REPORT ON

VOLTAGE DROP STUDY

FOR

CAROLINA POWER & LIGHT COMPANY

BRUNSWICK STEAM ELECTRIC PLANT

UNIT NO. 2

BY

UNITED ENGINEERS & CONSTRUCTORS INC.

Date: December 2, 1974

Rev. 1: February 6, 1978

UE&C J.O. No. 9527.018

Prepared by: John H. Wilson
J. H. Wilson - RE

Reviewed by: I Benks
I. Benks - SDE

Approved by: C D. Greiman
C. D. Greiman - SDE

Approved by: H G Kreider
H. G. Kreider - PM

1144 224

7910120 225

INDEX

1.0 PURPOSE

1.1 This study is an analysis of the voltage regulation performance of the Brunswick Steam Electric Plant auxiliary distribution system. First, the optimum transformer tap settings were determined for the various auxiliary transformers. Second, using these tap settings, the voltage ranges at the various auxiliary load terminals were determined, for the expected generator and 230KV switchyard voltage variations, and for postulated variations in load conditions. Third, limitations on generator and 230KV switchyard voltage variations were determined. These limitations were established such that under expected normal operating conditions equipment design lifetimes would not be decreased. Under emergency operating conditions the limits were set to provide proper operation of all safety-related equipment.

2.0 SUMMARY OF RESULTS

2.1 SOURCE VOLTAGE RESTRICTIONS

2.1.1 Criteria

For those operating conditions which are expected to continue for long periods of time, the voltage criteria at the load buses were chosen to maximize motor life (90% to 110% of the motor rated voltage), and the source voltage restrictions for these cases were based on such criteria. (See Article 3.2.1). For the emergency operating conditions, the voltage criteria were chosen to ensure that all safety-related equipment would function, (85% to 110% of the motor control center voltage), with the possibility that motor life might be adversely affected if operation beyond either voltage limit continued for a long period of time. (See Article 3.2.1). For all motor starting cases, both accident-related and normal operation, the voltage criteria were chosen to ensure that the motors in question would start (70% or 75% for 4000-volt safety-related motors, 85% for all 460-volt motors and 4000-volt BOP motors), and that the 480-volt starters would not drop out (70%).

It is recommended, for the operating conditions shown, that the source voltages be held within the restrictions tabulated in 2.1.2 below.

1184 227

2.1.2

GENERATOR AND SWITCHYARD VOLTAGES

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 2

VOLTAGE DROP STUDY

OPERATING VOLTAGE LIMITS

CASE	BUS	BASE VOLTAGE	PER-UNIT VOLTAGE	ACTUAL VOLTAGE	
LIGHT LOAD, UAT					
	GEN	24000.	1.0365	24876.	Max.
SCREEN WASH PUMP 2A START, UAT FULL LOAD					
	GEN	24000.	0.9666	23198.	Min.
LIGHT LOAD, SAT					
	SWYD	230000.	1.0090	232068.	Max.
SAT LOADS, UNIT LOADS FED FROM UAT					
	SWYD	230000.	1.0138	233185.	Max.
SCREEN WASH PUMP 2A START, SAT FULL LOAD					
	SWYD	230000.	0.9727	223711.	Min.
LOCA START					
	SWYD	230000.	0.9115	209646.	Min.
2XLOCA RUN, REACTOR BUILDING CLOSED COOLING WATER PUMPS 2A & 2C START					
	SWYD	230000.	0.9550	219655.	Min.
LOCA START, LOAD SHEDDING					
	SWYD	230000.	0.8854	203638.	Min.
2XLOCA RUN, LOAD SHEDDING, RBCCWP 2A AND 2C START					
	SWYD	230000.	0.9348	214999.	Min.

1114 228

2.2 TAP SETTINGS

Recommended transformer high-voltage winding tap settings are as follows:

UAT	1.00	(base)
SAT	.975	(-2.5%)
Unit Substations		
2E	.95	(-5%)
2F	.95	(-5%)
E7	.95	(-5%)
E8	.95	(-5%)
2SY	.975	(-2.5%)
Common D	.975	(-2.5%)
2L	1.00	(base)
4L	.975	(-2.5%)

The above tap settings will provide adequate voltage at the equipment terminals under the operating conditions evaluated and were used in calculating the source voltage limits govern in Table 2.1.2.

2.3 LOAD SHEDDING

LOCA condition studies were performed using two sets of parameters. In one case all BOP loads which were running before the start of an accident continued to run after the LOCA signal. Calculations for this case are noted as LOCA, 2X LOCA, etc. The second case involves automatic shedding of all BOP loads on the 4 KV buses in the event of a LOCA in order to improve the voltage performance of the emergency system with off-site power available. Calculations for this case were made under the load shedding titles. Load shedding offers an improvement of approximately 2% in the minimum permissible 230 KV switchyard voltage which must be maintained during the accident.

1144 230

3.0 DISCUSSION

3.1 BASES FOR COMPARISON

3.1.1 Tap Settings

The criterion used to choose transformer tap settings was to determine, for each set of tap settings, the maximum 230 KV switchyard voltage required to meet the load voltage requirements. To accomplish this, for each tap setting combination, voltage drop calculations were performed for the SAT Light Load case to determine the maximum switchyard voltage. Note that, because this case's loads do not depend on the presence or absence of Load Shedding, the transformer tap decision is also independent of Load Shedding. The tap settings chosen are those which most closely spproach the desired switchyard operating voltage range of 94.5 to 101%.[1] The tap settings chosen must also provide proper load voltages over the entire range of generator voltages from light l... to full load. (See Article 3.2.1). The recommended tap settings do this. (See Article 2.2).

