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AUTH.NAME AUTHOR AFFILIATION
DOLAN,J.E. Indiana & Michigan Electric Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation

SUBJECT: Forwards info re voltage level at safety buses,startup, shutdown & accident loading high & low voltage condition cases & transformers capacity in response to 790808 ltr. Simplified offsite power sources oversize drawing encl.

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P. O. BOX 18
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December 17,1979
AEP:NRC:00268

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

The attachments to this letter provide the information requested in Mr. W. Gammill's letter dated August 8, 1979. By letter dated October 5, 1979, we requested an extension of the due-date for responding to Mr. Gammill's request until December 15, 1979. By letter dated October 22, 1979, Mr. A. Schwencer granted us the extension as requested.

As the information transmitted herein is being submitted in direct response to a written request for information from the NRC Staff, IMECo. interprets 10 CFR 170.22 as requiring that no fee accompany this submittal.

Very truly yours,

John E. Dolan

John E. Dolan
Vice President

JED:em

cc: R. C. Callen
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R. W. Jurgensen
D. V. Shaller-Bridgman

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ATTACHMENT 1 TO
AEP:NRC:00268
DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
DOCKET NOS. 50-315 AND 50-316
LICENSE NOS.DPR-58 AND DPR-74

Following the "Guidelines for Voltage Drop Calculations" listed in Enclosure 2 of Mr. W. Gammill's letter of August 8, 1979 (Adequacy of Station Electric Distribution Systems Voltage) we have determined the voltage level at the safety buses for the following configurations:

a. Safety buses fed from the normal auxiliary power source,

b. Safety buses fed from the preferred offsite power source, and

c. Safety buses fed from the alternate offsite power source.

For each of the three power sources, a, b, and c listed above, we have analysed the voltage level at the safety buses as a result of the the transmission grid low and high voltage conditions as specified in paragraphs 6 and 11 of enclosure 2 of your letter. The minimum expected grid voltage value results from theoretical load flow studies where the following conditions are postulated: D. C. Cook Nuclear Units 1 and 2 are down, Palisades Nuclear Unit 1 is down, the Dumont-Wilton Center kV line is out of service, and the system is transferring 1000 MW toward the West (see Attachment 3). The base case used to conduct this study contains a model of the 1979 summer interconnected transmission system with the AEP internal peak load modeled at 12,250 MW. This load level is about 750 MW higher than the actual 1979 summer peak load and nearly equal to the projected 1980 summer peak load. The minimum expected value of grid voltage under these conditions is 1.006 per unit voltage (p.u.) at the 345 kV level and .973 p.u. at the 765 kV level.

The maximum expected grid voltage value results from the following assumptions: D. C. Cook Units 1 and 2 out, Palisades Unit 1 out, the Dumont station snychronous condenser out, all of the above during a period of the lightest expected system load conditions.

The maximum expected value of voltage under light load conditions at the 345 kV level is 1.07 p.u. For the 765 kV system the maximum expected voltage value under light load conditions is 1.04 p.u.

For the 69 kV subtransmission system the lower value of voltage occurs when the 345/138 kV Benton Harbor substation transformer is out of service. For this contingency, the 69 kV voltage level at the 69/4 kV substation at Cook Plant attains a low of 0.94 p.u. The 69 kV high voltage value is 1.05 p.u. and is based on historic data accumulated over the last year.

In considering which cases to analyze in responding to the NRC concerns expressed in the guidelines of enclosure 2 we have taken account of the fact that for D. C. Cook Units 1 and 2: 1) the startup, shutdown, and emergency (accident) loads are essentially identical; and 2) the onsite electrical distribution systems are also identical. We have, in every instance, considered the most adverse conditions that are credible for the system under study. We have addressed below the 13 items listed in enclosure 2 "guidelines":

1. Separate analysis have been performed assuming the power source to the safety buses are:

   a. The unit auxiliary transformer (normal auxiliary power source) cases A1, A2, A3,

   b. The startup transformer (Preferred Offsite Power Source) cases B1 through B6, and

   c. The Alternate Offsite Power Source cases C1, C2, C3.

   The need for electric power is assumed to be initiated by a shutdown in one unit plus shutdown and an accident in the other unit when the low voltage condition is investigated since this assumption presents the largest load demand situation. However, when a high voltage condition is investigated (following the demands of guideline No. 11) load demand from one unit only is assumed. This assumption presents the smallest load demand situation and hence the worst condition from a high voltage situation standpoint.

