12*
Total Outage Time (hours)	*23*	*2*	*32*	*14*	*20*
Availability Factor (per 100 Miles)	*0.9976*	*0.9998*	*0.9971*	*0.9979*	*0.9986*
Average Availability Factor for 5-Year Period: 0.9982 (per 100 Miles)					

Notes:

1. *Line tripouts refers to the total number of times a relay operation tripped a line, regardless of the cause.*
2. *Line lockouts refers to the number of tripouts in which reclosing was unsuccessful.*
3. *Total outage time includes outages from all causes.*

Table 8-6. Catawba Nuclear Station: Sequenced Loads To Be Supplied From One Of The Redundant Engineered Safety Power Distribution Systems

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
No. 1[(2)]	Motor Operated Valves and Dampers			575	50 HP	Yes	Yes	
(11 Seconds) After Diesel Starts)	Boric Acid Transfer Pump Motor	AB	NV	575	15.5 KW	Yes	Yes	1-15.5KW/diesel
	Motor Driven Aux. FDW. Pump Sump Pump Motor	AB	WL	575	7.5 HP	Yes	Yes	1-7.5HP/diesel
	Steam Turbine Driven Aux. FDW. Pump Sump Pump Motor	AB	WL	575	7.5 HP	Yes	Yes	1-7.5HP/diesel
	Aux. Building Ground Water Drainage Sump Pump Motor	AB	WZ	575	60 HP	Yes	Yes	3-20HP/unit Train A 1EMXG
	125VDC Vital Inst. & Cntrl. Btry Chrgr ECA,C(ECB,D)	AB	EPL	600	103 KVA	Yes	Yes	2-51.3KVA/diesel
	Liquid Radwaste ND & NS Sump Pump Motor	AB	WL	575	10 HP	Yes	Yes	1-10HP/diesel
	Annulus Ventilation Fan Mtr.	AB	VE	575	40 HP	Yes	--	1-40HP/diesel

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Annulus Ventilation Moisture Elimination Heater	AB	VE	600	45 KW	Yes	--	1-45KW/diesel
	Pump Room Heater-Demister Section	AB	VA	600	80 KW	Yes	Yes	2-40KW/unit Train A 1EMXG
	Aux. Bldg. Filtered Exhaust Fan Motor	AB	VA	575	200 HP	Yes	Yes	2-100HP/unit Train A 1EMXG
	Switchgear Room Air Handling Unit Fan Motor	AB	VC	575	30 HP	Yes	Yes	2-15HP/diesel
	Fuel Handling Area Filter Train Moisture Separator Heater	AB	VF	600	160 KW	--[5]	Yes	2-80KW/diesel
	Unit Essential Panelboard Transformers	AB	EPY	600	30 KVA	Yes	Yes	2-15KVA/diesel
	Fuel Handling Area Exhaust Fan Motor	AB	VF	575	100 HP	--[5]	Yes	2-50HP/diesel
	Aux. Shutdown Panel Area Air Conditioning Units	AB	VA	575	4 HP	Yes	Yes	1-4HP/diesel
	Nuclear Service Water Strainer Backwash Drive Motor	PH	RN	575	.75 HP	Yes	Yes	1-.75HP/diesel

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Nuclear Service Water Pump Structure Vent Fan Motor	PH	VZ	575	7.5 HP	Yes	Yes	1-7.5HP/diesel
	Deleted Per 2007 Update.							
	Diesel Starting Air Compressor Motor	DB	VG	575	20 HP	Yes	Yes	2-10HP/diesel
	AC Emergency Lighting Pnlbd.	AB	ELA	600	30 KVA	(5),(6)	Yes	1-30KVA/diesel
	Diesel 600/120V Panelboard	DB	EPY	600	5 KVA	Yes	Yes	1-5KVA/diesel
	Deleted Per 2007 Update.							
	Diesel Generator Engine Lube Oil Transfer Pump Motor	DB	LD	575	3 HP	(5)	Yes	1-3HP/diesel
	Deleted Per 2007 Update.							
	Diesel Battery Charger	DB	EPQ	600	20 KVA	Yes	Yes	1-20KVA/diesel
	Diesel Generator Room Sump Pump Motor	DB	WN	575	10 HP	Yes	Yes	2-5HP/diesel
	Diesel Bldg. Generator Vent Fan Motor	DB	VD	575	60 HP	Yes	Yes	2-30HP/diesel