3.2 CRITERIA

3.2.1 Allowable Load Voltage Ranges

3.2.1.1 Motor voltage criteria vary with the class of the motor, as well as the voltage rating. For 4000-volt motors, non-Class-IE, the requirements are:(2)(3)

Running continuous	4000-V base	90%-110%	3600-4400V
Starting	4000-V base	85%-110%	3400-4400V
Running transient	4000-V base	85%-110%	3400-4400V

For 4000-volt motors, Class IE, specified and supplied by G.E., the requirements are:(4) (5)

Running continuous	4000-V base	90%-110%	3600-4400V
Starting	4000-V base	70%-110%	2800-4400V
Running transient	4000-V base	70%-110%	2800-4400V

For 4000-volt motors, Class IE, specified by UE&C, the requirements are:(6)

Running continuous	4000-V base	90%-110%	3600-4400V
Starting	4000-V base	75%-110%	3000-4400V
Running transient	4000-V base	75%-110%	3000-4400V

For 460-volt motors, the requirements for normal motor life are:(7)

Running continuous	460-V base	90%-110%	414-506V
Starting	460-V base	85%-110%	391-506V
Running transient	460-V base	*70.7%-110%	325-506V

*Based on 200% torque at rated voltage for NEMA design motors.

Motor control centers were specified for 480 volts,(8) and the minimum hold-in voltage requirement for the starters is 70% of 480 volts, or 336 volts. The minimum pickup voltage requirement for starters is 85% of 480 volts, or 408 volts.

1114 232

3.2 CRITERIA (Cont'd)

3.2.1 Allowable Load Voltage Ranges (Cont'd)

3.2.1.2 For the normal operation cases, that is, for the UAT Full Load, SAT Full Load, UAT Light Load, and SAT Light Load cases, the load voltage restrictions are based on the rated continuous running voltages of motors to achieve normal lifetimes (90% to 110% of rated voltage, 4000V or 460V). (See Articles 3.2.3 for definitions of these cases).

3.2.1.3 Operation at voltages higher than those given would probably result in abnormal heating of motors due to saturation. This heating would shorten the Mean Time Between Failures for the motors so exposed. The MTBF could be expected to decrease with increased time at high voltages, and to decrease rapidly with increased voltage levels above the voltage where saturation begins. At the other extreme, because the speed of an induction motor varies greatly with changes in frequency and only slightly on voltage, the load speed remains essentially constant with decreasing voltage. Therefore, the load power and electrical volt-ampere requirements remain essentially constant for decreasing motor voltage, and the current increases. Below the limiting values shown in Article 3.2.1.1, the I^2R losses due to this increased current could be expected to produce abnormal heating and again result in reduced MTBF's. Both of these effects are long-term results of high- or low-voltage operation, hence these limiting values apply only to

1114 233

3.2. CRITERIA (Cont'd)

3.2.1 Allowable Load Voltage Ranges (Cont'd)

3.2.1.3 operating conditions expected to occur for a substantial portion of the forty-year plant lifetime. Since high voltages would occur with most motors stopped, while low voltages would occur with most motors running and therefore more motors would be exposed to the potentially damaging condition. Thus the decrease in reliability due to extended low-voltage operation would be much more severe than that due to extended high-voltage operation.

3.2.1.4 For 4000 volt motor starting cases, the criteria are simpler. At the 4160-volt level, the limitation is maintaining the minimum motor voltages cited in Article 3.2.1.1. Since motors can, without stalling, ride through a transient voltage dip at a voltage sufficient to start them, the limiting condition for the 4160-volt level is to maintain sufficient voltage to start the motors. At the 480-volt level, the limitation is that the starters of motors already running must not drop out when a 4000-volt motor starts. Starters are not guaranteed to hold in at voltages below 70% of their rated coil voltage, or in the case of BSEP, 70% x 480V or 336V. For 460 volt motor starting cases, the criterion is simply that the 460 volt motor must have no less than rated starting voltage (85% of 460V).

1144 234

3.2 CRITERIA (Cont'd)

3.2.1 Allowable Load Voltage Ranges (Cont'd)

3.2.1.5 For the running LOCA and 2X LOCA cases, including the load shedding and sequential loading cases, the postulated combination of depressed 230KV system voltage and heavy auxiliary load would not be expected to continue indefinitely. Because these are temporary conditions, and because such an accident could affect the operating life of the plant, reduction in motor MTBF becomes a secondary consideration. The important voltage limitation in these accident conditions is imposed by the requirement of 85% x 480V or 408V at the motor control centers to ensure that a starter will pick up.

3.2.1.6 Using the above values, voltage criteria were developed for buses and unit substations. At the 4160-volt level, the voltage drops due to cable impedances are negligible. Hence, the bus voltages are considered to be the same as the motor voltages. At the 480-volt level, the voltage drops between the unit substations and motor control centers, and between the motor control centers and the motor terminals are significant. VOLTS runs were made to determine the exact 480 Volt unit substation voltage required to maintain the required voltages at all motor control centers. It was found that if the voltage at Unit Substation E7 is above .8718, and that at Unit Substation E8 is above .8803, then all MC voltages will be at least 85%. VOLTS runs were also made

1114 235

3.2 CRITERIA (Cont'd)

3.2.1 Allowable Load Voltage Ranges (Cont'd)

3.2.1.6 to determine the minimum unit substation voltages to ensure that all MCC's will see not less than 70% voltage when 4000 volt motors start. It was found that if the Unit Substation E8 voltage is .7368 x 480V or more, all MCC's will see not less than 70% voltage. Note that specifying a single unit substation's voltage essentially specifies all unit substations' voltages, because unit substation voltages are determined by the 4KV system voltage.

