BALTIMORE GAS AND ELECTRIC COMPANY
GAS AND ELECTRIC BUILDING
BALTIMORE, MARYLAND 21203

ARTHUR E. LUNDVALL, JR.
VICE PRESIDENT
SUPPLY

October 8, 1979

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

Attn: Mr. Darrell G. Eisenhut
Acting Director

Subject: Calvert Cliffs Nuclear Power Plant
Units Nos. 1 and 2
Adequacy of Station Electric Distribution
Systems Voltages

Gentlemen:

In your letter of August 8, 1979, you requested information on adequacy of station electric distribution systems voltages. The responses to your questions are provided in the attachment and apply to Units 1 and 2.

Very truly yours,

Arthur E. Lundvall

Enclosure

cc: J. A. Biddison, Esquire
G. F. Trowbridge, Esquire
Mr. E. L. Conner, Jr. - NRC
Mr. P. W. Kruse - CE

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ATTACHMENT

Response to NRC Regarding Adequacy of Station Electric Distribution System Voltages

The offsite and the onsite distribution system was reviewed per your request.

The voltage distribution of the onsite distribution system was calculated by use of the General Electric "N Bus Load Flow" program. This was supplemented by additional calculations in order to analytically determine voltage conditions down to the terminals of each safety related load. The following plant operating conditions were evaluated:

1.) Full Auxiliary Plant load
2.) Full Auxiliary Plant load with one (1) Reactor Coolant Pump (RCP) start
3.) Full Auxiliary Plant load with one (1) Circulating Water Pump (CWP) start
4.) Full Auxiliary Plant load with one (1) Condensate Booster Pump (CBP) start
5.) Full Auxiliary Plant load with Engineered Safety Features (ESF) start
6.) Full Auxiliary Plant load with Engineered Safety Features running
7.) Shutdown load

The switchyard minimum voltage of 97% being the worst case for under voltage conditions was used for cases 1 through 6. Case 7 was evaluated for the maximum as well as the minimum switchyard voltages.

The "Guidelines for Voltage Drop Calculations" were applied during the reviews for Units 1 and 2 as indicated below.

1. Separate analyses should be performed assuming the power source to safety buses is (a) the unit auxiliary transformer; (b) the startup transformer; and (c) other available connections to the offsite network one by one assuming the need for electric power is initiated by (1) an anticipated transient (e.g., unit trip) or (2) an accident, whichever presents the largest load demand situation.

   Item (a) is not applicable since there is no unit auxiliary transformer. Grid connected 500 kV/14 kV station service transformers provide power for all plant loads including safety related buses. The largest load demand situation was plant auxiliaries at full load during Engineered Safety Features (ESF) actuation.

2. For multi-unit stations a separate analysis should be performed for each unit assuming (1) an accident in the unit being analyzed and simultaneous shutdown of all other units at that station; or (2) an anticipated transient in the unit being anaylzed(e.g., unit trip) and simultaneous shutdown of all other units at that station, whichever presents the largest load demand situation.

   These were guidelines for the calculations.

3. All actions the electric power system is designed to automatically initiate should be assumed to occur as designed (e.g., automatic bulk or sequential loading or automatic transfers of bulk loads from one transformer to another). Included should be consideration of starting of large non-safety loads (e.g., condensate pumps).

   Automatic bulk loading of offsite transmission lines with ESF loads was evaluated. There are no automatic transfers of loads from one transformer to another. Consideration was given to starting large non-safety related loads. See individual cases.

4. Manual load shedding should not be assumed.

   Manual load shedding was not considered.

5. For each event analyzed, the maximum load necessitated by the event and the mode of operation of the plant at the time of the event should be assumed in addition to all loads caused by expected automatic actions and manual actions permitted by administrative procedures.

   The full auxiliary plant load was derived from actual full load measurements and was utilized in all of the cases with the exception of case 7.

6. The voltage at the terminals of each safety load should be calculated based on the above listed considerations and assumptions and based on the assumption that the grid voltage is at the "minimum expected value". The "minimum expected value" should be selected based on the least of the following:

   a. The minimum steady-state voltage experienced at the connection to the offsite circuit.

   b. The minimum voltage expected at the connection to the offsite circuit due to contingency plans which may result in reduced voltage from this grid.

   c. The minimum predicted grid voltage from grid stability analysis, (e.g., load flow studies).

      The minimum predicted voltage at the connection to the offsite circuit is 485 kV (97%) during normal operation. All design studies such as load flows use this value as a basis. To prevent the voltage from dropping below this point, system operators change taps on the Waugh Chapel Transformers located at the other end of the offsite transmission line.

7. The voltage analysis should include documentation for each condition analyzed, of the voltage at the input and output of each transformer

and at each intermediate bus between the connection to the offsite circuit and the terminals of each safety load.

Voltage analysis of the onsite distribution system evaluated the voltage at each subsequent level of transformation down to the terminals of the safety-related load.

8. The analysis should document the voltage setpoint and any inherent or adjustable (with nominal setting) time delay for relays which (1) initiate or execute automatic transfer of loads from one source to another; (2) initiate or execute automatic load shedding; or (3) initiate or execute automatic load sequencing.

See response to Item 12

10. For each case evaluated the calculated voltages on each safety bus should be compared with the voltage-time settings for the undervoltage relays on these safety buses. Any identified inadequacies in undervoltage relay settings require immediate remedial action and notification of NRC.

See response to Item 12

12. Voltage-time settings for undervoltage relays shall be selected so as to avoid spurious separation of safety buses from offsite power during plant startup, normal operation and shutdown due to startup and/or operation of electric loads.

a) Each of the two redundant 4 kV emergency buses is equipped with two sets of four redundant and independent undervoltage relays. The first set of four relays are set to provide a two out of four undervoltage signal upon loss of bus voltage. (Relays are set to operate at 59% of 4160 V after time delay of 2 seconds.) The second set of four relays are set to provide a two out of four undervoltage signal on a sustained bus undervoltage. (Relays are set to operate at 87% of 4160 V after time delay of 8 seconds.) Upon coincidence of two out of four of either set of four relays, the preferred supply circuit breakers of the bus with which the undervoltage relays are associated are tripped. The signal from the undervoltage relays of a particular load group acts on circuit breakers of the same load group only.

b) The coincidence of two out of four undervoltage signals from either set of four relays also initiates starting of the diesel generator which is connected to the bus with which the undervoltage relays are associated.

Note: The selection of the relays and their respective settings was determined after a detailed investigation in response to NRC's generic letter of June 3, 1977.

9. The calculated voltages at the terminals of each safety load should be compared with the required voltage range for normal operation and starting of that load. Any identified inadequacies of calculated voltage require immediate remedial action and notification of NRC.

See response to Item 11

11. To provide assurance that actions taken tc assure adequate voltage levels for safety loads do not result in excessive voltage, assumming the maximum expected value of voltage at the connection to the offsite circuit, a determination should be made of the maximum voltage expected at the terminals of each safety load and its starting circuit. If this voltage exceeds the maximum voltage rating of any item of safety equipment immediate remedial action is required and NRC shall be notified.

Below is the calculated voltage distribution on the safety related buses for each of the conditions indicated. The figures shown are the calculated bus voltages using the nominal bus voltage as a basis.

			Starting				Running		Shutdown	
	Bus	Bus	+RCP	+CWP	+CBP	+ESF	Aux Load	A+ESF	Case 7	
Bus	Volts	No.	Case 2	Case 3	Case 4	Case 5	Case 1	Case 6	97%	103%
3	4.16 kV	11	.8951	.9261	.8638	.8531	.9418	.9238	.9913	1.0544
7	480 V	11A	.8969	.9295	.8639	.8166	.9460	.9172	1.0027	1.0683
8	480 V	11B	.9015	.9339	.8686	.8156	.9503	.9134	1.0082	1.0735

The calculated voltages at the terminals of each safety load is shown in the enclosed printout.

