VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

August 16, 1979

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. D. B. Vassallo, Assistant Director
for Light Water Reactors
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 352A
PO/FHT:scj
Docket No. 50-338
License No. NPF-4

Dear Mr. Denton:

North Anna Unit No. 1
Station Electrical Distribution System Voltages

In our previous letter on this subject, Serial No. 352/050279, dated July 5, 1979, we stated that analyses to verify the capability and capacity of the electric power system, as modified, to start and operate the required safety loads within their rated voltages were in progress and that results would be available on or about July 31, 1979. We herewith forward the results of those analyses.

The worst case reserve system loading that was considered in the design of the modification to the station electric power distribution system was one unit in the start-up mode on reserve power and the other unit at 100% power on station service power. The operating unit then trips and transfers to the reserve power system.

Using the above condition as the plant operating requirement we then used the following Emergency Bus requirements as a design basis. The Emergency Buses should not be inadvertently transferred from the preferred source (RSST) to the standby source (Emergency Diesels) on a transfer of the running unit to the reserve transformers. Therefore, the voltage on the emergency buses must remain above 90% indefinitely or it must recover to greater than 90% in 60 seconds or, in the case of a safety injection actuation, within 10 seconds.

Certain pre-conditions will be required to assure that the worst-case loading used in the voltage studies is not exceeded. These conditions also assure that one feedwater pump and one condensate pump will be running in each unit after automatic load shedding has occurred. These conditions are as follows:

B001
S
1/40

7908210 410

1. Anytime a unit is in a start-up mode when the other unit is on the line, a selector switch on the transformer protection panels for the start-up unit must be placed in the "Start-Up" position.

2. The unit that is on the line will be using two of three steam generator feed pumps; the start-up unit will use only one feedwater pump (this complies with the system design). It will be required that the start-up unit use the feedwater pump with a letter designation (which indicates the bus that it is fed from) which is different from the two operating on the other unit. For example, if the unit on the line has its "A" and "C" feedwater pumps operating, the start-up unit must use its "B" feedwater pump.

3. The start-up unit must use the condensate pump which is fed from the same bus as its running feedwater pump. For instance, if "B" feedwater pump is used for start-up, the "B" condensate pump must also be used.

4. The unit that is on the line may be running all three condensate pumps or must be running the two condensate pumps that are fed from the same buses that are feeding the two running feedwater pumps.

With these pre-conditions in effect, automatic load shedding will occur upon the trip of the unit on the line and subsequent fast transfer of the loads from the normal station service to the reserve station service.

This load shedding will trip off all high and low pressure heater drain pumps, two of three condensate pumps, and one of two feedwater pumps in the unit that was transferred to the reserve source.

Other data and assumptions that have been used in this study are as follows:

A. Minimum voltage on 500kv bus is 508kv based on studies which have previously been transmitted.

B. The reserve transformer load tap changer will correct voltages to the maximum extent possible. For motor starting conditions (accident cases) the LTC position before the incident was determined based on reasonably expected pre-conditions, the was assumed to remain in this position while the emergency motors are started.

C. Containment depressurization actuation results in tripping of all feedwater and condensate pumps on that unit.

D. No operator action to reduce load is assumed to occur for 1 hour after a unit trip.

E. Degraded voltage relay protection on the 4160 volt emergency buses has been considered and will not separate the emergency buses from the preferred source for the conditions analyzed.

The enclosed data show the results of our studies. These data clearly illustrate that for the worst case conditions examined, as defined earlier, the system will have acceptable voltage levels, both for emergency motor starting and continuous operation of all equipment. Following is a brief description of all enclosures:

Enclosure A: Three graphic results of studies conducted to examine the worst case loading configurations which can occur for the two unit station under the non-accident conditions defined earlier. The loads indicated are those which will remain after load shedding. The three different conditions represent the variations in loading that will occur dependent upon which feedwater pump the start-up unit uses. These results indicate that the voltages available on the 4160 volt and 480 volt emergency buses are adequate to operate all the loads continuously.

Enclosure B: Two graphic results of studies conducted to examine the two worst case loading configurations which could occur for containment depressurization actuation accident conditions. These cases are for accident conditions on one unit with subsequent fast transfer of loads, while the other unit is in its start-up mode, and for accident conditions for a unit while in startup mode, and for accident conditions for a unit while in start-up with other unit tripped from 100% power with subsequent fast transfer of loads. These results show that adequate voltages are available to start and continuously run all required emergency loads. It should be noted that the large emergency motors reach full speed within four seconds, by which time the voltage will have recovered to above 90% of the bus voltage rating.

Enclosure C: The enclosed one-line diagrams show the revised electrical power distribution system.

Enclosure D: The enclosed logic diagrams show the annunciation and control sequence for the load shedding scheme, the reserve station service load monitoring, and the revised relaying necessitated by the revisions to the distribution system.

Enclosure E: The enclosed letter from General Electric Company to our Mr. John M. Davis dated June 8, 1979 documents that our reserve station service transformer can carry 156% of maximum nameplate rating for one hour without significant loss of life.

We are continuing with other studies to further upgrade the offsite power supplies to unit auxiliary loads such that load shedding and administrative controls of equipment usage will not be required. These studies include consideration of the addition of Units 3 and 4 at this site.

In addition, we have determined the worst case voltage drops in the leads to emergency motors for cases BA and AW. (See enclosure 2). These worst case voltage drops are as follows:

A. 30.4 volts for the Unit 1 480 volt quench spray pumps for case BA.
B. 27.78 volts for the Unit 1 4160 volt service water pump for case BA.

We intend to perform tests to demonstrate the validity of the analysis results. A description of the test program will be forwarded as soon as it is available.