2. To comply with the recommendations of guideline No.2 we have made the following assumptions:

   a. Plant auxiliaries are fed from transformer bank No. 5. Transformer bank No. 5 has nearly twice the impedance of transformer bank No. 4 and therefore presents a worst case situation when low voltage conditions are being investigated, and

   b. Largest load demand for both D. C.Cook Units is assumed, i.e., shutdown load for one unit plus shutdown and accident load for the other unit (see cases B3, B4, B5, B6 in reference to this guideline).

(*) A detailed description of the cases analyzed is given in Attachment 2.

3. All actions the electric power system is designed to automatically initiate have been assumed to occur as designed. For instance for the low voltage condition cases, when the auxiliaries are fed from the Preferred Offsite Power Source the safety loads have been assumed to start in bulk. See Cases B4 and B5. On the other hand, when the Alternate Offsite Power Source is used, sequential loading was assumed, as would be the case in a real life situation, (see cases C2 and C3).

4. No manual load shedding has been assumed.

5. For each event analyzed, the maximum load necessitated by the event and the mode of operation of the plant at the time of the event has been assumed. This applies principally to the accident loads where redundant loads from the two safety trains have been accounted for, even though, clearly, they are not strictly needed for any particular event.

6. Guideline No. 6 has already been addressed above and the "minimum expected grid voltage" value has been defined. In the event voltages below the minimum expected value assumed in this study are experienced at the connection to the offsite circuit, the modifications outlined in Attachment No. 7 will protect the safety loads from trying to operate from a degraded power source. No Technical Specifications or additional Limiting Conditions for Operation are being proposed since none can be deduced from the results of this study.

7. The requirements of guideline No. 7 are covered case by case in Attachment No. 5.

8. Undervoltage relay setpoints at D. C. Cook Units 1 and 2 are as follows:

   a. 4 kV safety buses blackout setting is at 0.60 pu. Under blackout conditions, all non-safety load is automatically shed and the onsite emergency diesel generators are started. After the diesel generators have attained rated speed and voltage the 4 kV safety buses are sequentially loaded.

8. b. 34.5 kV bus degraded grid voltage setting is at 0.939 pu. When the 4 kV safety buses are being fed from the Preferred Offsite Power Source (during startup or shutdown), should the voltage level at the 34.5 kV bus reach the given setpoint, the 4 kV safety buses are separated from the non-safety buses (and hence from the Preferred Offsite Power Source); load on the 4 kV safety buses is shed and emergency diesel generators started. The safety buses are then sequentially loaded as previously described above.

   c. 4 kV buses undervoltage alarm is set at 0.90 pu. When this voltage level is reached an alarm sounds in the control room to alert the operator of an impending 4 kV safety bus low voltage condition.

   d. 600 volt buses undervoltage alarm is set at 0.90 pu. Again the purpose of this alarm is to alert the control room operator of an impending 600 volt safety bus low voltage condition.

9. The voltage profile tables of Attachment No. 5 list the voltage levels at the safety buses when the plant auxiliaries are fed from different offsite power sources as described in Attachment No.4. Study of these tables reveals that when feeding from the normal or the preferred power sources, under steady state conditions, no safety bus voltage is outside the 0.90 to 1.10 pu voltage range. During motor starting conditions no 4 kV bus is found to dip below 0.85 pu. When all the safety load motors are starting in block, voltages below the 0.85 pu are found at the 575 volt buses 11 B and 11 C. However this poses no problems since successful start of the 4-kV motors will improve the voltage conditions to allow re-establishing the 575 volt bus level to more than 90%.

   When feeding from the 69-kV alternate offsite power sources, some high voltage conditions (above 110%) are encountered that will be corrected as per the modifications proposed in Attachment No.7.

10. Even though the safety buses voltage range for normal operation and starting of the safety loads have been found adequate, the dipping of the 34.5 kV bus voltage to 0.924 pu during bulk accident loading starts is below the 34.5 kV degraded grid voltage setpoint of 0.939 pu with a 2 second time delay.

   These settings will cause spurious tripping of the safety buses under bulk starting of the safety loads. This will violate the recommendations of guideline No. 12. Attachment No. 7 includes the proposed, new, undervoltage protection scheme that will allow the system to accommodate short voltage dips due to motor starting thus avoiding spurious separation of the safety buses from a perfectly adequate offsite power source.

11. The requirements of guideline No. 11have been met by choosing the transfer with the lowest impedance, whenever there was a choice, while analyzing the safety buses high voltage condition (cases A1, B1, B2). For instance, in cases B1 and B2 transformer No. 4 was chosen over transformer No. 5 as a source for the Preferred Offsite Power system. Likewise the smallest load demand situation (startup and Accident load, one unit only) was chosen when analyzing the high voltage condition as was already pointed out when discussing the requirements of guideline No. 1. Safety bus high voltage conditions have been found during the analysis of the 69 kV Alternate Offsite Power source. Proposed recommendations to remedy this situation are listed in Attachment No. 7.

