MAINE YANKEE ATOMIC POWER COMPANY
ENGINEERING OFFICE
TURNPIKE ROAD (RT. 9)
WESTBORO, MASSACHUSETTS 01581
617-366-9011

B.3.2.1
WMY 80-100

June 30, 1980

United States Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Robert A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing

Reference:
(1) License No. DPR-36 (Docket No. 50-309)
(2) USNRC Letter to MYAPC, dated May 6, 1980
(3) MYAPC Letter to USNRC dated February 29, 1980
(4) YAEC #1204 "Auxiliary Power System Voltage Study for Maine Yankee Atomic Power Station" dated February 28, 1980
(5) USNRC Letter to All Power Reactors, dated August 8, 1979
(6) MYAPC Letter to USNRC dated September 16, 1876

Subject: Request for Additional Information on Adequacy of Station Electric Distribution System Voltages

Dear Sir:

As required in reference (2) we are providing additional information regarding the adequacy of the station electrical distribution system voltages at Maine Yankee. The seven items below correspond to the seven questions of reference (2).

1. <u>Question</u>

Reference (3) states that the computer program analysis was compared to the model of the station auxiliary power system. Comparing a computer analysis to a system model does not verify that the analysis correctly indicates the actual plant bus and load voltages. MYAPC should submit test procedures and verify the accuracy of the analyses per the NRC requirements.

<u>Response</u>

Our statements in references (3) and (4) apparently require clarification. Reference (3) should not be interpreted to imply that the computer program analysis was compared to the model of the station auxiliary power system. It was our intent that Reference (3) state that the analysis was verified by "using our computer program and our model of the station auxiliary power system to predict bus voltages for actual plant conditions."

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We have not compared the computer program analysis to a system model. We have taken readings of voltages and loads at Maine Yankee and inputted the load readings to the computer model. The resulting calculated voltages were compared in Table 5.1 of reference (4) to voltages reading from Maine Yankee. We trust this clarification satisfies your concern.

2. Question

Supply the calculated voltages for all low voltage ac (less than 480 V) Class 1E buses (including alternate sources) for each analyzed case. Do these systems supply any instruments or control circuits as required by GDC 13? If so, is all the equipment capable of sustaining the analyzed voltages without blowing of fuses, overheating, etc., and without affecting the equipment's ability to perform the required function?

Response

The four Class 1E 120 volt vital instrument buses are shown in the attached Figure 1. Each bus is fed directly from a 120 volt inverter. The inverter voltage is regulated to 120 V ac ± 2%.

Each inverter is normally powered by the station battery - battery charger. The battery charger requires 460 volts ±10% to operate successfully. Reference (4) demonstrates that adequate voltage is supplied by the station auxiliary power system to operate the battery chargers. If the battery chargers are not operable the inverters are supplied by the station batteries. There are no other ties from the station auxiliary power system to the Class 1E 120 volt buses. There are no other buses that supply 120 volt ac safety related instrument and control loads.

3. Question

The assumption that the reactor coolant pumps can be manually tripped is not permitted per the NRC guidelines. Therefore, MYAPC should provide a new analysis.

Response

We have repeated Case 3 of report YAEC #1204 and submit revised tables 3.3 and 4.3 as attachment 2. Note that tables 3.1, 3.2, 4.1, and 4.2 of YAEC #1204 are not affected because the auxiliary power system study did not assume that the reactor coolant pumps are tripped while the safeguards motors are starting.

4. Question

Assumptions that the maximum and minimum grid voltages [sections 3.3.3.b and 3.3.2.g of reference (4)] are both 120 kV is not consistent with reference (6). This letter states that 117 kV has been the minimum voltage on the grid and that 124 kV has been the maximum. Per guideline of 6 reference (5), the reference (6) grid voltage values should be used in the MYAPC analysis.