Tabulated below are the allowable operating ranges for continuous operation of safety related equipment.

Equipment	Continuous Voltage Range	% of 480 V or 4160 V	Minimum Starting Voltage	% of 480 V or 4160 V
460 V Motors	414 V - 506 V 460 V ± 10%	86.3 - 105.4%	345V	72%
4000 V Motors	3600 V - 4400 V 4000 V ± 10%	86.5 - 105.8%	3000V	72%
480 V Switchgear	508 V Maximum	105.8%	N/A	N/A
4160 V Switchgear	4760 Maximum	114.4%	N/A	N/A
480 V Motor Control Center	528 V Maximum	110.0%	398 V	85%

Three problems are evident

1) At shutdown and offsite transmission line voltage at 103%, the calculated bus voltages are 1.0% to 1.5% higher than allowable equipment voltages. The allowable offsite transmission line voltage range is 500 kV ± 3% with both units running. With only one unit operating, the allowable voltage range is 500 kV + 1%, -3%. Limiting the upper transmission line voltage at 500 kV + 1%, lowers the calculated voltages for case 7 to within allowable equipment ratings.

2) At full auxiliary load and ESF start, the 480 V bus voltages during the starting transient are about 3.5% below minimum pickup voltage for motor control center starters. This starting transient would have possibly caused fuses to blow in starter control circuits; however, in 1978 fuses were changed out as required to insure that a degraded voltage condition would not prevent motor starters from operating once the voltage recovered to 91.3% immediately after the starting transient. (Required as a result of NRC generic letter of June 3, 1977.)

3. At Full Auxiliary load and ESF start, the 4 kV bus voltages during the starting transient are about 1.5% below the undervoltage relay setting of 87%. In order to prevent the relay from operating during load starting transients a time delay setting of 8 seconds is utilized.

TESTS

Listed below are a number of tests that have been completed that verify the results of the calculations:

1) Reactor Coolant Pump Start Test. Three pumps were running and the fourth pump was started. The 500 kV Switchyard voltage was adjusted to 97% for the test. The 4 kV starting bus dropped to 95% of the initial steady state voltage. Comparing Case 2 with Case 1 we also see 95% drop $\left\{\frac{.8951}{.9418} = 95\%\right\}$

2) Condensate Booster Pump Start Test. The 4 kV bus voltage was monitored while the Condensate Booster Pump was started. The 500 kV Switchyard voltage was adjusted to 97% for the test. The 4 kV bus starting voltage dropped to 92.3% of initial steady state voltage. Comparing Case 4 with Case 1 we also see 92% drop. $\left\{\frac{.8638}{.9418} = 92\%\right\}$

3) The pick up characteristics of contactors in safety related motor control centers was tested. Some control transformers have been replaced as a result of the testing, in order to bring contactor coil voltage within acceptable pick up value.

To further verify the accuracy of the submitted calculations, we plan to run voltage profile tests during full ESF starting by December 31, 1979.

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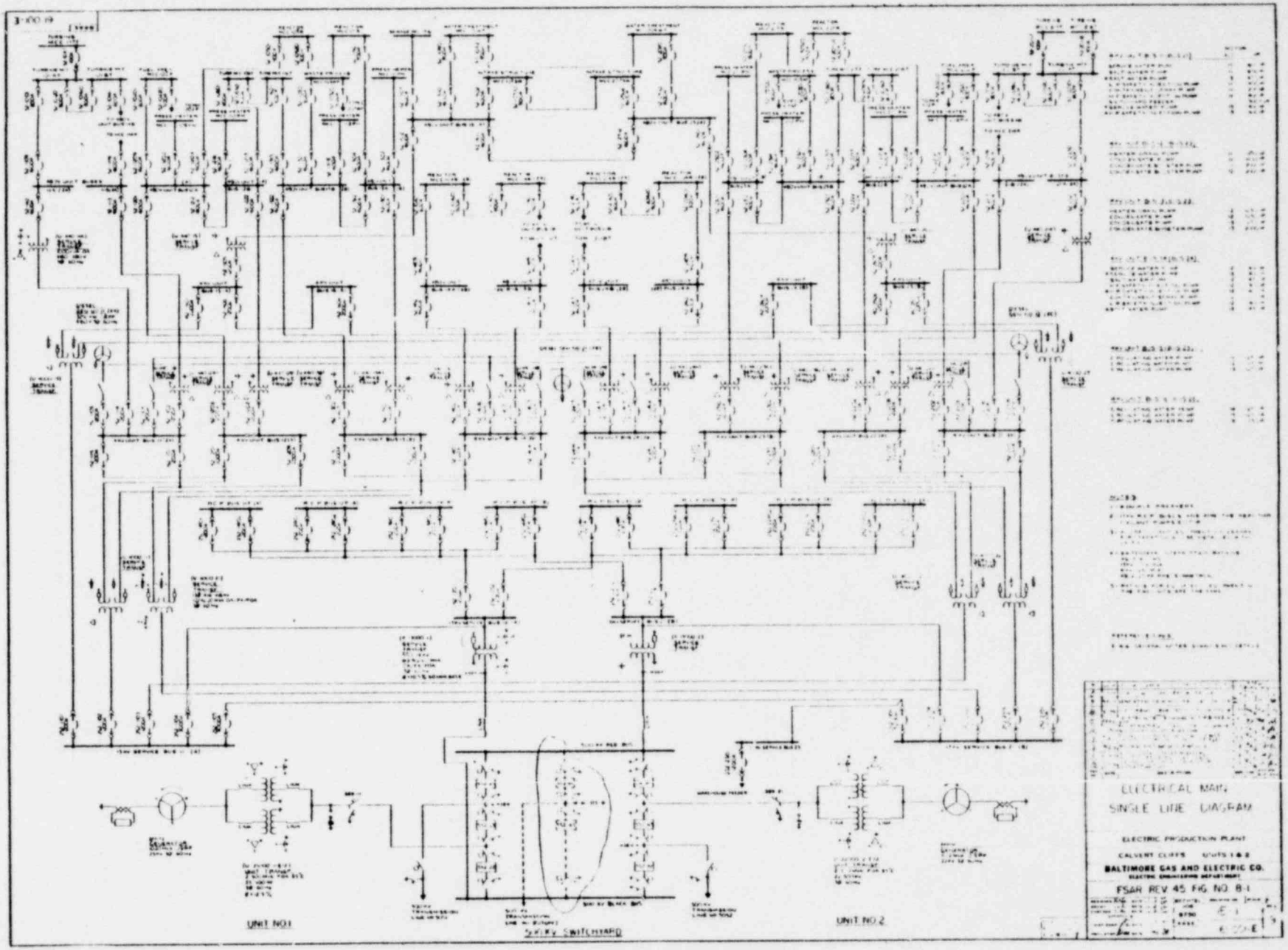
Electrical power from the power grid system to the switchyard is supplied by two physically independent transmission lines designed and located so as to minimize the likelihood of their simulataneous failure under operating and postulated accident and environmental conditions. Two physically independent circuits from the switchyard to the onsite electrical distribution system are also provided. The switchyard is designed with duplicate and redundant systems - e.g., two battery systems, two air supply systems, two trip coils per breaker, two protective relay schemes, and two auxiliary AC supplies from plant emergency buses.