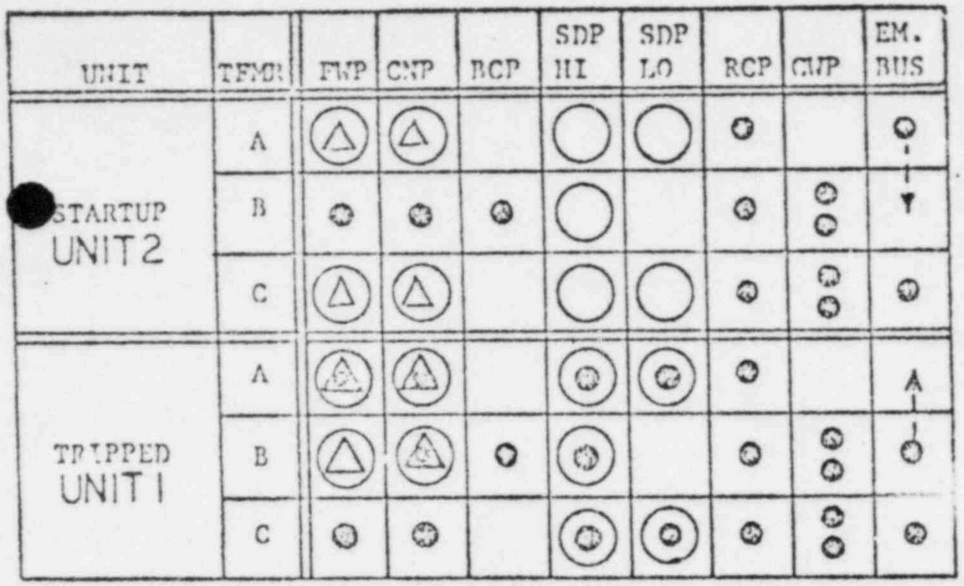
Very truly yours,

C. M. Stallings
C. M. Stallings
Vice President-Power Supply
and Production Operations

cc: Mr. James P. O'Reilly

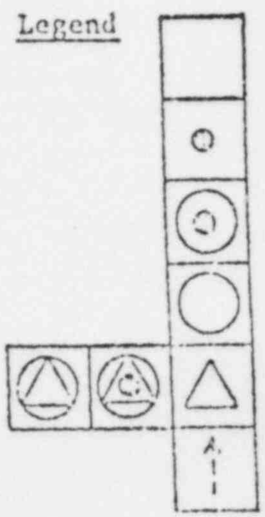
Enclosure A

VEPCO NORTH ANNA POWER STATION UNITS 1 & 2 J.O. No. 12050.42



CONDITIONS AFTER TRIP - RESERVE STATION SERVICE SYSTEM LOADS

Legend



NOT RUNNING

RUNNING

PREVIOUSLY RUNNING, NOW TRIPPED

PREVIOUSLY STANDBY, NOW TRIPPED

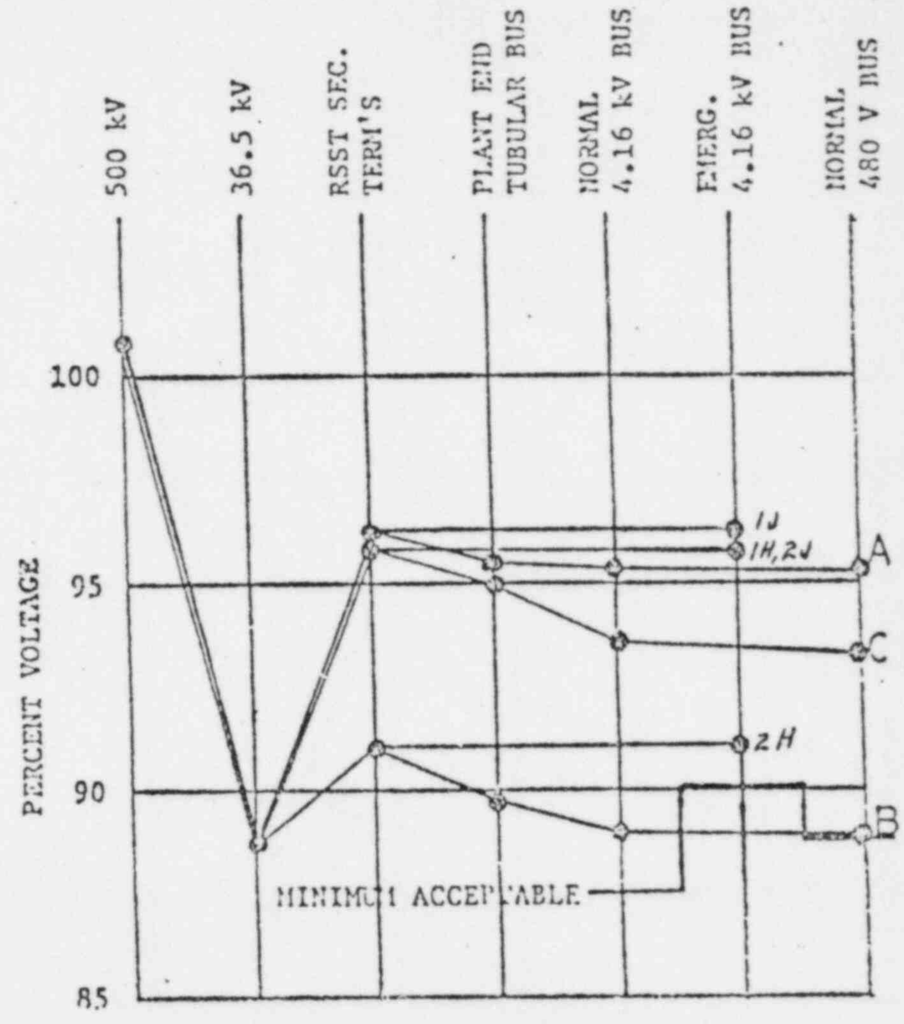
AUTO START DISABLED AUTOMATICALLY THROUGH OPERATOR-PRESET KEY SWITCHES

FED FROM OTHER TRANSFORMER WHEN UNIT 2 IS STARTUP

TFMR	% LOAD
A	59.30
B	138.74
C	135.77

VOLTAGE PROFILE
RESERVE STATION SERVICE TRANSFORMERS
AND CONNECTED BUSES

CASES AP AND AQ



6-15-79
awb

VEPCO NORTH ANNA POWER STATION UNITS 1 & 2 J.O. No. 12050.42

UNIT	TFMR	FWP	CNP	BCP	SDP HI	SDP LO	RCP	CWP	EM. BUS
STARTUP UNIT 2	A	(△)	(△)		◯	◯	o		o ↓
	B	(△)	(△)	o	◯		o	o o	↑
	C	o	o		◯	◯	o	o o	o
TRIPPED UNIT 1	A	o	o		⊙	⊙	o		↑
	B	(△⊙)	(△⊙)	o	⊙		o	o o	↓
	C	(△)	(△⊙)		⊙	⊙	o	o o	o

CONDITIONS AFTER TRIP - RESERVE STATION SERVICE SYSTEM LOADS

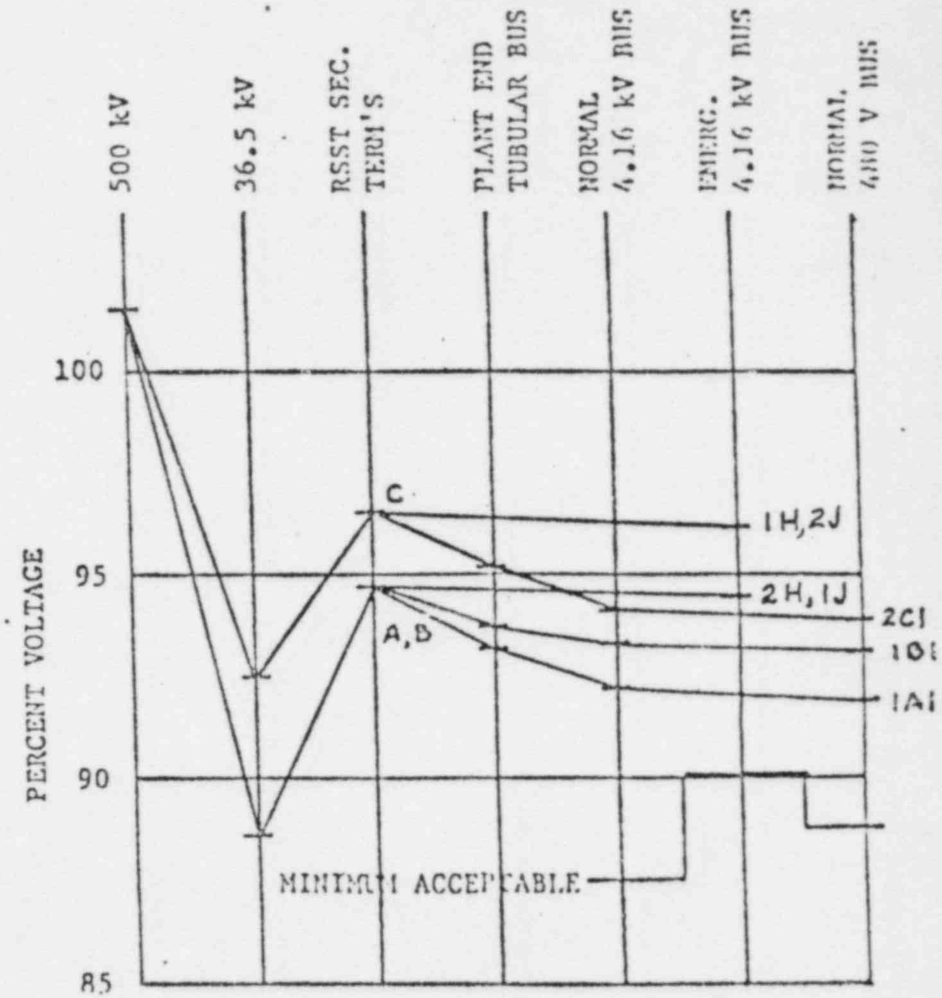
TFMR	% LOAD
A	99.04
B	96.45
C	134.54

Legend

(blank)	NOT RUNNING
o	RUNNING
⊙	PREVIOUSLY RUNNING, NOW TRIPPED
◯	PREVIOUSLY STANDBY, NOW TRIPPED
(△) (△⊙) △	AUTO START DISABLED AUTOMATICALLY THROUGH OPERATOR-PRESET KEY SWITCHES
A ↑	FED FROM OTHER TRANSFORMER WHEN UNIT 2 IS STARTUP

