MISSISSIPPI POWER & LIGHT COMPANY
Helping Build Mississippi
P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

June 11, 1982

NUCLEAR PRODUCTION DEPARTMENT

U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
File: 0260/0840/L-350.0
Transmittal of Evaluation for Control Systems Failures; SER License Condition Item 1.11(10)
AECM-82/261

Mississippi Power & Light (MP&L) letter, AECM-82/159, dated April 22, 1982, transmitted information in regard to Safety Evaluation Report (SER), NUREG-0831, License Condition 1.11(10). It was noted in the report that certain reviews/verifications were required and that a final report would be forthcoming. The attachment to this letter represents our final report and therefore, supercedes Attachment 1 to AECM-82/159.

If you have any questions or require further information, please contact this office.

Yours truly,

L. F. Dale
Manager of Nuclear Services

JTB/JGC/JDR:lg
Attachment: 1. Control Systems Failure Evaluation

cc: (See Next Page)

B001

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CONTROL SYSTEMS FAILURES EVALUATION

The evaluation discussed in this attachment was performed in response to the NRC letter dated April 16, 1981 (MAEC-82/80), from R. L. Tedesco to J. P. McGaughy.

A. Common Power Supplies Methodology

This evaluation covers the spectrum of all non-safety control systems whose failures (resulting from the loss of common power supplies) could have the potential to cause the consequences of transients or accidents evaluated in FSAR Chapter 15 analysis to be more severe.

The evaluation was developed in accordance with the steps described below:

1. A review of FSAR Chapter 15 events was conducted and a list of non-safety control systems was developed whose failure could have the potential to impact reactor pressure, reactor water level or reactor power. The list consisted of the following non-safety control systems:

   a. Reactor Feedwater System
   b. Reactor Turbine Pressure Regulator System
   c. Recirculation Flow Control System
   d. Feedwater Heater System (Condensate and Extraction Steam)
   e. Condenser Vacuum System
   f. Reactor Water Level 8 Turbine Trip
   g. Bypass System Operation
   h. Rod Control and Information System (RC&IS)
   i. Environmental Control System (Offgas Vent and Offgas Flow Control System)
   j. Instrument Air System (Isolation Actuation)

   Master Parts List (MPL) system number prefixes associated with the above non-safety control systems:

   B33, C11, C34, C85, D17, N19, N21, N23, N31, N32, N33, N34, N35, N36, N43, N62, N64, P52, P53

2. This step provided the data base necessary to identify the potential control systems and electrical loads which were to be considered for this analysis. In preparing data for a response to IE Bulletin 79-27 (letter submittal AECM-82/121, dated April 29, 1982), a complete set of tables were developed which included all electrical loads of power generation design basis systems. Each electrical load listed in the tables was identified by its unique MPL system number, circuit description, power distribution (lowest to highest level power source) and effects (primary and secondary) due to power loss. If the actual effect for each power loss evaluated could not be determined, the effect was delineated by a worst case assumption. For example, an actual effect would be a pump trip resulting from loss of power. However, if the loss of power caused a fail-as-is condition to a throttle valve, a worst case assumption would have to be made since the position of the valve prior to the power loss would be undetermined. An example of these tables is provided on Attachment No. 1 to this report.

3. All supporting electrical components or loads having the same MPL system number prefix as the ten non-safety systems defined in Step 1 were identified utilizing the drawings referenced in Step 2.

4. After identifying all components, a list of elimination criterion was established which provided a basis for determining whether an individual component would require further consideration or could be deleted from the analysis. Each of the original loads identified on the drawings (Step 3) were reviewed against each of the criteria listed below. A component which met any one of the following criteria was eliminated from consideration and the applicable elimination code (N1, N2, etc.) was indicated on the associated drawing next to the component's MPL system prefix. (Examples of loads eliminated are indicated on Attachment No. 1.)

Elimination Criterion Code*	Elimination Criterion
N1	Components whose failure effects are clearly bounded by a dominant failure effect on the same breaker can be eliminated by inspection. For example, the loss of several trips such as feedwater turbine overspeed trip on the same breaker as the solenoid that controls all remote trips. The solenoid loss is clearly the dominant effect. Also, in the case of identical components, only one of the components on that breaker need be listed. However, when it was not obvious by inspection that a component could be eliminated by this criteria, it was included for further analysis.
N2	Instrumentation which have no direct or indirect controlling function or passive input (such as permissive) into control logic. Instrumentation and other dedicated inputs to the process computer, as well as the computer itself, can be excluded. Operator actions as a result of indications are not considered control functions for the control systems failure analysis.
N3	Control systems and controlled components (heaters, fans) which have no direct or indirect interaction with reactor operation or reactor parameters. For example, communications, most unit heaters and controls, lighting controls and ventilation control systems for exterior buildings.

Elimination Criterion Code*	Elimination Criterion
N4	Control systems and controlled components (pumps, valves) that do interact or interface with reactor operating systems but which cannot affect the reactor parameters (water level, pressure or reactivity) either directly or indirectly. For example, some offgas components and area radiation monitors.
N5	Systems which are not used during normal power operation. For example, start-up, shutdown or refueling systems not used during normal operation.
N6	Some lube oil pumps are powered from AC busses but have a back-up pump powered from a DC source. Since a single electrical failure cannot disable the lube oil function these components were eliminated from the analysis.
Y	Required further analysis and therefore, were not eliminated.

*In some cases more than one of these criteria may apply.

5. Bus tree tables were then developed for all components requiring further analysis, utilizing the power distribution and other information described in Step 2. The bus tree tables were primarily developed in order to group all components according to their common bus structures thus, establishing a format to evaluate all potential combinations of electrical load failures that could occur as a result of a single bus failure. Bus tree development was limited to certain pre-selected high level busses in the power distribution system (See FSAR 8.1-1). The evaluation of loss of power supply was taken no higher than these pre-selected busses because the loss of the next higher level bus (bus 12R) initiates an event that is already bounded by loss of AC power evaluations presented in FSAR Chapter 15.2.6.

6. The above process resulted in a bus tree table consisting of those control systems remaining common at some power level and whose individual failures were shown to have a potential effect (see Attachment No. 2 columns labled "Primary Effect" and "Seconddy Effect") on one or more reactor parameters. Further analysis was performed to determine the combinational effects of multiple control systems failures where applicable due to the loss of a lowest common level power source (See Attachment No. 2 column labled "Combinational Effects").