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Control Room Air Handling Unit Fan Motor	AB	VC	575	50 HP	Yes	Yes	1-50HP/unit Train A 1EMXG
	Containment Air Return Isolation Damper	CV	VX	575	.38 HP	Yes	--	1-.38HP/diesel
	Control Room Area Filter Train Pressure Fan Motor	AB	VC	575	25 HP	Yes	Yes	1-25HP/unit Train A 1EMXG
	Control Room Area PFT-1 Moisture Separator Heater	AB	VC	600	25 KW	Yes	Yes	1-25KW/unit Train A 1EMXG
	Power Operated Pressurizer Relief Isolation Valves	CV	NC	575	4 HP	(10)	(10)	1-2HP/diesel Train A 2-2HP/diesel Train B
	Hydrogen Igniter Panelboard Transformer	AB	EHM	600	25 KVA	(5),(6)	--	1-25 KVA/diesel
No. 2 (12 Seconds After Diesel Starts)	Centrifugal Charging Pump Motor	AB	NV	4000	600 HP	Yes	Yes	1-600HP/diesel 4 KV 1E Load

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
No. 3 (15 Seconds After Diesel Starts)[3]	Safety Injection Pump Motor	AB	NI	4000	400 HP	Yes	--	1-400HP/diesel 4KV 1E Load
	CRDM Ventilation Fan Motor	CV	VV	575	200 HP	--	Yes	2-100HP/diesel
	Lower Containment Vent Unit Fan Motor	CV	VV	575	178 HP	--	Yes	2-89HP/diesel
	Upper Containment Vent Unit Fan Motor	CV	VV	575	15 HP	--	Yes	2-7.5HP/diesel
	Upper Containment Return Air Fan Motor	CV	VV	575	15 HP	--	Yes	2-7.5HP/diesel
	Containment Pipe Tunnel Booster Fan Motor	CV	VV	575	10 HP	--	Yes	1-10HP/diesel
	Containment Personnel Air Lock	AB	IAE	575	3 KVA	--	Yes	1-3KVA/diesel
	Incore Instrument Room Vent Unit Fan Motor	CV	VV	575	5 HP	--	Yes	1-5HP/diesel
	Site Assembly/Evacuation Alarm Transformers	AB	ECE	600	120 KVA	--	Yes	4-30KVA/Station Train B 1MXP, 2MXP

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Penetration Room Condensing Unit Transformer Bank	AB	EXS	600	43.3 KVA	--	Yes	1-43.3 KVA/diesel
	Penetration Room Air Handling Unit	AB	VA	575	10 HP	--	Yes	1-10 HP/diesel
	Control Room Air Intake Radiation Monitor Sample Pump Skid	AB	EMF	600	0.75 KVA	--	Yes	2-0.75 KVA/Station Unit 1 Train A Unit 2 Train B
	Containment Radiation Monitors Sample Pump Skid	AB	EMF	600	1.50 KVA	--	Yes	1-1.50 KVA/Unit Train A
No. 4 (20 Seconds After Diesel Starts)	Residual Heat Removal Pump Motor	AB	ND	4000	400 HP	Yes	--	1-400HP/diesel 4KV 1E Load
No. 5 (25 Seconds After Diesel Starts)	Deleted Per 2012 Updated							

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
No. 6 (30 Seconds After Diesel Starts)	Component Cooling Water Pump Motor	AB	KC	4000	500 HP	Yes	Yes	2-250HP/diesel 4KV 1E Load
No. 7 (35 Seconds After Diesel Starts)	Nuclear Service Water Pump Motor	PH	RN	4000	1000 HP	Yes	Yes	1-1000HP/diesel 4KV 1E Load
No. 8 (40 Seconds After Diesel Starts)	Aux. Feedwater Pump Motor	AB	CA	4000	600 HP	Yes	Yes	1-600HP/diesel 4KV 1E Load
No. 9 (50 Seconds After Diesel Starts)	Main Fire Protection Pump	INT	RY	4000	300 HP	--	Yes	2-300HP/station Non 1E 4KV Load IFTB, 2FTA
No. 10 (3)	Reactor Make-Up Water Pump Motor	AB	NB	575	25 HP	--	Yes	1-25HP/diesel