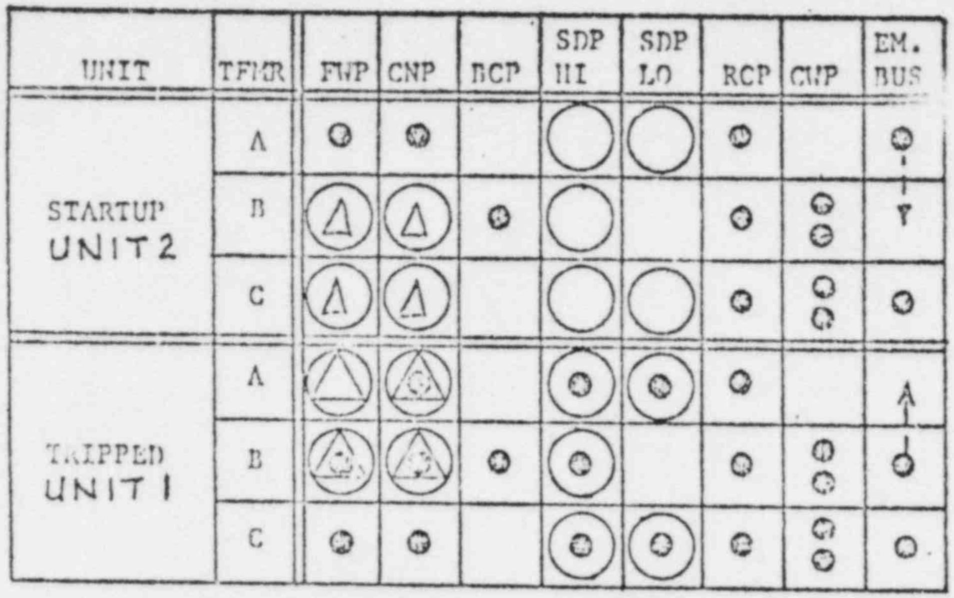
VOLTAGE PROFILE
RESERVE STATION SERVICE TRANSFORMERS
AND CONNECTED BUSES

CASES AR AND AS



6-15-79
auct

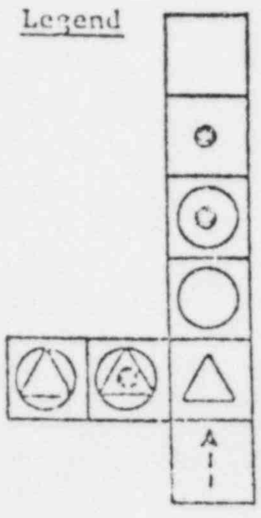
VEPCO NORTH ANNA POWER STATION UNITS 1 & 2 J.O. No. 12050.42



CONDITIONS AFTER TRIP - RESERVE STATION SERVICE SYSTEM LOADS

TFMR	% LOAD
A	94.93
B	98.09
C	135.86

Legend



NOT RUNNING

RUNNING

PREVIOUSLY RUNNING, NOW TRIPPED

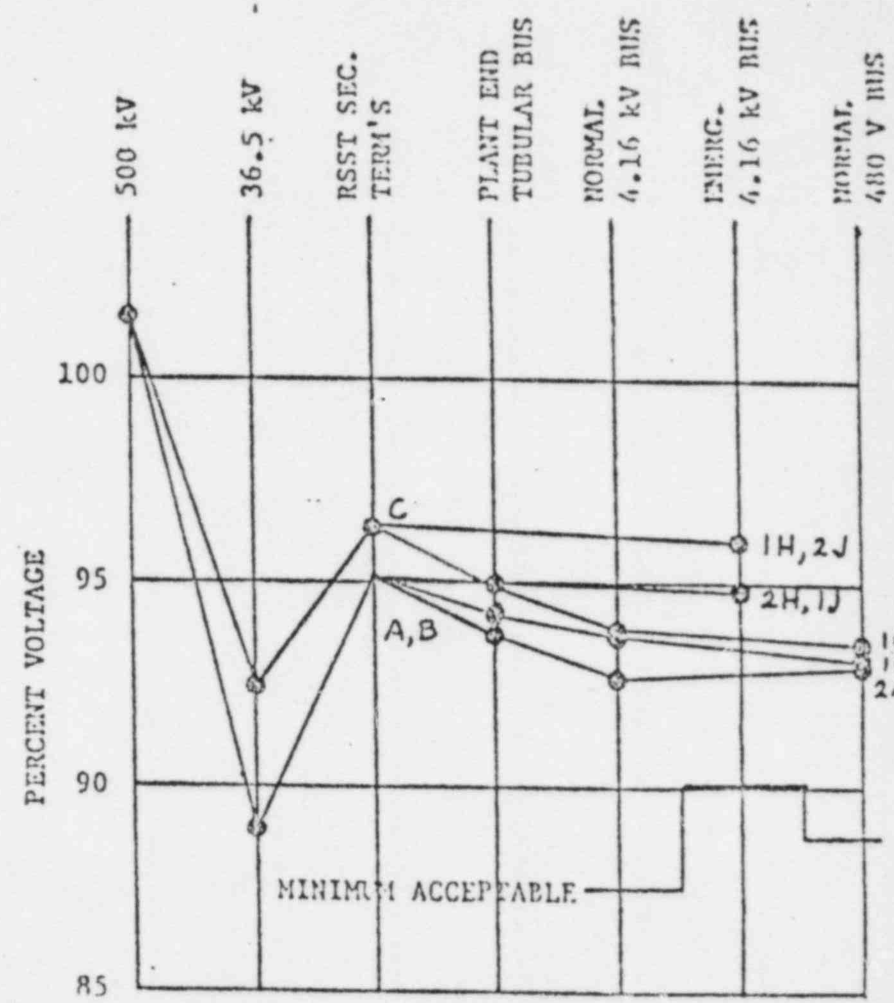
PREVIOUSLY STANDBY, NOW TRIPPED

AUTO START DISABLED AUTOMATICALLY THROUGH OPERATOR-PRESET KEY SWITCHES

FED FROM OTHER TRANSFORMER WHEN UNIT 2 IS STARTUP

VOLTAGE PROFILE
RESERVE STATION SERVICE TRANSFORMERS
AND CONNECTED BUSES

CASES AT AND AU



6-15-79
awb

Enclosure B

RUN AW

UNIT 2 - STARTUP AND CDA ("B" PUMPS)

UNIT 1 - TRIP FROM 100% POWER

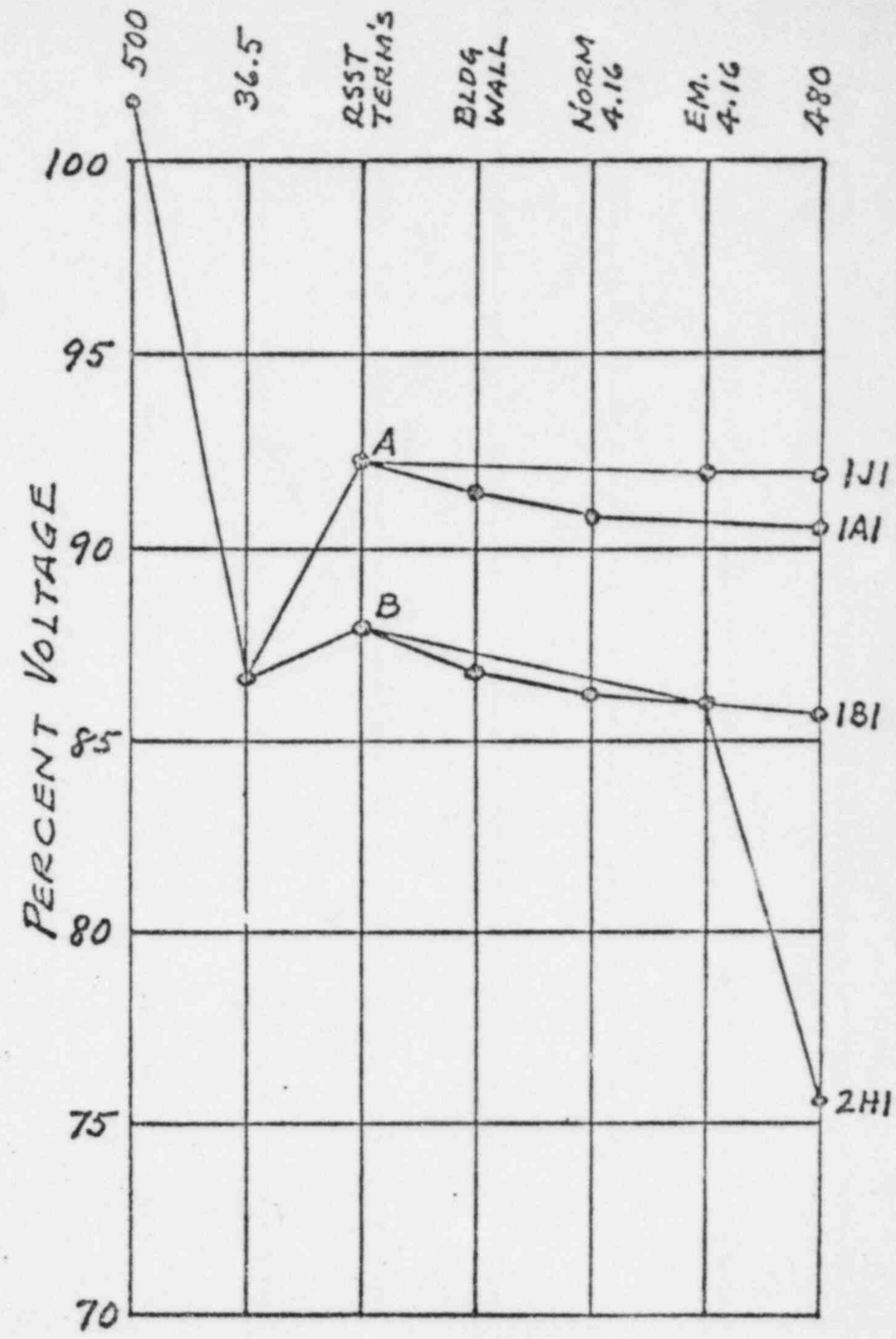
500 kV BUS AT 517 kV BEFORE
508 kV AFTER

