ELECTRICAL LOAD ANALYSIS

FOR

480 VOLT EMERGENCY POWER SYSTEM

SURRY POWER STATION

UNITS 1 AND 2

DOCKET NOS. 50-280
50-281

LICENSE NOS. DPR-32
DPR-37

ISSUED: May 17, 1979

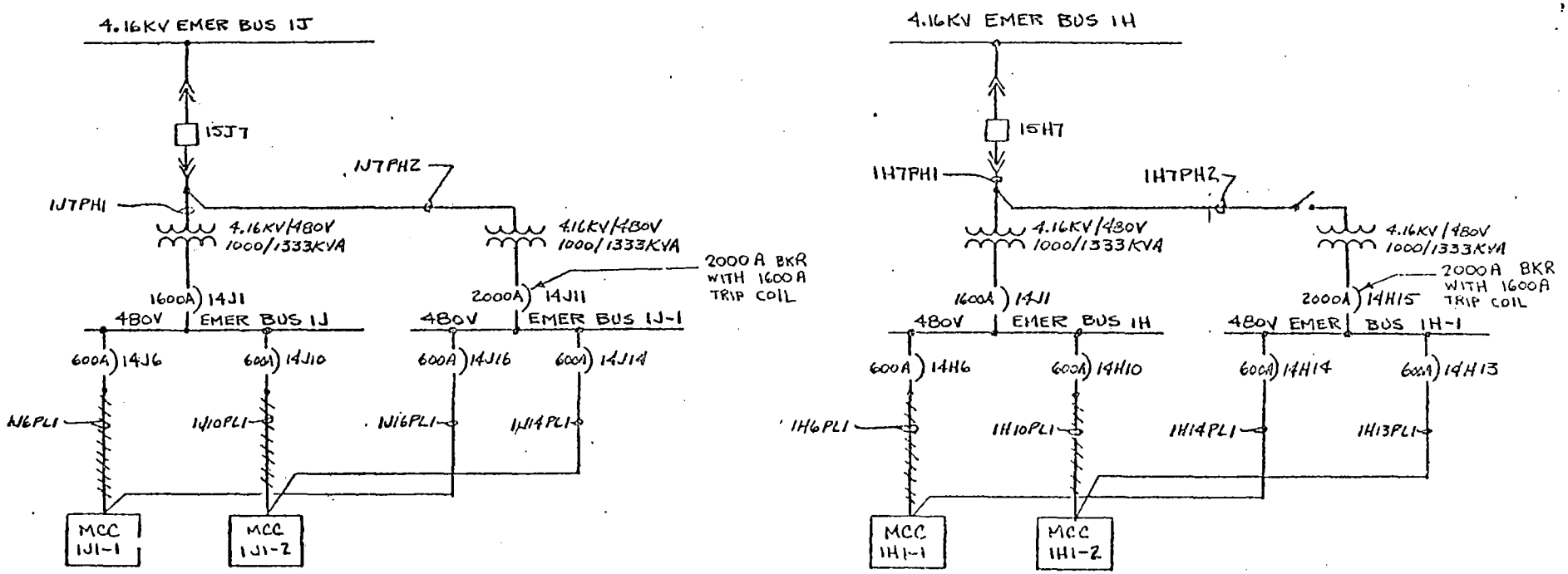
VIRGINIA ELECTRIC AND POWER COMPANY

INDEX

1.0 System Description

Reference attached Sketch 12846.23-EKS-2-2.

A 480V load center will be added to each train of the emergency power system. The equipment used will be Class IE load centers purchased for North Anna Units 3 and 4 and transferred from storage there. The load center transformer primaries will be connected in parallel with the primaries of the existing load center transformers to the 4160V feed breakers presently in use. Feeder cables to the existing motor control centers (i.e., two per load center) will be disconnected from the existing load centers and connected to the new load center of the associated train of emergency power. The new load centers will be located in the associated train emergency switchgear room near the existing 480V load centers.



NOTES

1) EXISTING CABLES 1J6PL1, 1H6PL1, 1J10PL1, & 1H10PL1 TO BE REROUTED AND RETAGGED AS SHOWN

QA. CAT. I

POWER INDUSTRY GROUP	TITLE: ONE LINE DIAGRAM 480V EMER. POWER SYSTEM	SCALE: NONE	
CHECKED 4/1/79		DATE: 4/9/79	
CORRECT 4/1/79			
APPROVED 4/4/79		SKETCH NUMBER 12846,23-EKS-2-2	
REVISIONS (2) (3) (4) (5)			

2.0 Load Tabulation

To calculate bus loadings accurately and conservatively, the following guidelines were established:

a. All loads which cycle under automatic control (sump pump, air compressors, etc.) were assumed running when analyzing a bus. This approach is highly conservative since it does not consider load duty cycling or diversity factor.

b. Where available, driven equipment brake-horsepower was used for load tabulation. If brake-horsepower was not available, motor nameplate horsepower was used.

c. Where the control room operator has a choice of equipment providing redundant services, (i.e., control room chillers) it was assumed that the equipment connected to the bus under analysis was in service.

d. All motor-operated valves on these buses were considered short-term loads of relatively low demand. The majority of these valves have operating times of less than 30 seconds. They were not listed as continuous load on the bus.

e. The breaker trip points were determined from the time vs. current trip characteristic curves for the device. Because of manufacturing tolerances, this curve is a band. The lower bound of this band was used to determine the earliest possible time at which the breaker could trip.

f. Loads were assumed as constant kva when computing voltage profiles. Appendix B is the tabulation of safety-related motor control center loadings.

Each load on the 480V emergency bus was also reviewed with station operating supervisors to establish which are connected for various plant conditions. This review established which loads ran only for refueling or were started by manual control (such as hydrogen recombiner). In addition, some loads were determined to be automatically shed by a consequence limiting safeguard (CLS) signal.

2.1 New 480V Load Centers 1H1 and 1J1

Data: Load Center 1H1

ITE 480V metal-clad unit substation, indoor-type.

1. Incoming Section: 5KV air disconnect switch with key interlock.

2. Transformer: 4,160V primary delta, 480V secondary delta, with 4 - 2 1/2% taps below rated voltage on primary. Impedance: 8% on 1,000 kva base transformer rated 1,000 kva self-cooled, 1,333 kva fan cooled (fans installed); dry type ventilated.

3. Switchgear: Two vertical sections with seven breaker compartments and one instrument compartment. 480V bus throat connected to transformer.

4. Breakers: ITE K600 series with K2000 (2,000 amp) incoming line breaker.

Load center 1J1 is the same as 1H1 except in place of 5kv air disconnect switch, Load center 1J1 has a 5kv air termination chamber (no switch).

The two new load centers, 1H1 and 1J1, will each feed two safety related motor control centers (MCCs). The MCCs are the only loads on these new buses.

The maximum loading on the load centers, as a result of the MCCs which occurs for a loss of coolant accident (LOCA), is summarized below:

LOCA Loading (Max)

Load Center 1H1	
MCC 1H1-1	384 kva
MCC 1H1-2	275 kva
Total:	659 kva
Load Center 1J1	
MCC 1J1-1	368 kva
MCC 1J1-2	367 kva
Total:	735 kva

The new load centers are rated 1000/1333 kva where the 1333 kva is a fan-cooled rating. The maximum loading on 1H1 is 49% of load center fan-cooled rating. The maximum loading of 1J1 is 55% of load center fan-cooled rating.

Summary: 480V load centers 1H1 and 1J1 are within design rated capacity for all station operating conditions.

2.2 Original 480V - Load Centers 1H and 1J

Data: Load Center 1H and 1J

ITE 480V metal-clad unit substation, indoor type.

1. Incoming Section: 5kv air termination chamber.

2. Transformer: 4160V primary delta; 480V secondary delta with 1-2½% tap above rated and 3-2½% taps below rated voltage on primary. Impedance: 8% on 1000 kva base transformer rated 1000 kva self-cooled, 1333 kva fan-cooled (fans installed); dry type ventilated.

3. Switchgear: Two vertical sections with seven breaker compartments

and one instrument compartment. 480V bus throat connected to transformer.