Enclosures: Voltage Study
Plant Single Line
Safety Related Load Listing

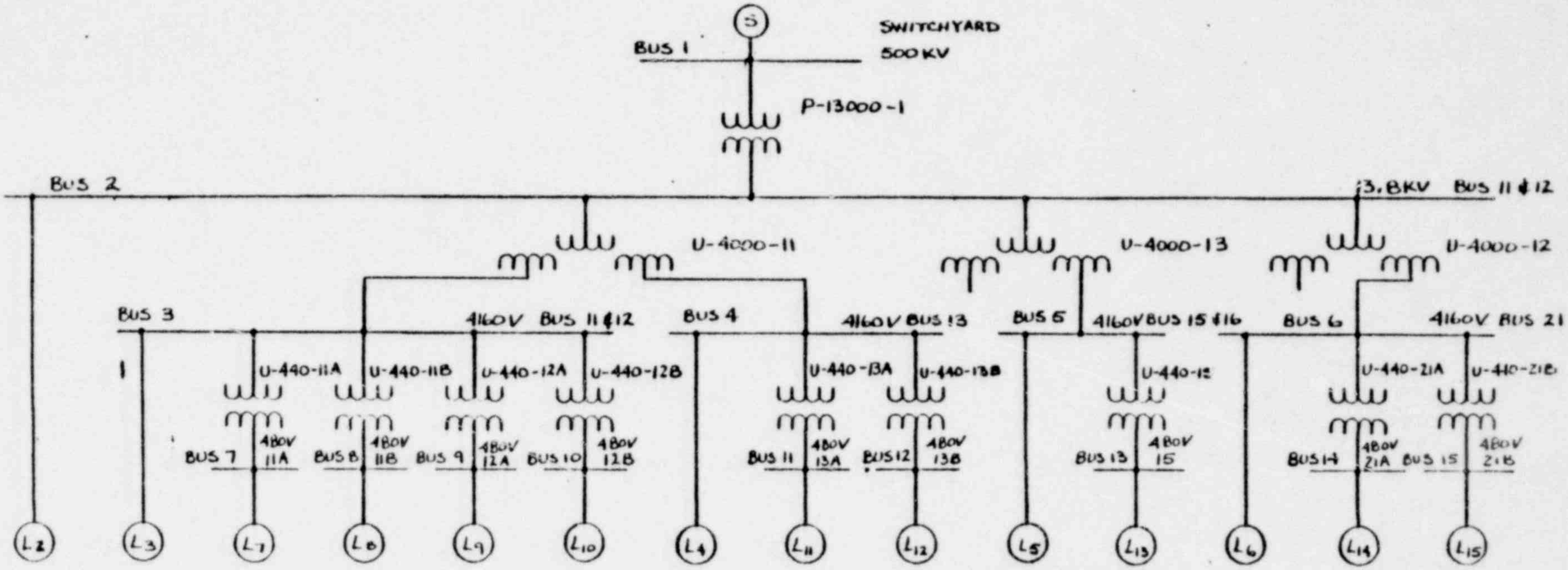


CALCULATION SHEET

DESIGNER Bruce Ritter DATE 9/2/76 CHECKER m J Shah DATE 10/1/76

TITLE Calvert Cliffs - Tap Setting Study JOB NO 6750

SUBJECT Single Line - Unit 1 SHEET NO 2



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GENERAL ELECTRIC CO. EUEO PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO, CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER P-13000-1

CASE 1 ALL AUXILIARY LOADS RUNNING FULL LOAD

SWITCHYARD VOLTAGE (97%) TRANSFORMERS 100%, 97.83%, 97.48%

LINE REMOVED FROM	TO	AREA	CIRCUIT
3	7	0	0
3	8	0	0
3	9	0	0
3	10	0	0
4	11	0	0
4	12	0	0
5	13	0	0
6	14	0	0
6	15	0	0

LINE ADDED FROM	TO	AREA	CIRCUIT	R	X	CHG
3	7	0	0	1.1600	5.9887	.0000
3	8	0	0	1.1600	5.9887	.0000
3	9	0	0	1.1600	5.9887	.0000
3	10	0	0	1.1600	5.9887	.0000
4	11	0	0	1.1600	5.9887	.0000
4	12	0	0	1.1600	5.9887	.0000
5	13	0	0	1.1600	5.9887	.0000
6	14	0	0	1.1600	5.9887	.0000
6	15	0	0	1.1600	5.9887	.0000

	LINE	AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
1 500KV	0	.9700	.00	35.27	19.06	.00	.00	.00	.00	.00	0	2 13.8KV	35.27	19.06
											0	1 500KV	-35.18	-16.16
											0	3 4KV 11	5.80	3.39
											0	4 4KV 13	4.36	2.28
											0	5 4KV 15	6.41	.71
											0	6 4KV 21	1.33	.87
2 13.8KV	0	.9504	-3.72	.00	.00	17.28	8.90	.00	.00	.00				
											0	2 13.8KV	-5.77	-3.03
											0	7 48011A	.39	.25
											0	8 48011B	.31	.20
											0	9 48012A	.81	.56
											0	10 48012B	.40	.26
3 4KV 11	0	.9418	-6.32	.00	.00	3.85	1.75	.00	.00	.00				
											0	2 13.8KV	-4.34	-2.09
											0	11 48013A	.40	.26
											0	12 48013B	.62	.41
4 4KV 13	0	.9511	-5.66	.00	.00	3.32	1.41	.00	.00	.00				
											0	2 13.8KV	-6.38	-.38
											0	13 48015	.58	.38
5 4KV 15	0	.9625	-6.66	.00	.00	5.80	.00	.00	.00	.00				
											0	2 13.8KV	-1.32	-.85
											0	14 48021A	.40	.26
											0	15 48021B	.28	.19
6 4KV 21	0	.9638	-4.30	.00	.00	.64	.40	.00	.00	.00				
											0	3 4KV 11	-.39	-.24
7 48011A	0	.9460	-7.61	.00	.00	.39	.24	.00	.00	.00				
											0	3 4KV 11	-.31	-.19
8 48011B	0	.9503	-7.34	.00	.00	.31	.19	.00	.00	.00				
											0	3 4KV 11	-.80	-.50
9 48012A	0	.9296	-9.02	.00	.00	.80	.50	.00	.00	.00				
											0	3 4KV 11	-.40	-.25
10 48012B	0	.9452	-7.64	.00	.00	.40	.25	.00	.00	.00				
											0	4 4KV 13	-.40	-.25
11 48013A	0	.9549	-6.96	.00	.00	.40	.25	.00	.00	.00				
											0	4 4KV 13	-.61	-.38
12 48013B	0	.9435	-7.66	.00	.00	.61	.38	.00	.00	.00				

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ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
13 480015	0	.9582	-8.48	.00	.00	.57	.35	.00	.00	.00	0	5 4KV 15	-.57	-.35
14 480218	0	.9682	-5.56	.00	.00	.40	.25	.00	.00	.00	0	6 4KV 21	-.40	-.25
15 480218	0	.9742	-5.17	.00	.00	.28	.18	.00	.00	.00	0	6 4KV 21	-.28	-.18

GENERAL ELECTRIC CO. EUED PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO. CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER 2-13000-1

CASE 2 ALL AUXILIARY LOADS RUNNING WITH ONE RCP START

SWITCHYARD VOLTAGE 97%, TRANSFORMERS 100%, 97.83%, 97.48%

LINE REMOVED FROM TO AREA CIRCUIT
1 2 0 0

LINE ADDED FROM TO AREA CIRCUIT R X CHG
1 2 0 0 .0051 .1749 .0000

LINE		AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000
14	6	0	0	1.16000	5.98870	.00000
15	6	0	0	1.16000	5.98870	.00000