3.2.1.7 Summary of Voltage Requirements

4160-Volt Buses	Minimum	Maximum
Running Voltage	3600	4400
Starting Voltage (non-Class IE)	3400	4400
Starting Voltage (Class IE Spec. by G.E.)	2800	4400
Starting Voltage (Class IE Spec. by UE&C)	3000	4400
460-Volt Motors		
Starting voltage at motor terminals	391	506

1114 236

3.2.1.7 SUMMARY OF VOLTAGE REQUIREMENTS

480 VOLT UNIT SUBSTATION VOLTAGES

CP&L BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 2

VOLTAGE DROP STUDY

OPERATING VOLTAGE LIMITS

CASE	BUS	BASE VOLTAGE	PER-UNIT VOLTAGE	ACTUAL VOLTAGE
LOCA RUNNING LOADS, UNIT SUBSTATION E7 MOTOR CONTROL CENTERS				
	2CA	480.	0.8500	408.
	E7	480.	0.8718	418.
LOCA RUNNING LOADS, UNIT SUBSTATION E8 MOTOR CONTROL CENTERS				
	2CB	480.	0.8500	408.
	E8	480.	0.8803	423.
LOCA STARTING, UNIT SUBSTATION E7 MOTOR CONTROL CENTERS				
	2CA	480.	0.7000	336.
	E7	480.	0.7265	349.
LOCA STARTING, UNIT SUBSTATION E8 MOTOR CONTROL CENTERS				
	2CB	480.	0.7000	336.
	E8	480.	0.7368	354.
FULL LOAD, UNIT SUBSTATION E7 MOTOR CONTROL CENTERS				
	2CA	460.	0.9000	414.
	E7	480.	0.8797	422.
FULL LOAD, UNIT SUBSTATION E8 MOTOR CONTROL CENTERS				
	2CB	460.	0.9000	414.
	E8	480.	0.8864	425.
FULL LOAD, UNIT SUBSTATION 2E MOTOR CONTROL CENTERS				
	2TK	460.	0.9000	414.
	2E	480.	0.8715	418.
FULL LOAD, UNIT SUBSTATION 2F MOTOR CONTROL CENTERS				
	2TG	460.	0.9000	414.
	2F	480.	0.8730	419.
FULL LOAD, UNIT SUBSTATION COMMON D MOTOR CONTROL CENTERS				
	RWD	460.	0.9000	414.
	COM D	480.	0.8753	420.

Note: First line represents the MCC having the lowest bus voltage for the operating condition. The second line represents the unit substation to which the MCC is connected and the corresponding voltage on its bus.

3.2 CRITERIA (Cont'd)

3.2.2 Loads

4000 Volt motor loads were based on the load brake horsepower, using the motors' actual efficiencies and power factors to determine the electrical loads. The starting admittance values for both 4000 Volt and large 460 Volt motors were derived from the motors' actual inrush currents and power factors. Running loads on the 480 Volt system were taken from the 480 Volt Load Study[9]

3.2.3 Postulated Events and Plant Operating Conditions

3.2.3.1 "Normal Operation", as used in this study, includes the entire range of steady-state non-accident conditions from cold shutdown to full power operation. Any of the conditions included in this concept could be expected to continue for weeks or months at a time, and therefore the load voltage range for these conditions is that described in Article 3.2.1.2. The load conditions for normal operation are:

UAT	Full Load
SAT	Full Load
UAT	Light Load
SAT	Light Load

3.2.3.2 "Motor Starting" cases refer to those motors which would be started at various times during normal plant operation. On each 4160 volt bus and each 480 volt unit substation, the largest motor was selected for study. It was assumed that the motor was starting while all other loads required for full power operation were running. If the largest motors

1144 238

3.2 CRITERIA (Cont'd)

3.2.3 Postulated Events and Plant Operating Conditions (Cont'd)

3.2.3.2 on each bus can be started under this condition, it is reasonable to assume that all motors can be started under all "Normal Operation" conditions. These motor starting runs were made for both the UAT and SAT. The following motors were studied:

Motor	HP	Fed From	Via
Reactor Recirculation Pump MG Set	7000	4160V Bus 2B	-
Circulating Water Intake Pump 2B	2250	4160V Bus 2D	-
Screen Wash Pump 2A	200	480V Unit Sub E7	MCC 2PA
Screen Wash Pump 2B	200	480V Unit Sub E8	MCC 2PB
Turbine Building Closed Cooling Water Pump 2A	200	480V Unit Sub 2E	MCC 2TJ
Turbine Building Closed Cooling Water Pump 2B	200	480V Unit Sub 2F	MCC 2TH
Backwash Air Blower 2-CFD-D063	150	480V Unit Sub Common D	MCC RWP
Reactor Building Closed Cooling Water Pumps 2A and 2C	75 + 75	480V Unit Sub E8	MCC 2XE

3.2 CRITERIA (Cont'd)

3.2.3 Postulated Events and Plant Operating Conditions (Cont'd)

3.2.3.3 "LOCA" cases are those initiated by a Loss of Coolant Accident on Unit 2. Both starting cases and running cases, with and without load shedding, were studied. For detailed descriptions of the load conditions, see Article 3.2.4. The voltage criteria for these cases are described in Article 3.2.1.4 (starting) and 3.2.1.5 (running).

3.4.3.4 "2X LOCA" cases are those initiated by a Loss of Coolant Accident on Unit 2 and a false LOCA signal from Unit 1, resulting in the starting and running of both units' ESS loads. Again, both starting and running cases, with and without load shedding or sequential loading, were studied. The voltage criteria for these cases are described in Article 3.2.1.4 (starting) and 3.2.1.5 (running).

3.2.3.5 "LOCA Motor Starting" and "2X LOCA Motor Starting" are the cases which address the problem of starting 460 volt motors after an accident, while the emergency motors are still running. The largest 460 volt motors fed from the emergency power system are the screen wash pumps, and starting and running of the screen wash pumps is blocked under LOCA conditions. The next largest motors on the 480 volt emergency system, which could start under LOCA conditions, are the 75 horsepower Reactor Building Closed Cooling Water Pumps. The worst case is a postulated simultaneous start of Reactor

3.2 CRITERIA (Cont'd)

3.2.3 Postulated Events and Plant Operating Conditions (Cont'd)

3.2.3.5 Building Closed Cooling Water Pumps 2A and 2C on loss of closed cooling water header pressure.

3.2.4 Load Conditions

The various load conditions studied are defined below:

3.2.4.1 UAT Full Load: This is the normal plant operating condition, with the generating unit at full power and with auxiliary loads fed as follows:

Source	UAT	SAT
4160V Bus 2B	X	
4160V Bus 2C	X	
4160V Bus 2D	X	
4160V Bus Common B		X
480V Bus 2E	X	
480V Bus 2F	X	
480V Bus E7	X	
480V Bus E8	X	
480V Bus 2SY		X
480V Bus Common D		X
480V Bus 2L		X
480V Bus 4L		X

3.2.4.2 SAT Full Load: This is the normal plant operating condition with the generating unit at full power and auxiliary loads fed from the SAT. The plant is in operation with the UAT out of service.