7. Further analysis was performed to determine the most severe bus failures and their combinational effects resulting from the effects of cascading power losses extending from lowest common level power sources to higher level distribution panels, battery busses, and load centers. This task was accomplished by utilizing the combined effects at the lowest common level bus (Attachment No. 2) as a starting point. The next higher common level bus was then postulated to fail and the total effects at that level were analyzed. This method was repeated for each higher level bus, continuing the process up to the highest level bus in the bus tree tables. For power losses where competing effects existed, the dominant failure effect was determined by an evaluation of the circuitry involved or a worst case assumption was made. An example of two competing effects resulting from the same bus loss, would be the generation of a trip signal to a pump's trip solenoid initiating a pump trip, in conjunction with the deenergization of the same trip solenoid resulting in the loss of the trip function. By evaluation, the dominant effect for the above case was determined to be the loss of the trip function. If it was not possible to determine the dominant effect, worst case assumptions were made considering all cases involved. Attachment No. 3 delineates the highest level busses and shows the most severe bus failures and their combinational effects resulting from the effects of cascading power losses.

8. The most severe combinational effects resulting from power losses were then analyzed against specific events in FSAR Chapter 15 (Attachment No. 3). The evaluation revealed no power supply failure which initiated an event not bounded by the current transient analysis presented in FSAR Chapter 15.

B. Common Instrument Line Methodology

This evaluation covers the spectrum of all non-safety control systems whose failure (resulting from the loss of common instrument lines) could have the potential to cause the consequences of transients or accidents evaluated in FSAR Chapter 15 analysis to be more severe.

The common instrument line failure analysis was performed after the common bus failure analysis was completed. The methodology used was as follows:

1. A list of instruments was developed that provided inputs to the non-safety control systems identified in Step 1 above and which also shared a common instrument line with another instrument.

2. The effect of the loss of these instruments was listed in terms of the systems or components affected.

3. Instrument combinations whose loss had been covered previously in the electrical portion of the control systems failure analysis were eliminated.

4. The remaining instruments were then grouped according to their common taps and evaluated for the case of a broken line or plugged line (Attachment No. 4). In the case of absolute pressure instruments, the plugging mechanism was assumed to cause an increase in pressure since this would cause the worst case effects.

5. The effects on the reactor parameters resulting from the loss of common instruments were then analyzed against events in FSAR Chapter 15 (Attachment No. 4). The evaluation revealed no common instrument failure which initiated an event not bounded by the current transient analysis presented in FSAR Chapter 15.

Attachment 1

VIT BAR NO	AC PANEL/ SWITCH	DC PANEL/ INVERTER DRAWING	FAILURE MODES	ALARM INDICATION	BKR NO	CONTROL POWER SUPPLY	CONTROL POWER SUPPLY DRAWING	FAILURE MODES	ALARM INDICATION	FUSE NO	CIRCUIT I.D. (ENGLISH DESCRIPTION)	SYSTEM NO	SCHEMATIC OR LOOP NO	FAILURE MODES	CONTROL ROOM ALARM INDICATION	CONTROL DEVICES	INSTRUMENTS	OTHER INDICATION	PRIMARY EFFECTS	SECONDARY EFFECTS	REMARKS
N	1032				75	[illegible]	[illegible]	[illegible]	NONE	F09 F10	MULT RLYS FOR RADWASTE BLDG SUPPLY AIR FANS AND CHARCOAL FIRE DETEC	X41	E-0128-18	F09 F10	NONE				LOSS OF MULT RELAYS LOSS OF ANN & COMP TAH-L008 & TAAH-L607, H018 & H017	RADWASTE BLDG SUPPLY FANS C002A & B STARTED AUTO	POSSIBLE TO STOP FANS MANUALLY
										F09 F10	MULT RELAYS FOR DIESEL DRIVEN FIRE PUMP H5P64,D03P-A COMP AND ALARMS	P64	E-0231-25	F09 F10	NONE			"B" & "R" LIGHTS ON 1H13-P382 OUT	LOSS OF ANN & COMP PTS P64-L011A-H006A, L013A,L014A,L015A, H004A,L008A,H027A, XA-L010A,JAL-L011A, PAL-L014A,JAL-L015A, TAH-L018A,XA-L009A, L009A	LOSS OF ANNUNCIATION	
										F01 F02	AUX STEAM SYS MULTIPLYING RELAYS	N12	E-0134-15	F01 F02	NONE				LOSS OF AUX STEAM MULT RELAYS/ LOSS OF PUMP AUTO "COMP J001A,B,C & 3. J002A,B,C & 2	LOSS OF AUTO CAPABILITY TO START AUX BOILER FOR PUMPS C001A B,C & D LOSS OF AUTO CAPABILITY TO STOP ON "LOW" LEVEL OR START ON "LOW" PRESS AUX CONDENSATE PUMPS C002 A,B & C	MANUALLY AVAIL
									Y	F15 F16	FEEDWATER SYS RFPT TRIP SOL SVF612A	N21	E-1154-14	F15 F16		N21SVF612A		"W" & 2"R" LIGHTS AT HS-M653-OUT	RFPT TRIP SOL SVF 612A-DE-ENERG. LOSS OF ANN & COMP XAL-B80A	LOSS OF REMOTE CAPABILITY TO TRIP RFPT C004A	CAN TRIP LOCALLY
										F19 F20	FEEDWATER SYS	N21 N1	E-1154-15	F19 F20	NONE	N21SVF608A			LOSS OF RFPT C004A & EMERG TRIP TEST RESET SOL SVF608A	LOSS OF CAPABILITY TO OBTAIN TRIP TURB CONDITION & TRIP TURB C004A, LOSS AUTO CAPABILITY TO OPEN F025A & F024	MANUALLY AVAILABLE
										F23 F24	FEEDWATER SYS	N21 N2	E-1154-16	F23 F24	NONE	SVF611A SVF609A		2 GREEN LIGHTS AT HS-M655A-OUT	LOSS OF THRUST BRG WEAR TEST AND LIGHTS SV SF611A & 609A	LOSS OF BEARING WEAR LIGHTS CAPABILITY	
										F27 F28	FEEDWATER SYS	N21 N1	E-1154-17	F27 F28	NONE	SVF610A SVF613A		G & R LIGHTS AT HSM650A AND "R" & "W" LIGHTS AT HSM651A OUT	LOSS OF OVER SPEED TEST LOCKOUT VALVES & IND LIGHTS SVF608A & 613A	LOSS OF CAPABILITY TO OBTAIN OVERSPEED TURB TRIP COND & TRIP TURB	
										F39 F40	FEEDWATER SYS DC EMER OIL PMP N21C002A	N21 N6	E-1154-20	F39 F40	XA-L860A				DC EMER OIL PUMP C002A INOPERATIVE	LOSS OF DC BACKUP PUMP	USED IN CASE OF LOSS OF OFF SITE PWR
									Y	F35 F36	FEEDWATER SYS MOTOR SPEEDCHANGER CONTROL	N21	E-1154-18	F35 F36				"R" LIGHTS AT HS-M662A & "G" LIGHT HSM607- OUT	LOSS OF MOTOR SPEED CHANGER CONTROL N21 C004	LOSS OF CAPABILITY TO CHANGE SPEED OF RFPT C004A,POSSIBLE TRIP RFPT & REDUCE PLANT PWR	
										F03 F04	AREA RADIATION MONI- TORING SYS	D21	E-1178-02	F03 F04	NONE				LOSS OF ANN & COMP PTS D21-K620Z, K621Z,K630Z,K634Z, K631Z,K614Z,K622Z, K641Z,RAH-L011,RAH- L012,RAH-L014,RAH- L015,RAH-L018,RAH- L016,RAH-L020,RAH- L010,RAH-L019 & RAH- L025	LOSS OF ANNUNCIATION	
										F07 F08	AREA RADIATION MONI- TORING SYSTEM	D21	E-1178-04	F07 F08	NONE				LOSS OF ANN & COMP PTS: D21-L699 D21-RAL-L699	LOSS OF ANNUNCIATION	