RSST "A" ON LTC TAP R11

RSST "B" ON LTC TAP R16

BOTH ON 35.3 kV PRIMARY TAP

AUTOMATIC LOAD SHED



7-9-79
AWD

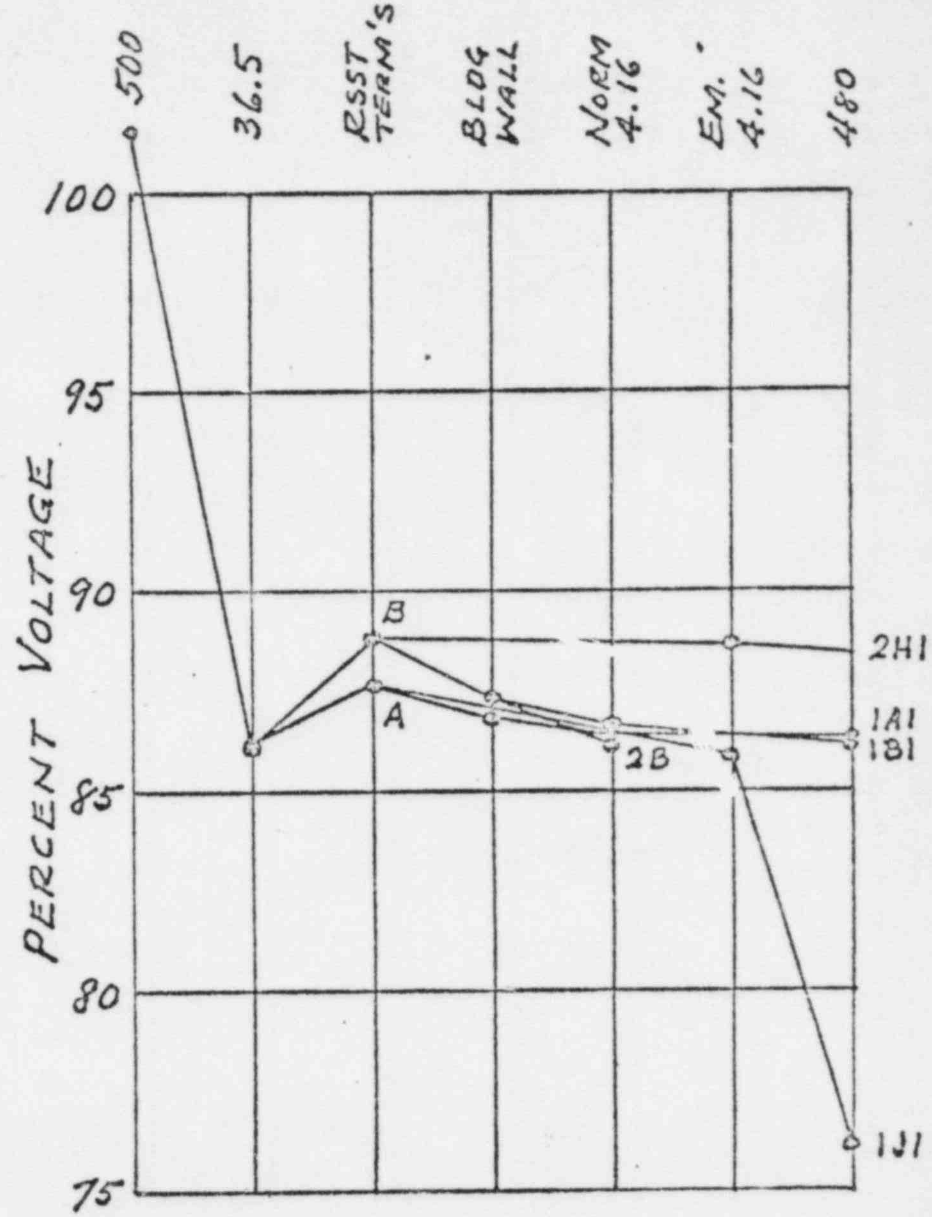
CASE BA

UNIT 2 STARTUP ("B" PUMPS)
UNIT 1 TRIP AND CDA

500 kV BUS AT 517 kV BEFORE
508 kV AFTER

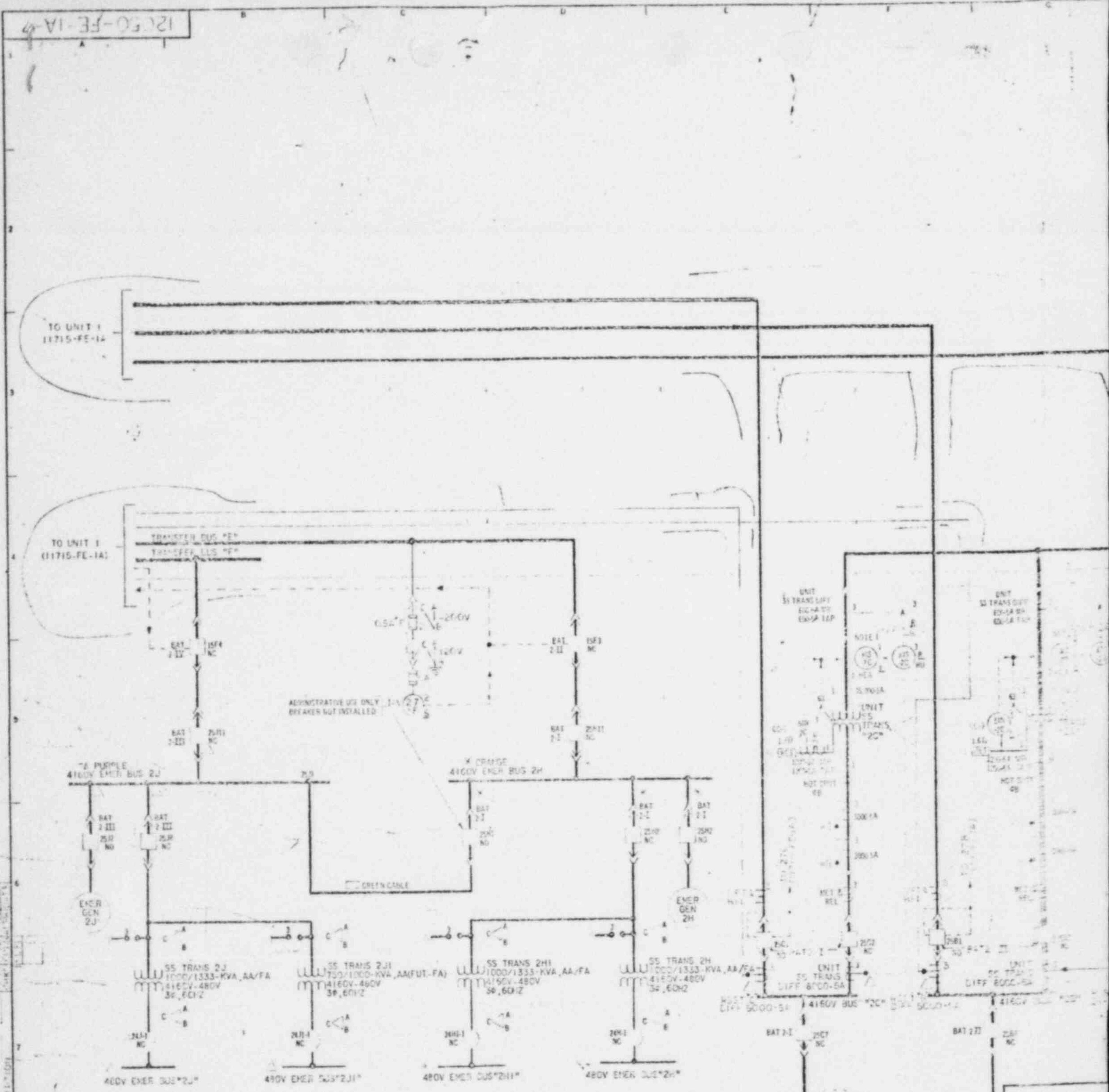
RSST "A" ON LTC TAP R10
RSST "B" ON LTC TAP R16
BOTH ON 35.3 kV PRIMARY TAP

AUTOMATIC LOAD SHED



7-12-79
AWH

Enclosure C

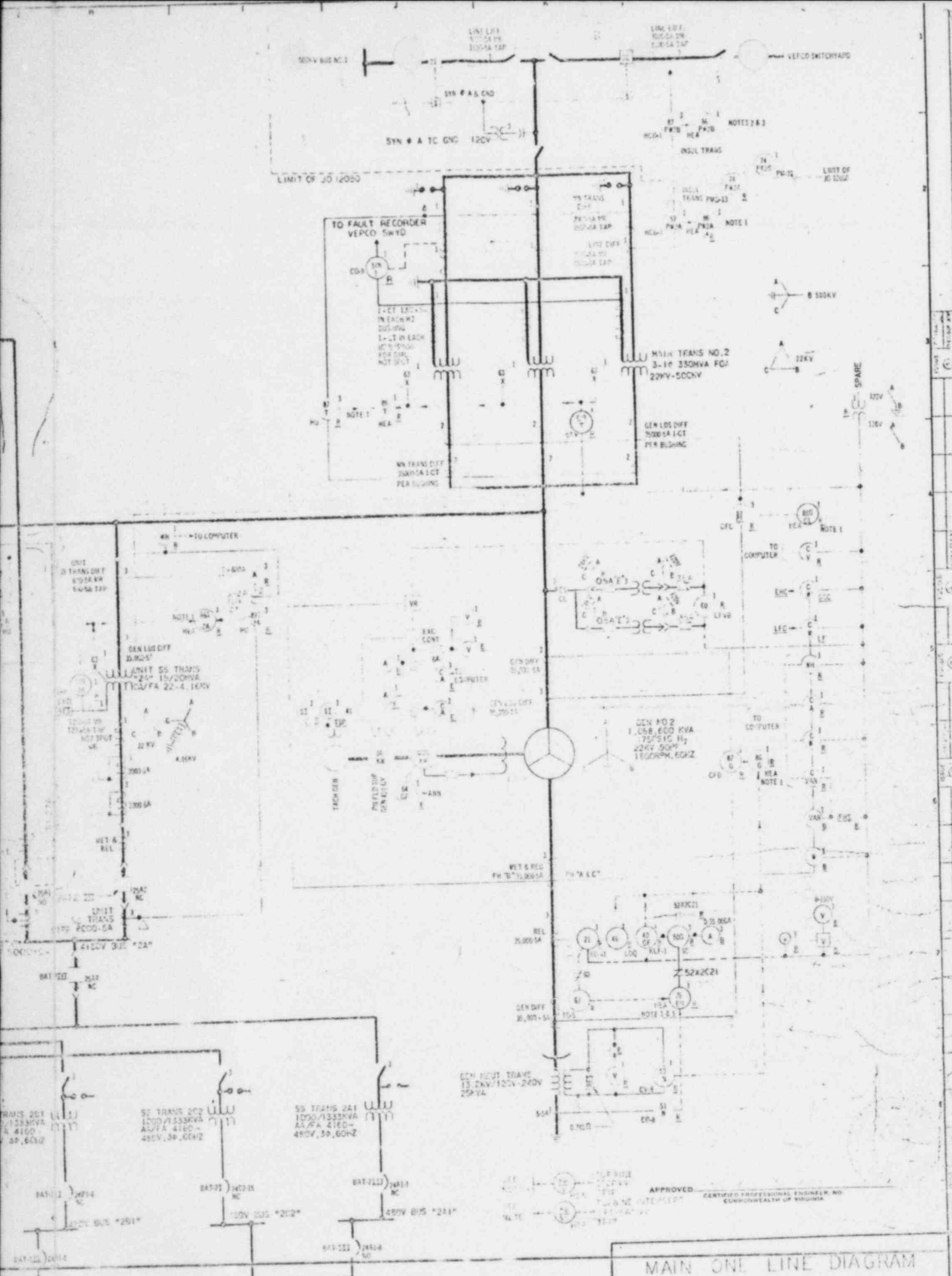


NOTES:

1. TRIPS & LOCKOUT SS TRANS BKRS 25A2, B2 & C2 500KV PCB'S 21 & 2C REGULATOR SUPPLY BKR TURB SOL VV & ANN
2. TRIPPED BY PILOT WIRE BACK-UP RELAY BY VEPCO.
3. TRIPS & LOCKOUT 500KV PCB'S 21 & 2C & TRIPS 86-PC2A & ANN
4. FOR REFERENCES & SYMBOLS, STD-ME-10.1, 11.1-11.5
5. TRIPPED BY PCB'S 21 & 2C BREAKER FAILURE LOCKOUT HEA BY VEPCO

IDENTIFICATION OF VITAL CKTS

* VITAL CKT(ORANGE CABLE) ON BUS "2H" & "2H1"
& VITAL CKT(PURPLE CABLE) ON BUS "2J" & "2J1"
VITAL CKT(GREEN CABLE) ON BUS "2H" OR "2J"