INITIAL TAP SETTINGS

LINE		RATIO	ANGLE	AREA	CKT
2	3	.9783	.000	0	0
2	4	.9783	.000	0	0
2	5	.9783	.000	0	0
2	6	.9783	.000	0	0
3	7	.9748	.000	0	0
3	8	.9748	.000	0	0
3	9	.9748	.000	0	0
3	10	.9748	.000	0	0
4	11	.9748	.000	0	0
4	12	.9748	.000	0	0
5	13	.9748	.000	0	0

	BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
	1 500KV	0	.9700	.00	35.70	43.81	.00	.00	.00	.00	.00	0	2 13.8KV	35.70	43.81
												0	1 500KV	-35.53	-38.04
												0	3 4KV 11	5.81	3.45
												0	4 4KV 13	4.36	2.31
												0	5 4KV 15	6.42	.75
	2 13.8KV	0	.9064	-3.87	.00	.00	12.96	6.67	4.68	23.99	.00	0	6 4KV 21	1.33	.88
												0	2 13.8KV	-5.77	-3.05
												0	7 48011A	.39	.26
												0	8 48011B	.31	.20
												0	9 48012A	.81	.57
*	3 4KV 11	0	.8951	-6.73	.00	.00	3.85	1.75	.00	.00	.00	0	10 48012B	.40	.27
												0	2 13.8KV	-4.34	-2.10
												0	11 48013A	.40	.27
												0	12 48013B	.62	.42
	4 4KV 13	0	.9050	-6.01	.00	.00	3.32	1.41	.00	.00	.00				
												0	2 13.8KV	-6.38	-.39
												0	13 48015	.58	.38
	5 4KV 15	0	.9170	-7.10	.00	.00	5.80	.00	.00	.00	.00				
												0	2 13.8KV	-1.33	-.86
												0	14 48021A	.40	.27
												0	15 48021B	.28	.19
	6 4KV 21	0	.9184	-4.51	.00	.00	.64	.40	.00	.00	.00				
												0	3 4KV 11	-.39	-.24
*	7 48011A	0	.8969	-8.17	.00	.00	.39	.24	.00	.00	.00				
												0	3 4KV 11	-.31	-.19
	8 48011B	0	.9015	-7.87	.00	.00	.31	.19	.00	.00	.00				
												0	3 4KV 11	-.80	-.50
*	9 48012A	0	.8720	-9.75	.00	.00	.80	.50	.00	.00	.00				
												0	3 4KV 11	-.40	-.25
*	10 48012B	0	.8941	-8.20	.00	.00	.40	.25	.00	.00	.00				
												0	4 4KV 13	-.40	-.25
	11 48013A	0	.9065	-7.45	.00	.00	.40	.25	.00	.00	.00				
												0	4 4KV 13	-.61	-.38
*	12 48013B	0	.8944	-8.23	.00	.00	.61	.38	.00	.00	.00				

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
13 4R015	0	.9098	-9.12	.00	.00	.57	.35	.00	.00	.00	0	5 4KV 15	-.57	-.35
											0	6 4KV 21	-.40	-.25
14 4R021A	0	.9200	-5.90	.00	.00	.40	.25	.00	.00	.00				
											0	6 4KV 21	-.28	-.18
15 4R021B	0	.9269	-5.47	.00	.00	.28	.18	.00	.00	.00				

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GENERAL ELECTRIC CO. EUED PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO, CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER P-13000-1

CASE 3 ALL AUXILIARY LOADS RUNNING WITH ONE CWP START

SWITCHYARD VOLTAGE 97%, TRANSFORMERS 100% , 97.83%, 97.48%

LINE REMOVED FROM	TO	AREA	CIRCUIT
3	7	0	0
3	8	0	0
3	9	0	0
3	10	0	0
4	11	0	0
4	12	0	0
5	13	0	0
6	14	0	0
6	15	0	0

LINE ADDED FROM	TO	AREA	CIRCUIT	R	X	CHG
3	7	0	0	1.1600	5.9887	.0000
3	8	0	0	1.1600	5.9887	.0000
3	9	0	0	1.1600	5.9887	.0000
3	10	0	0	1.1600	5.9887	.0000
4	11	0	0	1.1600	5.9887	.0000
4	12	0	0	1.1600	5.9887	.0000
5	13	0	0	1.1600	5.9887	.0000
6	14	0	0	1.1600	5.9887	.0000
6	15	0	0	1.1600	5.9887	.0000

	LINE	AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000

ELECTRICAL AUX SYSTEM

	BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
	1 500KV	0	.9700	.00	35.80	27.41	.00	.00	.00	.00	.00	0	2 13.8KV	35.80	27.41
												0	1 500KV	-35.69	-23.74
												0	3 4KV 11	5.80	3.41
												0	4 4KV 13	4.36	2.29
												0	5 4KV 15	6.91	8.27
												0	6 4KV 21	1.33	.87
	2 13.8KV	0	.9385	-3.81	.00	.00	17.28	8.90	.00	.00	.00				
												0	2 13.8KV	-5.77	-3.03
												0	7 48011A	.39	.25
												0	8 48011B	.31	.20
												0	9 48012A	.81	.56
												0	10 48012B	.40	.27
	3 4KV 11	0	.9261	-6.49	.00	.00	3.85	1.75	.00	.00	.00				
												0	2 13.8KV	-4.34	-2.09
												0	11 48013A	.40	.26
												0	12 48013B	.62	.42
	4 4KV 13	0	.9336	-5.82	.00	.00	3.32	1.41	.00	.00	.00				
												0	2 13.8KV	-6.82	-7.31
												0	13 48015	.58	.38
*	5 4KV 15	0	.8872	-6.94	.00	.00	4.83	.00	1.42	6.93	.00				
												0	2 13.8KV	-1.32	-.85
												0	14 48021A	.40	.26
												0	15 48021B	.28	.19
	6 4KV 21	0	.9485	-4.41	.00	.00	.64	.40	.00	.00	.00				
												0	3 4KV 11	-.39	-.24
	7 48011A	0	.9295	-7.83	.00	.00	.39	.24	.00	.00	.00				
												0	3 4KV 11	-.31	-.19
	8 48011B	0	.9339	-7.55	.00	.00	.31	.19	.00	.00	.00				
												0	3 4KV 11	-.80	-.50
	9 48012A	0	.9056	-9.30	.00	.00	.80	.50	.00	.00	.00				
												0	3 4KV 11	-.40	-.25
	10 48012B	0	.9287	-7.86	.00	.00	.40	.25	.00	.00	.00				
												0	4 4KV 13	-.40	-.25
	11 48013A	0	.9386	-7.15	.00	.00	.40	.25	.00	.00	.00				
												0	4 4KV 13	-.61	-.38
	12 48013B	0	.9270	-7.88	.00	.00	.61	.38	.00	.00	.00				

ELECTRICAL AUX SYSTEM

	BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
*	13 480?5	0	.8702	-9.10	.00	.00	.57	.35	.00	.00	.00	0	5 4KV 15	-.57	-.35
	14 480?1A	0	.9522	-5.71	.00	.00	.40	.25	.00	.00	.00	0	6 4KV 21	-.40	-.25
	15 480218	0	.9583	-5.31	.00	.00	.28	.18	.00	.00	.00	0	6 4KV 21	-.28	-.18

11139 088

GENERAL ELECTRIC CO. EUEO PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO, CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER P-13000-1