DC BUS	
FAILURE MODES	ALARM INDICATION
72-11001	L21S715
1003	L21S4L600
72-11002	L21S714
1004	L51S712
	L51S714
	L51S774
72-11003	L21S715
1005	L51S713
	L51S715
	[illegible]

NO	ELECTRICAL	CONTROL SYSTEMS	DATE
0	[illegible]	[illegible]	7-14-81

REVISIONS

BECHTEL
[illegible]

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION
UNITS 1 & 2

CONTROLS AND INSTRUMENTS SUPPLIED BY:
DC BUS 11DF
DWG NO E-1002

JOB NO	DRAWING NO	REV
9645	1504 SH 32	0

ADC CAD FILE [illegible]

Attachment 2

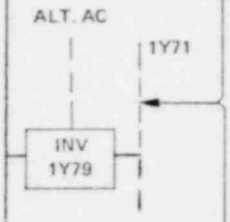
Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11DA — 1DA1	1501-5	B33	RECIRC PUMP MOTOR A TRIP CIRCUIT	LOSS OF TRIP CIRCUIT FOR BREAKER 252-1205B	LOSS OF AUTO PROTECT REMOTE TRIP CAPABILITY NO EFFECT *		CLASS 1E BREAKER 252-1205C SERVICING THE SAME MOTOR IN SERIES IS AVAILABLE TO TRIP.
1DA2	1501-22	B33	RECIRC PUMP MOTOR B TRIP CIRCUIT	LOSS OF TRIP CIRCUIT FOR BREAKER 252-1103B	LOSS OF AUTO PROTECT REMOTE TRIP CAPABILITY NO EFFECT*		CLASS 1E BREAKER SERVICING THE SAME MOTOR IN SERIES IS AVAILABLE TO TRIP.
BATTERY BUS 11DB — 1DB1	1502-3	B33	RECIRC PUMP A & B MOTOR BREAKER	RECIRC PUMP A & B BREAKER FAIL AS IS	FAIL CLOSED - NO EFFECT FAIL OPEN - LFMG ONLY POWER SOURCE; LIMITING PUMP TO 25% OF MAX RPM DUE TO LFMG OPERATION.		NO EFFECT AT NORMAL POWER OPERATION.

* NO EFFECT AS USED IN THESE EVALUATIONS MEANS NO SIGNIFICANT CONTRIBUTION TO AN EFFECT ON SAFETY OUTSIDE THE BOUNDS OF THE FSAR CHAPTER 15 ANALYSIS.

Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11DD  	1504-6	N23	BOP PROCESS INSTRUMENTS	LOSS OF POWER TO BOP PROCESS INSTRUMENTS	LOSS OF FEEDWATER AND CONDENSATE CONTROL		LOSS OF BUS UNLIKELY SINCE INVERTER WHICH FEEDS IT IS BACKED UP BY AN ALTERNATE AC SOURCE AND AUTO-TRANSFER LOSS OF THIS BUS CANNOT CASCADE INTO FAILURE OF 1Y74 LOSS OF FEEDWATER AND CONDENSATE CONTROL. POSSIBLE PARTIAL LOSS OF FEEDWATER HEATING.
	1504-16	N21	RFPT A CONTROLLER	LOSS OF RFPT A CONTROL (RFPT B ON BUS 11 DE)	LOSS OF REMOTE AUTO CONTROL OF RFPT A		

Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11DD	1504-29	N21	RFPT A DISCHARGE TRIP	LOSS OF RFPT A DISCHARGE TRIP	LOSS OF AUTO CAPA-BILITY TO TRIP RFPT PUMPS C004A & C004B ON DISCHARGE PRESSURE		LOSS OF REMOTE ABILITY TO TRIP RFPT A. PARTIAL LOSS OF FEEDWATER HEATING. THE LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED OF RFPT A HAS NO EFFECT ON REACTOR WATER LEVEL.
		N21	RFPT A TRIP ON LOW RECIRC FLOW OR LOW SUCTION PRESSURE	LOSS OF RFPT A TRIP RELAY (RFPT B TRIP ON BUS 11DE)	LOSS OF AUTO ABILITY TO TRIP ON RECIRC LOW FLOW OR LOW SUCTION PRESSURE		
1DD2	1504-30	N36	EXTRACTION STEAM SYSTEM SOLENOID VALVE SVF 525A	FAILS CLOSED	INLETS TO FLOW HEATERS 5A & 6A CLOSED, LOSS OF HEATER STRING, RATED FW FLOW REDUCED TO 95%.		
	1504-32	N21	RFPT A TRIP SOLENOID SVF 612A	SVF 612A DEENERGIZED (TRIP B SOLENOID ON BUS 11DE)	LOSS OF REMOTE CAPA-BILITY TO TRIP RFPT A.		
	1504-32	N21	RFPT A SPEED CHANGER CONTROL	LOSS OF SPEED CHANGER CONTROL (RFPT B ON BUS 11DE)	LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED.		
	1504-33	B33	RECIRC PUMP BREAKER 3A CONTROL	BKR 3A FAILS AS IS (CLASS 1E BKR IS BACK-UP)	NONE		
		B33	RECIRC PUMP BREAKER 4A CONTROL	BKR 4A FAILS AS IS (CLASS 1E BKR IS BACK-UP)	NONE		