3.2.4.3 UAT Light Load: This represents the estimated minimum auxiliary load that would exist with the generator connected to the system. Load buses are fed from the same sources as cited under "UAT Full Load".

3.2.4.4 SAT Light Load: This represents the minimum auxiliary load, with the plant shut down and all auxiliary loads fed from the SAT.

3.2 CRITERIA (Cont'd)

3.2.4 Load Conditions (Cont'd)

3.2.4.5 LOCA Start: This represents the inrush condition at the start of an accident, with 2 RHR pumps and 2 Core Spray pumps simultaneously starting, with all other loads running as in the SAT Full Load condition except that the Turbine Building Air Conditioning Compressors are tripped.

3.2.4.6 LOCA Run: This represents the steady-state condition during an accident, with 2 RHR pumps and 2 Core Spray pumps running in addition to the running loads cited in the LOCA Start case above.

3.2.4.7 2X LOCA Start: This represents the simultaneous starting of all RHR pumps and Core Spray pumps, with all the other loads running as in the SAT Full Load condition except that the Turbine Building Air Conditioning Compressors are tripped.

3.2.4.8 2X LOCA Run: This represents the steady-state condition following 2X LOCA Start, with all RHR pumps, all Core Spray pumps, and all other loads (except Turbine Building Air Conditioning Compressors) running. It should be noted that this condition (or the "2X LOCA Load Shedding Run" condition) applies during a LOCA on Unit 2 and simultaneous shutdown cooling of Unit 1.

3.2.4.9 LOCA Load Shedding Start: This represents the inrush condition at the start of an accident, if all 4KV BOP loads are tripped by the accident signal. Starting loads are 2 RHR pumps and 2 Core Spray pumps.

3.2.4.10 LOCA Load Shedding Run: This represents the steady-state condition during an accident, with 2 RHR pumps and 2 Core Spray pumps running, with all 4KV BOP loads tripped.

3.2.4.11 2X LOCA Load Shedding Start: This represents the inrush condition when all RHR and Core Spray pumps start simultaneously, with all 4KV BOP loads tripped by the accident signal.

3.2 CRITERIA (Cont'd)

3.2.4 Load Conditions (Cont'd)

3.2.4.12 2X LOCA Load Shedding Run: This represents the steady-state condition with all RHR and Core Spray pumps running, with all 4KV BOP loads tripped.

3.3 METHOD OF ANALYSIS

3.3.1 Program

The UE&C computer program "VOLTS" was used to calculate bus voltages. This program performs a Gauss-Seidel load flow calculation, with provision for constar .IVA loads to model running motors, and constant admittance loads to model starting motors. Up to 25 buses can be modeled. Transformers with tap changers can be represented. Bus voltages are computed by the program to a tolerance of ±.0001±j.0001 per unit.

3.3.2 Per Unit Values

Calculations were performed using a per-unit scheme with base values as follows

System	Base Volts	Base MVA
230-KV	230 KV	100
24-KV	23.5 KV*	100
4160-V	4160-V	100
480-V	480-V	100

*23.5 KV is the base value for computer calculations only. Where generator voltages are expressed in %, the base value is the rated generator voltage, i.e., 24 KV.

1144 243

3.3 METHOD OF ANALYSIS (Cont'd)

3.3.3. Impedances

The transformer impedances in the study are the actual impedances taken from the test reports.[10] Cable impedances were calculated from the manufacturer's data. In order to stay within the computer program's 25-bus limitation, cable impedances were combined with transformer impedances as required.

4.0 ANALYSIS OF ALTERNATES

4.1 NO LOGIC CHANGE

Two alternatives for LOCA loading conditions were considered. One involves load shedding of non essential 4000 volt loads and the other does not (except turbine building air conditioning). Of the two alternatives, the second is clearly the least expensive, since it does not require any logic change to the existing system. However, the 230 KV switchyard voltage required for the 2X LOCA case is 95.5%, which is significantly higher than the 94.5% value desired. Therefore, an alternative which would permit operation over a wider range of 230 KV switchyard voltage was sought.

4.2 LOAD SHEDDING

The other alternative studied was the automatic shedding of all BOP 4000V loads in response to a LOCA signal. The resulting minimum 230 KV switchyard voltage would be 93.48%, comfortably below the 94.5% value.

5.0 REFERENCES

5.1 Letter UC-09227

5.2 United Engineers and Constructors, Miscellaneous Induction Motors 100 HP and Larger, Specification Number 9527-01-128-2, Revision 3, dated June 8, 1971.

5.3 United Engineers and Constructors, Synchronous Motors 100 HP and Larger, Specification Number 9527-01-128-3, Revision 3, dated June 9, 1971.

5.4 General Electric Company Letter GU 894 to United Engineers and Constructors, dated April 21, 1971.

5.5 General Electric Company, Electric Motor List, GE Specification Number 22A827, Revision 1, dated November 23, 1970.

5.6 United Engineers and Constructors, Class I Induction Motors 100 HP and Larger, Specification Number 9527-01-128-4, Revision 3, dated July 12, 1971.

5.7 United Engineers and Constructors, Non-Special Alternating Current Induction Motors less than 100 HP in size, Specification Number 9527-01-128-1, Revision 3, dated October 26, 1970.

5.8 United Engineers and Constructors, 480 Volt Motor Control Centers, Specification Number 9527-01-143-1, Revision 3, dated October 29, 1971.

5.9 United Engineers and Constructors, 480 Volt Load Study for Carolina Power and Light Company, Brunswick Steam Electric Plant, Unit 2, Revision 1, dated September 23, 1977.