CASE = ALL AUXILIARY LOADS RUNNING WITH ONE CRP START

SWITCHYARD VOLTAGE 97%, TRANSFORMERS 100%, 97.83%, 97.48%

LINE REMOVED FROM TO AREA CIRCUIT
1 2 0 0

LINE ADDED FROM TO AREA CIRCUIT R X CHG
1 2 0 0 .0051 .1749 .0000

LINE		AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000
14	6	0	0	1.16000	5.98870	.00000
15	6	0	0	1.16000	5.98870	.00000

INITIAL TAP SETTINGS

LINE		RATIO	ANGLE	AREA	CKT
2	3	.9783	.000	0	0
2	4	.9783	.000	0	0
2	5	.9783	.000	0	0
2	6	.9783	.000	0	0
3	7	.9748	.000	0	0
3	8	.9748	.000	0	0
3	9	.9748	.000	0	0
3	10	.9748	.000	0	0
4	11	.9748	.000	0	0
4	12	.9748	.000	0	0
5	13	.9748	.000	0	0

11139 0809

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
1 500KV	0	.9700	.00	35.21	27.63	.00	.00	.00	.00	.00	0	2 13.8KV	35.21	27.63
											0	1 500KV	-35.10	-24.02
											0	3 4KV 11	5.75	11.23
											0	4 4KV 13	4.36	2.29
											0	5 4KV 15	6.41	.73
											0	6 4KV 21	1.33	.88
2 13.8KV	0	.9351	-3.75	.00	.00	17.28	8.90	.00	.00	.00				
											0	2 13.8KV	-5.62	-9.91
											0	7 48011A	.39	.26
											0	8 48011B	.31	.20
											0	9 48012A	.82	.58
											0	10 48012B	.40	.27
* 3 4KV 11	0	.8628	-6.21	.00	.00	2.13	1.07	1.57	7.54	.00				
											0	2 13.8KV	-4.34	-2.09
											0	11 48013A	.40	.26
											0	12 48013B	.62	.42
4 4KV 13	0	.9351	-5.76	.00	.00	3.32	1.41	.00	.00	.00				
											0	2 13.8KV	-6.38	-.38
											0	13 48015	.58	.38
5 4KV 15	0	.9467	-6.78	.00	.00	5.80	.00	.00	.00	.00				
											0	2 13.8KV	-1.33	-.85
											0	14 48021A	.40	.26
											0	15 48021B	.28	.19
6 4KV 21	0	.9480	-4.34	.00	.00	.64	.40	.00	.00	.00				
											0	3 4KV 11	-.39	-.24
* 7 48011A	0	.8939	-7.75	.00	.00	.39	.24	.00	.00	.00				
											0	3 4KV 11	-.31	-.19
* 8 48011B	0	.8686	-7.43	.00	.00	.31	.19	.00	.00	.00				
											0	3 4KV 11	-.80	-.50
* 9 48012A	0	.8378	-9.47	.00	.00	.80	.50	.00	.00	.00				
											0	3 4KV 11	-.40	-.25
* 10 48012B	0	.8690	-7.79	.00	.00	.40	.25	.00	.00	.00				
											0	4 4KV 13	-.40	-.25
11 48013A	0	.9381	-7.10	.00	.00	.40	.25	.00	.00	.00				
											0	4 4KV 13	-.61	-.38
12 48013B	0	.9263	-7.83	.00	.00	.61	.38	.00	.00	.00				

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
											0	5 4KV 15	-.57	-.35
13 4R015	0	.9414	-8.57	.00	.00	.57	.35	.00	.00	.00				
											0	6 4KV 21	-.40	-.25
14 4R021A	0	.9517	-5.65	.00	.00	.40	.25	.00	.00	.00				
											0	6 4KV 21	-.28	-.18
15 4R021B	0	.9578	-5.25	.00	.00	.28	.18	.00	.00	.00				

GENERAL ELECTRIC CO. EUED PROGRAM

MODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO. CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 11/16/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER F-13000-1

CASE 5 ALL AUXILIARY LOADS RUNNING WITH AN ESF START

SWITCHYARD VOLTAGE 97% , TRANSFORMERS 100%,97.73%, 97.48%

INPUT DATA FOR THIS RUN

LINE		AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000
14	6	0	0	1.16000	5.98870	.00000
15	6	0	0	1.16000	5.98870	.00000

ELECTRICAL AUX SYSTEM

	BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
	1 500KV	0	.9700	.00	36.94	28.95	.00	.00	.00	.00	.00	0	2 13.8KV	36.94	28.95
												0	1 500KV	-36.83	-24.97
												0	3 4KV 11	7.47	12.18
												0	4 4KV 13	4.36	2.29
												0	5 4KV 15	6.41	.72
												0	6 4KV 21	1.33	.87
	2 13.8KV	0	.9329	-3.94	.00	.00	17.28	8.90	.00	.00	.00				
												0	2 13.8KV	-7.31	-10.49
												0	7 48011A	.47	.77
												0	8 48011B	.46	.79
												0	9 48012A	.82	.58
												0	10 48012B	.40	.27
*	3 4KV 11	0	.8531	-7.31	.00	.00	3.85	1.75	1.31	6.33	.00				
												0	2 13.8KV	-4.34	-2.09
												0	11 48013A	.40	.26
												0	12 48013B	.62	.42
	4 4KV 13	0	.9328	-5.96	.00	.00	3.32	1.41	.00	.00	.00				
												0	2 13.8KV	-6.38	-.38
												0	13 48015	.58	.38
	5 4KV 15	0	.9445	-6.99	.00	.00	5.80	.00	.00	.00	.00				
												0	2 13.8KV	-1.32	-.85
												0	14 48021A	.40	.26
												0	15 48021B	.28	.19
	6 4KV 21	0	.9458	-4.54	.00	.00	.64	.40	.00	.00	.00				
												0	3 4KV 11	-.46	-.71
*	7 48011A	0	.8166	-8.85	.00	.00	.39	.24	.07	.47	.00				
												0	3 4KV 11	-.44	-.72
*	8 48011B	0	.8156	-8.77	.00	.00	.31	.19	.13	.53	.00				
												0	3 4KV 11	-.80	-.50
*	9 48012A	0	.8262	-10.65	.00	.00	.80	.50	.00	.00	.00				
												0	3 4KV 11	-.40	-.25
*	10 48012B	0	.8518	-8.93	.00	.00	.40	.25	.00	.00	.00				
												0	4 4KV 13	-.40	-.25
	11 48013A	0	.9357	-7.31	.00	.00	.40	.25	.00	.00	.00				
												0	4 4KV 13	-.61	-.38
	12 48013B	0	.9240	-8.04	.00	.00	.61	.38	.00	.00	.00				

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
13 4P015	0	.9390	-8.89	.00	.00	.57	.35	.00	.00	.00	0	5 4KV 15	-.57	-.35
14 4P021A	0	.9493	-5.85	.00	.00	.40	.25	.00	.00	.00	0	6 4KV 21	-.40	-.25
15 4P021B	0	.9554	-5.45	.00	.00	.28	.18	.00	.00	.00	0	6 4KV 21	-.28	-.18

GENERAL ELECTRIC CO. EHEO PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO, CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER P-13000-1