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11DD	1504-39	B33	HPU CONTROL CIRCUITS DIVISION "A"	LOSS OF DIV. "A" HPU CONTROL CIRCUITS (DIV. B ON BUS 11 DE)	DIV. "B" TAKES OVER (BUS IS INVERTER FED WITH AC BACK-UP)		LOSS OF BUS UNLIKELY SINCE INVERTER WHICH FEEDS IT IS BACKED UP BY AN ALTERNATE AC SOURCE AND AUTO-TRANSFER LOSS OF THIS BUS CANNOT CASCADE INTO FAILURE OF 1Y71.
		C34	TOTAL FEEDWATER CONTROL SYSTEM	LOSS OF FEEDWATER CONTROL AND FLOW MONITOR SYSTEM	RFPT A & B TRIP		LOSS OF FEED FLOW LOSS OF REACTOR RECIRC LOOP "A" FLOW CONTROL.
ALT. AC 1Y74 INV 1Y80	1504-40	C34	REACTOR HIGH WATER LEVEL TRIP "A"	HIGH WATER LEVEL SIGNAL "A" GENERATED (TRIP "B" ON BUS 11 DE) (TRIP "C" ON BUS 11 DD)	HI LEVEL TRIP "A" OCCURS (2 OF 3 REQUIRED TO TRIP RFPT'S NO EFFECT)		
	1504-41	C34	RFPT A & B CONTROL SIGNAL FAILURE INTERLOCK	LOSS OF INTERLOCK	FEED PUMPS RUNDOWN AND STOP		
		B33	RECIRC LOOP "A" FLOW CONTROL	LOSS OF LOOP "A" FLOW CONTROL (LOOP "B" ON BUS 11 DE)	NONE		

Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11DD	1504-49	N21	RFPT A SPEED CHANGER CONTROL	LOSS OF SPEED CHANGER CONTROL (RFPT B ON BUS 11 DE)	LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED OF RFPT A.		THE LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED OF RFPT A HAS NO EFFECT ON REACTOR WATER LEVEL.
	1504-50	N35	MOISTURE SEPARATOR REHEATER VENTS & DRAIN.	LOSS OF DRAIN CONTROL	POSSIBLE WATER INDUCTION AND/OR OVER SPEED TRIP OF MAIN TURBINE.		POSSIBLE MAIN TURBINE TRIP.
1DD1		N35	MOISTURE SEPARATOR REHEATER DRAIN LEVEL AND ALARMS	LOSS OF LEVEL INPUT CONTROL.	LOSS OF DIV. "A" CONTACTS TO TRIP TURBINE ON HI-HI LEVEL (DIV. "B" BACK-UP)		
	1504-54	C34	REACTOR HIGH WATER LEVEL TRIP "C"	HIGH WATER LEVEL SIGNAL "C" GENERATED (TRIP "A" ON BUS 11DD) (TRIP "B" ON BUS 11DE)	RX HI LEVEL TRIP "C" OCCURS (2 OF 3 REQUIRED TO TRIP RFPT'S NO EFFECT)		
		B33	RECIRC PROTECTIVE RELAY LOGICS "A"	LOSS OF PROTECTIVE RELAY LOGICS "A"	NONE		

Attachment 1

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT	COMBINATIONAL EFFECTS
BATTERY BUS 11 DE → 1DE2	1505-12	N21	RFPT B TRIP SOLENOID SVF-6128	SOLENOID DE-ENERGIZED (RFPT A TRIP SOLENOID ON BUS 11 DD)	LOSS OF REMOTE CAPABILITY TO TRIP RFPT B	THE LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED OF RFPT B HAS NO EFFECT ON REACTOR WATER LEVEL.
	1505-13	N21	RFPT B SPEED CHANGER CONTROL	LOSS OF SPEED CHANGER CONTROL (RFPT A ON BUS 11 DD)	LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED OF RFPT B.	
	1505-14	N21	RFTP B TRIP & ALARMS	LOSS OF TRIP & ALARMS (RFPT A ON BUS 11 DD)	LOSS OF ABILITY TO TRIP RFPT B ON LOW SUCTION AND LOW RECIRC FLOW	
	1505-16	N32	TURBINE TRIP SYSTEM POWER SUPPLY	LOSS OF TRIP SYSTEM	LOSS OF LOW VACUUM TRIP, TURBINE THRUST BEARING TRIP, LOW LUBE OIL PRESS TRIP	PARTIAL LOSS OF CAPABILITY TO TRIP MAIN TURBINE AUTOMATIC PROTECTIVE CAPABILITY TO TRIP MAIN TURBINE NOT AFFECTED.
BATTERY BUS → 1Y26 → AC ALT. → INV 1YR2	1505-22	N21	RFPT B CONTROLLER	LOSS OF RFPT B CONTROL (RFPT A ON BUS 11 DD)	LOSS OF REMOTE AUTO CONTROL OF RFPT B.	LOSS OF BUS UNLIKELY SINCE INVERTER WHICH FEEDS IT IS BACKED UP BY AN ALTERNATE AC SOURCE.
	1505-25	B33	RECIRC LOOP "B" FLOW CONTROL	LOSS OF LOOP "B" FLOW CONTROL (LOOP A ON BUS 11 DD)	NONE	LOSS OF REACTOR RECIRC LOOP "B" FLOW CONTROL.
		B33	HPU CONTROL CIRCUITS DIVISION "B"	LOSS OF DIV "B" HPU CONTROL CIRCUITS (DIV "A" ON BUS 11 DD)	SHUTDOWN OF LOOP "B" DIV. "A" TAKES OVER (BUS IS INVERTER FED WITH AC BACK-UP)	WITH THE LOSS OF RFPT B REMOTE AUTO CONTROL, MAINTENANCE OF NORMAL REACTOR WATER LEVEL IS LIMITED TO THE CAPACITY OF THE REMAINING RFPT. WORST CASE LOSS OF TOTAL FEEDWATER CONTROL IF REMAINING RFPT IS IN MANUAL MODE.

Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11 DE (1DE1)	1505-32	C34	REACTOR HIGH WATER LEVEL TRIP "B"	HIGH WATER LEVEL SIGNAL "B" GENERATED (TRIP "A" ON BUS 11DD) (TRIP "C" ON BUS 11DD)	HI LEVEL TRIP "B" OCCURS (2 OF 3 REQUIRED TO TRIP RFPT'S-NO EFFECT)		THE LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED OF RFPT B HAS NO EFFECT ON REACTOR WATER LEVEL.
HARD WIRED TO BUS	1505-33	N21	RFPT B SPEED CHANGER CONTROL	LOSS OF RFPT B SPEED CHANGER CONTROL (RFPT A ON BUS 11 DD)	LOSS OF REMOTE MANUAL CAPABILITY TO CHANGE SPEED.		

Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11 DH	1508 1	N32	EHC CABINET TURBINE CONTROL	LOSS OF POWER	BATTERY BACK-UP- NO EFFECT		SEE AC BUS 13AD AND SEE BATTERY BUS 11 DJ FOR BACK-UP
			CHANNEL 1 STEAM PRESSURE CONTROL	LOSS OF POWER			
			CHANNEL 2 STEAM PRESSURE CONTROL	LOSS OF POWER			
			CHANNEL 3 STEAM PRESSURE CONTROL	LOSS OF POWER			
			AUXILIARIES STEAM PRESSURE CONTROL	LOSS OF POWER			
			STRESS/SPEED MEASURING UNIT	LOSS OF POWER			

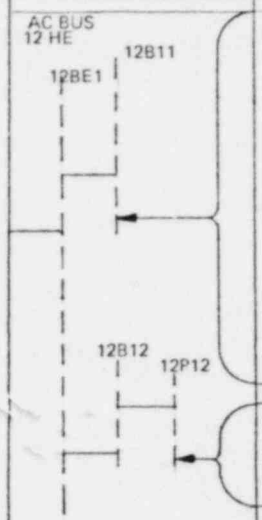
Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
BATTERY BUS 11 DJ	1509-1 1509-2	N32	EHC CABINET TURBINE TURBINE CONTROL	LOSS OF POWER	BATTERY BACK-UP– NO EFFECT		SEE AC BUS 13AD AND SEE BATTERY BUS 11 DH FOR BACK-UP
			CHANNEL 1 STEAM PRESSURE CONTROL	LOSS OF POWER			
			CHANNEL 2 STEAM PRESSURE CONTROL	LOSS OF POWER			
			CHANNEL 3 STEAM PRESSURE CONTROL	LOSS OF POWER			
			AUXILIARIES STEAM PRESSURE CONTROL	LOSS OF POWER			
			STRESS/SPEED MEASURING UNIT	LOSS OF POWER			
AC BUS 11 HD	1201-2	B33	REACTOR RECIRC SYSTEM RECIRC PUMP A MOTOR POWER CIRCUIT	PUMP A INOPERATIVE AT FULL SPEED (PUMP B ON BUS 12 HE)	PLANT POWER LEVEL IS LIMITED		PLANT POWER LEVEL IS LIMITED

Attachment 2

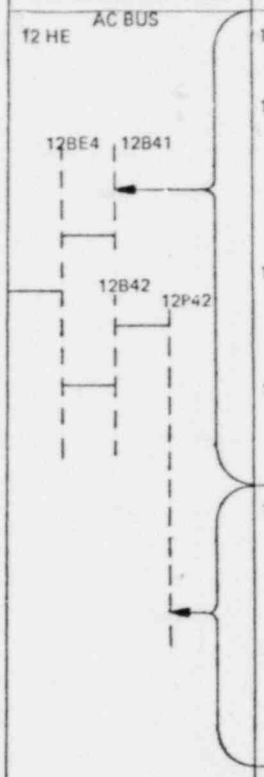
Common Bus Tree Table



	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
	1121-4	N23	MOV HEATER DRAIN PUMP B DISCHARGE	MOV FAILS	F.C.: DRAIN PUMP B OUT OF SERVICE. DRAIN PUMP A AVAIL.		NO EFFECT UNLESS FEEDWATER FLOW DEMAND INCREASES.
		N23	MOV HEATER DRAIN PUMP B SUCTION		F.C.: DRAIN PUMP B OUT OF SERVICE. DRAIN PUMP A AVAIL.		
	1121-4	N19	MOV CONDENSATE PUMP C SUCTION	FAILS AS IS	F.C.: LOSS OF CONDENSATE PUMP C		
		N19	MOV CONDENSATE PUMP B SUCTION	FAILS AS IS	F.C.: LOSS OF CONDENSATE PUMP B		
		N19	MOV CONDENSATE PUMP B DISCHARGE	FAILS AS IS	F.C.: LOSS OF CONDENSATE PUMP B		
	1122-3	N23	FEEDWATER HEATERS 3B, 3C, 4B & 4C LEVEL CONTROL VALVES	FAIL AS IS (CLOSED)	DUMP VALVE WILL MAINTAIN LEVEL. HEATERS MAY LOSE EFFICIENCY		PARTIAL LOSS OF FEEDWATER HEATING

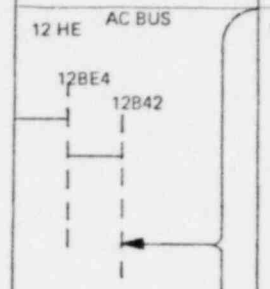
Attachment 2

Common Bus Tree Table



IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
1125-1	N19	CONDENSATE BOOSTER PUMP "C" DISCHARGE MOV	FAIL AS IS	PUMP C OUT OF SERVICE		LOSS OF CONDENSER VACUUM AND TURBINE TRIP AFTER TWO MINUTES – WORSE CASE
1125-4	N62	MOV, CONDENSER OUTLET "B"	FAILS AS IS	PUMP B OUT OF SERVICE		
		MOV STEAM SUPPLY	FAIL AS IS	WORSE CASE IS LOSS OF		
		MOV FIRST STAGE SJAE "B" SUCTION	FAIL AS IS	CONDENSER VACUUM AND TURBINE TRIP "A"		
		MOV SJAE "B" EXHAUST	FAIL AS IS	AFTER TWO MINUTES		
1125-5		MOV SECOND STAGE SJAE SUCTION	FAIL AS IS			
		MOV SEPARATOR "B" DRAIN	FAIL AS IS			
1125-6		MOV INTERCONDENSER "B" DRAIN	FAIL AS IS			
		MOV FIRST STAGE SJAE "B" INLET	FAIL AS IS			
1126-2	N64	GAS DRYER SKID AND CONTROL PANEL	LOSS OF PANEL "A"	NONE, PANEL "B" AVAILABLE		LOSS OF CONDENSER VACUUM AND TURBINE TRIP AFTER TWO MINUTES - WORSE CASE
	N64	OFF GAS HYDROGEN ANALYZER "A"	LOSS OF ANALYZER "A"	NONE, "B" AVAILABLE		
	N64	OFF GAS VALVES	VALVES FAIL AS IS	NONE		
1126-3	N64	OFF GAS POWER SUPPLY	LOSS OF SYSTEM	NONE		
	N64	HEATER AND CONTROL CIRCUIT "A"	LOSS OF HEATER	NONE		
	N64	HEATER AND CONTROL CIRCUIT "B"	LOSS OF HEATER	NONE		

Common Bus Tree Table



	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
	1126-1	N64	GLYCOL REFRIG COMPRESSOR "A"	LOSS OF COMP	WORSE CASE–LOSS OF CONDENSER VACUUM AND TURBINE TRIP AFTER TWO MINUTES		TURBINE TRIP AFTER TWO MINUTES –WORSE CASE
			GLYCOL REFRIG COMPRESSOR "C"	LOSS OF COMP			
			GAS DRYER BLOWER "A"	LOSS OF BLOWER			
			GLYCOL COOLER TANK AGITATOR	LOSS OF AGITATOR			
			GAS DRYER HEATER	LOSS OF HEATER			
			CONDENSER GLYCOL PUMP "A"	LOSS OF PUMP			
			CONDENSER GLYCOL PUMP "C"	LOSS OF PUMP			
			MOV WATER SEPARATOR OUTLET	FAIL AS IS			
			CATALYTIC RECOMBINER HEATER TRANSFORMER	LOSS OF TRANSFORMER			
	1202-3	B33	REACTOR RECIRC SYSTEM RECIRC PUMP B MOTOR POWER CIRCUIT	PUMP B INOPERATIVE AT FULL SPEED (PUMP A ON BUS 11 HD)	PLANT POWER LEVEL LIMITED		PLANT POWER LEVEL LIMITED