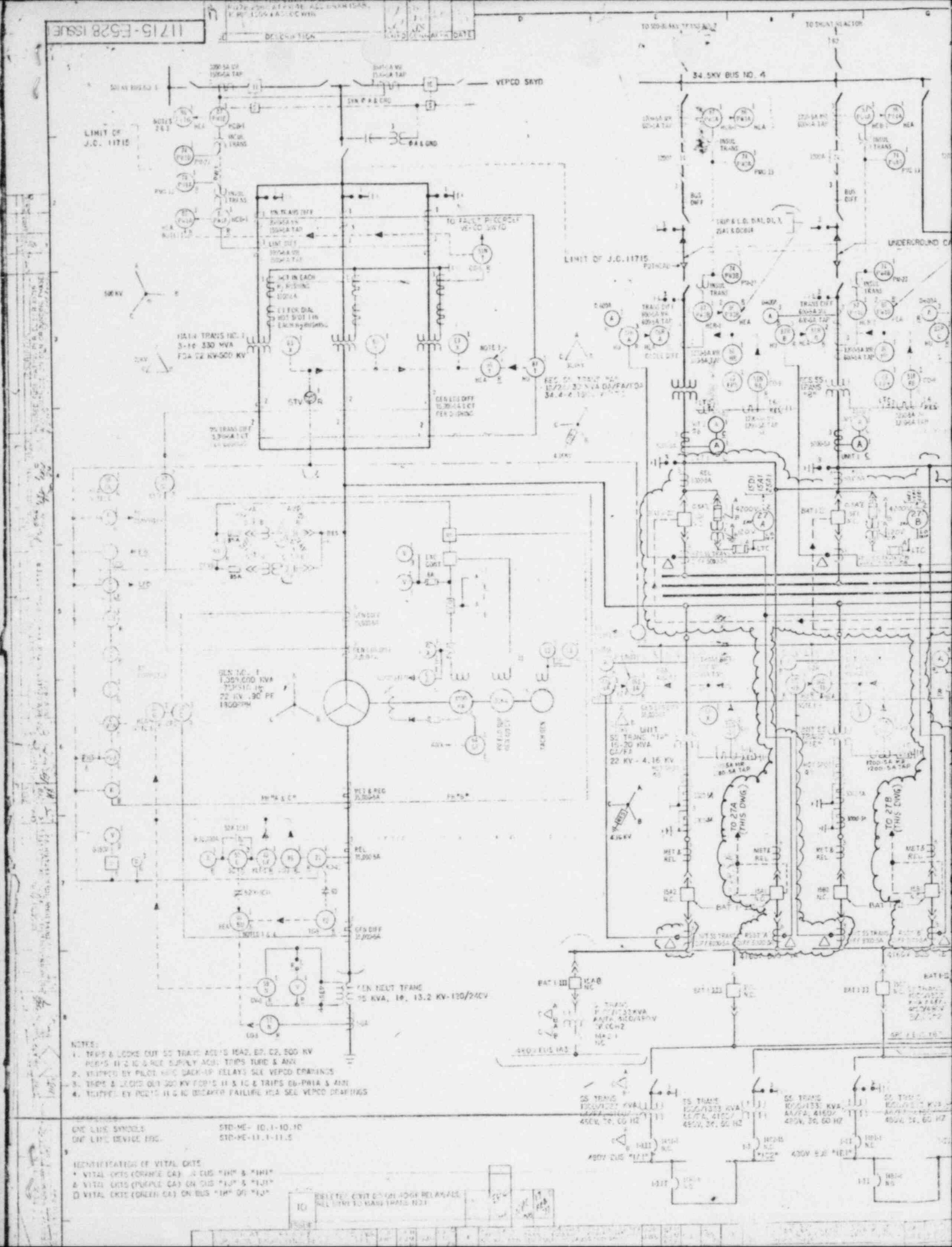
MAIN ONE LINE DIAGRAM

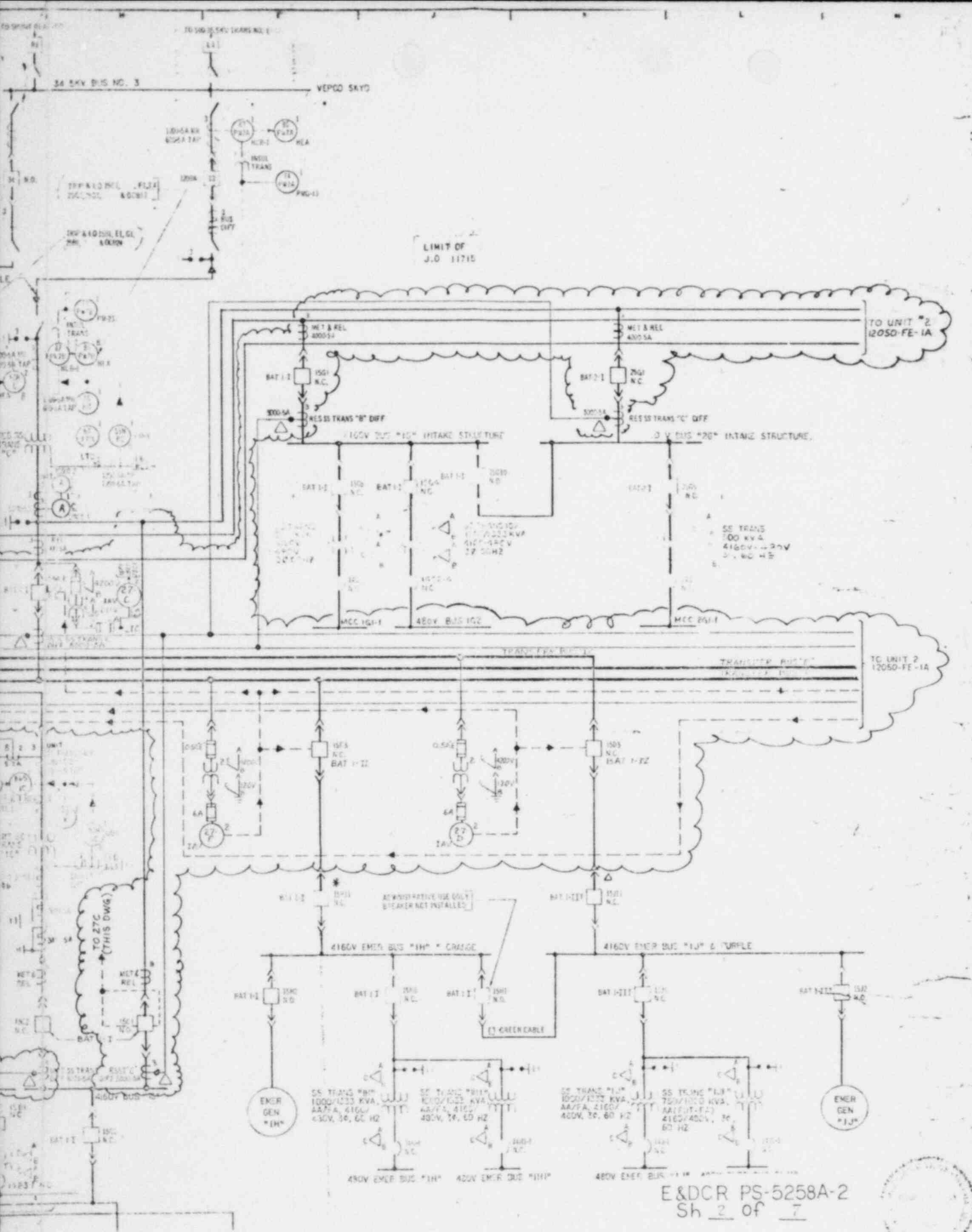
UNIT 2—NORTH ANNA POWER STATION

VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12050-FE-1A-7


11715-E528 ISSUE
VEPCO SWYD
34.5KV BUS NO. 4
LIMIT OF J.C. 11715
UNDERGROUND CA
500 KV
UNIT SS TRANS "1H"
15-20 MVA
OA/FA
22 KV - 4.16 KV
TO 27A (THIS DWG)
TO 27B (THIS DWG)
480V BUS 1A3
NOTES:
1. TRIPS & LOCKS OUT SS TRANS ACB'S 15A2, E2, C2, 500 KV
2. TRIPPED BY PILOT WIRE BACK-UP RELAYS SEE VEPCO DRAWINGS
3. TRIPS & LOCKS OUT 500 KV PCB'S 11 & 1C & TRIPS 86-PW1A & ANN
4. TRIPPED BY PCB'S 11 & 1C BREAKER FAILURE SEE VEPCO DRAWINGS
ONE LINE SYMBOLS
STD-ME- 10.1-10.10
ONE LINE DEVICE
STD-ME-11.1-11.5
IDENTIFICATION OF VITAL CKTS
VITAL CKTS (ORANGE CA) ON BUS "1H" & "1H1"
VITAL CKTS (PURPLE CA) ON BUS "1J" & "1J1"
VITAL CKTS (GREEN CA) ON BUS "1H" OR "1J"



E&DCR PS-5258A-2
Sh 2 of 7

APPROVED

CERTIFIED PROFESSIONAL ENGINEER IN COMMONWEALTH OF VIRGINIA

THE INFORMATION ON THIS DRAWING MAY NOT BE COPIED OR USED FOR OTHER THAN THE CONSTRUCTION, MAINTENANCE OR REPAIR OF THE PLANT FACILITY DESCRIBED IN THE TITLE BLOCK.