4. Breaker: ITE K600 series with K1600 (1600 amp) incoming line breaker.

Loading on the original 480V load centers 1H and 1J is reduced by transferring feeders for two MCCs from 1H and 1J to the new load centers.

Load center power requirements are outlined on tabulation of loads sheets 1 and 2, attached. From the totals on tabulation sheets 1 and 2, the maximum connected loads on buses 1H and 1J would occur during a LOCA. This maximum load represents:

1002 kva/1333 kva, or 75.2% of bus 1H capacity

1002 kva/1333 kva, or 75.2% of bus 1J capacity

Although pressurizer heaters trip on low pressurizer level, it is possible to re-energize them without exceeding ratings of load centers. With pressurizer heaters on during a LOCA, bus 1H would be 94% loaded and bus 1J would be 90% loaded.

Summary: 480V load centers 1H and 1J are within design rated capacity for all station operating conditions.

480V UNIT SUBSTATION "1H"

TABULATION OF LOADS - SHEET 1

MODIFIED SYSTEM

BREAKER NO.	UNIT SUBSTATION 1H DESCRIPTION OF LOAD	KVA LOAD(4) LOCA W/LOOP	LOOP	NORMAL
14H1	Incoming Line, 1600A			
14H2	Pressurizer Heater; 250 Kw	(2)	250	250
14H3	LHSI Pp, 1-SI-P-1A; 250 Hp	223	-	-
14H4	Inside Recirc Spray Pp, 1-RS-P-1A; 300 Hp	277	-	-
14H5	Containment Spray Pp, 1-CS-P-1A; 250 Hp	225	-	-
14H6	Spare	-	-	-
14H7	Outside Recirc Spray Pp, 1-RS-P-2A; 300 Hp	277	-	-
14H8	Containment Recirc Fan, 1-VS-F-1A; 125 Hp	(1)	118	118
14H9	Future	-	-	-
14H10	Spare	-	-	-
	TOTALS	1,002	368	368

(1) Trips on receipt of SIS signal.

(2) Trips on low pressurizer level.

(3) Normal load by field measurement.

(4) Abbreviations for Unit conditions:

LOCA - Loss of Coolant Accident

LOOP - Loss of Offsite Power

NORMAL - Normal Unit Operation, 100% Power

480V UNIT SUBSTATION "1J"

TABULATION OF LOADS - SHEET 2

MODIFIED SYSTEM

BREAKER NO.	UNIT SUBSTATION 1J DESCRIPTION OF LOAD	KVA LOAD(3) LOCA W/LOOP	LOOP	NORMAL
14J1	Incoming Line, 1600A			
14J2	Spare	-	-	-
14J3	LHSI Pp, 1-SI-P-1B; 250 Hp	223	-	-
14J4	Inside Recirc Spray Pp, 1-RS-P-1B; 300 Hp	277	-	-
14J5	Containment Spray Pp, 1-CS-P-1B, 250 Hp	225	-	-
14J6	Spare	-	-	-
14J7	Outside Recirc Spray Pp, 1-RS-P-2B; 300 Hp	277	-	-
14J8	Containment Recirc Fan, 1-VS-F-1B; 125 Hp	(1)	118	118
14J9	Pressurizer Heater, 200Kw	(2)	200	200
14J10	Spare	-	-	-
	TOTALS	1,002	318	318

(1) Trips on receipt of SIS signal.

(2) Trips on low pressurizer level.

(3) Abbreviations for Unit conditions:

LOCA - Loss of Coolant Accident

LOOP - Loss of Offsite Power

NORMAL - Normal Unit operation, 100% power

3.0 Voltage Analysis; 480 Volt Safety Buses

The following voltage range was calculated for the 4KV safety buses 1H and 1J, which feed the 480V safety related load centers. The calculations are included in Appendex A and the results are included below:

Voltage levels are on a 4000 volt base.

4KV safety bus 1H; minimum = 1.0105 p.u.
maximum = 1.0961 p.u.

4KV safety bus 1J; minimum = 0.9865 p.u.
maximum = 1.0910 p.u.

Using the load tabulations of section 2.0, the following voltage profiles for 480 volt safety bus H and J were calculated for maximum and minimum 4KV bus levels:

1. Voltage profiles for maximum steady state loading on 480V buses 1H, 1J, 1H1 and 1J1.

2. Voltage profile for starting the largest safety related 300 HP motor on buses 1H and 1J while bus is at maximum load.

3. Light load voltage profile for 480V buses 1H, 1H1, 1J, 1J1 using highest voltages on the 4 KV input buses.

   The calculations examine the highest grid voltage with light loading of the buses and the lowest grid voltage with the heaviest loading of these buses. These two conditions bound the bus voltage range for the load centers. If the motor voltage remains within equipment design range at these bounds then it remains within this design range for all voltages.

3.1 Program Data

Calculations were run on Stone & Webster program 6995 - Station Service System Calculations; Input Data Sheet 11. This program is used to determine running (steady state) motor voltage and motor starting voltage for any chosen load center primary voltage.

Data:

a) Safety related motors for Surry power station were specified and purchased with 70% starting nameplate voltage.

b) Motor nameplate is 460 volts.

c) Design operating range of equipment is 460 volts ± 10%.

d) Load centers transformers are 1000/1333 KVA, 4160V 480V. Primary tap at 4056 volts.

e) Load center transformers impedance is 8% on 1000 KVA.

f) Review of manufacturers motor data on motors fed from the 480V load centers indicates starting power factors of 0.26 and above. A power factor of 0.25 was used for motor starting calculations.

g) Locked rotor current for motor starting was taken from motor data.

h) MVA minimum short circuit available at transformer primary was calculated on data sheet 5, runs 1401 and 1403, included in Appendix A.

3.2 Voltage Profile - Maximum Steady State Bus Loading

The voltage profiles for maximum bus loading were computed as outlined below.

For each run, motor running voltage was computed for the maximum and minimum grid voltage conditions computed in Appendix A. Grid low voltage (on 36.5 KV bus) will give lowest motor running voltage. Maximum loading for buses is given in Section 2.0.

3.2.1 Run No. 1405 - 480V Bus 1J - maximum loading

Grid low - motor running voltage = 92.86% of 460V
Diesel feed - motor running voltage = 98.74% of 460V

3.2.2 Run No. 1407 - 480V Bus 1J1 - maximum loading

Grid low - motor running voltage = 94.60% of 460V
Diesel feed - motor running voltage = 100.36% of 460V

3.2.3 Run No. 1409 - 480V Bus 1H - maximum loading

Grid low - motor running voltage = 95.51% of 460V
Diesel feed - motor running voltage = 98.74% of 460V

3.2.4 Run No. 1411 - 480V Bus 1H1 - maximum loading

Grid low - motor running voltage = 97.65% of 460V
Diesel feed - motor running voltage = 100.80% of 460V

3.3 Voltage Profile - Motor Starting

All large 480V safety related motors are fed from load centers 1H and 1J. Maximum loading on these switchgears occurs during Safety Injection (LOCA) conditions. Worst voltage starting condition is starting the last motor with the load center at maximum load. This motor, the largest on the bus, would be the 300 HP outside Recirculation Pump Motor which starts 5 minutes after containment hi-hi pressure signal. If this motor starting voltage remains above 70% of nameplate, then all other motors on this load center will have a minimum of 70% starting voltage.

3.3.1 Run No. 1406 - Load Center 1J - starting 300 HP 1-RS-P-2B

Motor leads impedance from cable schedule data is 0.0127 + j 0.113 ohms/phase

Nominal switchyard -motor starting voltage -75.07% of 460V
Grid low -motor starting voltage -73.68% of 460V
Diesel feed -motor starting voltage -78.17% of 460V

3.3.2 Run No. 1410 - Load Center 1H - starting 300 HP 1-RS-P-2A

Motor leads impedance from cable schedule data is 0.0092 + j 0.0090 ohms.phase

Nominal switchyard -motor starting voltage -78.65% of 460V
Grid low -motor starting voltage -77.26% of 460V
Diesel feed -motor starting voltage -79.72% of 460V

3.4 Light Load Analysis - Voltage Profile

Highest voltage seen at 480V load centers would occur at load center light loading, Reserve Station Service transformer light loading, and switchyard grid high voltage.