Attachment 2

Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT	COMBINATIONAL EFFECTS
13AD AC BUS 13BD1 13B11	1131-6	N32	TURB CONT SYS BCU/IPC AUX CH B TURB CONT SYS BCU/IPC CHANNEL 1 CAB TURB CONT SYS BCU/IPC CHANNEL 2 CAB TURB CONT SYS BCU/IPC CHANNEL 3 CAB	LOSS OF AC POWER LOSS OF AC POWER LOSS OF AC POWER LOSS OF AC POWER	NONE-BATTERY BACK-UP (SEE BATTERY BUS - 11DH AND 11DJ)	NONE
13P12 13B12	1132-10	N32	TURB CONT SYS ELECTRO-HYDRAULIC CONTROLLER	LOSS OF AC POWER	NONE-BATTERY BACK-UP (SEE BATTERY BUS - 11DH AND 11DJ)	NONE
						WORSE CASE - PARTIAL LOSS OF FEEDWATER HEATING
	1132-2	N21	FEEDWATER SYSTEM HIGH PRESS. FEEDWATER HEATER OUTLET MOV	MOV F009A-N FAILS AS-IS	FAILED CLOSED- LOSS OF H.P. FW STRING. PLANT POWER LIMITED TO 95%	
		N19	CONDENSATE SYSTEM LOW PRESS. FEEDWATER HTRS STRINGS "A" INLET MOV	MOV F042A-N FAILS AS-IS	FAILED CLOSED-LOSS OF L.P. FW STRING "A"	
		N19	CONDENSATE SYSTEM LOW PRESS. FEEDWATER HTRS STRINGS "A" OUTLET MOV	MOV F040A-N FAILS AS-IS	FAILED CLOSED-LOSS OF L.P. FW STRING "A"	

Attachment 2

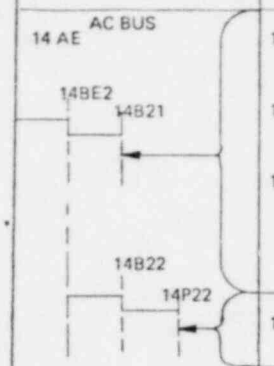
Common Bus Tree Table

	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
13AD AC BUS (Cont'd) 13P12	1132-3	N36	EXTRACTION STEAM SYS. FEEDWATER HTR 5A INLET	MOV F010A-N FAILS AS-IS	FAILED CLOSED–LOSS OF FEEDWATER HTR B005A		PARTIAL LOSS OF FEEDWATER HEATING
		N36	EXTRACTION STEAM SYS. FEEDWATER HTR 6A INLET	MOV F011A-N FAILS AS-IS	FAILED CLOSED–LOSS OF FEEDWATER HTR B006A		
	1132-5	N36	EXTRACTION STEAM SYS. FEEDWATER HEATER	BTV-F013 FAILS CLOSED	LOSS OF B005B FEED-WATER HEATER		
		N36	EXTRACTION STEAM SYS. FDW HTR & DRAIN VALVE	BTV-F012 FAILS CLOSED F008A FAILS OPEN	LOSS OF B006B FEED-WATER HEATER		

Common Bus Tree Table

13AD AC BUS	IEB 79-27 TABLE NO.	SYS NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
13BD2 (Cont'd) 13B21	1134-2	N62	CONDENSER AIR REMOVAL SYSTEM	LOSS OF PRESSURE CONTROLLERS	LOSS OF CONDENSER VACUUM–TURBINE TRIP		WORSE CASE MAIN TURBINE TRIP–AFTER SOME DELAY
13P21	1134-1	N19	CONDENSATE BOOSTER PUMP DISCHARGE VALVE	FAIL AS IS	FAIL OPEN – NONE FAIL CLOSED –LOSS OF C002B PUMP		NO IMMEDIATE EFFECT UNLESS FEEDWATER FLOW DEMAND INCREASES
		N19	CONDENSATE BOOSTER PUMP SUCTION MOV	FAIL AS IS	FAIL CLOSED – LOSS OF C002A PUMP		
		N19	CONDENSATE BOOSTER PUMP SUCTION MOV	FAIL AS IS	FAIL CLOSED – LOSS OF C002B PUMP		
	1134-5	N19	CONDENSATE MOV-SPACE HEATER	FAIL AS IS	WORSE CASE – LOSS OF C003A PUMP, C002A PUMP,		
		N19	CONDENSATE MOV-PUMP "B" DISCH.	FAIL AS IS			
		N19	CONDENSATE MOV-PUMP "A" SUCTION	FAIL AS IS			
		N19	CONDENSATE MOV- PUMP "B" SUCTION	FAIL AS IS			
	1134-6	N19	CONDENSATE MOV-PUMP "A" DISCHARGE	FAIL AS IS			
13BD2 13B22	1135-1	N35	MOISTURE SEPARATOR REHEATER VENTS MOV	FAIL AS IS	WORSE CASE – LOSS OF FEEDWATER HTR 6A		PARTIAL LOSS OF FEEDWATER HEATING
	1135-3	N23	FEEDWATER HEATER 4A & 3A LEVEL CONTROL VALVES	FAIL AS IS (CLOSED)	DUMP VALVE WILL MAINTAIN LEVEL .HEATERS MAY LOSE EFFICIENCY.		
	1203-1	N19	CONDENSATE BOOSTER PUMPS C002 A & C002B	PUMPS INOPERATIVE	NONE		RFPT A & B WILL TRIP ON LOW SUCTION PRESSURE
	1203-2	N19	CONDENSATE PUMP C003A	PUMP INOPERATIVE	NONE		
		N23	HEATER DRAIN PUMP A	PUMP A INOPERATIVE (BACK UP PUMP B ON BUS 14 AE)	NONE		