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
(60 Seconds After Diesel Starts)	Feedwater Pump Turbine Turning Gear Motor	AB	IWE	575	1.5 HP	--	Yes	1-1.5HP/diesel
	Main Turbine Turning Gear Oil Pump Motor	TB	LT	575	50 HP	--	Yes	1-50HP/Unit Train B
	Main Turbine Turning Gear Motor	TB	ITE	575	60 HP	--	Yes	1-60HP/Unit Train A
	Diesel Building CO_2 Storage Tank Refrigeration Unit	TB	RF	575	3 HP	--	Yes	1-3HP/Unit Train B
	Main Turbine Lube Oil Lift Pump Motor	TB	LT	575	40 HP	--	Yes	8-5HP/Unit Train B
	Generator Main Seal Oil Pump Motor	TB	LG	575	25 HP	--	Yes	1-25HP/Unit Train A
	Generator Recirculating Seal Oil Pump Motor	TB	LG	575	10 HP	--	Yes	1-10HP/Unit Train B
	Generator Seal Oil Vacuum Pump Motor	TB	LG	575	2 HP	--	Yes	1-2HP/Unit Train B
	Fire Protection Jockey Pump Motor	SB	RF	575	5 HP	--	Yes	1-5HP/Unit Train A
	Fire Protection Jockey Pump Motor	SB	RF	575	25 HP	--	Yes	1-25HP/Station Unit 1 Train B

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Boric Acid Tank Room Unit Heaters	AB	VA	600	10 KW	--	Yes	6-5KW/Station 1MXW, 1MXX, 2MXW
	Boric Acid Filter Room Unit Heaters	AB	VA	600	5 KW	--	Yes	2-5KW/Station Train A 1MXW, 2MXW
	Boric Acid Transfer Room Unit Heaters	AB	VA	600	5 KW	--	Yes	2-5KW/Station Train B 1MXX, 2MXX
	Tech. Support Center Filter Unit Preheater	SB	VH	600	4.00 KW	--	Yes	1-4.00KW/Station Train A SMXE
	Tech. Support Center Filter Unit Fan Motor	SB	VH	575	7.5 HP	--	Yes	1-7.5HP/Station Train A SMXE
	Tech. Support Center Condensing Unit	SB	VH	600	30.75 KW	--	Yes	1-30.75KW/Station Train A SMXE
	Tech. Support Center Lighting Transformer	SB	ELN	600	45.0 KVA	--	Yes	1-45.0KVA/Station Train A SMXE
	Tech. Support Center Duct Heaters	SB	VH	600	15 KW	--	Yes	3-5.0KW/Station Train A SMXE
	Tech. Support Center Air Handling Unit	SB	VH	575	7.5 HP	--	Yes	1-7.5HP/Station Train A SMXE
	Unit Vent Radiation Monitors Sample Pump Skid	AB	EMF	600	1.50 KVA	--	Yes	1-1.50 KVA/Unit Train B

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Fuel Bldg Ventilation Radiation Monitor Sample Pump Skid	AB	EMF	600	0.75 KVA	--	Yes	1-0.75 KVA/Unit Train B
	Condensate Steam Air Ejector Exhaust Radiation Monitor Sample Pump Skid	TB	EMF	600	0.75 KVA	--	Yes	1-0.75 KVA/Unit Train A
	Auxiliary Bldg Ventilation Radiation Monitor Sample Pump	AB	EMF	575	0.75 HP	--	Yes	1-0.75 HP/Station Unit 2 Train A
	Transformer KTSA	AB	N/A	600	30 KVA	--	Yes	Unit 1 Train A Unit 2 Train B
No. 11 (2) (10 Minutes After Diesel Starts)	Electric Hydrogen Recombiner Power Supply Panel	CV	VX	600	75 KVA	Yes	--	1-75KVA/Diesel
	Control Room Area Air Handling Unit Fan Motor	AB	VC	575	150 HP	Yes	Yes	1-150HP/unit Train A 1EMXG
	Containment Air Return Fan Motor	CV	VX	575	60 HP	Yes	--	1-60HP/Diesel
	Hydrogen Skimmer Fan Motor	CV	VX	575	75 HP	Yes	--	1-75HP/Diesel