From Appendix A, calculation Runs 1401 and 1403, light loading voltages at high grid are as follows:

4KV Bus 1J light load = 1.0910 p.u. @ 460V
4KV Bus 1H light load = 1.0961 p.u. @ 460V

3.4.1 Run No. 1408 - Light Load 480V - Load Centers 1J and 1J1

Minimum loading condition on buses is conservatively estimated as 100 KVA.

Grid high -light load - motor running voltage = 109.16%
Diesel feed -light load - motor running voltage = 103.89%

3.4.2 Run No. 1412 - Light Load 480V - Load Centers 1H and 1H1

Minimum loading condition on buses is conservatively estimated as 100 KVA.

Grid high -light load - motor running voltage = 109.69%
Diesel feed -light load - motor running voltage = 103.89%

3.5 Summary of Voltage Calculations

The 480V safety load center voltage remains within the equipment design range of ± 10% of 460 volts at the equipment terminals for 4KV transfer bus heavy and light load voltage conditions.

Motor starting voltage, for safety related motors, remains above 70% for transfer bus heavy and loght load conditions and switchyard high and low grid voltage.

With the lighest loading on safety buses and high switchyard grid voltage, equipment terminal voltages remain within 10% of nameplate rating.

4.0 Feeder Cables to New Load Centers 1H1, and 1J1

4.1 Data

Voltage 4 KV nominal.

Cable identification:	1J7PH2 to 1J1 1H7PH2 to 1H1
Cable lengths:	1J7PH2 = 50 feet 1H7PH2 = 90 feet
Cable type:	3/C 500 MCM aluminum cable with aluminum armor 90°C rated 5KV
Cable impedance:	0.0461 + j 0.0283 ojms/1000 ft.
Cable ampacity:	NEC 310-16, = 330 Amps

4.2 Ampacity

Load center 1J1 and 1H1 maximum loadings can be taken as their maximum rating on 1333 KVA. Using lowest allowable bus voltage of 0.90 4000 = 3600 volts. Maximum current = 214 Amps.

This is within cable rated ampacity of 330 Amps.

4.3 Cable Voltage Drop

Cable voltage drop will be calculated on maximum current of section 4.2 plus 25% for motor starting = 268 Amps
power factor = 0.80 for diesel feed to bus.

$V = IZ\sqrt{3}$ where V = Voltage drop line to line (vector)
I = Full load current (vector)
Z = Cable impedance (vector)

Cable 1J7PH2

$Z = 50 \text{ ft} \times (0.0461 + j\ 0.0283) \text{ ohms/1000 ft}$
$Z = 0.0023 + j\ 0.0014$
$I = 268 \text{ Amps} \angle 36.8°$
$I = 214.4 + j\ 160.8$

$V = IZ\sqrt{3}$
$V = (214.4 + j\ 160.8)\ (0.0023 + j\ 0.0014)(1.732)$
$V = (0.268 + j\ 0.67)\ (1.732)$

Volatge drop for cable 1J7PH2 = 1.24 volts
Voltage drop = 0.031%

Cable 1H7PH2

Since voltage drop is a linear function with impedance, a ratio of cable lengths will give voltage drop for cable 1H7PH2.

Voltage drop $\frac{90\ Ft}{50\ Ft}$ x 1.25 volt = 2.25 volts or 0.06%

480 Volt Bus 1J Maximum Loading DATA SHEET 11

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

X JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1405 BY D.J. Ganeta DJG DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY DJG

* 1 HP MOTOR BEING STARTED DATE 5/16/79

* 460 V. MOTOR NAMEPLATE

** 1 AMP. LOCKED ROTOR CURRENT R = * MOTOR LEADS X = * OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 1002 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 160 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	1.0789		105.28
100.00	.9695		94.35
95.00	.9142		88.82
96.06	.9260		90.00
NOMINAL SWYD			
100.30	.9728		94.68
GRID HIGH			
101.94	.9909		96.48
GRID LOW			
98.65	.9546		92.86
DIESEL			
104.00	1.0135		98.74

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

DATA SHEET 11

480V Bus 1J; Starting 300Hp Motor 1-RS-P-2B

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

X JOB ORDER NO 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1406 BY D.F. Agneta DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY [signature]

DATE 5/16/79

* 300 HP MOTOR BEING STARTED

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 2450 AMP. LOCKED ROTOR CURRENT R = *.0127 X = *.0113 OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 725 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 160 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	.9429	83.17	
100.00	.8481	74.82	
95.00	.8003	70.60	
106.18	.9069	80.00	
NOMINAL SWYD			
100.30	.8510	75.07	
GRID HIGH			
101.94	.8666	76.45	
GRID LOW			
98.65	.8353	73.68	
DIESEL			
104.00	.8862	78.17	

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

DATA SHEET 11

480 Volt Bus 1J1(new); Maximum Loading

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

X JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1407 BY D.F. Agneta DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY DJH

* 1 HP MOTOR BEING STARTED DATE 5/16/79

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 1 AMP. LOCKED ROTOR CURRENT R = * X = * OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 735 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 160 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	1.0939		106.78
100.00	.9866		96.06
95.00	.9326		90.65
94.39	.9260		90.00
NOMINAL SWYD			
100.30	.9898		96.38
GRID HIGH			
101.94	1.0075		98.15
GRID LOW			
98.65	.9720		94.60
DIESEL			
104.00	1.0296		100.36

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

DATA SHEET 11

480 Volt Buses 1J and 1J1; Plant Light Load Condition

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

X JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1408 BY D F. Agneta DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY [signature]

* 1 HP MOTOR BEING STARTED DATE 5/16/79

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 1 AMP. LOCKED ROTOR CURRENT R = * X = * OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 100 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 160 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	1.1269		110.09
100.00	1.0235		99.75
95.00	.9718		94.58
NOMINAL SWYD LIGHT LOAD			
107.51	1.1012		107.52
GRID HIGH LIGHT LOAD			
109.10	1.1176		109.16
GRID LOW-LIGHT LOAD			
105.91	1.0847		105.86
DIESEL -BUS LIGHT LOAD			
104.00	1.0649		103.89

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

DATA SHEET 11

480 Volt Bus 1H; Maximum Loading

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

X JOB ORDER NO 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1409 BY D. F. Gaynette DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY [illegible]

* 1 HP MOTOR BEING STARTED DATE 5/16/79

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 1 AMP. LOCKED ROTOR CURRENT R = * X = * OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 1002 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 163 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	1.0789		105.28
100.00	.9695		94.35
95.00	.9142		88.82
96.06	.9260		90.00
NOMINAL SWYD			
102.75	.9998		97.37
GRID HIGH			
104.43	1.0182		99.21
GRID LOW			
101.05	.9811		95.51
DIESEL			
104.00	1.0135		98.74

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

DATA SHEET 11

480 Volt 1H; Starting 300Hp Motor 1-RS-P-2A

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

X JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1410 BY D.F. Agneta DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY [illegible]

* 300 HP MOTOR BEING STARTED DATE 5/16/79

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 2450 AMP. LOCKED ROTOR CURRENT R = *.0092 X = *.0090 OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 725 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 163 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	.9358	84.82	
100.00	.8418	76.30	
95.00	.7943	71.99	
104.33	.8826	80.00	
NOMINAL SWYD			
102.75	.8677	78.65	
GRID HIGH			
104.43	.8836	80.08	
GRID LOW			
101.05	.8517	77.20	
DIESEL			
104.00	.8795	79.72	

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

DATA SHEET 11

480 Volt Bus 1H1 (new); Maximum Loading

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

* JOB ORDER NO 12846.23 CLIENT Vepco PLANT Surry

RUN NO. 1411 BY D.F. Iglesia DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY [illegible]

DATE 5/16/79

* 1 HP MOTOR BEING STARTED

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 1 AMP. LOCKED ROTOR CURRENT R = * X = * OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 659 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 163 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	1.0980		107.20
100.00	.9913		96.53
95.00	.9376		91.15
93.93	.9260		90.00
NOMINAL SWYD			
102.75	1.0207		99.47
GRID HIGH			
104.43	1.0387		101.26
GRID LOW			
101.05	1.0025		97.65
DIESEL			
104.00	1.0341		100.80