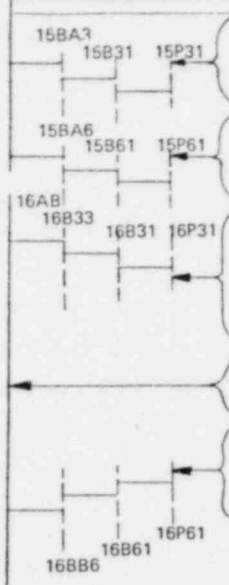
Common Bus Tree Table



	IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
	1143-2	N36	EXTRACTION STEAM SYSTEM	H.P. HEATER STRING "B" OUT			PARTIAL LOSS OF FEEDWATER HEATING & FEEDWATER FLOW
	1143-3	N36	EXTRACTION STEAM SYSTEM FW HEATER VALVE	FAIL AS IS	DROP IN WATER TEMP TO REACTOR		
	1143-7	N21	HIGH PRESSURE FW HEATER START-UP MOV	FAIL AS IS	FAIL OPEN–HEATER OUTPUT BYPASSED TO CRW, 95% OF FEED–WATER FLOW TO REACTOR		
	1144- 5,6	N64	OFF GAS CONTROL SYS. POWER SUPPLY	LOSS OF POWER SUPPLY	WORSE CASE IS TURBINE TRIP		WORSE CASE–TURBINE TRIP
	1204-1	N32	CONTROL FLUID PUMP	LOSS OF PUMP	BACK-UP AVAILABLE, TURBINE TRIP IF NOT.		WORSE CASE–TURBINE TRIP
		N23	HEATER DRAIN PUMP B	PUMP B INOPERATIVE (BK-UP PUMP A ON BUS 13AD)	NO EFFECT		RFPT A & B WILL TRIP
		N19	CONDENSATE BOOSTER PUMPS C002C, C003B,C003C	PUMPS INOPERATIVE	RFPT A & B WILL TRIP ON LOW SUCTION PRESSURE		

Attachment 2

Common Bus Tree Table



IEB 79-27 TABLE NO.	SYS. NO.	COMPONENT DESCRIPTION	PRIMARY EFFECT	SECONDARY EFFECT		COMBINATIONAL EFFECTS
1153-2	P52	SERVICE AIR	LOSS OF BACK-UP AIR	MSIV'S CLOSE		MSIV CLOSURE, REACTOR SCRAM
	P53	INSTRUMENT AIR TO CONTAINMENT, DRYWELL, & AUX BLDG.	LOSS OF INSTRUMENT AIR			
1157-5	B33	ATWS INSTRUMENTS POWER SUPPLY	TRIP RECIRC PUMPS (ATWS TRIP "B" ON BUS 16AB)	REDUCED REACTOR POWER		ATWS TRIP "A"
1163-2	P53	INSTRUMENT AIR BOOSTER A	LOSS OF BOOSTER	NO EFFECT		NONE
	P53	INSTRUMENT AIR BOOSTER B	LOSS OF BOOSTER	NO EFFECT		
1206-2	P53	INSTRUMENT AIR COMPRESSOR	LOSS OF INSTRUMENT AIR (SERVICE AIR IS BACK-UP)	NONE		NONE
1167-3	B33	ATWS INSTRUMENTS POWER SUPPLY	TRIP RECIRC PUMPS (ATWS TRIP "A" ON BUS 15AA)	REDUCED REACTOR POWER		ATWS TRIP "B"

Attachment 3

Combinational Effects of Common Bus Loss

DC BUS 11DA - The effect of loss of this bus is the loss of the normal recirculation pump A & B trips. Since the 1E trips powered by safety busses are still available, there are no effects on reactor parameters and hence no effect on the Chapter 15 analysis.

DC Bus 11DB - The effect of loss of this bus is the loss of ability to transfer recirculation pumps A & B from the LFMG power to the normal power source and hence limits the pumps to 25% of normal flow. Limitation of power falls within normal operational limits and does not affect the Chapter 15 analysis.

The Loss of this bus at full power has no effect since the recirculation pumps will be on the normal power source.

DC BUS 11DH
DC BUS 11DJ - These two busses provide back-up power to the main turbine controls. Normal power is supplied by AC bus 13AD. Loss of either of these busses will cause no transient and hence no effect on the Chapter 15 analysis.

DC BUS 11DD - The busses supplied by 11DD are analyzed separately as follows:

AC BUS 1Y74 - Loss of this bus will cause a loss of control of recirculation loop 'A'. The control valve fails as is and there will be no effects on reactor parameters of water level, pressure, or power, since the 'B' loop will adjust to compensate for any demand changes. Loss of this bus will also cause a total loss of feedwater. This event is analyzed in Chapter 15.2.7. There is no additional consequence of loss of recirculation control since reactor parameters are not affected.

AC BUS 1Y71 - Loss of this bus will cause a loss of feedwater control and other elements of the feedwater system. There is also the possibility as a worst case effect of a coincident partial loss of feedwater heating. Normal operator action in this event would be to manually control the feedwater pumps and shutdown the plant.

As a result of the total loss of feedwater control the reactor water level may increase significantly, decrease significantly, or remain relatively unchanged.

If the water level increases significantly and reaches the high water level trip point, a reactor scram and a feedwater turbine trip will result. This event is bounded by the feedwater controller failure event analyzed in Chapter 15.1.2.

Attachment 3

Combinational Effects of Common Bus Loss (Continued)

If the water level decreases significantly and reaches the low water level trip point, a reactor scram will result. This event is bounded by the loss of feedwater event analyzed in Chapter 15.2.7.

In either one of these two events the effect of the loss of feedwater heating will not reach the vessel quickly enough to change the event before a reactor scram.

If the water level remains relatively unchanged, this event is bounded by the loss of feedwater heating event analyzed in Chapter 15.1.1.

DC BUS 1DD1 - Loss of this bus will cause a loss of the feedwater speedchanger A and a possible trip of the main turbine. If the feedwater 'A' control is being operated in the full automatic mode, loss of this remote manual capability has no effect on the automatic control. If operated in the manual mode, the speed changer fails as is and the RFPT speed will remain at the last setting. In either case the reactor water level is not affected. Main turbine trip is analyzed in Chapter 15.2.3.

DC BUS 1DD2 - Loss of this bus will cause the loss of the ability to trip feedwater turbine A remotely. There would also be a partial loss of feedwater heating and loss of the remote manual control of feedwater turbine A. The loss of the feedwater turbine trip would not affect the feedwater heating loss event which is bounded by Chapter 15.1.1. The loss of remote manual feedwater 'A' control is discussed under bus 1DD1 except for a possible reactor water level decrease due to the increased power from colder feedwater. Loss of the feedwater turbine trip would not affect this event either since the water level is decreasing.

The only other combination of failures possible on Bus 11DD, since two of the sub-busses are inverter fed with automatic transfer to the AC back-up, is the coincident loss of 1DD1 and 1DD2. This event would be identical to the Bus 1DD2 event except for the immediate initiation of safety systems in the event of a main turbine trip. Main turbine trip is analyzed in Chapter 15.2.3.

DC BUS 11DE - The busses supplied by 11DE are analyzed separately as follows:

AC BUS 1Y76 - Loss of this bus will cause a loss of control of recirculation loop 'B'. The control valve fails as is and there will be no effects on reactor parameters of water level, pressure or power, since the 'A' loop will adjust to compensate for any demand changes.