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Control Room Area Chilled Water Pump Motor	AB	YC	575	50 HP	Yes	Yes	1-50HP/unit Train A 1EMXG
	Control Room Chiller Compressor Oil Pump Motor and Chiller Controls	AB	YC	575	1.5 HP	Yes	Yes	1-1.5HP/unit Train A 1EMXG
No. 12 (11 Minutes After Diesel Starts)	Control Room Area Chiller Compressor	AB	YC	4000	479 KW	Yes	Yes	1-479KW/diesel 4KV 1E Load
No. 13 (12 minutes after diesel starts)	Instrument Air Compressor	SB	VI	575	350 HP	--	--	2-350HP/station Non 1E L.C. Load 1LXI,2LXH
	Fuel Pool Cooling Pump Motor	AB	KF	4000	300 HP	--	--	4KV 1E Load 1-300HP/diesel
	Reactor Coolant Pressurizer Heater Power Panel	AB	ETC	600	346 KW	--	(9)	1-416KW/diesel Non 1E L.C. Load
	Auxiliary Building Unfiltered Exhaust Fan Motor	AB	VA	575	40 HP	--	(9)	1-40HP/diesel

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks
	Auxiliary Building Supply Unit Fan Motor	AB	VA	575	100 HP	--	(9)	1-100HP/diesel
	125VDC Aux. Control Battery Charger 1CCA(1CCB)	AB	EPK	600	150 KVA	--	--	1-150KVA/diesel Non 1E L.C. Load
	250VDC Power Battery Charger 1DPC (2DPC)	SB	EPJ	600	100 KVA	--	--	1-100KVA/unit Non 1E L.C. Load Train B
	Auxiliary Building Filter Room Exhaust Fan Motor	AB	VA	575	3 HP	--	--	1-3HP/Unit Train B
No. 13	Unit Blackout Panelboard Transformer	AB	ETE	600	30 KVA	--	Yes	1-30 KVA/diesel Non 1E L.C. Load

Sequence No. and Initiation Time[7]	Equipment Name	Location[1]	System	Voltage	Auto. Connected Per Diesel	Auto Connected for LOCA	Auto. Connected for Blackout	Remarks

Notes:

1. AB - Auxiliary Building
   PH - Pump House (Nuclear Service Water Intake Structure)
   DB - Diesel Building
   CV - Reactor Building (inside containment)
   TB - Turbine Building
   SB - Service Building
   INT - LPSW Intake
2. Class 1E 600 volt MCC Loads
3. Non-Class 1E 600V MCC Loads
4. Disconnected on LOCA Signal
5. Given a permissive manual connection after all LOCA loads are sequenced on.
6. Disconnected on LOCA Signal and Blackout Signal
7. The load sequence interval tolerance for each load group is as follows:

LOAD GROUP NUMBER	SEQUENCE TIME (Seconds)
Initiate Timer (T_0)	9.7 ± 0.3
1 (T_1)	$T_0 + 0.9 \pm 0.1$
2 (T_2)	$T_0 + 1.9 \pm 0.1$
3 (T_3)	$T_0 + 4.7 \pm 0.3$
4 (T_4)	$T_0 + 9.4 \pm 0.6$
5 (T_5)	$T_0 + 14.1 \pm 0.9$
6 (T_6)	$T_0 + 18.8 \pm 1.1$
7 (T_7)	$T_0 + 23.5 \pm 1.4$
8 (T_8)	$T_0 + 28.2 \pm 1.8$
9 (T_9)	$T_0 + 37.6 \pm 2.4$
10 (T_{10})	$T_0 + 47.0 \pm 3.0$
11 (T_{11})	$T_0 + 555.0 \pm 35.0$
12 (T_{12})	$T_{11} + 56.4 \pm 3.6$
13 (T_{13})	$T_{11} + 112.8 \pm 7.2$

8. This table gives HP/KW/KVA ratings of the different loads and information about the number of such loads per diesel or per unit for general reference only. For the actual load ratings and summation of total loading, refer to calculation CNC-1381.05-00-0147.
9. Load is credited in licensing basis and must be manually restarted following Load Group 13 actuation.
10. Power is available to these valves, but they must be operated via a pushbutton in the Control Room.