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

Station condition: Both Units at 100% power
Light load on Rss For 480V bus 1H and Bus 1H1

DATA SHEET 11

STATION SERVICE SYSTEM CALCULATIONS

Starting Voltage - Low Voltage Motors

* JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1412 BY D.F. Agneta DATE 5-14-79

.000000006995ex0 PROGRAM VERIFICATION NO. REVIEWED BY DFA

* 1 HP MOTOR BEING STARTED DATE 5/16/79

* 460 V. MOTOR NAMEPLATE

MOTOR LEADS

** 1 AMP. LOCKED ROTOR CURRENT R = * X = * OHMS/PHASE

** .25 PF OF LOCKED ROTOR CURRENT

* 1000 KVA TRANSFORMER, STEP-DOWN TO MOTOR VOLTAGE

* 8.00 PER CENT IMPEDANCE VOLTS, STEP-DOWN TRANSFORMER

* 100 KVA PRIOR LOAD ON TRANSFORMER SECONDARY

** .85 PF, PRIOR LOAD

* 163 MVA MIN. SHORT CIRCUIT AVAILABLE AT TRANSF. PRI. TERMINALS

NOM. PRI. VOLTAGE:* 4000 V; PRI. TAP:** RECOM.* 4056 CHOSEN

(7) PRI. VOLTAGE LOADED, %	(8) SEC. VOLTAGE LOADED, PU	(9) MOTOR STARTING VOLTAGE, %	(10) MOTOR RUNNING VOLTAGE, %
110.00	1.1269		110.09
100.00	1.0235		99.75
95.00	.9718		94.58
NOMINAL SWYD- LIGHT LOAD			
107.98	1.1061		108.00
GRID HIGH- LIGHT LOAD			
109.61	1.1229		109.69
GRID LOW- LIGHT LOAD			
106.35	1.0892		106.32
DIESEL-Bus LIGHT LOAD			
104.00	1.0649		103.89

(7) NOM. PRI. VOLTAGE BASE

(8) (9) (10) MOTOR NAMEPLATE VOLTAGE BASE

APPENDIX A

STATION SERVICE SYSTEM CALCULATIONS

This appendix is a calculation of the voltage profile for the Unit 1 4160 volt emergency buses. The redundant emergency 4160V buses 1H and 1J are fed from the Reserve Station Service Transformers A and C respectively. Reserve Station Service Transformers are supplied from separate 36.5 KV switchyard buses.

Calculation of light loading and heavy loading conditions on the Reserve Transformers is used to determine the voltage profile of the 4160V Emergency buses.

Data for Calculations

1. Reserve Station Service Transformer A

Rating 18,000/24,000/30,000 KVA OA/FA/FA

Nominal 34.5 KV Primary to 4160V Secondary

Impedance = 5.77% nominal at 18,000 KVA

"No load" primary taps:

Tap 1	36,200 volts
Tap 2	35,300 volts
Tap 3	34,400 volts
Tap 4	33,500 volts
Tap 5	32,600 volts

Primary tap in use: Tap 3 34,400 volts

current primary tap setting on 3; 34,400

Secondary load tap changer 16 raise steps
16 lower steps

Maximum raise (boost)	4670 volts
Neutral	4154 volts
Minimum lower (buck)	3740 volts

The secondary is currently set to maintain 4300 volts at the transfer buses with a 30 second time delay.

2. Reserve Station Service Transformer C

All data is the same as Transformer A except Impedance = 5.63% nominal at 18,000 KVA.

3. Switchyard Voltage Range (swing)

The Reserve Transformers are supplied from 36.5 KV switchyard buses. These buses are fed from 36.5 KV tertiary windings of the 500 KV to 230 KV auto transformers. The present tap setting on the auto transformers primaries is 512,500V.

From VEPCO system planning department,

total voltage swing oN 500 KV lines:

minimum	505 KV
maximum	520 KV

corresponding 36.5 KV swing:

minimum = (505,000 KV/512,500 KV) x 36.5 KV = 35.96 KV

maximum = (520,000 KV/512,000 KV) x 36.5 = 37.03 KV

4. Minimum Short Circuit Available on 36.5 KV bus

From VEPCO automation and control department the minimum short short circuit available from 36.5 buses is 519 MVA.

5. Impedance of Cables from Reserve Secondaries

Cables 4 - 2000 MCM aluminum cables per phase 90°C rated; 610 feet length.

Impedance: = 0.00197 + j 0.01069 ohms

On 1MVA, 4.16KV base

per unit resistance = 0.000114
per unit resistance = 0.000618

Station Service System Calculations - Voltage Profile

A. This calculation determines the automatic tap changer position for light load on Reserve Station Service Transformer A.

Station condition:

2 units at 100% power; Reserve Station Service Transformer A feeding bus 1J; load on bus 1J = 2.39 MVA

Total local load on transformer primary source:

Bus 1J + Bus 2H + Bus 2G =

2.39 MVA + 2.39 MVA + 8.8 MVA = 13.58 MVA

The transformer load tap changer is set to maintain 4300 volts at transfer bus D.

Data sheet 4, Run No. 1401, is the program input data.
Data sheet 5, Run No. 1401, is program output.

A search was made by the program on Data sheet 5 to find the primary transformer tap which results in 4300 volts (1.075 p.u.) on the medium or transfer bus. the result is printed in column (5). As shown, a tap of 34.65 KV results in 1.0751 at the transfer bus. Maximum bus voltage on the grid is 37.03 or 1.0146 p.u. The light load maximum 4 KV bus voltage is 1.0910 p.u. for this high grid condition as shown on data sheet 5.

B. This calculation determines the minimum voltage at 4160 volt emergency bus for heavy loading on the RSS transformer A.

Station Condition: Unit 2 - 100% power
Unit 1 - trip from 100% power with SI signal.

Reserve Station Service Transformer A

RSS A feeding emergency bus 1J and station bus 1A.

Loading on RSS A is 16.35 KVA

Other local load on transformer primary source is transfer bus D, E, and intake structure bus 2G; total = 39.25 MVA

The load tap changer position prior to the unit trip was determined in Run No. 1401 as 34.65 KV. Upon unit trip, it is assumed that the load tap changer does not move to increase voltage to the preset level.

Program inputs are shown on Data Sheet 4, Run No. 1402. Program outputs are shown on Data Sheet 5. The autotap changer was set at 34.65 KV. From output data, at nominal grid voltage of 36.5 KV the 4 KV emergency bus 1J would be at 1.0030 p.u. The minimum voltage on this bus occurs at grid low level of 35.96 and would be 0.9865 p.u. as shown on the data sheet attached.

SUMMARY:

From calculation Run Nos. 1401 and 1402, the voltage profile for 4 KV emergency bus 1J is :

minimum bus voltage = 0.9865 p.u. or 3946 volts
maximum bus voltage = 1.0910 p.u. or 4364 volts

Similar calculations were also made for 4160 volt emergency bus 1H. The input and output data are attached on data sheets for Run Nos. 1403 and 1404.