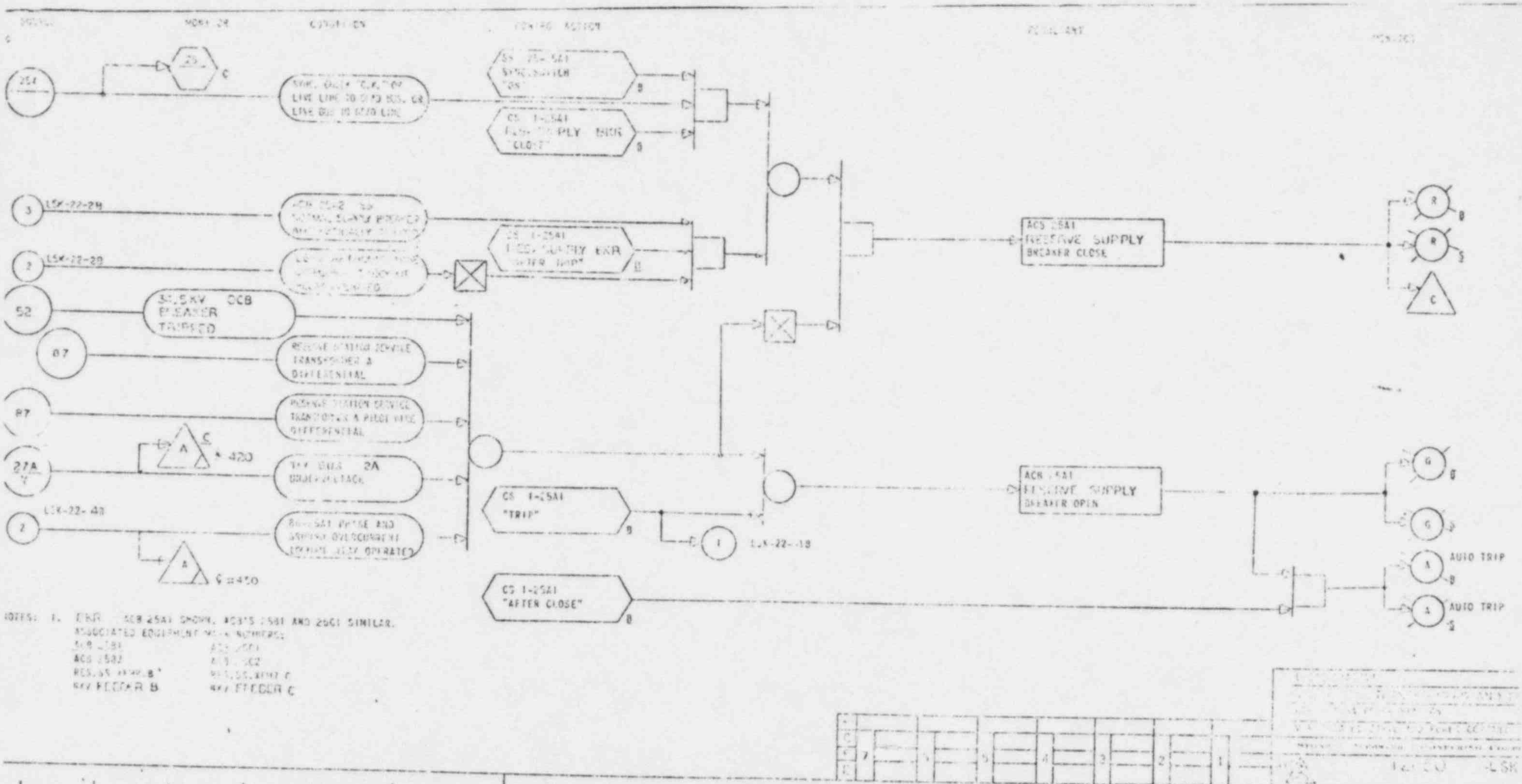
MAIN ONE LINE DIAGRAM

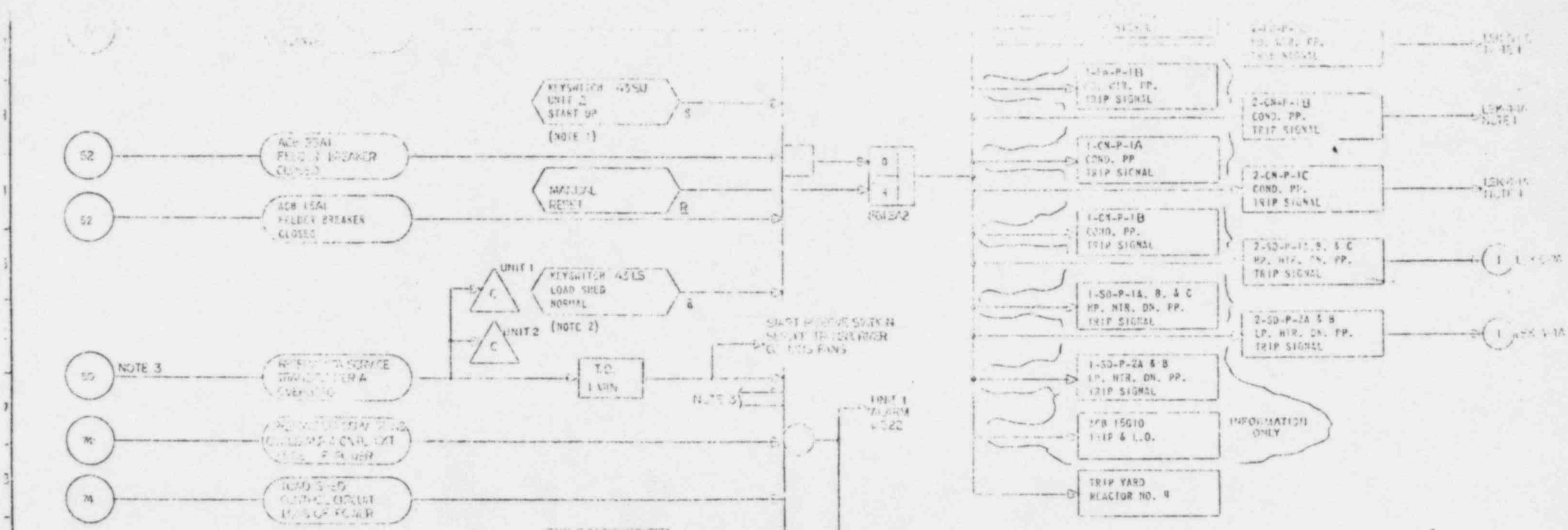
NORTH ANNA POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORP.
BOSTON, MASS.

E-528 ISSUE 1

DRAWING NUMBER 11715-FE-1A

Enclosure D

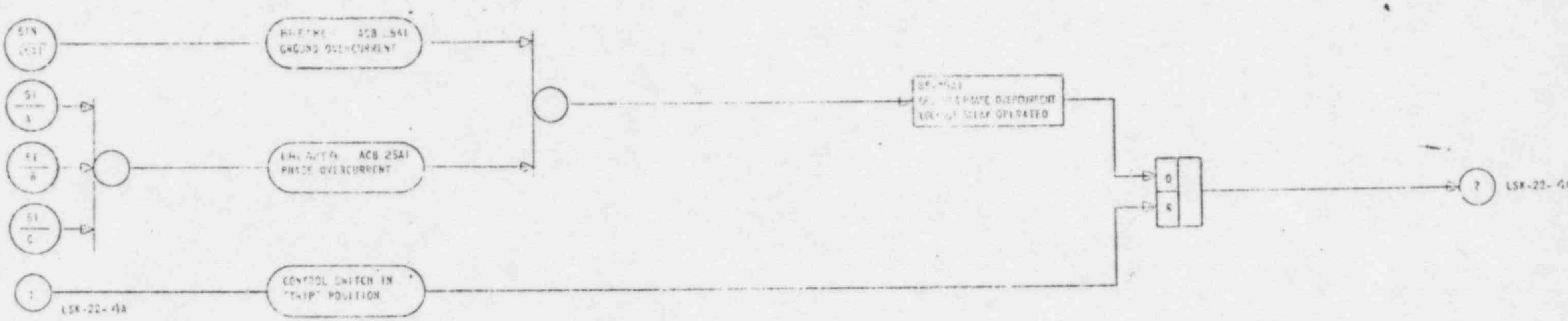

25
35.5KV OCB
BREAKER
TRIPPED
52
87
27A
CS 1-25A1
"TRIP"
CS 1-25A1
"AFTER CLOSE"
ACB 25A1
RESERVE SUPPLY
BREAKER CLOSE
ACB 25A1
RESERVE SUPPLY
BREAKER OPEN
AUTO TRIP
AUTO TRIP
LSK-22-2B
LSK-22-2B
LSK-22-4B
LSK-22-1B



NOTES: 1. TWO POSITION SWITCH UNIT 1 - UNIT 2 (COMMON TO BOTH UNITS).

2. TWO POSITION SWITCH NORMAL - DEFEAT (COMMON TO BOTH UNITS).

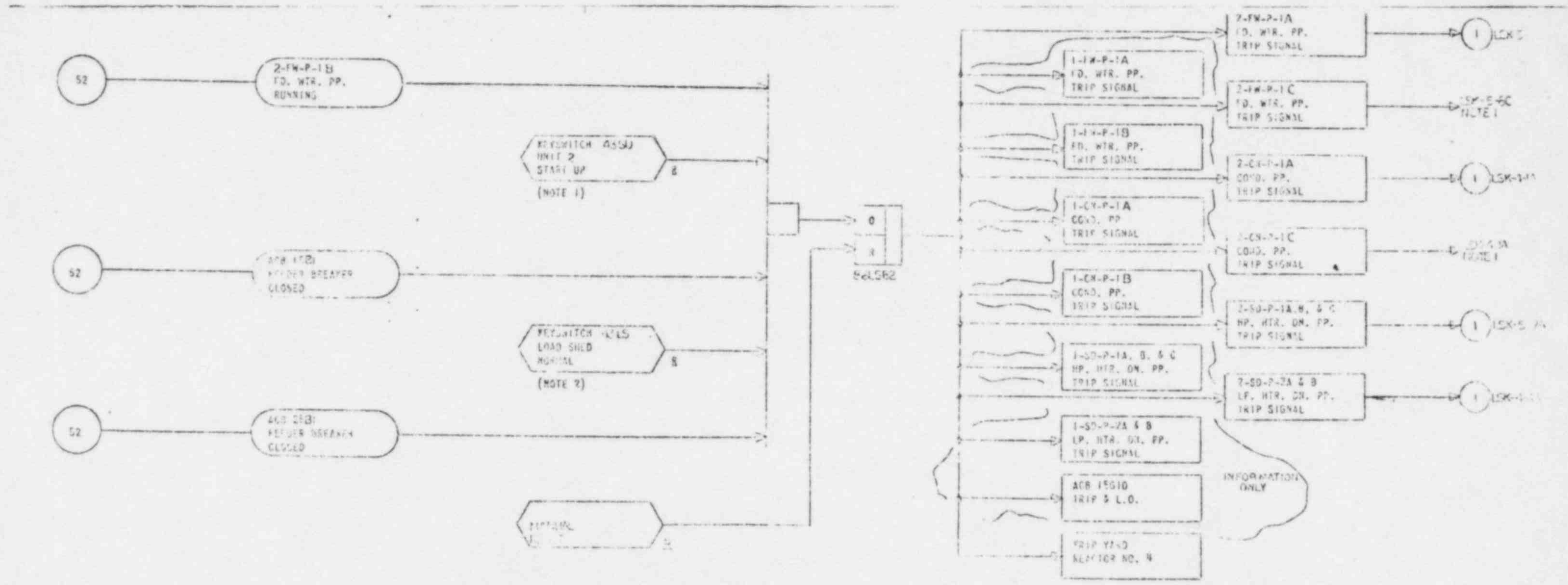
3. CONTROL FOR RESERVE STATION SERVICE TRANSFORMER A SHOWN. CONTROL FOR TRANSFORMERS B AND C SIMILAR.