Loss of this bus also causes a loss of automatic control of RFPT B. If RFPT A is in the full automatic mode at the time of this event, normal reactor water level will be maintained by RFPT A. If RFPT A is in the manual mode, the water level may increase, decrease, or remain the same as discussed under bus 1Y71. This event is bounded by Chapter 15.1.2 and 15.2.7 for increase or decrease in water level. There is no additional consequence of loss of recirculation control since reactor parameters are not affected.

Attachment 3

Combinational Effects of Common Bus Loss (Continued)

DC BUS 1DE1 - Loss of this bus will cause a loss of the feedwater speedchanger. If the feedwater 'B' control is being operated in the full automatic mode, loss of this remote manual capability has no effect on the automatic control. If operated in the manual mode, the speed changer fails as is and the RFPT speed will remain at the last setting. In either case the reactor water level is not affected and causes no transient.

DC BUS 1DE2 - Loss of this buss will cause the loss of the ability to trip feedwater turbine B from the control room and a loss of control of feedwater turbine B. The loss of feedwater turbine B control is discussed under bus 1DE1. Loss of the feedwater turbine trip does not complicate this event.

The only combination of failures possible on Bus 11DE, since 1Y76 is inverter fed with automatic transfer to the AC back-up, is the coincident loss of 1DE1 and 1DE2. This event would be bounded by the loss of 1DE2 alone and cause no transient.

AC BUS 11HD - The effect of this bus is the trip of recirculation pump A to the LFMG set power. This limits plant power but does not affect the Chapter 15 analysis.

AC BUS 12HE - The worst consequence of the loss of individual busses fed from 12HE, or loss of 12HE itself, is possible loss of condenser vacuum and turbine trip in conjunction with loss of some feedwater heating. The most severe event has been identified to be the loss of condenser vacuum in conjunction with the loss of feedwater heater. Timing would be an important factor to determine the severity of the consequence. The worst combination of these two events would be that the low vacuum induced turbine trip occurs prior to the thermal power monitor (TPM) scram or at the maximum power level if the TPM scram setpoint has not ever been reached.

An ODYN run was performed to simulate this event for Grand Gulf initial core. The maximum temperature reduction resulting from the single power source failure was identified to be 68° F, which was used in the analysis. The result showed that the thermal power leveled off at 110% NBR power prior to the turbine trip. The peak heat flux at the turbine trip was approximately 110% NBR. The change in CPR is estimated to be only 0.06 compared to 0.12 for the loss of feedwater heater event evaluated in FSAR Chapter 15. The maximum dome pressure was 1212 psia which was bounded by the Chapter 15 turbine trip with bypass failure case (1217 psia). Thus, the loss of bus 12HE event is bounded by the FSAR Chapter 15 analysis.

Attachment 3

Combined Effects of Common Bus Loss - (Continued)

AC BUS 13AD - The worst case combination of failures associated with this bus would be a main turbine trip and a partial loss of feedwater heating. This event is bounded by the FSAR Chapter 15 analysis as described under Bus 12HE.

AC BUS 14AE - The worst case combination of failures associated with this bus is partial loss of feedwater heating and a main turbine trip. This event is identical to the bus 12HE failure and is bounded as described above under bus 12HE.

AC BUS 15AA - The effect of loss of the busses fed from 15AA is either a loss of instrument air which is analyzed in Chapter 15.2.10 or a trip of both recirculation pumps which is analyzed in Chapter 15.3.1. Loss of bus 15AA itself will initiate both events. Recirculation pump trip would also occur as a result of the loss of instrument air scenario and there is no reliance on recirculation pump operation in the loss of instrument air analysis.

AC BUS 16AB - The effect of the loss of this bus is identical to 15AA and therefore bounded by Chapter 15 analysis.

AC BUS 12R - This bus feeds 11HD, 12HE, 13AD, 14AE. Loss of bus will cause a plant scram and MSIV closure since it supplies the RPS MG sets. The analysis in Chapter 15.2.6 would bound this event.

Attachment 4

Common Instrument Table

COMMON LINES	INSTRUMENT	INST FUNCTION	SYSTEM AFFECTED	EFFECT OF BROKEN LINE	PLUGGED LINE	COMMENT
NO. 1 LOWER TAP	B21-LT-N099B B21-LT-N099F	ATWS RX VESSEL LEVEL ATWS RX VESSEL LEVEL	AFFECTS REACTOR RECIRC SYSTEM ONLY	INSTRUMENTS INDICATE LOW WATER, TRIPS TO BOTH RECIRC PUMPS	LOSS OF TRIP FUNCTION, NO EFFECT WITHOUT ADDITIONAL FAILURES	RECIRC PUMP TRIPS ANALYZED IN CH. 15.3.1
NO. 2 UPPER TAP ONLY TAP	B21-LT-N099B B21-LT-N099F C34-LT-N004B B33-PT-N040 B21-PT-N058B B21-PT-N058F	ATWS RX VESSEL LEVEL ATWS RX VESSEL LEVEL FW LEVEL B VESSEL DOME PRESSURE ATWS VESSEL PRESSURE ATWS VESSEL PRESSURE	AFFECTS REACTOR RECIRC SYSTEM & FEEDWATER CONTROL SYSTEM	WATER LEVEL INSTRUMENTS INDICATE HIGH WATER, NO TRIP TO RECIRC PUMPS, NO TRIP TO FEEDWATER (Requires 2 out of 3) PRESSURE INSTRUMENTS INDICATE LOW PRESSURE NO TRIPS OCCUR	LOSS OF LEVEL TRIP FUNCTION, NO EFFECT WITHOUT ADDITIONAL FAILURES WORSE CASE IS ATWS TRIP OF BOTH RECIRC PUMPS. DOMINANT EFFECT IS A TRIP EVEN WITH LOSS OF LEVEL TRIP.	SAME AS ABOVE
NO. 3 LOWER TAP	B21-LT-N099A B21-LT-N099E	ATWS RX VESSEL LEVEL ATWS RX VESSEL LEVEL	AFFECTS REACTOR RECIRC SYSTEM ONLY	SAME AS NO. 1	SAME AS NO. 1	SAME AS ABOVE
NO. 4 UPPER TAP ONLY TAP	B21-LT-N099A B21-LT099E C34-LT-N004A C34-PT-N005 B21-PT-N058A B21-PT-N058E	ATWS RX VESSEL LEVEL ATWS RX VESSEL LEVEL FW LEVEL A WIDE RANGE PRESSURE ATWS VESSEL PRESSURE ATWS VESSEL PRESSURE	AFFECTS REACTOR RECIRC SYSTEM & FEEDWATER CONTROL SYSTEM	SAME AS NO. 2	SAME AS NO. 2	SAME AS ABOVE

THESE INSTRUMENTS ARE LOCATED WITH BOTH ELECTRICAL AND MECHANICAL DIVISION TAKEN INTO CONSIDERATION