Table 8-7. Catawba Nuclear Station - Switchgear Control Power Sources. Unit 1[1]

Bus	Control Power Source
13.8 KV Switchgear	
1HTA	1CDA
6.9 KV SWITCHGEAR	
1TA[3]	1CDA
1TB[3]	1CDB
1TC[3]	1CDA
1TD[3]	1CDB
RCP1A	1CDA
RCP1B	1CDB
RCP1C	1CDA
RCP1D	1CDB
4.16 KV Switchgear	
1ETA[2]	1EDE[2]
1ETB[2]	1EDF[2]
1GTA	1CDA
1GTB	1CDB
1FTA	1CDA
1FTB	1CDB
600 V Load Centers	
1ELXA[2]	1EDE[2]
1ELXB[2]	1EDF[2]
1ELXC[2]	1EDE[2]
1ELXD[2]	1EDF[2]
1LXA	1CDA
1LXB	1CDA
1LXC	1CDB
1LXD	1CDB
1LXE	1CDA
1LXF	1CDA
1LXG	1CDA
1LXN	1CDA

Bus	Control Power Source
1SLXA	1CDB
1SLXB	1CDB
1SLXC	1CDB
1SLXD	1CDB
1SLXG	SDSP1
1LXH	1CDB
1LXI	1CDA

Notes:

1. Unit 2 is similar
2. Safety Related
3. The feeder breaker which feeds the reactor coolant pump motor switchgear receives control power from the distribution center associated with the opposite battery.

Table 8-8. Single Failure Analysis of the Onsite Power Systems

	Component	Malfunction	Safety Significance/Comments
1.	Auxiliary Transformer (including associated non-segregated bus to 6900 volt normal auxiliary switchgear)	Fault on one auxiliary transformer	No Safety significance: Protective relaying trips the associated switchyard and generator circuit breakers and the appropriate 6900 volt normal auxiliary switchgear incoming circuit breakers to isolate the faulted transformer. The 6900 volt switchgear incoming breakers normally connected to the faulted transformer zone are tripped and the switchgear tie breakers are closed with a maximum dead - bus time of 93 milliseconds with arcing, thus all unit auxiliaries continue to receive power. The unit generator automatically runs back to approximately 56% of rated output.

	Component	Malfunction	Safety Significance/Comments
2.	6900 Volt Normal Auxiliary Switchgear Source Breaker	Breaker fault or failure to open during a fault	No safety significance: The associated generator circuit breaker trips to isolate the unit generator from the fault, and the two applicable switchyard PCBs trip to isolate the system from the fault. The unit generator runs back to approximately 56% of rated output. The 6900 volt switchgear tie breaker of the affected switchgear is locked open. The other 6900 volt normal auxiliary switchgear that are supplied from the affected transformer zone are connected by a rapid transfer to their alternate supplies. A rapid transfer closes the switchgear tie breaker with a maximum dead-bus time of 93 milliseconds with arcing. If the faulty breaker is the normal source for a reactor coolant pump motor and the unit generator is operating above P-8 (reference UFSAR Tables 7-1 and 7-2), both the unit generator and the reactor are tripped. This results in the tripping of the remaining generator circuit breaker to maintain power to the unit auxiliaries from the remaining train of preferred power. If one of the 4160 volt essential auxiliary switchgear is connected to the affected 6900 volt normal auxiliary switchgear, one train of essential power is lost. The redundant train of essential auxiliaries continues to operate unaffected on power from the redundant train to essential power. The diesel generator of the affected train of essential power is automatically started, and its blackout loads are sequenced on.

	Component	Malfunction	Safety Significance/Comments
3.	6900 Volt Normal Auxiliary Switchgear bus	Bus faulted	No safety significance: The 6900 volt normal auxiliary switchgear source breaker is tripped and the switchgear tie breaker is locked open. If the fault is on a section of switchgear that supplies one of the reactor coolant pump motors and the unit generator is operating above P-8 (reference UFSAR Tables 7-1 and 7-2), both the unit generator and the reactor are tripped. This results in the tripping of both generator circuit breakers to maintain power to the unit auxiliaries through the two immediate access offsite power sources. However, if the unit generator is operating below P-8, the reactor and generator are not tripped. If one of the 4160 volt essential auxiliary switchgear is connected to the affected 6900 volt normal auxiliary switchgear, one train of essential power is lost. The redundant train of essential auxiliaries continues to operate unaffected. The diesel generator of the affected train of essential power is automatically started, and its blackout loads are sequenced on.
4.	6900 Volt Normal Auxiliary Switchgear Feeder Breaker	Breaker fault or failure to open during a fault.	No safety significance: Same as 3 above.
5.	Feeder Cable to the 4160VAC Essential Auxiliary Power System Switchgear	Cable fault	No safety significance: The associated 6900 volt and 4160 volt switchbreakers are tripped and one train of essential power is lost. However, the redundant train of essential auxiliaries continue to operate unaffected. The diesel generator of the affected train of essential power is automatically started, and its blackout loads are sequenced on.
6.	6900/4160 Volt Auxiliary Transformer	Transformer fault	No safety significance: Same as 5 above.