12. The requirements of guideline No. 12 were already discussed together with the requirements of guideline No. 10.

13. Assumptions made in the analysis have already been presented These assumptions are also listed case by case in Attachment No. 4.

The results presented in this study will be validated by comparison with actual measured data taken at the Donald C. Cook Nuclear Plant on the safety buses. A startup following a Unit outage, is required to do this validation. Presently, Unit 1 is at full power operation and Unit 2 is undergoing refueling, its auxiliaries being fed through the Preferred Offsite Power Source. However, the refueling load is very small as compared with the capacity of the Reserve Power transformers and therefore cannot be used to validate the results obtained by analysis with a much greater load.

Unit 2 refueling outage will be completed before the end of the year, at which time the Unit 2 startup load using the Preferred Offsite Power Source will be used to measure the voltages at the 345 kV, 34.5 kV, 4 kV and 600 kV volt buses as per Mr. Gammill's letter. The measured results will be compared with calculated results using the measured 345 kV voltage and startup load.

The evaluated results will be transmitted to the NRC for inclusion into this report.

ATTACHMENT 2 TO AEP:NRC:00268
DONALD C. COOK NUCLEAR PLANT UNITS 1&2
DOCKET NOS. 50-315 & 50-316
LICENSE NOS. DPR-58 & DPR-74

The cases selected for study as a result of the Enclosure 2 guidelines are:

A. Safety Buses fed from the Normal Auxiliary Power Source

High voltage condition (Case A1)

The most adverse case for this condition is to use the lighest load within the constraints of this study, the highest available voltage, and the lowest available transformer impedance. Case A1 meets all of the above re-requirements and therefore presents the worst case for the high voltage condition when the normal auxiliary power source is used.

Attachment #4 includes a summary of all the cases run in this study. The parameters used for each case are also listed.

Low Voltage Condition (Cases A2 and A3)

The most adverse case for this condition is to use the largest load demand, the lowest imput voltage, and the highest transformer impedance. Case A2 meets all of the above requirements and therefore presents the worst case for the steady state low voltage condition when the normal auxiliary power source is used. Case A3 uses same load and configuration as Case A2 except that voltage is calculated during bulk starting of the safety load motors.

B. Safety Buses fed from the Preferred Offsite Power Source

High Voltage Condition (Cases B1 and B2)

The most adverse case for this condition is to use the lower impedance transformer (Transformer #4) as a source and to use the lightest possible loading conditions: startup plus accident loading condition (steady state), one unit only. Any other cases such as shutdown plus accident (see Case B2) or using Transformer #5 as a source will increase the voltage drop in the power distribution system and therefore will alleviate the high voltage condition at the safety buses.

Low Voltage Condition (Cases B3, B4, B5 and B6)

These cases represent the most severe cases for the low voltage condition; they use the higher impedance Transformer #5 as a source and the largest possible loading conditions, i.e., Unit 1 shutdown load plus Unit 2 shutdown accident loading. For comparison purposes, Case B6 uses the startup plus accident load in one unit and the shutdown load in the other unit. Case B3 considers the steady state safety buses voltage level after all the accident loading has already started. Case B4 considers the safety buses voltage while the accident loading is starting in block.

Case B5 considers the same loading conditions as B3 and B4 except that the safety load is started sequentially. Voltage profile is calculated during starting of the last and largest motor.

C. Safety Buses fed from the Alternate Offsite Power Source

High Voltage Condition (Case C1)

Since there is only one transformer to serve as a power source in this case, the most adverse conditions result from using the lighest load demand being considered by this study and the highest imput voltage available at this location.

Low Voltage Condition (Cases C2 and C3)

These cases cover the most adverse conditions at the safety buses should they need to rely for power on the Alternate Offsite Power Source when there is a degraded grid voltage condition on the 69 kV subtransmission system. Case C2 presents the steady state voltage profile at the safety buses after all the safety loads are operating. Case C3 presents the voltage profile at its worst during the start of the largest and last motor in the accident load starting sequence. Operation of the 69 kV Alternate Offsite Power Source is strictly manual. As such, the system is loaded sequentially and only one safety train per unit is energized. The load considered is therefore the Unit 1 shutdown load (one safety train only) plus the Unit 2 shutdown and accident loads (one train only).