NOTES:

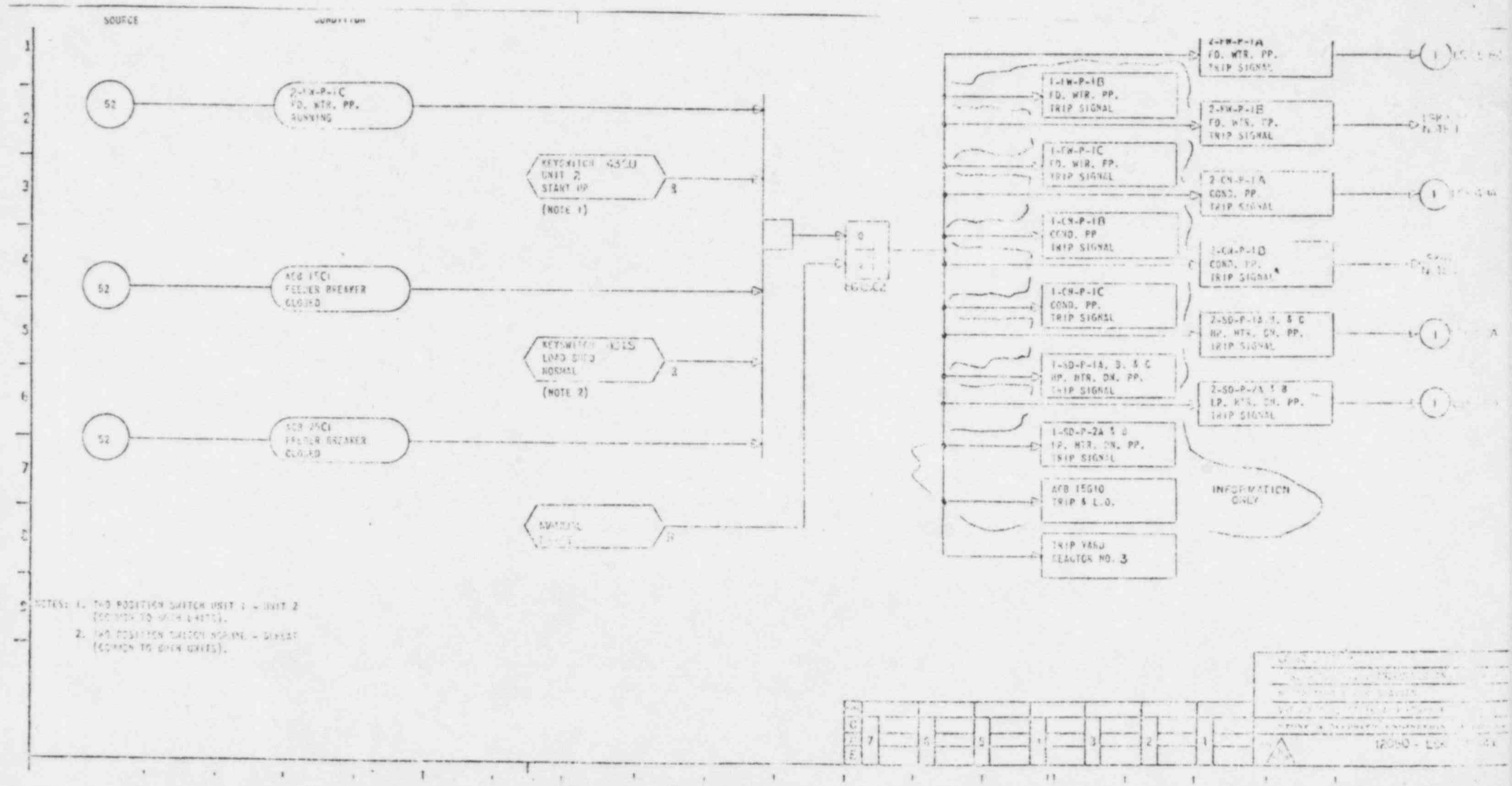
1. THE 86 RELAY FOR PHASE AND GROUND OVERCURRENT IS SHOWN FOR BREAKER 25A1 AND IS SIMILAR FOR 25D1 & 25C1.

LOGIC DIAGRAM
STATION
12050



NOTES: 1. TWO POSITION SWITCH UNIT 1 - UNIT 2
(COMMON TO BOTH UNITS).
2. TWO POSITION SWITCH NORMAL - DEFEAT
(COMMON TO BOTH UNITS).

A	B	C	D	E	F	G	H	I	K	L	M	N	P	Q	R	S	T	U	V


SOURCE
CONDITION
52
2-FW-P-1C
FD. WTR. PP.
RUNNING
KEYSWITCH
UNIT 2
START UP
(NOTE 1)
52
ACB 15C1
FEEDER BREAKER
CLOSED
KEYSWITCH
LOAD SHED
NORMAL
(NOTE 2)
52
ACB 25C1
FEEDER BREAKER
CLOSED
MANUAL
2-FW-P-1A
FD. WTR. PP.
TRIP SIGNAL
1-FW-P-1B
FD. WTR. PP.
TRIP SIGNAL
2-FW-P-1B
FD. WTR. PP.
TRIP SIGNAL
1-FW-P-1C
FD. WTR. PP.
TRIP SIGNAL
2-CN-P-1A
COND. PP.
TRIP SIGNAL
1-CN-P-1B
COND. PP
TRIP SIGNAL
2-CN-P-1B
COND. PP.
TRIP SIGNAL
1-CN-P-1C
COND. PP.
TRIP SIGNAL
2-SD-P-1A, B, & C
HP. HTR. DN. PP.
TRIP SIGNAL
1-SD-P-1A, B, & C
HP. HTR. DN. PP.
TRIP SIGNAL
2-SD-P-2A & B
LP. HTR. DN. PP.
TRIP SIGNAL
1-SD-P-2A & B
LP. HTR. DN. PP.
TRIP SIGNAL
ACB 15G10
TRIP & L.O.
TRIP YARD
REACTOR NO. 3
INFORMATION
ONLY
NOTES: 1. TWO POSITION SWITCH UNIT 1 - UNIT 2
2. TWO POSITION SWITCH NORMAL
12050 - LSK

Enclosure E

GENERAL ELECTRIC

ELECTRIC UTILITY

SALES DIVISION

GENERAL ELECTRIC COMPANY, P. O. BOX 6974, RICHMOND, VIRGINIA 23230
Phone (804) 288-4071

June 8, 1979

Subject: Vepco P.O. #49766
G.E. Reqn. 326-88100
Reserve Station Service
Transformers - North Anna
Power Plant

Mr. John M. Davis
Virginia Electric & Power Compan
Post Office Box 26666
Richmond, VA 23261

Dear Mr. Davis:

Our Medium Transformer factory in Rome, Georgia, has analyzed the above referenced transformers to determine the overload capability of the windings and ancillary components.

Specifically, we assumed the transformer had been operating at 75% of maximum rated load for 8 - 12 hours prior to overload, in a 40°C ambient.

We then assumed an emergency occurred and the transformer was loaded to 177% of its maximum nameplate rating for one hour. Under this condition, the top oil reached a temperature of 110.5°C, and the winding hot spot temperature was 139.6°C. The copper lead from the winding to the bushing reached a temperature of 209.8°C.

Based on these temperatures, our computer program predicts a .03% loss of life for the winding and a 10% loss of life for the lead.

If the overload were limited to 156% of maximum nameplate rating for one hour (52.4 MVA), the top oil temperature would reach 100.8°C, the winding hot spot would be 126.2°C, and the lead from the winding to bushing would reach 180°C. These reduced temperatures would cause an insignificant loss of life for the winding and ancillary components.

GENERAL ELECTRIC

Please let me know if further information is needed.

Sincerely,

Ed Summers

Edmund N. Summers
Transmission Equipment
Sales Engineer

/ljl
cc: JC Shaw
MTPD, Rome