Response

The reference (6) grid voltage values are based on actual readings of voltmeters at the Maine Yankee 115 kV switchyard. The voltages used in reference (4) are based on the latest system load flow studies of the grid and therefore reflect a more realistic and accurate model of the power system than available using the values of reference (6). Furthermore, it was not our intent that reference (4) assume that the maximum and minimum voltages both equal 120 kV as stated in your question 4. We believe that reference (4), section 3.3.3.b and 3.3.2.g stated that voltage at Mason and Surowic station is controlled at 120 kV. Examination of tables 4.1 through 4.4 of reference (4) shows that node #1 voltage (115 kV switchyard at Maine Yankee) is 117 kV, 115.8 kV, 117.7 kV and 120 kV respectively. We, therefore, feel that the values in tables 4.1, 4.2 and 4.3 are consistent with the statements in reference (6). Even if the 120 kV voltage in table 4.4 is increased to 124 kV the voltages at all loads are well within the allowable voltages. We trust this clarification satisfies your concern.

5. Question

NRC guideline requires a separate analysis for each source of off-site power, including unit auxiliary transformer, to the Class 1E buses. The analysis should include the following sources of power:

(a) 22 kV source through transformer X24;

(b) 115 kV source through tertiary winding of transformer X16 unless there is an LCO for this source in the technical specifications.

Response

(a) An analysis for the 22 kV source through transformer X24 is provided in Attachment 3.

(b) An analysis for the 115 kV source through the tertiary winding of transformer X16 is not being provided. Transformer X16 is a wye-wye transformer and requires a tertiary for circulating zero sequence current. A tertiary of 4.16 kV was selected and the tertiary was connected to one safety bus only as a further precaution in the event of loss of X14 and one diesel generator. No credit is taken for this connection in order to meet the requirements of GDC 17 as it is both above and beyond the requirements of GDC 17.

6. Question

Per the NRC guideline, reference (3), the study should include starting of a large non-safety load when all Class 1E loads are operating.

Response

The required analysis is included in Attachment 3.

7. Question

What are the 480 volt and lower equipment terminal voltages when starting the largest 480 V class 1E load while all other Class 1E equipment is operating?

Response

The required analysis is included in Attachment 3.

We trust this information is satisfactory; however, should you desire additional information, please contact us.