ATTACHMENT 3 TO
AEP:NRC:00268
DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
DOCKET NOS. 50-315 AND 50-316
LICENSE NOS.DPR-58 AND DPR-74

DONALD C. COOK NUCLEAR PLANT
SIMPLIFIED OFFSITE POWER
SOURCES ONE-LINE ESK - 103079

ATTACHMENT 4 TO AEP:NRC:00268

1. Definition of Startup, Shutdown, and Accident Loading.

2. Summary of High and Low Voltage Condition Cases Run In This Study.

Load demand during Startup conditions include, but are not limited to, the following components (per unit):

Four Reactor Coolant Pumps
Two Circulating Water Pumps
One Hotwell Pump
One Condensate Booster Pump
One Auxiliary Feedwater Pump
One Centrifugal Charging Pump
One Essential Service Water Pump
One Component Cooling Water Pump
One Non-Essential Service Water Pump

Load demand during Shutdown conditions include, but are not limited to, the following components (per unit):

Four Reactor Coolant Pumps
Two Circulating Water Pumps
One Hotwell Pump
One Condensate Booster Pump
One Turning Gear Motor
One Auxiliary Feedwater Pump
One Centrifugal Charging Pump
One Essential Service Water Pump
One Component Cooling Water Pump
One Non-Essential Service Water Pump

Accident load includes, but is not limited to, the following components (per unit):

Two Centrifugal Charging Pumps
Two Safety Injection Pumps
Two Residual Heat Removal Pumps
Two Component Cooling Water Pumps
Two Auxiliary Feedwater Pumps (a total of two for both units)
Two Containment Spray Pumps
Two Non-Essential Service Water Pumps

Shutdown load (per unit) = (27.515 +j 21.095) mva = 34.67 mva

Startup load (per unit) = (29.919 +j 16.526) mva = 34.18 mva

Accident load (per unit) = (3.716 +j 2.542) mva = 4.5 mva

Some safety load is already running during startup and/or shutdown and therefore this load is not included in the accident load (4.5 mva).

GSU SOURCES

CASE A1: Normal Auxilary Power Source (Unit No. 1)

High Voltage: 369 kv

Startup plus Accident Load in one unit only = 33.635 +j 19.057 mva = 38.66 mva total

TR1 (345 kv UAT Source), lower impedance = 11.5% on 1300 mva base

Steady state analysis (after safety motors have started)

CASE A2: Normal Auxiliary Power Source (Unit No. 2)

Low Voltage: 744.35 kv

Shutdown plus Accident Load in one unit only = 31.231 +j 23.637 mva = 39.17 mva total

TR2 (765 kv UAT Source), higher impedance = 16.5% on 1300 mva base

Steady state analysis (after safety motors have started)

CASE A3: Normal Auxiliary Power Source (Unit No. 2)

Low Voltage: 744.35 kv

Shutdown plus Accident Load in one unit only = 31.231 +j 23.637 mva = 39.17 mva

TR2 (765 kv UAT Source), higher impedance = 16.5% on 1300 mva base

Transient (during starting of all safety motors)

RESERVE SOURCES

CASE B1: Preferred Offsite Power Source

High Voltage: 369 kv

Startup plus Accident in one unit only = 33.635 +j 19.057 mva = 38.66 mva total

TR4 (lower impedance) = 17.25% 345 mva base

Steady state (after sfaety motors have started)

CASE B2: Preferred Offsite Power Source

High Voltage: 369 kv

Shutdown plus Accident in one unit only = 31.231 +j 23.637 mva = 39.17 mva total

TR4 (lower impedance) = 17.25% 345 mva base

Steady state (after safety motors have started)

CASE B3: Preferred Offsite Power Source

Low Voltage: 347 kv

Shutdown and Accident in one unit, shutdown in other unit = 58.746 +j 44.732 = 73. 84 mva total

TR5 (larger impedance) = 16.2% 150 mva base

Steady state (after safety motors have started)

CASE B4: Preferred Offsite Power Source

Low Voltage: 347 kv

Shutdown and Accident in one unit, shutdown in other unit = load measured during start of the safety motors in block

TR5 (larger impedance) = 16.2% 150 mva base

Transient (during starting of all safety motors)

CASE B5: Preferred Offsite Power Source

Low Voltage: 347 kv

Shutdown and Accident in one unit, shutdown in other unit = load measured during the start of the last and biggest of the safety motors.

TR5 (larger impedance) = 16.2% 150 mva base

Transient (during starting of last and largest safety motor)

CASE B6: Preferred Offsite Power Source

Low Voltage: 347 kv

Startup and Accident in one unit, shutdown in other unit = 61.15 +j 40.152 = 73.15 mva total

TR5 (larger impedance) = 16.2% mva base

Steady state (after all safety motors have started)

69 kV: ALTERNATE OFFSITE POWER SOURCE

CASE C1: High Voltage: 72.45 kV

Shutdown and Accident in one unit, shutdown in other unit
= 5.672 +j 3.286 = 6.56 mva

TR12 EP (picks up one train in each unit)
= 7% 7500 Kva base

Steady state (after all safety motors have started)

CASE C2: Low Votage: 64.86 kV

Shutdown and Accident in one unit, shutdown in other unit
= 5.672 +j 3.286 = 6.56 mva

TR12 EP (picks up one train in each unit)
= 7% 7500 Kva base

Steady state (after all safety motors have started)

CASE C3: Low Voltage: 64.86 kV

Shutdown and Accident in one unit, shutdown in other unit

= Load measured during the start of last and biggest safety motor.