	Component	Malfunction	Safety Significance/Comments
7.	4160VAC Essential Auxiliary Power System Switchgear Source Breaker	Breaker fault or failure to open during a fault	No safety significance: The affected 4160 volt essential switchgear is de-energized. The feeder breaker in the 6900 volt normal auxiliary switchgear is tripped, and the diesel generator breaker is locked out. The redundant train of essential auxiliaries remains operable from the redundant train of essential power.
7a.	4160 VAC Essential Auxiliary Power System Switchgear Source Breaker	Breaker fails to open due to load sequencer malfunction during coincident LOCA and loss of off-site power	The affected 4160 VAC essential switchgear is de-energized and the diesel generator breaker remains open due to the load sequencer load shed interlock. The redundant train of essential auxiliaries remains operable from the redundant train of auxiliary power.
8.	4160VAC Essential Auxiliary Power System Switchgear Bus	Bus fault	No safety significance: The affected 4160 volt essential switchgear is de-energized. The 4160 volt essential switchgear source breaker and the diesel generator breaker are locked out. The redundant train of essential auxiliaries remains operable from the redundant train of essential power.
9.	4160 Volt Essential Switchgear Feeder Breaker	Breaker fault	No safety significance: Same as 8 above.
10.	4160VAC Essential Auxiliary Power System Switchgear Feeder Cables to Loads	Fault on one cable	No safety significance: The associated load feeder breaker trips to isolate the switchgear from the fault. The load supplied by the affected cable is lost but the redundant load of the other train remains available.
11.	4160/600 Volt Essential Load Center Transformer	Fault on one transformer	No safety significance: Same as 10 above. A spare standby transformer is readily available to replace the affected transformer.

	Component	Malfunction	Safety Significance/Comments
12.	600 Volt Essential Load Center Source Breaker	Fault on one breaker	No safety significance: Same as 10 above.
13.	600 Volt Essential Load Center Bus	Bus fault	No safety significance: The 600 volt essential load center source breaker trips. The loads supplied by the affected load center are lost, but the redundant loads of the other train remain available.
14.	600 Volt Essential Load Center Feeder Breaker	Breaker fault	No safety significance: Same as 13 above.
15.	600 Volt Essential Load Center Feeder Cable	Cable fault	No safety significance: The 600 volt essential load center feeder breaker trips. The loads supplied by the affected motor control center are lost, but the redundant loads of the other train remain available.
16.	600 Volt Essential Motor Control Center Bus	Bus fault	No safety significance: Same as 15 above.
17.	600 Volt Essential Motor Control Center Feeder Cable	Cable fault	No safety significance: Interlocked armor cable faults are unlikely; however, some faults beyond the motor control center feeder breaker may trip the motor control center incoming breaker also for some MCCs. The main incoming breakers of essential MCCs 2EMXA, 2EMXB, 2EMXC, 2EMXD, 2EMXI, 2EMXJ, 2EMXK and 2EMXL have been removed in order to enhance the coordination. The feeder breakers of these MCCs coordinate with the upstream breaker in the load center which feeds the MCC. The loads supplied by the affected motor control center are lost, but the redundant loads of the other train remain available.

Table 8-9. Deleted Per 1991 Update

Table 8-10. Single Failure Analysis of the 125VDC Vital Instrumentation and Control Power System

Component	Malfunction	Safety Significance/Comments
1. Battery Charger	Loss of 600 volt ac power supply to one battery charger	No safety significance - Associated 125 volt battery is available to supply power to the 125 volt dc distribution center without interruption. An annunciator in the control room alerts the operator to the malfunction.
	Loss of charger output	No safety significance - Associated 125 volt battery is available to supply power to the 125 volt dc distribution center without interruption. An annunciator in the control room alerts the operator to the malfunction. Additionally, a spare battery charger is readily available to replace the non-functional charger.
	Internal battery charger fault	No safety significance - If the battery charger output breaker does not clear the fault the battery breaker may trip also. Power is lost to the instrumentation and control channel served by the faulted charger; however, the redundant channels continue to operate unaffected. An annunciator in the control room alerts the operator to the malfunction. Additionally, a spare battery charger is readily available to replace the faulted charger.
2. 125 volt Battery	Battery fault	No safety significance - Power is lost to the instrumentation and control channel served by the faulted battery; however, the redundant channels continue to operate unaffected. An annunciator in the control room alerts the operator to the malfunction. The faulted battery is isolated from its dc distribution center by the distribution center circuit breaker. Power is restored to the affected distribution center by manually connecting it to its train associated distribution center.
3. Load Group DC Distribution Center	Fault between positive and negative buses in one dc distribution center	No safety significance - Power is lost to the instrumentation and control channel served by the faulted distribution center; however, the redundant channels continue to operate unaffected. An annunciator in the control room alerts the operator to the malfunction. Power is restored to the affected loads after the fault is cleared.