Very truly yours,

MAINE YANKEE ATOMIC POWER COMPANY

R. H. Groce

R. H. Groce
Senior Engineer - Licensing

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Attachments

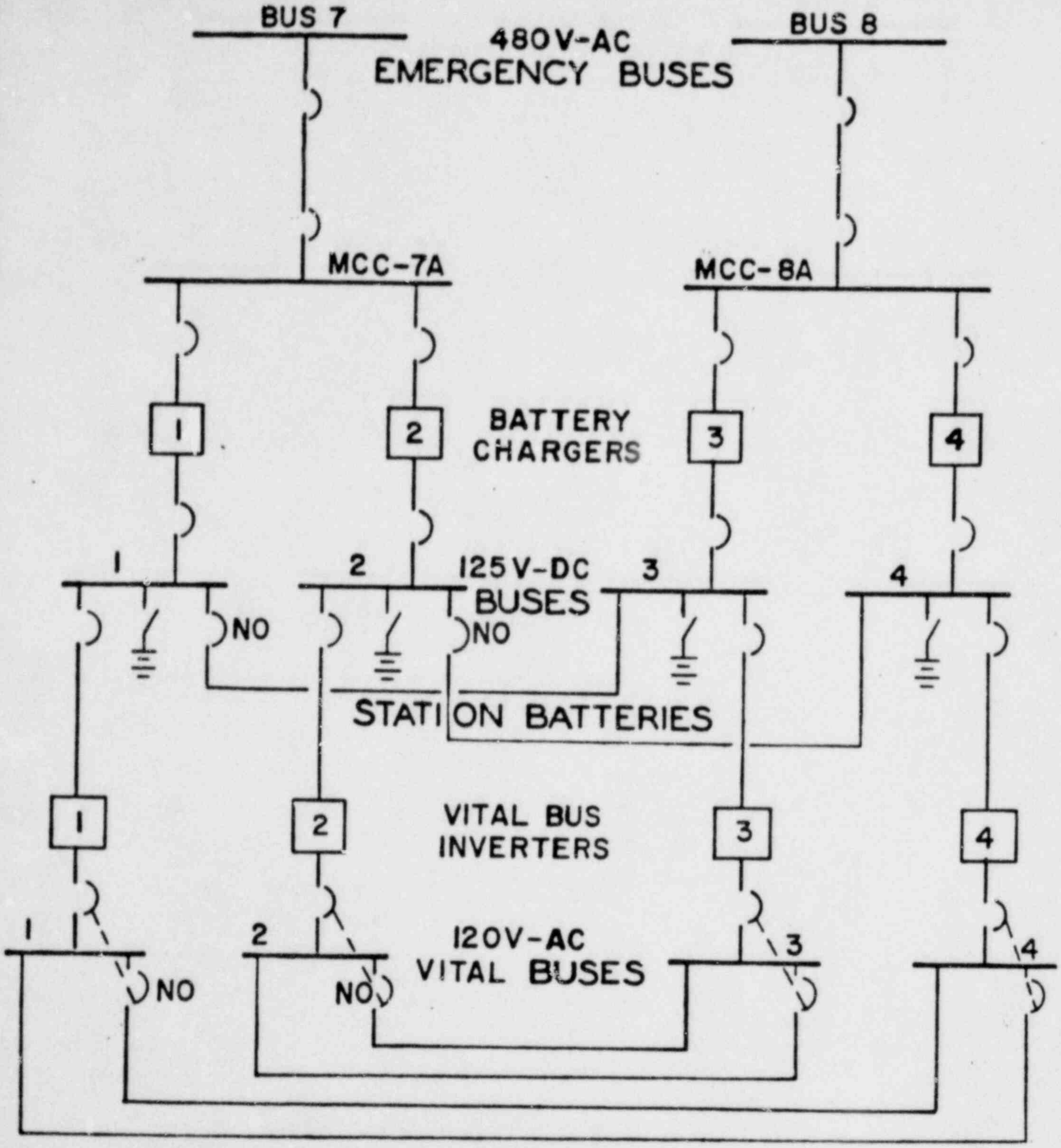

FIG. 1
ONE LINE DIAGRAM–125-DC BUSES
AND 120V-AC VITAL BUSES
MAINE YANKEE ATOMIC POWER COMPANY

REVISED DECEMBER 1970

Table 3.3

Loading Assumptions - Case 3

Conditions: Maximum Load
Reserve Station Service Transformer Carrying Auxiliary Loads

Node No.*	Description	Steady-State Loading
1	115 kV Switchyard	
61	6.9 kV Buses 1 and 2	39,600 kVA
31	4.16 kV Bus 3	5,500 kVA
3	4.16 kV Bus 5	
41	4.16 kV Bus 4	4,200 kVA
4	4.16 kV Bus 6	
5	Charging Pump P-14A	800 hp
6	Primary Component Cooling Water Pump P-9A	350 hp
7	Containment Spray Pump P-61A	350 hp
9	Low Pressure Safety Injection Pump P-12A	400 hp
10	Low Pressure Safety Injection Pump P-12B	400 hp
11	Secondary Comp. Cooling Wtr. Pump P-10B	350 hp
12	Containment Spray Pump P-61B	350 hp
14	Charging Pump P-14B	800 hp
15	480 Volt Bus 7	250 hp
16	480 Volt Bus 8	375 hp
17	Service Water Pump P-29A	250 hp
18	Service Water Pump P-29B	250 hp
19	480 Volt MCC 7A	340 kVA
20	480 Volt MCC 7B	13 kVA
21	480 Volt MCC 8B	13 kVA
22	480 Volt MCC 8A	213 kVA
24	480 Volt MCC 7B1	25 kVA
25	HCV-271	---
26	480 Volt MCC 8B1	50 kVA
27	Containment Air Compressor C-5B	7.5 hp
28	Control Air Compressor C-1A	75 hp
29	Spray Pump Room Exhaust Fan FN-44A	25 hp
30	Spray Pump Room Exhaust Fan FN-44B	25 hp