TR12 EP (picks up one train in each unit)

Transient (during starting of last and biggest motor)

ATTACHMENT NO. 5

TABULATIONS ON SAFETY BUS VOLTAGE PROFILES FOR EACH CASE RUN IN THIS STUDY

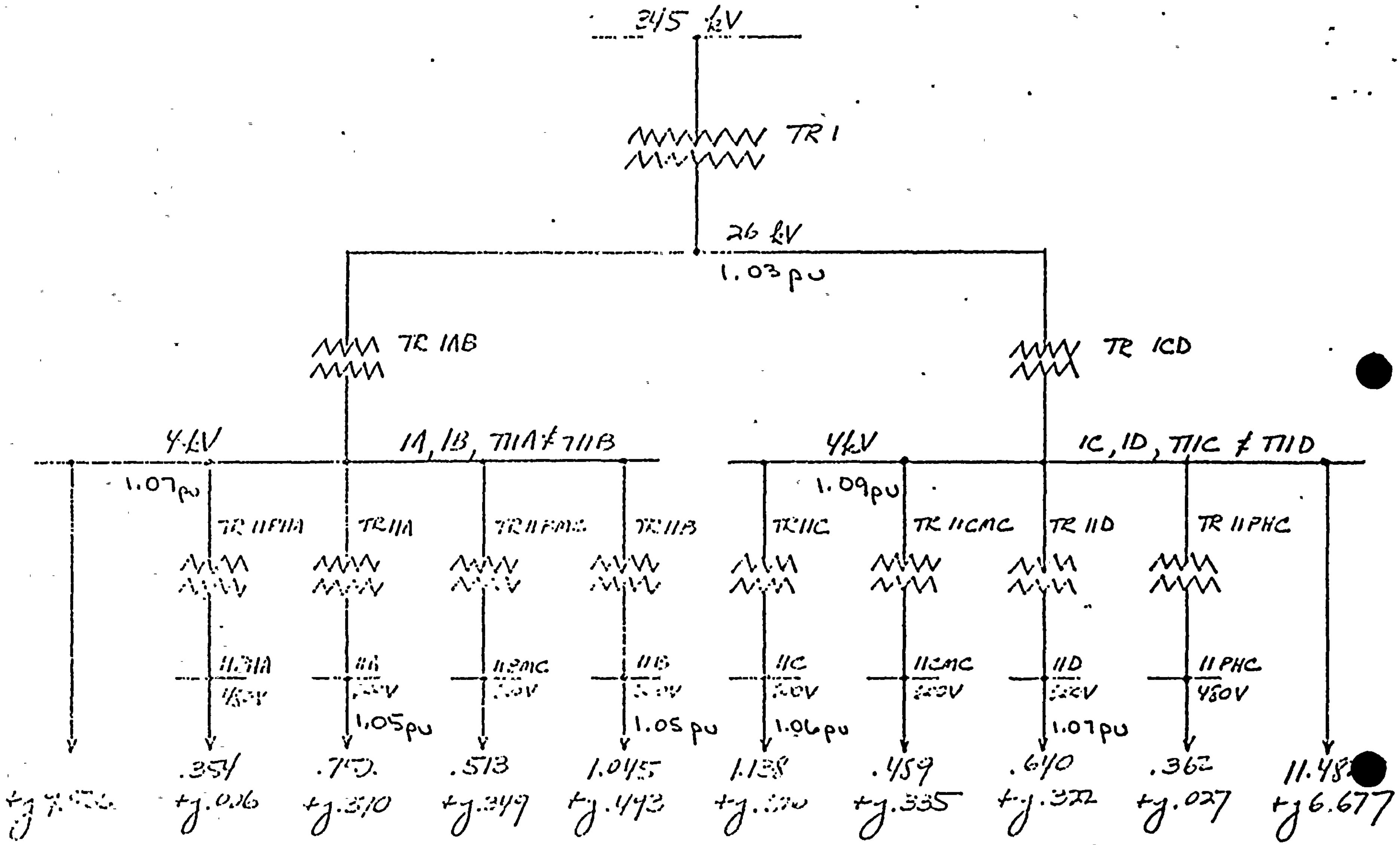
ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
2 BROADWAY
NEW YORK