The results are a voltage profile for 4 KV emergency bus 1H:

minimum bus voltage = 1.0105 p.u. or 4042 volts
maximum bus voltage = 1.0961 p.u. or 4384 volts

Station Condition: Both Units at 100% power
Light Load Condition
Reserve Station Service Trans. A

DATA SHEET 4

STATION SERVICE SYSTEM CALCULATIONS

Motor Starting Voltage

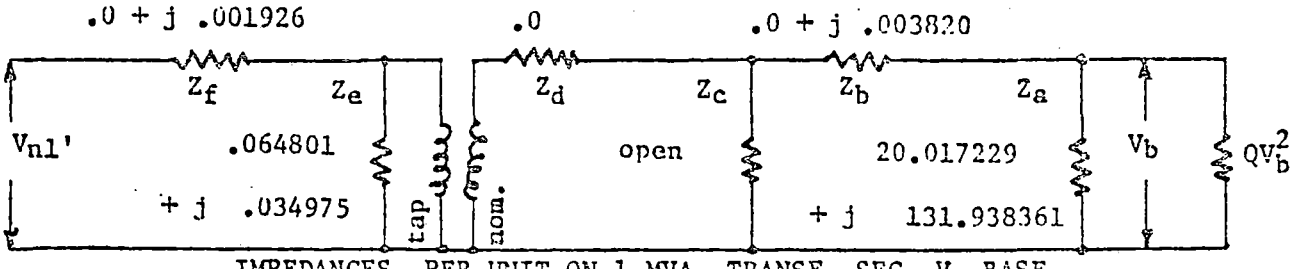
X.0000000006473ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO.* 1401 BY D.J. Agneta DATE 5-14-79

REVIEWED BY CDH DATE 5/16/79

* 1.	1	HORSEPOWER, MOTOR TO BE STARTED
** 2.	4.00	KV, MOTOR NAMEPLATE RATING
** 3.	1	AMP, LOCKED ROTOR CURRENT FOR ABOVE MOTOR
** 4.	30.00	MVA, TRANSFORMER TOP PRIMARY RATING
** 5.	1	NUMBER OF SECONDARIES ON TRANSFORMER
** 6.	.00	MVA, PRIOR LOAD ON OTHER SECONDARY
** 7.	2.39	MVA, PRIOR LOAD ON SAME SECONDARY
** 8.	519	MVA, MINIMUM SHORT CIRCUIT FROM PRIMARY SOURCE
* 9.	5.77	PER CENT, TRANSFORMER NOMINAL IMPEDANCE
**10.	.000555000	TRANSFORMER BASE CONVERSION FACTOR (tbcf on Data Sheet 3)
**11.	.000618	PER UNIT, TRANSFORMER SECONDARY LEADS REACTANCE (lx on Data Sheet 3)
**12.	.000114	PER UNIT, RESISTANCE OF TRANSFORMER AND LEADS (p' on Data Sheet 3)
*13.	13.58	MVA, OTHER LOCAL LOAD ON TRANSFORMER PRIMARY SOURCE



IMPEDANCES, PER UNIT ON 1 MVA, TRANSF. SEC. V. BASE

Z_a = LOCKED ROTOR OF MOTOR BEING STARTED
Z_b = SUPPLY TRANSFORMER SECONDARY AND SECONDARY LEADS
Z_c = SUPPLY TRANSFORMER, OTHER SECONDARY, LEADS, AND RUNNING LOAD
Z_d = SUPPLY TRANSFORMER PRIMARY
Z_e = RUNNING LOAD ON SUPPLY TRANSFORMER PRIMARY CIRCUIT
Z_f = HIGH VOLTAGE SOURCE, MAXIMUM

Light Load Condition
Reserve Station Service Trans A

STATION SERVICE SYSTEM CALCULATIONS DATA SHEET 5

X.000000006815ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1401 BY D.F. Agneta DATE 5-14-79
DFA 5/16/79

160.8 MVA, MIN. TRANSFORMER SHORT CIRCUIT CONTRIBUTION AT BUS

AT pf = .8800 Q = .368200 + j .198733 PU AT FULL VOLTAGE

NOM. PRI. VOLTAGE:* 36.50 PRI. TAP:** RECOM.* 34.40 CHOSEN

VOLTAGE PROFILE

(1)	(2)	(3)	(4)	(5)	(6)	(7)
NO LOAD			AT SPECIFIED LOADS			
SOURCE		TRANSF.	TRANSF.	MED VOLT	MOTOR	
%	KV	SEC. PU	PRI. PU	BUS PU	START %	RUN %
105.00	38.32	1.1586	1.0347	1.1377		113.28
100.00	36.50	1.1034	.9853	1.0829		107.80
95.00	34.67	1.0483	.9358	1.0281		102.31
99.28	36.23	1.0955	.9781	1.0750		107.01
NEW TAP:	36.06					
105.00	38.32	1.1053	1.0347	1.0850		108.00
100.00	36.50	1.0526	.9852	1.0327		102.77
NEW TAP:	35.00					
105.00	38.32	1.1388	1.0347	1.1181		111.31
100.00	36.50	1.0845	.9853	1.0642		105.93
NEW TAP:	35.50					
105.00	38.32	1.1227	1.0347	1.1022		109.73
100.00	36.50	1.0692	.9853	1.0491		104.42
NEW TAP:	34.75					
105.00	38.32	1.1469	1.0347	1.1262		112.13
100.00	36.50	1.0923	.9853	1.0719		106.70
NEW TAP:	34.60					
105.00	38.32	1.1519	1.0347	1.1311		112.62
100.00	36.50	1.0971	.9853	1.0766		107.17
NEW TAP:	34.65					
105.00	38.32	1.1503	1.0347	1.1295		112.45
100.00	36.50	1.0955	.9853	1.0751		107.01
101.46	37.03	1.1115	.9997	1.0910		108.60
98.53	35.96	1.0794	.9707	1.0591		105.41

(1) (2) (4) NOM. PRI. VOLTAGE BASE
(3) (5) (6) (7) MOTOR NAMEPLATE VOLTAGE BASE

Station Condition: Unit 1- Trip from 100% power with SI signal
Unit 2- 100% power

Heavy Loading RSS Trans. A

DATA SHEET 4

STATION SERVICE SYSTEM CALCULATIONS

Motor Starting Voltage

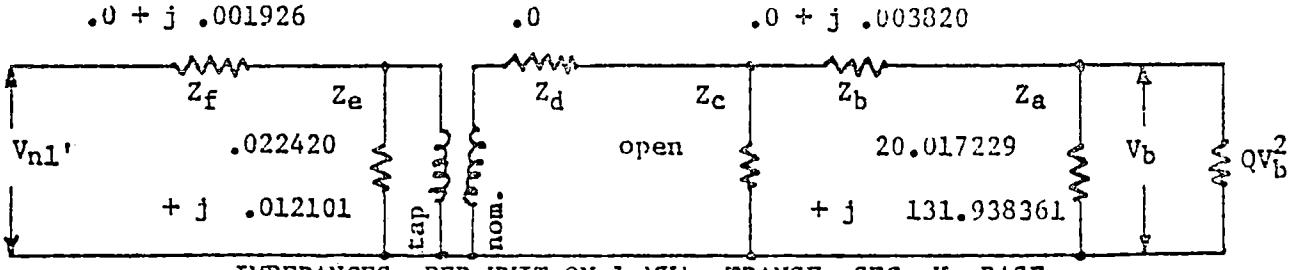
X.000000006473ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO.* 1402 BY D.J. Agneta DATE 5-14-79

REVIEWED BY DJA DATE 5/16/79

* 1.	1	HORSEPOWER, MOTOR TO BE STARTED
** 2.	4.00	KV, MOTOR NAMEPLATE RATING
** 3.	1	AMP, LOCKED ROTOR CURRENT FOR ABOVE MOTOR
** 4.	30.00	MVA, TRANSFORMER TOP PRIMARY RATING
** 5.	1	NUMBER OF SECONDARIES ON TRANSFORMER
** 6.	.00	MVA, PRIOR LOAD ON OTHER SECONDARY
** 7.	16.35	MVA, PRIOR LOAD ON SAME SECONDARY
** 8.	519	MVA, MINIMUM SHORT CIRCUIT FROM PRIMARY SOURCE
* 9.	5.77	PER CENT, TRANSFORMER NOMINAL IMPEDANCE
**10.	.000555000	TRANSFORMER BASE CONVERSION FACTOR (tbcf on Data Sheet 3)
**11.	.000618	PER UNIT, TRANSFORMER SECONDARY LEADS REACTANCE (lx on Data Sheet 3)
**12.	.000114	PER UNIT, RESISTANCE OF TRANSFORMER AND LEADS (p' on Data Sheet 3)
*13.	39.25	MVA, OTHER LOCAL LOAD ON TRANSFORMER PRIMARY SOURCE



IMPEDANCES, PER UNIT ON 1 MVA, TRANSF. SEC. V. BASE

Z_a = LOCKED ROTOR OF MOTOR BEING STARTED
Z_b = SUPPLY TRANSFORMER SECONDARY AND SECONDARY LEADS
Z_c = SUPPLY TRANSFORMER, OTHER SECONDARY, LEADS, AND RUNNING LOAD
Z_d = SUPPLY TRANSFORMER PRIMARY
Z_e = RUNNING LOAD ON SUPPLY TRANSFORMER PRIMARY CIRCUIT
Z_f = HIGH VOLTAGE SOURCE, MAXIMUM