* See Figure 3.1

Table 4.3

Bus and Equipment Terminal Voltages - Case 3

Conditions: Maximum Load
Reserve Station Service Transformer Carrying Auxiliary Loads

Node No.*	Description	Voltage (volts)	Allowable Voltage Range (volts) (Table 2.1)
1	115 kV Switchyard	116,500	
61	6.9 kV Buses 1 and 2		---
31	4.16 kV Bus 3	3839	---
3	4.16 kV Bus 5	3839	---
41	4.16 kV Bus 4	3839	---
4	4.16 kV Bus 6	3839	---
5	Charging Pump P-14A	3833	4400-3600
6	Primary Comp. Cooling Wtr. Pump P-9A	3836	4400-3600
7	Containment Spray Pump P-61A	3831	4400-3600
9	Low Pressure Safety Injection Pump P-12A	3831	4400-3600
10	Low Pressure Safety Injection Pump P-12B	3830	4400-3600
11	Secondary Comp. Cooling Wtr. Pump P-10B	3835	4400-3600
12	Containment Spray Pump P-61B	3832	4400-3600
14	Charging Pump P-14B	3834	4400-3600
15	480 Volt Bus 7	432	---
16	480 Volt Bus 8	430	---
17	Service Water Pump P-29A	421	506-414
18	Service Water Pump P-29B	420	506-414
19	480 Volt MCC 7A	430	506-414
20	480 Volt MCC 7B	430	506-414
21	480 Volt MCC 8B	427	506-414
22	480 Volt MCC 8A	428	506-414
24	480 Volt MCC 7B1	428	506-414
25	HCV-271	---	---
26	480 Volt MCC 8B1	425	506-414
27	Containment Air Compressor C-5B	425	506-414
28	Control Air Compressor C-1A	416	506-414
29	Spray Pump Room Exhaust Fan FN-44A	425	506-414
30	Spray Pump Room Exhaust Fan FN-44B	422	506-414

* See Figure 3.1

ADDITIONAL ANALYSIS FOR MAINE YANKEE ATOMIC POWER COMPANY

1. Analysis for 22 kV Source Through the Unit Station Service Transformer

The source through the unit station service transformer is a delayed access source which is available through removal of the generator links. Because this source is delayed access and is available only when the generator is off-line, we assume that the following loads are shed prior to connection:

a) condensate pumps
b) heater drain pumps
c) circulating water pumps

The analysis is based on the 345 kV system maximum and minimum voltage limits of 362 kV and 345 kV respectively.

Four studies were performed for the analysis of the 22 kV source. The first two studies present the voltages for the maximum load and minimum load studies. The loading and voltages for the maximum load study are shown in Table 3-1-A. The loading and voltages for the minimum load study are shown in Table 3-1-B.

The maximum load study demonstrates the capability to operate all safeguard loads through the unit station service transformer without exceeding the minimum allowable voltage. The minimum load study demonstrates that with light load the maximum allowable voltage is not exceeded at any bus.

Two additional studies were performed - the start of a large non-safety 4 kV load and the start of the largest 480 volt class 1E load. These studies are discussed below.

2. Analysis for Start of Large Non-Safety Load

As required, we have performed studies of the start of a large non-safety load from both the reserve station service transformer and the unit station service transformer. We have studied the start of a 2500 hp, 4000 volt condensate pump. The 8000 hp, 6600 volt reactor coolant pump is the largest load at Maine Yankee but the start of the 4000 volt condensate pump would have a more direct effect on the 4160 volt safety buses.

The analysis assumes that the following loads have been shed prior to the start of the condensate pump.

a. condensate pumps
b. heater drains pump
c. circulating water pump

The loading assumptions are provided in Table 3-2-A.