CASE 6 ALL AUXILIARY AND ESF LOADS RUNNING FULL LOAD

SWITCHYARD VOLTAGE 97%, TRANSFORMERS 100%, 97.83%, 97.48%

LINE REMOVED FROM 1 TO AREA 2 0 CIRCUIT 0

LINE ADDED FROM 1 TO AREA 2 0 CIRCUIT 0 R .0051 X .1749 CHG .0000

LINE	AREA	CKT	R	X	CHARGING
1 2	0	0	.00510	.17490	.00000
2 1	0	0	.00510	.17490	.00000
2 3	0	0	.07060	.75500	.00000
2 4	0	0	.07060	.75500	.00000
2 5	0	0	.07060	.75500	.00000
2 6	0	0	.07060	.75500	.00000
3 2	0	0	.07060	.75500	.00000
3 7	0	0	1.16000	5.98870	.00000
3 8	0	0	1.16000	5.98870	.00000
3 9	0	0	1.16000	5.98870	.00000
3 10	0	0	1.16000	5.98870	.00000
4 2	0	0	.07060	.75500	.00000
4 11	0	0	1.16000	5.98870	.00000
4 12	0	0	1.16000	5.98870	.00000
5 2	0	0	.07060	.75500	.00000
5 13	0	0	1.16000	5.98870	.00000
6 2	0	0	.07060	.75500	.00000
6 14	0	0	1.16000	5.98870	.00000
6 15	0	0	1.16000	5.98870	.00000
7 3	0	0	1.16000	5.98870	.00000
8 3	0	0	1.16000	5.98870	.00000
9 3	0	0	1.16000	5.98870	.00000
10 3	0	0	1.16000	5.98870	.00000
11 4	0	0	1.16000	5.98870	.00000
12 4	0	0	1.16000	5.98870	.00000
13 5	0	0	1.16000	5.98870	.00000
14 6	0	0	1.16000	5.98870	.00000
15 6	0	0	1.16000	5.98870	.00000

INITIAL TAP SETTINGS

LINE		RATIO	ANGLE	AREA	CKT
2	3	.9783	.000	0	0
2	4	.9783	.000	0	0
2	5	.9783	.000	0	0
2	6	.9783	.000	0	0
3	7	.9748	.000	0	0
3	8	.9748	.000	0	0
3	9	.9748	.000	0	0
3	10	.9748	.000	0	0
4	11	.9748	.000	0	0
4	12	.9748	.000	0	0
5	13	.9748	.000	0	0

96 6911

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
1 500KV	0	,9700	,00	37,39	21,22	,00	,00	,00	,00	,00	0	2 13,8KV	37,39	21,22
											0	1 500KV	-37,29	-17,88
											0	3 4KV 11	7,95	5,12
											0	4 4KV 13	4,36	2,29
											0	5 4KV 15	6,41	,72
											0	6 4KV 21	1,33	,88
2 13,8KV	0	,9467	-3,96	,00	,00	17,28	8,90	,00	,00	,00				
											0	2 13,8KV	-7,88	-4,40
											0	7 48011A	,57	,38
											0	8 48011B	,64	,43
											0	9 48012A	,81	,57
											0	10 48012B	,40	,27
3 4KV 11	0	,9238	-7,58	,00	,00	5,46	2,75	,00	,00	,00				
											0	2 13,8KV	-4,34	-2,09
											0	11 48013A	,40	,26
											0	12 48013B	,62	,41
4 4KV 13	0	,9472	-5,92	,00	,00	3,32	1,41	,00	,00	,00				
											0	2 13,8KV	-6,38	-,38
											0	13 48015	,58	,38
5 4KV 15	0	,9587	-6,92	,00	,00	5,80	,00	,00	,00	,00				
											0	2 13,8KV	-1,33	-,85
											0	14 48021A	,40	,26
											0	15 48021B	,28	,19
6 4KV 21	0	,9599	-4,54	,00	,00	,64	,40	,00	,00	,00				
											0	3 4KV 11	-,56	-,35
7 48011A	0	,9172	-9,52	,00	,00	,56	,35	,00	,00	,00				
											0	3 4KV 11	-,63	-,39
8 48011B	0	,9134	-9,78	,00	,00	,63	,39	,00	,00	,00				
											0	3 4KV 11	-,80	-,50
9 48012A	0	,9031	-10,40	,00	,00	,80	,50	,00	,00	,00				
											0	3 4KV 11	-,40	-,25
10 48012B	0	,9282	-8,95	,00	,00	,40	,25	,00	,00	,00				
											0	4 4KV 13	-,40	-,25
11 48013A	0	,9508	-7,22	,00	,00	,40	,25	,00	,00	,00				
											0	4 4KV 13	-,61	-,38
12 48013B	0	,9393	-7,94	,00	,00	,61	,38	,00	,00	,00				

1139 960

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
13 48015	0	.9541	-8.76	.00	.00	.57	.35	.00	.00	.00	0	5 4KV 15	-.57	-.35
14 48021A	0	.9642	-5.81	.00	.00	.40	.25	.00	.00	.00	0	6 4KV 21	-.40	-.25
15 48021B	0	.9702	-5.42	.00	.00	.28	.18	.00	.00	.00	0	6 4KV 21	-.28	-.18

1139 097

GENERAL ELECTRIC CO. EUED PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO, CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER P-13000-1

CASE 7 ALL AUXILIARY LOADS UNDER NORMAL PLANT SHUTDOWN

SWITCHYARD VOLTAGE 97%, TRANSFORMERS 100%, 97.83% 97.48%

LINE REMOVED FROM	TO AREA	CIRCUIT
3	7	0 0
3	8	0 0
3	9	0 0
3	10	0 0
4	11	0 0
4	12	0 0
5	13	0 0
6	14	0 0
6	15	0 0

LINE ADDED FROM	TO AREA	CIRCUIT	R	X	CHG
3	7	0 0	1.1600	5.9887	.0000
3	8	0 0	1.1600	5.9887	.0000
3	9	0 0	1.1600	5.9887	.0000
3	10	0 0	1.1600	5.9887	.0000
4	11	0 0	1.1600	5.9887	.0000
4	12	0 0	1.1600	5.9887	.0000
5	13	0 0	1.1600	5.9887	.0000
6	14	0 0	1.1600	5.9887	.0000
6	15	0 0	1.1600	5.9887	.0000

LINE		AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
1 500KV	0	.9700	.00	3.61	2.32	.00	.00	.00	.00	.00	0	2 13.8KV	3.61	2.32
											0	1 500KV	-3.60	-2.29
											0	3 4KV 11	1.88	1.19
											0	4 4KV 13	.33	.21
											0	5 4KV 15	.28	.19
											0	6 4KV 21	1.11	.71
2 13.8KV	0	.9708	-.37	.00	.00	.00	.00	.00	.00	.00				
											0	2 13.8KV	-1.87	-1.16
											0	7 4801[illegible]	.29	.19
											0	8 4801[illegible]	.18	.11
											0	9 48012A	.39	.25
											0	10 48012B	.23	.12
3 4KV 11	0	.9913	-1.14	.00	.00	.78	.48	.00	.00	.00				
											0	2 13.8KV	-.33	-.21
											0	11 48013A	.06	.03
											0	12 48013B	.27	.18
4 4KV 13	0	.9907	-.50	.00	.00	.00	.00	.00	.00	.00				
											0	2 13.8KV	-.28	-.18
											0	13 48015	.28	.19
5 4KV 15	0	.9909	-.48	.00	.00	.00	.00	.00	.00	.00				
											0	2 13.8KV	-1.11	-.69
											0	14 48021A	.17	.11
											0	15 48021B	.16	.10
6 4KV 21	0	.9954	-.82	.00	.00	.78	.48	.00	.00	.00				
											0	3 4KV 11	-.29	-.18
7 48011A	0	1.0027	-2.00	.00	.00	.29	.18	.00	.00	.00				
											0	3 4KV 11	-.18	-.11
8 48011B	0	1.0082	-1.67	.00	.00	.18	.11	.00	.00	.00				
											0	3 4KV 11	-.39	-.24
9 48012A	0	.9977	-2.30	.00	.00	.39	.24	.00	.00	.00				
											0	3 4KV 11	-.23	-.12
10 48012B	0	1.0070	-1.83	.00	.00	.23	.12	.00	.00	.00				
											0	4 4KV 13	-.06	-.03
11 48013A	0	1.0231	-.68	.00	.00	.06	.03	.00	.00	.00				
											0	4 4KV 13	-.27	-.17
12 48013B	0	1.0123	-1.29	.00	.00	.27	.17	.00	.00	.00				