Heavy Loading RSS Trans A

STATION SERVICE SYSTEM CALCULATIONS DATA SHEET 5

X.000000006815ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1402 BY D F. Agneta DATE 5-14-79

160.8 MVA, MIN. TRANSFORMER SHORT CIRCUIT CONTRIBUTION AT BUS

AT pf = .8800 Q = .053822 + j .029050 PU AT FULL VOLTAGE

NOM. PRI. VOLTAGE:* 36.50 PRI. TAP:** RECOM.* 34.65 CHOSEN

VOLTAGE PROFILE

(1)	(2) NO LOAD		(3)	(4)	(5) AT SPECIFIED LOADS	(6)	(7)
	SOURCE		TRANSF.	TRANSF.	MED VOLT	MOTOR	
	%	KV	SEC. PU	PRI. PU	BUS PU	START %	RUN %
	105.00	38.32	1.1503	.9946	1.0588		105.39
	100.00	36.50	1.0955	.9454	1.0030		99.81
	95.00	34.67	1.0407	.8959	.9468		94.18
	90.81	33.14	.9949	.8544	.8993		89.43
	91.38	33.35	1.0011	.8601	.9057		90.08
	91.30	33.32	1.0002	.8593	.9048		89.99
	91.31	33.33	1.0004	.8594	.9050		90.00
	91.31	33.33	1.0003	.8594	.9049		90.00
NOMINAL SWYD							
	100.00	36.50	1.0955	.9454	1.0030		99.81
GRID HIGH							
	101.46	37.03	1.1115	.9598	1.0194		101.44
GRID LOW							
	98.53	35.96	1.0794	.9308	.9865		98.16

(1) (2) (4) NOM. PRI. VOLTAGE BASE
(3) (5) (6) (7) MOTOR NAMEPLATE VOLTAGE BASE

Station Condition Both Units at 100% power
Light Load Condition
Reserve Station Service Trans C

DATA SHEET 4

STATION SERVICE SYSTEM CALCULATIONS

Motor Starting Voltage

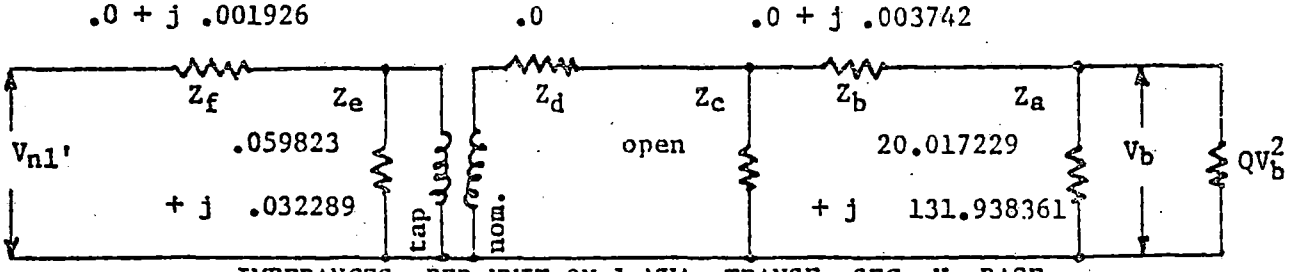
X.000000006473ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO.* 1403 BY D.F. Ignata DATE 5-14-79

REVIEWED BY [illegible] DATE 5/16/79

* 1.	1	HORSEPOWER, MOTOR TO BE STARTED
** 2.	4.00	KV, MOTOR NAMEPLATE RATING
** 3.	1	AMP, LOCKED ROTOR CURRENT FOR ABOVE MOTOR
** 4.	30.00	MVA, TRANSFORMER TOP PRIMARY RATING
** 5.	1	NUMBER OF SECONDARIES ON TRANSFORMER
** 6.	.00	MVA, PRIOR LOAD ON OTHER SECONDARY
** 7.	5.91	MVA, PRIOR LOAD ON SAME SECONDARY
** 8.	519	MVA, MINIMUM SHORT CIRCUIT FROM PRIMARY SOURCE
* 9.	5.63	PER CENT, TRANSFORMER NOMINAL IMPEDANCE
**10.	.000555000	TRANSFORMER BASE CONVERSION FACTOR (tbcf on Data Sheet 3)
**11.	.000618	PER UNIT, TRANSFORMER SECONDARY LEADS REACTANCE (lx on Data Sheet 3)
**12.	.000114	PER UNIT, RESISTANCE OF TRANSFORMER AND LEADS (p' on Data Sheet 3)
*13.	14.71	MVA, OTHER LOCAL LOAD ON TRANSFORMER PRIMARY SOURCE



IMPEDANCES, PER UNIT ON 1 MVA, TRANSF. SEC. V. BASE

Z_a = LOCKED ROTOR OF MOTOR BEING STARTED
Z_b = SUPPLY TRANSFORMER SECONDARY AND SECONDARY LEADS
Z_c = SUPPLY TRANSFORMER, OTHER SECONDARY, LEADS, AND RUNNING LOAD
Z_d = SUPPLY TRANSFORMER PRIMARY
Z_e = RUNNING LOAD ON SUPPLY TRANSFORMER PRIMARY CIRCUIT
Z_f = HIGH VOLTAGE SOURCE, MAXIMUM

Light Loading RSS Trans C

STATION SERVICE SYSTEM CALCULATIONS DATA SHEET 5

X.000000006815ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEPCO PLANT Surry

RUN NO. 1403 BY D F Agnetti DATE 5-14-79

163.0 MVA, MIN. TRANSFORMER SHORT CIRCUIT CONTRIBUTION AT BUS

AT pf = .8800 Q = .148900 + j .080367 PU AT FULL VOLTAGE

NOM. PRI. VOLTAGE:* 36.50 PRI. TAP:** RECOM.* 34.40 CHOSEN

VOLTAGE PROFILE

(1)	(2) NO LOAD		(3)	(4)	(5) AT SPECIFIED LOADS	(6)	(7)
SOURCE			TRANSF.	TRANSF.	MED VOLT	MOTOR	
%	KV		SEC. PU	PRI. PU	BUS PU	START %	RUN %
105.00	38.32		1.1586	1.0305	1.1271		112.21
100.00	36.50		1.1034	.9808	1.0718		106.69
NEW TAP:	36.31						
105.00	38.32		1.0977	1.0304	1.0667		106.17
100.00	36.50		1.0454	.9808	1.0143		100.93
NEW TAP:	34.15						
105.00	38.32		1.1671	1.0305	1.1355		113.05
100.00	36.50		1.1115	.9809	1.0798		107.49
NEW TAP:	33.91						
105.00	38.32		1.1754	1.0305	1.1437		113.87
100.00	36.50		1.1194	.9809	1.0876		108.27
NEW TAP:	34.15						
105.00	38.32		1.1671	1.0305	1.1355		113.05
100.00	36.50		1.1115	.9809	1.0798		107.49
95.00	34.67		1.0559	.9312	1.0241		101.91
HIGH GRID							
101.46	37.03		1.1277	.9953	1.0961		109.11
LOW GRID							
98.53	35.96		1.0952	.9663	1.0635		105.85

(1) (2) (4) NOM. PRI. VOLTAGE BASE
(3) (5) (6) (7) MOTOR NAMEPLATE VOLTAGE BASE

Station Condition: Unit 1- Trip from 100% power wi[redacted]SI signal
Unit 2 100% power
Heavy LOading Reserve Station Service Trans C DATA SHEET 4

STATION SERVICE SYSTEM CALCULATIONS

Motor Starting Voltage

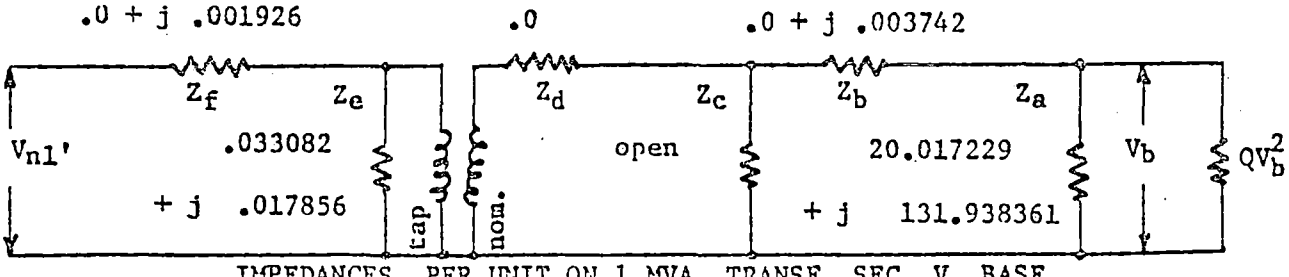
X.000000006473ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT VEBCO PLANT Surry