The analysis results are provided in Table 3-2-B for the start of the condensate pump through both the reserve station service transformer and the unit station service transformer. The results indicate that during the start of the condensate pump no undervoltage relays will operate and no 480 volt contactors will drop out; furthermore, the voltage at the 4 kV buses and 480 volt buses may drop to slightly lower than the voltage required for continuous operation. This voltage dip is transitory (lasting only during the start of the condensate pump) and it will not affect the successful operation of the safety-related loads. The voltage at the condensate pump terminals may drop to approximately 3585 volts or 89.6% of rated. It can be shown that the condensate pump will accelerate under these conditions.

3. Analysis for Start of Largest 480 V Class 1E Load

As required, we have performed studies of the start of the largest 480 volt Class 1E load, the 250 hp station service water pump. The loading assumptions for this analyses are provided in Table 3-3-A.

The analysis results are provided in Table 3-3-B for the start of the station service water pump through both the reserve station service transformer and the unit station service transformer. The results indicate that the terminal voltage at the station service water pump could drop to 379 volts, 82.5% of rated voltage. It can be shown that the service water pump motor will accelerate its load at this voltage. The results indicate that no 480 volt contactors drop out during this starting transient and no undervoltage relays are actuated.

The voltages for equipment on the Class 1E 120 volt buses are not affected by the start of the service water pump. Please refer to our response to Question 2.

Table 3-1-A

Maximum Load Study

Conditions: Unit Station Service Transformer Carrying Auxiliary Load
Maximum Load

Node No.	Description	Steady-State Loading	Voltage (volts)
2	345 kV Switchyard		345 kV
61	6.9 kV Buses 1 and 2	39,600 kVA	---
31	4.16 kV Bus 3	1,475 kVA	4039
3	4.16 kV Bus 5	1,200 kVA	4039
41	4.16 kV Bus 4		4039
4	4.16 kV Bus 6		4039
5	Charging Pump P-14A	800 hp	4033
6	Primary Component Cooling Water Pump P-9A	350 hp	4036
7	Containment Spray Pump P-61A	350 hp	4030
9	Low Pressure Safety Injection Pump P-12A	400 hp	4031
10	Low Pressure Safety Injection Pump P-12B	400 hp	4030
11	Secondary Comp. Cooling Wtr. Pump P-10B	350 hp	4035
12	Containment Spray Pump P-61B	350 hp	4031
14	Charging Pump P-14B	800 hp	4034
15	480 Volt Bus 7	250 hp	455
16	480 Volt Bus 8	375 hp	454
17	Service Water Pump P-29A	250 hp	445
18	Service Water Pump P-29B	250 hp	445
19	480 Volt MCC 7A	340 kVA	454
20	480 Volt MCC 7B	13 kVA	453
21	480 Volt MCC 8B	13 kVA	451
22	480 Volt MCC 8A	213 kVA	452
24	480 Volt MCC 7B1	25 kVA	452
25	HCV-271		453
26	480 Volt MCC 8B1	50 kVA	449
27	Containment Air Compressor C-5B	7.5 hp	447
28	Control Air Compressor C-1A	75 hp	441
29	Spray Pump Room Exhaust Fan FN-44A	25 hp	449
30	Spray Pump Room Exhaust Fan FN-44B	25 hp	446

Table 3-1-B

Minimum Load Study

Conditions: Unit Station Service Transformer Carrying Auxiliary Load
Minimum Load