Component	Malfunction	Safety Significance/Comments
	Gradual decay of the voltage on one dc distribution center	No safety significance - The voltage of each 125 volt dc bus is monitored and will initiate a low voltage alarm at a voltage level above that required for safe shutdown of the unit. In the event of a low voltage condition, power may be restored by correcting the cause of the low voltage or by connecting the bus to its alternate source.
4. Auctioneered Distribution Center	Fault between positive and negative buses in one auctioneered distribution center	No safety significance - Power is lost to the train of dc loads served by the faulted distribution center; however, the redundant train continues to operate unaffected. An annunciator in the control room alerts the operator to the malfunction. Power is restored to the affected loads after the fault is cleared.
5. Load Group or Auctioneered DC Distribution Center	Ground on one bus	No safety significance - The 125 volt dc system is an ungrounded system. A single ground will not prevent the operation of the required safety loads. Ground detection equipment monitors the 125 volt dc system and initiates an alarm in the control room to alert the operator in the event of a ground.
6. Distribution Center Feeder Cable	Cable fault	No safety significance - All dc distribution center feeder cables are provided with isolating circuit breakers that would isolate a shorted cable on a sustained fault condition. Power to the load(s) supplied by the faulted cable is lost until the fault is cleared; however, the redundant load(s) continues to operate unaffected. An annunciator in the control room alerts the operator to the malfunction.
7. 125 Volt DC Power Panelboard	Fault between positive and negative buses in one 125 volt dc power panelboard	No safety significance - The dc distribution center breaker isolates the faulted panelboard as described above for a faulted feeder cable. Power is lost to the loads served by the affected panelboard; however, the redundant loads of the remaining load groups continue to operate unaffected. An annunciator in the control room alerts the operator to the malfunction.
8. Auctioneering Diode Assembly	Loss of power from one auctioneering diode assembly	No safety significance - Power to the associated distribution center is supplied without interruption from the alternate auctioneering diode assembly.

Table 8-11. Single Failure Analysis of the 120VAC Vital Instrumentation and Control Power System

	Component	Malfunction	Safety Significance/Comments
1.	125VDC-120VAC Static Inverter	Loss of 125VDC supply to one static inverter or failure of one inverter	No safety significance - Power is lost to the associated channel of 120VAC instrumentation; however, the redundant channels continue to operate unaffected. An annunciator in the control room alerts the operator to the malfunction. Each unit has two swing inverters available (one per train) to allow an inoperable inverter to be removed from service but allow the AC panelboard to remain on Class 1E power.
2.	Static Inverter Feeder Cable	Failure of feeder cable	No safety significance - Same as 1 above.
3.	120VAC Power Panelboard	Failure of one 120VAC panelboard	No safety significance - Power is lost to the associated channel of 120VAC instrumentation; however, the redundant channels continue to operate unaffected. An annunciator in the control room alerts the operator of the malfunction.

Table 8-12. Single Failure Analysis of the 125VDC Diesel Essential Auxiliary Power System

Component	Malfunction	Safety Significance/Comments
1. Battery Charger	Loss of 600VAC supply to one battery charger	No safety significance - The 125VDC battery is available to supply the affected loads without interruption. An annunciator in the control room alerts the operator of the malfunction.
	Loss of 125VDC output from one battery charger	No safety significance - Same as above for loss of 600VAC supply.
	Internal fault in one battery charger	No safety significance - Same as above for loss of 600VAC supply. The battery chargers are designed to prevent the battery from discharging into an internal charger fault.
2. Battery	Fault on one battery	No safety significance - Power is lost to the loads of the affected train, however, an independent train of 125VDC is provided for the redundant diesel generator. An annunciator in the control room alerts the operator of the malfunction.