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
13 4B015	0	1.0118	-1.29	.00	.00	.28	.18	.00	.00	.00	0	5 4KV 15	-.28	-.18
14 4B021A	0	1.0127	-1.31	.00	.00	.17	.11	.00	.00	.00	0	6 4KV 21	-.17	-.11
15 4B021B	0	1.0124	-1.29	.00	.00	.16	.10	.00	.00	.00	0	6 4KV 21	-.16	-.10

GENERAL ELECTRIC CO. EUED PROGRAM

NODAL ITERATIVE LOAD FLOW

BALTIMORE GAS & ELEC CO. CALVERT CLIFFS NUCLEAR PLANT SYSTEM NUMBER- 1 10/1/76 ELECTRICAL AUX SYSTEM

UNIT 1 AUXILIARY SYSTEM FED FROM TRANSFORMER P-13000-1

CASE 7 ALL AUXILIARY LOADS UNDER NORMAL PLANT SHUTDOWN

SWITCHYARD VOLTAGE 103%, TRANSFORMERS 100%, 97.83%, 97.48%

LINE REMOVED FROM	TO	AREA	CIRCUIT
1	2	0	0

LINE ADDED FROM	TO	AREA	CIRCUIT	R	X	CHG
1	2	0	0	.0051	.1749	.0000

LINE		AREA	CKT	R	X	CHARGING
1	2	0	0	.00510	.17490	.00000
2	1	0	0	.00510	.17490	.00000
2	3	0	0	.07060	.75500	.00000
2	4	0	0	.07060	.75500	.00000
2	5	0	0	.07060	.75500	.00000
2	6	0	0	.07060	.75500	.00000
3	2	0	0	.07060	.75500	.00000
3	7	0	0	1.16000	5.98870	.00000
3	8	0	0	1.16000	5.98870	.00000
3	9	0	0	1.16000	5.98870	.00000
3	10	0	0	1.16000	5.98870	.00000
4	2	0	0	.07060	.75500	.00000
4	11	0	0	1.16000	5.98870	.00000
4	12	0	0	1.16000	5.98870	.00000
5	2	0	0	.07060	.75500	.00000
5	13	0	0	1.16000	5.98870	.00000
6	2	0	0	.07060	.75500	.00000
6	14	0	0	1.16000	5.98870	.00000
6	15	0	0	1.16000	5.98870	.00000
7	3	0	0	1.16000	5.98870	.00000
8	3	0	0	1.16000	5.98870	.00000
9	3	0	0	1.16000	5.98870	.00000
10	3	0	0	1.16000	5.98870	.00000
11	4	0	0	1.16000	5.98870	.00000
12	4	0	0	1.16000	5.98870	.00000
13	5	0	0	1.16000	5.98870	.00000
14	6	0	0	1.16000	5.98870	.00000
15	6	0	0	1.16000	5.98870	.00000

INITIAL TAP SETTINGS

LINE		RATIO	ANGLE	AREA	CKT
2	3	.9783	.000	0	0
2	4	.9783	.000	0	0
2	5	.9783	.000	0	0
2	6	.9783	.000	0	0
3	7	.9748	.000	0	0
3	8	.9748	.000	0	0
3	9	.9748	.000	0	0
3	10	.9748	.000	0	0
4	11	.9748	.000	0	0
4	12	.9748	.000	0	0
5	13	.9748	.000	0	0

ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
1 500KV	0	1.0300	.00	3.61	2.34	.00	.00	.00	.00	.00	0	2 13.8KV	3.61	2.34
											0	1 500KV	-3.61	-2.31
											0	3 4KV 11	1.88	1.19
											0	4 4KV 13	.33	.20
											0	5 4KV 15	.28	.18
											0	6 4KV 21	1.11	.70
2 13.8KV	0	1.0409	-.33	.00	.00	.00	.00	.00	.00	.00				
											0	2 13.8KV	-1.88	-1.15
											0	7 48011A	.29	.19
											0	8 48011B	.18	.11
											0	9 48012A	.39	.25
											0	10 48012B	.23	.12
3 4KV 11	0	1.0544	-1.01	.00	.00	.78	.48	.00	.00	.00				
											0	2 13.8KV	-.33	-.20
											0	11 48013A	.06	.03
											0	12 48013B	.27	.18
4 4KV 13	0	1.0623	-.45	.00	.00	.00	.00	.00	.00	.00				
											0	2 13.8KV	-.28	-.18
											0	13 48015	.28	.19
5 4KV 15	0	1.0625	-.43	.00	.00	.00	.00	.00	.00	.00				
											0	2 13.8KV	-1.11	-.69
											0	14 48021A	.17	.11
											0	15 48021B	.16	.10
6 4KV 21	0	1.0583	-.73	.00	.00	.78	.48	.00	.00	.00				
											0	3 4KV 11	-.29	-.18
7 48011A	0	1.0683	-1.77	.00	.00	.29	.18	.00	.00	.00				
											0	3 4KV 11	-.18	-.11
8 48011B	0	1.0735	-1.48	.00	.00	.18	.11	.00	.00	.00				
											0	3 4KV 11	-.39	-.24
9 48012A	0	1.0637	-2.03	.00	.00	.39	.24	.00	.00	.00				
											0	3 4KV 11	-.23	-.12
10 48012B	0	1.0724	-1.62	.00	.00	.23	.12	.00	.00	.00				
											0	4 4KV 13	-.06	-.03
11 48013A	0	1.0875	-.60	.00	.00	.06	.03	.00	.00	.00				
											0	4 4KV 13	-.27	-.17
12 48013B	0	1.0773	-1.14	.00	.00	.27	.17	.00	.00	.00				

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ELECTRICAL AUX SYSTEM

BUS	AREA	VOLTAGE	ANGLE	GENERATOR MW	GENERATOR MVAR	LOAD MW	LOAD MVAR	REACTOR MW	REACTOR MVAR	STATIC MVAR	CKT	TO BUS	LINE FLOW MW	LINE FLOW MVAR
13 48015	0	1.0768	-1.14	.00	.00	.28	.18	.00	.00	.00	0	5 4KV 15	-.28	-.18
14 48021A	0	1.0776	-1.17	.00	.00	.17	.11	.00	.00	.00	0	6 4KV 21	-.17	-.11
15 48021B	0	1.0793	-1.14	.00	.00	.16	.10	.00	.00	.00	0	6 4KV 21	-.16	-.10