1144 246

5.10 Transformer Test Report

Transformer	Foreign Print Number
Main	F.P. 9527-30131
Unit Auxiliary	F.P. 9527-3873
Start up Auxiliary	F.P. 9527-3821
Unit Substations:	
2E	F.P. 9527-30073
2F	F.P. 9527-30072
E7	F.P. 9527-30069
E8	F.P. 9527-30071
2L	F.P. 9527-30075
4L	F.P. 9527-30075
2SY	F.P. 9527-30076
Common D	F.P. 9527-30073

1114 247

5.11 Key Single Line Diagrams

9527-F-3043	230KV, 24KV, 4160V Key Single Line Diagram
9527-F-3044	480V

5.12 Single Line Diagrams

9527-F-3002	4160V System SWGR 2B, 2C, 2D and Common "B"
9527-F-3003	4160V Emergency System Buses E3 and E4
9527-F-3004	4160V Emergency System Buses E1 and E2
9527-F-3005	480V System Unit Substations 2E, 2F, E7, E8 and Common "D"
9527-F-3045	480V Motor Control Centers 2TA, 2TB, 2TC, 2TF, 2TJ
9527-F-3047	480V Motor Control Centers 2TD, 2TE, 2TG, 2TH
9527-F-3048	480V Motor Control Centers 2TK, 2TL, 2TM, 2TN
9527-F-3049	480V Motor Control Centers 2XA, 2XC, 2XE, 2XG, 2XJ, 2XL
9527-F-3050	480 V Motor Control Centers 2XB, 2XD, 2XF, 2XH, 2XK, 2XM
9527-F-3051	480V Motor Control Centers RWA, RWB, RWC, RWD
9527-F-3052	480V Motor Control Centers BHA, SBA, WTA and WHA
9527-F-3053	480V Motor Control Centers 2CA, 2CB, 2PA, 2PB, 2SA
9527-F-3055	480V Motor Control Centers SYA, SYB, SYC and SYD
9527-F-3057	480V Motor Control Centers DGA, DGB, DGC and DGD

1114 248

6.0 APPENDICIES

APPENDIX A

VOLTAGE DROP STUDY

FOR

CAROLINA POWER & LIGHT COMPANY

BRUNSWICK STEAM ELECTRIC PLANT

UNIT NO. 2

BY

UNITED ENGINEERS & CONSTRUCTORS INC.

VOLTAGES

AND

IMPEDANCE DIAGRAMS

NO LOAD SHEDDING

1114 250

VOLTAGE DROP STUDY

APPENDIX A

GENERAL NOTES

1. The choice of source voltages to be studied was made as follows: An initial VOLTS run was made at the appropriate limiting value determined by the source in question. For the full load, motor starting, and LOCA cases, the initial runs were made at 95% of 24KV for the UAT cases, and 95% of 230KV for the SAT cases. For the light load and shutdown cases, the initial runs were made at 110% of 24KV for the UAT cases and 105% of 230KV for the SAT cases. If the voltages which resulted from a given initial run were satisfactory for all loads, then no further runs were made for that particular operating case. If the voltages were not satisfactory, then a second run was made at a voltage chosen so that the two voltages would bracket the limiting voltage. After load voltages were available for two source voltages, a linear interpolation calculation was done to determine the limiting voltage. The VOLTS run was then performed using the limiting source voltage, and these are the runs which are presented in those cases where the limiting voltage would be determined by the loads. In the accident cases a minimum voltage limited by the loads was determined in every case, even when this voltage was below the expected minimum 230KV switchyard voltage.

1144 251

VOLTAGE DROP STUDY

APPENDIX A

UAT LIGHT LOAD
(Fig. No. A1)

BUS NAMES	MAXIMUM
GENERATOR (24 KV BASE)	1.0364
4160 VOLT BUS 2B	1.1
4160 VOLT BUS 2C, 2D, E3 & E4	1.059
480 VOLT UNIT SUBSTATION E7	1.0648
480 VOLT UNIT SUBSTATION 2E	1.0721
480 VOLT UNIT SUBSTATION 2F	1.0685
480 VOLT UNIT SUBSTATION E8	1.0631

NOTE: ALL VOLTAGES, EXCEPT GENERATOR, ARE ON 4000 VOLT OR 460 VOLT BASE AS APPROPRIATE.

VOLTAGE DROP STUDY

APPENDIX A

BUS NAMES	UAT FULL LOAD (Fig. No. A2) MINIMUM
GENERATOR (24 KV BASE)	.95
4160 VOLT BUS 2B	.9448
4160 VOLT BUS 2C, 2D, E3 & E4	.9191
480 VOLT UNIT SUBSTATION E7	.9095
480 VOLT UNIT SUBSTATION 2E	.9175
480 VOLT UNIT SUBSTATION 2F	.9135
480 VOLT UNIT SUBSTATION E8	.9076

NOTE: ALL VOLTAGES ARE EXPRESSED IN PER UNIT ON THE BASE VOLTAGE SHOWN IN THE LEFT-HAND COLUMN

1114 253

VOLTAGE DROP STUDY

APPENDIX A

UAT

REACTOR RECIRC. PUMP MG SET 2B MOTOR STARTING
(Fig. No. A3)

BUS NAMES	MINIMUM
GENERATOR (24 KV BASE)	.95
4160 VOLT BUS 2B	.8093
4160 VOLT BUS 2C, 2D, E3 & E4	.9374
480 VOLT UNIT SUBSTATION E7	.93
480 VOLT UNIT SUBSTATION 2E	.9378
480 VOLT UNIT SUBSTATION 2F	.934
480 VOLT UNIT SUBSTATION E8	.9282
4000V REACTOR RECIRC. MG SET 2B MOTOR	.8307

NOTE: ALL VOLTAGES ARE ON THE BASE SHOWN IN THE LEFT-HAND COLUMN.