Node No.	Description	Steady-State Loading	Voltage (volts)
1	345 kV Switchyard		362 kV
61	6.9 kV Buses 1 and 2		---
31	4.16 kV Bus 3	335 kVA	4329
3	4.16 kV Bus 5	335 kVA	4329
41	4.16 kV Bus 4		4329
4	4.16 kV Bus 6		4329
5	Charging Pump P-14A		
6	Primary Component Cooling Water Pump P-9A	350 hp	4329
7	Containment Spray Pump P-61A		
9	Low Pressure Safety Injection Pump P-12A		
10	Low Pressure Safety Injection Pump P-12B		
11	Secondary Comp. Cooling Wtr. Pump P-10B	350 hp	4329
12	Containment Spray Pump P-61B		
14	Charging Pump P-14B		
15	480 Volt Bus 7	110 kVA	498
16	480 Volt Bus 8	110 kVA	498
17	Service Water Pump P-29A		
18	Service Water Pump P-29B		
19	480 Volt MCC 7A		
20	480 Volt MCC 7B		
21	480 Volt MCC 8B		
22	480 Volt MCC 8A		
24	480 Volt MCC 7B1		
25	HCV-271		
26	480 Volt MCC 8B1		
27	Containment Air Compressor C-5B		
28	Control Air Compressor C-1A		
29	Spray Pump Room Exhaust Fan FN-44A		
30	Spray Pump Room Exhaust Fan FN-44B		

Table 3-2-A

Loading Assumptions

Conditions: Start Condensate Pump

Node No.	Description	Steady-State Loading	Starting Load
2	345 kV Switchyard		
1	115 kV Switchyard		
61	6.9 kV Buses 1 and 2	39,600 kVA	
31	4.16 kV Bus 3	1,475 kVA	2500 hp
3	4.16 kV Bus 5		
41	4.16 kV Bus 4	1200 kVA	
4	4.16 kV Bus 6		
5	Charging Pump P-14A	800 hp	
6	Primary Component Cooling Water Pump P-9A	350 hp	
7	Containment Spray Pump P-61A	350 hp	
9	Low Pressure Safety Injection Pump P-12A	400 hp	
10	Low Pressure Safety Injection Pump P-12B	400 hp	
11	Secondary Comp. Cooling Wtr. Pump P-10B	350 hp	
12	Containment Spray Pump P-61B	350 hp	
14	Charging Pump P-14B	800 hp	
15	480 Volt Bus 7	250 hp	
16	480 Volt Bus 8	375 hp	
17	Service Water Pump P-29A	250 hp	
18	Service Water Pump P-29B	250 hp	
19	480 Volt MCC 7A	340 kVA	
20	480 Volt MCC 7B	13 kVA	
21	480 Volt MCC 8B	13 kVA	
22	480 Volt MCC 8A		
24	480 Volt MCC 7B1	213 kVA	
25	HCV-271	25 kVA	
26	480 Volt MCC 8B1	50 kVA	
27	Containment Air Compressor C-5B	7.5 hp	
28	Control Air Compressor C-1A	75 hp	
29	Spray Pump Room Exhaust Fan FN-44A	25 hp	
30	Spray Pump Room Exhaust Fan FN-44B	25 hp	

Table 3-2-B

Bus and Equipment Terminal Voltages

Conditions: Start Condensate Pump

Node No.	Description	Voltage: Reserve Station Service XFMR Source	Voltage: Unit Station Service XFMR Source
2	345 kV Switchyard		345 kV
1	115 kV Switchyard	115.9 kV	
61	6.9 kV Buses 1 and 2		
31	4.16 kV Bus 3	3598	3690
3	4.16 kV Bus 5	3598	3690
41	4.16 kV Bus 4	3598	3692
4	4.16 kV BUs 6	3598	3692
5	Charging Pump P-14A	3593	3685
6	Primary Comp. Cooling Wtr Pump P-9A	3595	3687
7	Containment Spray Pump P-61A	3590	3682
9	Low Pressure Safety Injection Pump P-12A	3590	3682
10	Low Pressure Safety Injection Pump P-12B	3590	3683
11	Secondary Comp. Cooling Wtr. Pump P-10B	3595	3688
12	Containment Spray Pump P-61B	3592	3685
14	Charging Pump P-14B	3594	3687
15	480 Volt Bus 7	405	416
16	480 Volt Bus 8	404	415
17	Service Water Pump P-29A	394	405
18	Service Water Pump P-29B	394	406
19	480 Volt MCC 7A	403	414
20	480 Volt MCC 7B	403	414
21	480 Volt MCC 8B	401	412
22	480 Volt MCC 8A	402	413
24	480 Volt MCC 7B1	402	413
25	HCV-271	400	414
26	480 Volt MCC 8B1	399	410
27	Containment Air Compressor C-5B	397	408
28	Control Air Compressors C-1A	390	402
29	Spray Pump Room Exhaust Fan FN-44A	399	410
30	Spray Pump Room Exhaust Fan FN-44B	396	407