CALVERT CLIFFS NUCLEAR POWER PLANT

TERMINAL VOLTAGE AT SAFETY RELATED EQUIPMENT-CASE 5

CMPNT NO	% VOLT AT EQPT AT STARTING	EQPT NOM VOLT
1MA107	88.6748	4000.0000
1MA108	88.6224	4000.0000
1MA110	88.6176	4000.0000
1MA104	88.6463	4000.0000
1MA105	88.4227	4000.0000
1MA412	88.2427	4000.0000
1MA109	88.6355	4000.0000
1MA411	88.6441	4000.0000
1MA407	88.6595	4000.0000
1MA408	88.5629	4000.0000
1MA110	88.6176	4000.0000
1MA404	88.5986	4000.0000
1MA405	88.4666	4000.0000
1MA412	88.2427	4000.0000
1MA409	88.6430	4000.0000
1MA411	88.6441	4000.0000
1MOV509	85.0447	460.0000
1MOV508	85.0389	460.0000
1M1406	83.3456	460.0000
1MOV6579	84.9015	460.0000
1MOV4144	84.1190	460.0000
1MOV659	84.8714	460.0000
1MOV617	84.7812	460.0000
1MOV627	84.7812	460.0000
1MOV637	84.8595	460.0000
1MOV647	84.9485	460.0000
1MOV2080	85.0402	460.0000
1MOV615	84.3156	460.0000
1MOV625	84.3156	460.0000
1MOV656	84.6585	460.0000
1M1402	84.6727	460.0000
1MOV4516	84.4858	460.0000
1MOV614	84.9946	460.0000
1MOV624	84.7874	460.0000
1M1404	83.9344	460.0000
1MOV5250	84.9675	460.0000
1MOV501	85.0309	460.0000
1MB102	84.2151	460.0000
1MB105	84.3728	460.0000
1MB106	82.2617	460.0000
1MB108	84.9573	460.0000
1MB110	80.9548	460.0000
1MB404	80.3057	460.0000
1MB114	83.5534	460.0000
1MB121	84.4509	460.0000
1MB116	82.5774	460.0000
1MB115	79.6610	460.0000
1M0231	82.4627	460.0000
1MOV514	85.1515	460.0000
1MC406	83.5266	460.0000
1MOV5463	85.0551	460.0000
1MOV4145	84.4811	460.0000
1MOV660	85.0843	460.0000
1MOV635	84.8206	460.0000

1MOV645	84.6658	460.0000
1MOV616	84.9633	460.0000
1MOV626	84.9633	460.0000
1MOV636	85.0525	460.0000
1MOV646	85.0525	460.0000
1MO402	84.7607	460.0000
1MOV4517	84.7431	460.0000
1MOV634	84.9193	460.0000
1MOV644	84.9193	460.0000
1MO404	84.1985	460.0000
1MOVS251	85.0854	460.0000
1MOV5462	84.9512	460.0000
1MB402	84.4071	460.0000
1ME405	83.4789	460.0000
1ME40	82.6787	460.0000
1MB411	81.0940	460.0000
1ME410	82.2722	460.0000
1MB404	80.4098	460.0000
1MB414	83.6938	460.0000
1MB121	84.5787	460.0000
1MB116	82.6787	460.0000
1MB415	79.8304	460.0000

COMPONENT NUMBER	DESCRIPTION
1M0231	CNTMNT PURGE AIR SUP FAN 11
1M0311	CNTMNT PURGE AIR EXH FAN 11
1M0402	PENETRATION RM EXH FAN 12
1M0404	SU AIR COMPRESSOR 12
1M0406	BORIC ACID PUMP 12
1M1402	PENETRATION RM EXH FAN 11
1M1404	SU AIR COMPRESSOR 11
1M1406	BORIC ACID PUMP 11
1MA104	LPSI PUMP 11
1MA105	SALT WATER PUMP 11
1MA107	CNTMNT SPRAY PUMP 11
1MA108	HPSI PUMP 11
1MA109	SERVICE WATER PUMP 11
1MA110	HPSI PUMP 13
1MA110	HPSI PUMP 13
1MA404	LPSI PUMP 12
1MA405	SALT WATER PUMP 12
1MA407	CNTMNT SPRAY PUMP 12
1MA408	HPSI PUMP 12
1MA409	SERVICE WATER PUMP 12
1MA411	SERVICE WATER PUMP 13
1MA411	SERVICE WATER PUMP 13
1MA412	SALT WATER PUMP 13
1MA412	SALT WATER PUMP 13
1MB101	CAVITY COOLING FAN 11
1MB102	CNTMNT COOLING FAN 11
1MB105	CNTMNT FILTER 11
MB106	COMPONENT COOLING PUMP 11
MB108	CONTROL RM A/C COMPRESSOR 11
1MB110	SWGR RM A/C COMPRESSOR 11
1MB114	CNTMNT COOLING FAN 12
1MB115	CHARGING PUMP 11
1MB116	COMPONENT COOLING PUMP 13
1MB116	OMPONENT COOLING PUMP 13
1MB117	IN PLANT EXHAUST FAN 11
1MB118	STRUMENT AIR COMPRESSOR 11
1MB121	NTMNT FILTER 13
1MB121	CNTMNT FILTER 13
1MB401	CAVITY COOLING FAN 12
1MB402	CNTMNT COOLING FAN 13
1MB403	PLANT AIR COMPRESSOR 11
1MB404	CHARGING PUMP 13
1MB404	CHARGING PUMP 13
1MB405	CNTMNT FILTER 12
1MB406	COMPONENT COOLING PUMP 12
1MB410	SWGR RM A/C COMPRESSOR 12
1MB411	FUEL POOL COOLING PUMP 11
1MB414	CNTMNT COOLING FAN 14
1MB415	CHARGING PUMP 12
1MB417	MAIN PLANT EXHAUST FAN 12
1MB418	INSTRUMENT AIR COMPRESSOR 12

COMPONENT NUMBER	DESCRIPTION
1MOV2080	INSTR AIR CNTMNT ISOL
1MOV4144	CNTMNT SUMP DISCH
1MOV4145	CNTMNT SUMP DISCH
1MOV4516	SG 11 FEEDWATER ISOL 1MOV4516
1MOV4517	SG 12 FEEDWATER ISOL 1MOV4517
1MOV501	VOL CONT TK DISCH MOV
1MOV508	BA TK 12 TO CHARG PUMP SUCT
1MOV509	BA TK 11 TO CHARG PUMP SUCT
1MOV514	BA PUMPS TO CHARG PUMP SUCT
1MOV5250	SW TO CIRC WTR PUMP RM COOLERS
1MOV5251	SW TO CIRC WTR PUMP RM COOLERS
1MOV5462	CNTMNT NORM SUMP MORT
1MOV5463	CNTMNT NORM SUMP MORT
1MOV614	SI TANK 11A ISOL 1MOV614
1MOV615	LPSI TO LOOP 11A CONT 1MOV615
1MOV616	MAN HPSI TO LOOP 11A 1MOV616
1MOV617	HPSI TO LOOP 11A CONT 1MOV617
1MOV624	SI TANK 11B ISOL 1MOV624
1MOV625	LPSI TO LOOP 11B CONT 1MOV625
1MOV626	MAN HPSI TO LOOP 11B 1MOV626
1MOV627	HPSI TO LOOP 11B CONT 1MOV627
1MOV634	SI TANK 12A ISOL 1MOV634
1MOV635	LPSI TO LOOP 12A CONT 1MOV635
1MOV636	MAN HPSI TO LOOP 12A 1MOV636
1MOV637	HPSI TO LOOP 12A CONT 1MOV637
1MOV644	SI TANK 12B ISOL 1MOV644
1MOV645	LPSI TO LOOP 12B CONT 1MOV645
1MOV646	MAN HPSI TO LOOP 12B 1MOV646
1MOV647	HPSI TO LOOP 12B CONT 1MOV647
1MOV656	MANUAL HPSI HDR ISOL 1MOV656
1MOV6579	CNTMNT ISOL
1MOV659	CS & SI PUMPS RECIRC
1MOV660	CS & SI PUMPS RECIRC