1114 254

VOLTAGE DROP STUDY

APPENDIX A

UAT

CIRCULATING WATER PUMP STARTING
(Fig. No. A4)

BUS NAMES	MINIMUM
GENERATOR (24 KV BASE)	.95
4160 VOLT BUS 2B	.9505
4160 VOLT BUS 2C, 2D, E3 & E4	.8723
480 VOLT UNIT SUBSTATION E7	.8563
480 VOLT UNIT SUBSTATION 2E	.865
480 VOLT UNIT SUBSTATION 2F	.8607
480 VOLT UNIT SUBSTATION E8	.8543
4000V CIRCULATING WATER PUMP 2B MOTOR	.8803

NOTE: ALL VOLTAGES ARE ON THE BASE SHOWN IN THE LEFT-HAND COLUMN.

1144 255

VOLTAGE DROP STUDY

APPENDIX A

UAT

SCREEN WASH PUMP 2A STARTING
(Fig. No. A5)

BUS NAMES	MINIMUM
GENERATOR (24 KV BASE)	.9665
4160 VOLT BUS 2B	.9628
4160 VOLT BUS 2C, 2D, E3 & E4	.9321
480 VOLT UNIT SUBSTATION E7	.8807
480 VOLT UNIT SUBSTATION 2E	.932
480 VOLT UNIT SUBSTATION 2F	.9281
480 VOLT UNIT SUBSTATION E8	.9222
480 VOLT MOTOR CONTROL CENTER 2PA	.8298
460 V SCREEN WASH PUMP 2A MOTOR TERMINALS	.8501

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

VOLTAGE DROP STUDY

APPENDIX A

UAT

TURBINE BUILDING CLOSED COOLING WATER PUMP 2A STARTING
(Fig. No. A6)

BUS NAMES	MINIMUM
GENERATOR (24 KV BASE)	.95
4160 VOLT BUS 2B	.9455
4160 VOLT BUS 2C, 2D, E3 & E4	.9135
480 VOLT UNIT SUBSTATION E7	.9031
480 VOLT UNIT SUBSTATION 2E	.8655
480 VOLT UNIT SUBSTATION 2F	.9072
480 VOLT UNIT SUBSTATION E8	.9012
480 VOLT MOTOR CONTROL CENTER 2TJ	.8338
460V TURBINE BUILDING CLOSED COOLING WATER PUMP 2A	.8573

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 257

VOLTAGE DROP STUDY

APPENDIX A

UAT

TURBINE BUILDING CLOSED COOLING WATER PUMP 2B STARTING
(Fig. No. A7)

BUS NAMES	MINIMUM
GENERATOR (24 KV BASE)	.956
4160 VOLT BUS 2B	.9519
4160 VOLT BUS 2C, 2D, E3 & E4	.9201
480 VOLT UNIT SUBSTATION E7	.9106
480 VOLT UNIT SUBSTATION 2E	.9187
480 VOLT UNIT SUBSTATION 2F	.8684
480 VOLT UNIT SUBSTATION E8	.9087
480 VOLT MOTOR CONTROL CENTER 2TH	.8381
460 V TURBINE BUILDING CLOSED COOLING WATER PUMP 2B	.8501

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 258

VOLTAGE DROP STUDY

APPENDIX A

UAT

SCREEN WASH PUMP 2B STARTING
(Fig. No. A8)

BUS NAMES	MINIMUM
GENERATOR (24 KV BASE)	.9576
4160 VOLT BUS 2B	.9535
4160 VOLT BUS 2C, 2D, E3 & E4	.9223
480 VOLT UNIT SUBSTATION E7	.913
480 VOLT UNIT SUBSTATION 2E	.921
480 VOLT UNIT SUBSTATION 2F	.9171
480 VOLT UNIT SUBSTATION E8	.8681
480 VOLT MOTOR CONTROL CENTER 2PB	.832
460V SCREEN WASH PUMP 2B MOTOR TERMINALS	.8502

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1114 259

VOLTAGE DROP STUDY

APPENDIX A

SAT

SHUTDOWN
(Fig. No. A9)

BUS NAMES	MAXIMUM
230 KV SWITCHYARD	1.009
4160 VOLT BUS 2B	1.0751
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	1.0599
480 VOLT UNIT SUBSTATION E7	1.0813
480 VOLT UNIT SUBSTATION 2E	1.0927
480 VOLT UNIT SUBSTATION 2F	1.1001
480 VOLT UNIT SUBSTATION E8	1.0765
480 VOLT UNIT SUBSTATION 2SY	1.0809
480 VOLT UNIT SUBSTATION COMMON D	1.0813
480 VOLT UNIT SUBSTATION 2L	1.0549
480 VOLT UNIT SUBSTATION 4L	1.0725

NOTE: ALL VOLTAGES, EXCEPT SWITCHYARD, ARE ON 4000 VOLT OR 460 VOLT BASE AS APPROPRIATE.

1144 260

VOLTAGE DROP STUDY

APPENDIX A

SAT SYSTEM VOLTAGES (UNIT LOADS FED FROM UAT)
(Fig. No. A10)

BUS NAMES	MAXIMUM
230 KV SWITCHYARD	1.0138
4160 VOLT BUS COMMON B	1.0787
480 VOLT UNIT SUBSTATION 2SY	1.0999
480 VOLT UNIT SUBSTATION COMMON D	1.0931
480 VOLT SUBSTATION 2L	1.0738
480 VOLT UNIT SUBSTATION 4L	1.0922

NOTE: ALL VOLTAGES, EXCEPT SWITCHYARD, ARE ON 4000 VOLT OR 460 VOLT BASE AS APPROPRIATE.