Table 3-3-A

Loading Assumptions

Conditions: Start Service Water Pump

Node No.	Description	Steady-State Loading	Starting Load
2	345 kV Switchyard		
1	115 kV Switchyard		
61	6.9 kV Buses 1 and 2	39,600 kVA	
31	4.16 kV Bus 3	1,475 kVA	
3	4.16 KV Bus 5		
41	4.16 kV Bus 4	1,200 kVA	
4	4.16 kV Bus 6		
5	Charging Pump P-14A	800 hp	
6	Primary Comp. Cooling Wtr. Pump P-9A	350 hp	
7	Containment Spray Pump P-61A	350 hp	
9	Low Pressure Safety Injection Pump P-12A	400 hp	
10	Low Pressure Safety Injection Pump P-12B	400 hp	
11	Secondary Comp. Cooling Wtr. Pump P-10B	350 hp	
12	Containment Spray Pump P-61B	350 hp	
14	Charging Pump P-14B	800 hp	
15	480 Volt Bus 7	250 hp	
16	480 Volt Bus 8	375 hp	
17	Service Water Pump P-29A		250 hp
18	Service Water Pump P-29B	250 hp	
19	480 Volt MCC 7A	340 kVA	
20	480 Volt MCC 7B	13 kVA	
21	480 Volt MCC 8B	13 kVA	
22	480 Volt MCC 8A	213 kVA	
24	480 Volt MCC 7B1	25 kVA	
25	HCV-271		
26	480 Volt MCC 8B1	50 kVA	
27	Containment Air Compressor C-5B	7.5 hp	
28	Control Air Compressor C-1A	75 hp	
29	Spray Pump Room Exhaust Fan FN-44A	25 hp	
30	Spray Pump Room Exhaust Fan FN-44B	25 hp	

Table 3-3-B

Bus and Equipment Terminal Voltages

Conditions: Start Service Water Pump

Node No.	Description	Voltage: Reserve Station Service XFMR Source	Voltage: Unit Station Service XFMR Source
2	345 kV Switchyard		345 kV
1	115 kV Switchyard	116.9 kV	
61	6.9 kV Buses 1 and 2		
31	4.16 kV Bus 3	3910	3989
3	4.16 kV Bus 5	3910	3989
41	4.16 kV Bus 4	3910	3989
4	4.16 kV Bus 6	3910	3989
5	Charging Pump P-14A	3904	3984
6	Primary Comp. Cooling Wtr. Pump P-9A	3907	3986
7	Containment Spray Pump P-61A	3902	3981
9	Low Pressure Safety Injection Pump P-12A	3901	3981
10	Low Pressure Safety Injection Pump P-12B	3901	3981
11	Secondary Comp. Cooling Wtr. Pump P-10B	3906	3986
12	Containment Spray Pump P-61B	3902	3982
14	Charging Pump P-14B	3905	3984
15	480 Volt Bus 7	408	417
16	480 Volt Bus 8	439	449
17	Service Water Pump P-29A	379	387
18	Service Water Pump P-29B	429	439
19	480 Volt MCC 7A	407	415
20	480 Volt MCC 7B	406	415
21	480 Volt MCC 8B	435	445
22	480 Volt MCC 8A	437	447
24	480 Volt MCC 7B1	405	413
25	HCV-271	403	415
26	480 Volt MCC 8B1	433	443
27	Containment Air Compressor C-5B	432	442
28	Control Air Compressor C-1A	425	435
29	Spray Pump Room Exhaust Fan FN-44A	402	411
30	Spray Pump Room Exhaust Fan FN-44B	431	440