SUBJECT Cook Voltage Study

DATE 12-7-79 BY [illegible] CK. ____
COMPANY ____ G.O. ____
PLANT ____

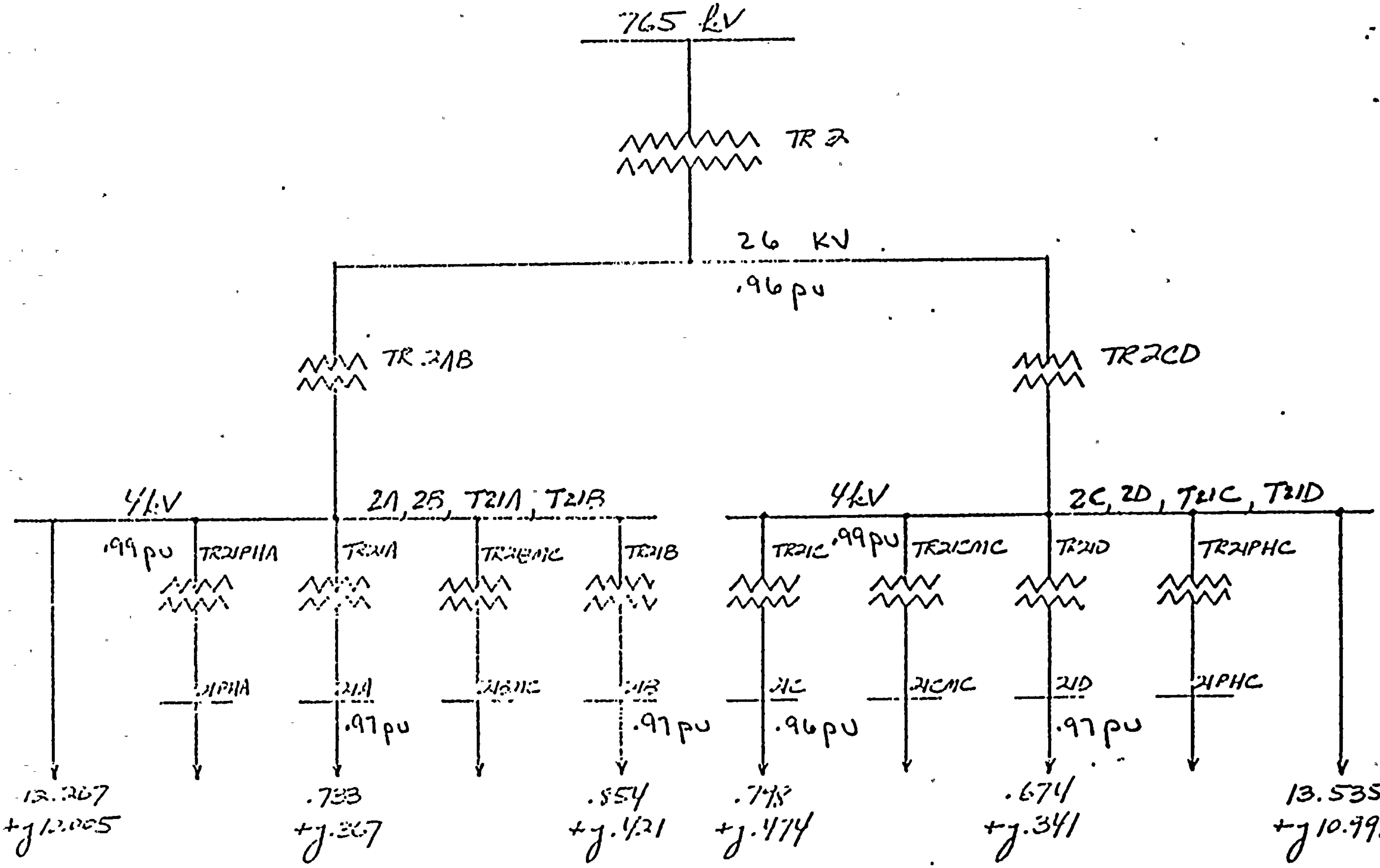
Normal Auxiliary Source

BUS	MACHINE BASE	HIGH VOLTAGE CASE #A1	LOW VOLTAGE STEADY STATE CASE #A2	LOW VOLTAGE MOTOR START CASE #A3
34kV	2.4kV	1.03	.96	.96
AB	4kV	1.07	.99	.93
CD	4kV	1.07	.99	.91
A	575V	1.05	.97	.91
B	575V	1.05	.97	.90
C	575V	1.06	.95	.82
D	575V	1.07	.97	.89