1144 261

VOLTAGE DROP STUDY

APPENDIX A

SAT FULL LOAD
(Fig. No. A11)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.95
4160 VOLT BUS 2B	.9384
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.9119
480 VOLT UNIT SUBSTATION E7	.9013
480 VOLT UNIT SUBSTATION 2E	.9095
480 VOLT UNIT SUBSTATION 2F	.9055
480 VOLT UNIT SUBSTATION E8	.8994
480 VOLT UNIT SUBSTATION 2SY	.9243
480 VOLT UNIT SUBSTATION COMMON D	.9167
480 VOLT UNIT SUBSTATION 2L	.9027
480 VOLT UNIT SUBSTATION 4L	.9157

NOTE: ALL VOLTAGES ARE EXPRESSED IN PER UNIT ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 262

VOLTAGE DROP STUDY

APPENDIX A

SAT

REACTOR RECIRC. PUMP MG SET 2B MOTOR STARTING
(Fig. No. A12)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.95
4160 VOLT BUS 2B	.8019
4160 VOLT BUS 2C, 2D, COMMON B, E3 & E4	.9004
480 VOLT UNIT SUBSTATION E7	.8882
480 VOLT UNIT SUBSTATION 2E	.8965
480 VOLT UNIT SUBSTATION 2F	.8924
480 VOLT UNIT SUBSTATION E8	.8863
480 VOLT UNIT SUBSTATION 2SY	.9123
480 VOLT UNIT SUBSTATION COMMON D	.9046
480 VOLT UNIT SUBSTATION 2L	.891
480 VOLT UNIT SUBSTATION 4L	.9036
4000V REACTOR RECIRC. PUMP MG SET MOTOR TERMINALS	.8231

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 263

VOLTAGE DROP STUDY

APPENDIX A

SAT

CIRCULATING WATER PUMP 2B MOTOR STARTING
(Fig. No. A13)

REST ARE RUNNING

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.95
4160 VOLT BUS 2B	.9348
4160 VOLT BUS 2C, 2D, COMMON B, E3 & E4	.8642
480 VOLT UNIT SUBSTATION E7	.847
480 VOLT UNIT SUBSTATION 2E	.8559
480 VOLT UNIT SUBSTATION 2F	.8515
480 VOLT UNIT SUBSTATION E8	.845
480 VOLT UNIT SUBSTATION 2SY	.8747
480 VOLT UNIT SUBSTATION COMMON D	.8667
480 VOLT UNIT SUBSTATION 2L	.8544
480 VOLT UNIT SUBSTATION 4L	.8656
4000V CIRCULATING WATER PUMP MOTOR 2B	.8721

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 264

VOLTAGE DROP STUDY

APPENDIX A

SAT

SCREEN WASH PUMP 2A STARTING
(Fig. No. A14)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9727
4160 VOLT BUS 2B	.9623
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.9319
480 VOLT UNIT SUBSTATION E7	.8807
480 VOLT UNIT SUBSTATION 2E	.8318
480 VOLT UNIT SUBSTATION 2F	.9279
480 VOLT UNIT SUBSTATION E8	.9221
480 VOLT UNIT SUBSTATION 2SY	.9451
480 VOLT UNIT SUBSTATION COMMON D	.9377
480 VOLT UNIT SUBSTATION 2L	.9229
480 VOLT UNIT SUBSTATION 4L	.9367
480 VOLT MOTOR CONTROL CENTER 2PA	.8299
460V SCREEN WASH PUMP 2A	.8502

NOTE: BASE VOLTAGES [illegible] SHOWN IN THE LEFT HAND COLUMN.

1144 265

VOLTAGE DROP STUDY

APPENDIX A

SAT

TURBINE BUILDING CLOSED COOLING WATER PUMP 2A MOTOR STARTING
(Fig. No. A15)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.95
4160 VOLT BUS 2B	.9379
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.9061
480 VOLT UNIT SUBSTATION E7	.8947
480 VOLT UNIT SUBSTATION 2E	.8579
480 VOLT UNIT SUBSTATION 2F	.8989
480 VOLT UNIT SUBSTATION E8	.8928
480 VOLT UNIT SUBSTATION 2SY	.9182
480 VOLT UNIT SUBSTATION COMMON D	.9106
480 VOLT UNIT SUBSTATION 2L	.8968
480 VOLT UNIT SUBSTATION 4L	.9096
480 VOLT MOTOR CONTROL CENTER 2TJ	.8265
460V TURBINE BUILDING CLOSED COOLING WATER PUMP 2A	.8498

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1114 266

VOLTAGE DROP STUDY

APPENDIX A

SAT

TURBINE BUILDING CLOSED COOLING WATER PUMP 2B START
(Fig. No. A16)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9623
4160 VOLT BUS 2B	.9511
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.92
480 VOLT UNIT SUBSTATION E7	.9104
480 VOLT UNIT SUBSTATION 2E	.9185
480 VOLT UNIT SUBSTATION 2F	.8684
480 VOLT UNIT SUBSTATION E8	.9085
480 VOLT UNIT SUBSTATION 2SY	.9326
480 VOLT UNIT SUBSTATION COMMON D	.9252
480 VOLT UNIT SUBSTATION 2L	.9108
480 VOLT UNIT SUBSTATION 4L	.9242
480 VOLT MOTOR CONTROL CENTER 2TH	.8382
460 V TURBINE BUILDING CLOSED COOLING WATER PUMP 2B	.8501

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1104 267

VOLTAGE DROP STUDY

APPENDIX A

SAT

SCREEN WASH PUMP 2B STARTING
(Fig. No. A17)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9638
4160 VOLT BUS 2B	.9527
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.9222
480 VOLT UNIT SUBSTATION E7	.9126
480 VOLT UNIT SUBSTATION 2E	.9207
480 VOLT UNIT SUBSTATION 2F	.9167
480 VOLT UNIT SUBSTATION 2SY	.8679
480 VOLT UNIT SUBSTATION COMMON D	.9347
480 VOLT UNIT SUBSTATION 2L	.9273
480 VOLT UNIT SUBSTATION 4L	.9263
480 VOLT MOTOR CONTROL CENTER 2PB	.8319
460 V SCREEN WASH PUMP 2B	.8501