RUN NO.* 1404 BY D.F. Ignata DATE 5-14-79

REVIEWED BY [signature] DATE 5/16/79

* 1.	1	HORSEPOWER, MOTOR TO BE STARTED
** 2.	4.00	KV, MOTOR NAMEPLATE RATING
** 3.	1	AMP, LOCKED ROTOR CURRENT FOR ABOVE MOTOR
** 4.	30.00	MVA, TRANSFORMER TOP PRIMARY RATING
** 5.	1	NUMBER OF SECONDARIES ON TRANSFORMER
** 6.	.00	MVA, PRIOR LOAD ON OTHER SECONDARY
** 7.	18.20	MVA, PRIOR LOAD ON SAME SECONDARY
** 8.	519	MVA, MINIMUM SHORT CIRCUIT FROM PRIMARY SOURCE
* 9.	5.63	PER CENT, TRANSFORMER NOMINAL IMPEDANCE
**10.	.000555000	TRANSFORMER BASE CONVERSION FACTOR (tbcf on Data Sheet 3)
**11.	.000618	PER UNIT, TRANSFORMER SECONDARY LEADS REACTANCE (lx on Data Sheet 3)
**12.	.000114	PER UNIT, RESISTANCE OF TRANSFORMER AND LEADS (p' on Data Sheet 3)
*13.	26.60	MVA, OTHER LOCAL LOAD ON TRANSFORMER PRIMARY SOURCE



IMPEDANCES, PER UNIT ON 1 MVA, TRANSF. SEC. V. BASE

Z_a = LOCKED ROTOR OF MOTOR BEING STARTED
Z_b = SUPPLY TRANSFORMER SECONDARY AND SECONDARY LEADS
Z_c = SUPPLY TRANSFORMER, OTHER SECONDARY, LEADS, AND RUNNING LOAD
Z_d = SUPPLY TRANSFORMER PRIMARY
Z_e = RUNNING LOAD ON SUPPLY TRANSFORMER PRIMARY CIRCUIT
Z_f = HIGH VOLTAGE SOURCE, MAXIMUM

Heavy Loading RSS Trans C

STATION SERVICE SYSTEM CALCULATIONS DATA SHEET 5

X.000000006815ex0 PROGRAM VERIFICATION NO.

JOB ORDER NO. 12846.23 CLIENT Vepco PLANT Surry

RUN NO. 1404 BY D.F. Agneta DATE 5-14-79

163.0 MVA, MIN. TRANSFORMER SHORT CIRCUIT CONTRIBUTION AT BUS

AT pf = .8800 Q = .048351 + j .026097 PU AT FULL VOLTAGE

NOM. PRI. VOLTAGE:* 36.50 PRI. TAP:** RECOM.* 34.15 CHOSEN

VOLTAGE PROFILE

(1)	(2) NO LOAD		(3)	(4)	(5) AT SPECIFIED LOADS	(6)	(7)
SOURCE			TRANSF.	TRANSF.	MED VOLT	MOTOR	
%	KV		SEC. PU	PRI. PU	BUS PU	START %	RUN %
105.00	38.32		1.1671	1.0057	1.0850		108.01
100.00	36.50		1.1115	.9557	1.0275		102.25
95.00	34.67		1.0559	.9055	.9694		96.45
88.55	32.32		.9843	.8404	.8936		88.87
89.68	32.73		.9969	.8519	.9070		90.21
89.47	32.65		.9945	.8498	.9046		89.96
89.51	32.67		.9950	.8502	.9050		90.01
89.50	32.67		.9949	.8501	.9049		90.00
89.50	32.67		.9949	.8501	.9050		90.00
NOMINAL SWYD							
100.00	36.50		1.1115	.9557	1.0275		102.25
GRID HIGH							
101.46	37.03		1.1277	.9703	1.0443		103.94
GRID LOW							
98.53	35.96		1.0952	.9410	1.0105		100.55

(1) (2) (4) NOM. PRI. VOLTAGE BASE
(3) (5) (6) (7) MOTOR NAMEPLATE VOLTAGE BASE

APPENDIX B

TABULATION OF LOADS

480V EMERGENCY POWER SYSTEM

SURRY - UNIT 1

480V UNIT SUBSTATION "1H1"

TABULATION OF LOADS

SECTION NO.	MOTOR CONTROL CENTER 1H1-1 DESCRIPTION OF LOAD	KVA LOAD LOCA W/LOSP	LOSP	LOCA
1-C	Feeder to MCC 1H1-1A (See Page 4)	24.7	24.7	24.7
1-D	Control Room Emerg Supply Fan 1-VS-F-41	(1)	-	(1)
1-E	Charging Pump Service Wtr Pp 1-SW-P-10A	8	8	8
1-F	Computer Feeder Back-up	-	-	-
1-F	480V Pwr Receptacle	-	-	-
2-D	Radiation Monitoring (2-5KVA XFMRS)	5	5	5
2-D	Vital Bus (1-10KVA XFMR)	5	5	5
3-D	Control and Relay Room A/C Cond. Pp	14.5	14.5	14.5
4-A	Chilled Wtr A/C 1-VS-AC-1	11.2	11.2	11.2
4-A	Chilled Wtr A/C 1-VS-AC-7	11.2	11.2	11.2
4-B	Chilled Wtr A/C 2-VS-AC-7	7.1	7.1	7.1
4-B	Chilled Wtr A/C 2-VS-AC-9	7.8	7.8	7.8
4-E	A/C Chiller Pp 1-VS-P-2A	19.9	19.9	19.9
5-A	Control and Relay Room Wtr Chiller 1-VS-E-4A	95.6	95.6	95.6
5-B	Battery Charger 1A-1	38.8	19.4	38.8
5-B	Battery Charger 1A-2	(2)	(2)	(2)
5-C	Charging Pp Cooling Wtr Pp 1-CC-P-2A	11.2	11.2	11.2
5-D	Emerg Generator Fuel Oil Pp 1-EE-P-1A	1.1	1.1	1.1
5-E	Heat Tracing (1-30 KVA XFMR)	15	15	15
6-A	Safeguards Cond Pp 1-HS-P-3B	-	-	-
6-E	Relay Room Emerg Supply Fan 1-VS-F-42	(1)	-	(1)
7-D	Seal Oil Back-up Pp	25.5	25.5	25.5
8-C	Heat Tracing (1-15KVA XFMR)	7.5	7.5	7.5
8-C	Heat Tracing (1-30KVA XFMR)	15	15	15
8-D	Turning Gear	59.8	59.8	59.8
	TOTALS	383.9	364.5	383.9

(1) Manual start 60 min flowing LOCA.

(2) Assumed single charger operating at full load.