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 268

VOLTAGE DROP STUDY

APPENDIX A

LOCA START

NO LOAD SHEDDING
(Fig. No. A18)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9115
4160 VOLT BUS 2B	.9218
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.7577
480 VOLT UNIT SUBSTATION E7	.7457
480 VOLT UNIT SUBSTATION 2E	.7151
480 VOLT UNIT SUBSTATION 2F	.7079
480 VOLT UNIT SUBSTATION E8	.7366
480 VOLT UNIT SUBSTATION 2SY	.7603
480 VOLT UNIT SUBSTATION COMMON D	.7485
480 VOLT UNIT SUBSTATION 2L	.741[illegible]
480 VOLT UNIT SUBSTATION 4L	.7468
4000 VOLT CORE SPRAY PUMP 2A	.7735
4000 VOLT RHR PUMP 2A	.7807
4000 VOLT CORE SPRAY PUMP 2B	.7705
4000 VOLT RHR PUMP 2B	.7777

NOTE: BASE VOLTAGES FOR ALL LOADS ARE THE RATED VOLTAGES SHOWN IN THE LEFT HAND COLUMN.

1144 269

VOLTAGE DROP STUDY

APPENDIX A

LOCA RUN

NO LOAD SHEDDING
(Fig. No. A19)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9291
4160 VOLT BUS 2B	.9478
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.8843
480 VOLT UNIT SUBSTATION E7	.8876
480 VOLT UNIT SUBSTATION 2E	.8637
480 VOLT UNIT SUBSTATION 2F	.8582
480 VOLT UNIT SUBSTATION E8	.8804
480 VOLT UNIT SUBSTATION 2SY	.8927
480 VOLT UNIT SUBSTATION COMMON D	.8828
480 VOLT UNIT SUBSTATION 2L	.8711
480 VOLT UNIT SUBSTATION 4L	.8814

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 270

VOLTAGE DROP STUDY

APPENDIX A

LOCA WITHOUT LOAD SHEDDING

REACTOR BUILDING CLOSED COOLING WATER PUMPS STARTING
(Fig. No. A20)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9509
4160 VOLT BUS 2B	.97
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.9049
480 VOLT UNIT SUBSTATION E7	.8776
480 VOLT UNIT SUBSTATION 2E	.8873
480 VOLT UNIT SUBSTATION 2F	.882
480 VOLT UNIT SUBSTATION E8	.9035
480 VOLT UNIT SUBSTATION 2SY	.9142
480 VOLT UNIT SUBSTATION COMMON D	.9045
480 VOLT UNIT SUBSTATION 2L	.8921
480 VOLT UNIT SUBSTATION 4L	.9032
480 VOLT MOTOR CONTROL CENTER 2XE	.8267
460V REACTOR BUILDING CLOSED COOLING WATER PUMP 2A	.8501
460V REACTOR BUILDING CLOSED COOLING WATER PUMP 2C	.8535

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 271

RHR & Core Spray Start
Need ... [illegible]

VOLTAGE DROP STUDY

APPENDIX A

2X LOCA START

NO LOAD SHEDDING
(Fig. No. A21)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9593
4160 VOLT BUS 2B	.9673
4160 VOLT BUS 2C, 2D, E3, E4, & COMMON B	.758
480 VOLT UNIT SUBSTATION E7	.7459
480 VOLT UNIT SUBSTATION 2E	.7154
480 VOLT UNIT SUBSTATION 2F	.7082
480 VOLT UNIT SUBSTATION E8	.7368
480 VOLT UNIT SUBSTATION 2SY	.7605
480 VOLT UNIT SUBSTATION COMMON D	.7487
480 VOLT UNIT SUBSTATION 2L	.7421
480 VOLT UNIT SUBSTATION 4L	.7471
4000 VOLT CORE SPRAY PUMP 2A	.7737
4000 VOLT RHR PUMP 1A	.7798
4000 VOLT RHR PUMP 2A	.7809
4000 VOLT CORE SPRAY PUMP 2B	.7708
4000 VOLT RHR PUMP 1B	.7311
4000 VOLT RHR PUMP 2B	.7709

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

VOLTAGE DROP STUDY

APPENDIX A

2X LOCA RUN

NO LOAD SHEDDING
(Fig. No. A22)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.9351
4160 VOLT BUS 2B	.9534
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.8843
480 VOLT UNIT SUBSTATION E7	.8876
480 VOLT UNIT SUBSTATION 2E	.8636
480 VOLT UNIT SUBSTATION 2F	.8581
480 VOLT UNIT SUBSTATION E8	.8803
480 VOLT UNIT SUBSTATION 2SY	.8926
480 VOLT UNIT SUBSTATION COMMON D	.8827
480 VOLT UNIT SUBSTATION 2L	.871
480 VOLT UNIT SUBSTATION 4L	.8814

NOTE: ALL VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1114 273

VOLTAGE DROP STUDY

APPENDIX A

2X LOCA WITHOUT LOAD SHEDDING

REACTOR BUILDING CLOSED COOLING WATER PUMPS 2A AND 2C START
(Fig. No. A23)

BUS NAMES	MINIMUM
230 KV SWITCHYARD	.955
4160 VOLT BUS 2B	.9739
4160 VOLT BUS 2C, 2D, E3, E4 & COMMON B	.9048
480 VOLT UNIT SUBSTATION E7	.8775
480 VOLT UNIT SUBSTATION 2E	.8872
480 VOLT UNIT SUBSTATION 2F	.8819
480 VOLT UNIT SUBSTATION E8	.9033
480 VOLT UNIT SUBSTATION 2SY	.9141
480 VOLT UNIT SUBSTATION COMMON D	.9044
480 VOLT UNIT SUBSTATION 2L	.892
480 VOLT UNIT SUBSTATION 4L	.9031
480 VOLT MOTOR CONTROL CENTER 2XE	.8266
460V REACTOR BUILDING CLOSED COOLING WATER PUMP 2A	.85
460V REACTOR BUILDING CLOSED COOLING WATER PUMP 2C	.8534

NOTE: ALL LOAD VOLTAGES ARE ON THE BASE VOLTAGE SHOWN IN THE LEFT HAND COLUMN.

1144 274