480V UNIT SUBSTATION "1H1"

TABULATION OF LOADS

SECTION NO.	MOTOR CONTROL CENTER 1H1-2 DESCRIPTION OF LOAD	KVA LOAD LOCA W/LOSP	LOSP	LOCA
SOUTH				
2-D	Boron Inj Tank Heater 1-SI-TK-2	3	3	3
4-D	Control and Relay Room Group No. 2	1.1	1.1	1.1
5-D1	480V Power Receptacle	-	-	-
5-D2	Aux Bldg Elevator	-	-	-
6-D	Hydrogen Recombiner A	-	-	-
9-A	Gaseous Waste Blower 1-GW-C-3A	-	-	-
10-A	Boric Acid Trans Pp 1-CH-P-2A	14.3	14.3	14.3
10-B	Aux Bldg Centra Area Exhaust Fan, 1-VS-F-8A	76.5	76.5	76.5
NORTH				
1-D	Charging Pp Aux Oil Pp 1-CH-P-1A	-	-	-
2-A	Aux Feedwater Pp Motor Heater	-	2	-
2-D	Containment Vacuum Pp 1-CV-P-1A	-	1.4	-
3-A	Emerg Generator Fuel Oil Pp 1-EE-P-1D	(1)	(1)	(1)
3-B	Gaseous Waste Blower 1-GW-C-2A	-	-	-
3-D	Containment I.A. Comp 1-IA-C-3A	8	8	8
4-A	Safeguard Area Sump Pp 1-DA-P-1A	1.3	1.3	1.3
4-D	Recirc Spray Pp Motor Htr	-	2	-
5-A	Cont Spray Pp Motor Htr	-	2	-
5-D	Safeguards Area Exh Fan 1-VS-F-40A	8.7	8.7	8.8
6-A	LHSI Pp Motor Htr	-	2	-
6-D	Recirc Spray Pp Motor Htr	-	2	-
7-A	Boric Acid Tank A Htr	7.5	7.5	7.5
7-D	Boric Acid Tank B Htr	7.5	7.5	7.5
8-D1	4KV Bus 1J Heater	-	7.5	-
8-D2	Incore Instrument Drive D	-	-	-
10-D	Emerg F.W. Make-up Pp 1-FW-P-4A	-	-	-
11-B	Control Rod Cooling Fan 1-VS-F-60A	73.3	73.3	73.3
1-C	Control Rod Cooling Fan 1-VS-F-60F	73.3	73.3	73.3
	TOTALS	274.5	293.4	274.5

(1) Assumed single pump operating, 1-EE-P-1A from previous page.

480V UNIT SUBSTATION "1H1"

TABULATION OF LOADS

SECTION NO.	MOTOR CONTROL CENTER 1H1-1A DESCRIPTION OF LOAD	KVA LOAD LOCA W/LOSP	LOSP	LOCA
1-A	Incoming Line Section	-	-	-
1-B	Space	-	-	-
1-C	Air Compressor No. 1	8.76	8.76	8.76
1-D	Air Compressor No. 2	8.76	8.76	8.76
1-E1	Battery Charger	3.45	3.45	3.45
1-E2	Diesel Generator Control Cab.	(1)	(1)	(1)
1-D2	480V Power Receptacle	-	-	-
1-F1	Lighting Cabinet (1-7.5 KVA XFMR)	3.75	3.75	3.75
	TOTALS	24.7	24.7	24.7

(1) Not required when diesel running.

480V UNIT SUBSTATION "1J1"

TABULATION OF LOADS

SECTION NO.	MOTOR CONTROL CENTER 1J1-1 DESCRIPTION OF LOAD	KVA LOAD LOCA W/LOSP	LOSP	LOCA
1-C	Turning Gear Motor	51.8	51.8	51.8
2-A1	Vepco Test Equip Recp	-	-	-
2-A2	Heat Tracing XFMR Cab 2, 30 KVA	15	15	15
2-B	Roadway Lighting	-	-	-
3-A1	Rad Monitoring	5	5	5
3-A2	Vital Bus 1-IV FDR	5	5	5
3-B1	Low Pressure CO_2 Sys Refrig			
3-B2	RSS Trans Cooling Fans	25	25	25
4-B	Gen Brg Lift Pump	6.1	6.1	6.1
4-C	Charging Pp Service Wtr Pump	8.0	8.0	8.0
4-D	Emer Gen F.O. Pump 1-EE-P-1C	1.1	1.1	1.1
4-E	Charging Pp Cooling Wtr Pump	11.1	11.1	11.1
5-C1	Batt Chgr 1B-1	(38.8)	19.4	(38.8)
5-C2	Batt Chgr 1B-2	-	-	-
5-D	Spare	-	-	-
5-E	Safeguards Duplex Cond Pump 1-HS-P-3B	-	-	-
6-A	Cont and Rel Rm A/C Cond Pp 1-VS-P-1B	(14.5)	(14.5)	(14.5)
6-B	A/C Chiller Pump 1-VS-P-2B	19.9	19.9	19.9
6-C	Cont and Rel Rm Wtr Chlr	95.6	95.6	95.6
6-D	Charging Pp Aux Oil Pp 1-CH-P-1B	-	-	-
6-E	MCC 1J1-1A Gen Rm No. 3	28.5	28.5	28.5
7-D1	Semi-Vital Bus Feeder	20	20	20
7-D2	FDR 30 KVA Heat Trace XFMR Cab 9	15	15	15
8-D2	FDR 15 KVA Heat Trace XFMR Cab 4	7.5	7.5	7.5
	TOTALS	367.9	348.5	367.9

480V UNIT SUBSTATION "1J1"

TABULATION OF LOADS

SECTION NO.	MOTOR CONTROL CENTER 1J1-2 DESCRIPTION OF LOAD	KVA LOAD LOCA W/LOSP	HOT SB LOSP	LOCA
EAST				
1-D	Cont Air Compressor	11.2	11.2	11.2
2-A	Inst Air Compressor	(86.0)	(86.0)	(86.0)
3-B	Cont Vac Pp 1-CV-P-1B	-	1.4	-
3-C	Cont Spray Pp Mtr Htr 1-CS-P-1B	-	2	-
3-D	Safeguards Area Sump Pp 1-DA-P-1B	1.4	1.4	1.4
3-E	Stm Gen Aux Fd Pump Mot Htr 1-FW-P-3A	-	2	-
4-D	Recirc Spray Pp Mtr Htr 1-RS-P-1B	-	2	-
5-D	Recirc Spray Pp Mtr Htr 1-SI-P-1B	-	2	-
6-D	Hydrogen Rec B	-	-	-
7-D	Lo Hd Saf Inj Mot Htr 1-SI-P-1B	-	2	-
8-D	Recirc Spray Pp Mot Htr 1-RS-P-2B	-	2	-
9-C	Boric Acid Tk Htr 1-CH-E-6C	7.5	7.5	7.5
9-D1	4Kv Swgr Bus H Htr FDR	-	7.5	-
9-D2	Incore Inst Drive "E"	-	5	-
10-C	Control Rod Drive Cooling Fan 1-VS-F-60C	73.3	73.3	73.3
WEST				
1-D1	Personnel Hatch	-	-	-
1-D2	Mn Air Dryer 1-IA-D-1	2.8	2.8	2.8
2-D	Charging Pp Aux Oil Pump 1-CH-P-1C	-	-	-
3-D	Boron Inj Tank Htr 1-SI-TK-2	3	3	3
4-D2	Cont Air Compressor Dryer 1-IA-D-2	2	2	2
6-B	Emer Make-Up Pp 1-FW-P-4B	-	-	-
8-D	Control Rod Drive Cooling Fan 1-VS-F-60D	73.3	73.3	73.3
9-D	Blower 1-GW-C-3B			
9-E	Safeguards Supply HV Unit 1-VS-HV-4	15.5	15.5	15.5
10-B	Boric Acid XFER Pump	14.3	14.3	14.3
)-C	Aux Bldg Central Exh Fan 1-VS-F-8B	76.5	76.5	76.5
	TOTALS	366.8	392.7	366.8

480V UNIT SUBSTATION "1J1"

TABULATION OF LOADS

SECTION NO.	MOTOR CONTROL CENTER 1J1-1A DESCRIPTION OF LOAD	KVA LOAD LOCA W/LOSP	LOSP	LOCA
1-A	Incoming Line	-	-	-
1-B	Filler	-	-	-
1-C	Space	-	-	-
1-D	Air Compressor No. 1	8.76	8.76	8.76
1-E1	Diesel Generator Control Cab.	(1)	(1)	(1)
1-E2	Spare	-	-	-
1-F1	Battery Charger	3.45	3.45	3.45
1-F2	480V Power Receptacle	-	-	-
2-A	Space	-	-	-
2-B	Air Compressor No. 2	8.76	8.76	8.76
2-C	Space	-	-	-
2-D1	Lighting Cabinet 1S9	3.75	3.75	3.75
2-D2	Lighting Cabinet 1S10	3.75	3.75	3.75
	TOTALS	28.45	28.45	28.45

(1) Not required when diesel running.