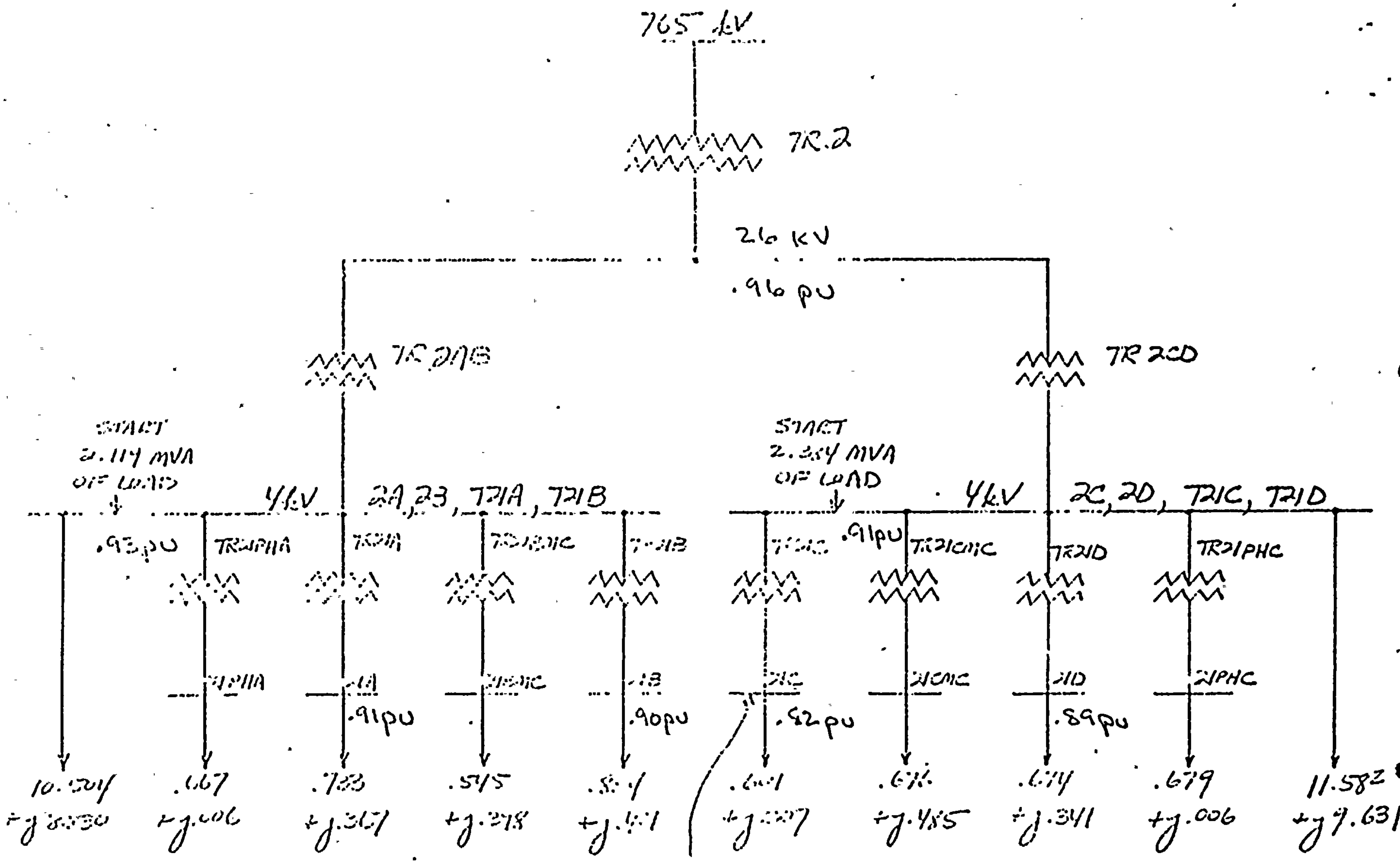
LOAD GIVEN IN MVA

CASE # A1
SOURCE : TR 1
LOAD CONDITION : STARTUP + ACCIDENT
SYSTEM VOLTAGE : 369 kV



LOAD GIVEN IN MVA

CASE # A2
SOURCE: 765 kV
LOAD CONDITION { SHUTDOWN (STEADY STATE) + ACCIDENT
SYSTEM VOLTAGE: 744 kV



START
MVA
LOAD

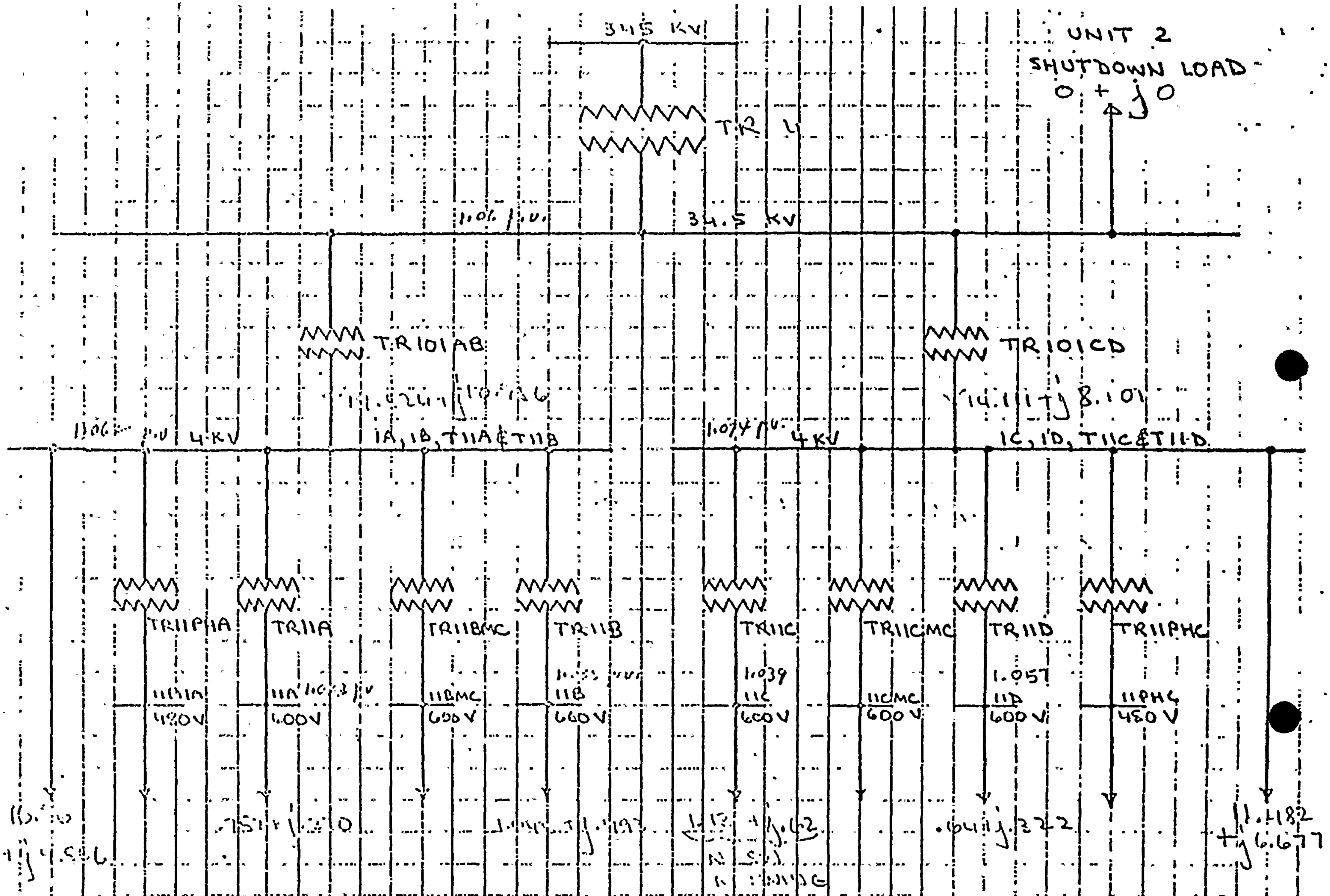
LOAD GIVEN IN MVA

CASE # A3
SOURCE : 765 kV
LOAD CONDITION { SHUTDOWN (TRANSIENT) + ACCIDENT
SYSTEM VOLTAGE : 795 kV

RESERVE SOURCES

BUS	MOTOR BASE	B1 HIGH V STEADY STATE STARTUP	B2 HIGH V STEADY STATE SHUTDOWN	B3 LOW V STEADY STATE SHUTDOWN	B4 LOW V: MOTOR START SHUTDOWN	B5* LOW V MOTOR START SHUTDOWN	B6 LOW V STEADY STATE STARTUP
34.5 KV	34.5 KV	1.06	1.057	.946	.924	.940	.952
AB	4000 V	1.062	1.057	.937	.874	.918	.946
CD	4000 V	1.074	1.053	.933	.873	.914	.958
11A	575 V	1.043	1.038	.916	.851	.896	.924
11B	575 V	1.035	1.034	.912	.845	.893	.916
11C	575 V	1.039	1.028	.904	.781	.885	.920
11D	575 V	1.057	1.036	.913	.851	.894	.940

* STARTING OF LARGEST SAFETY MOTOR ON EACH BUS WITH EVERYTHING ELSE RUNNING

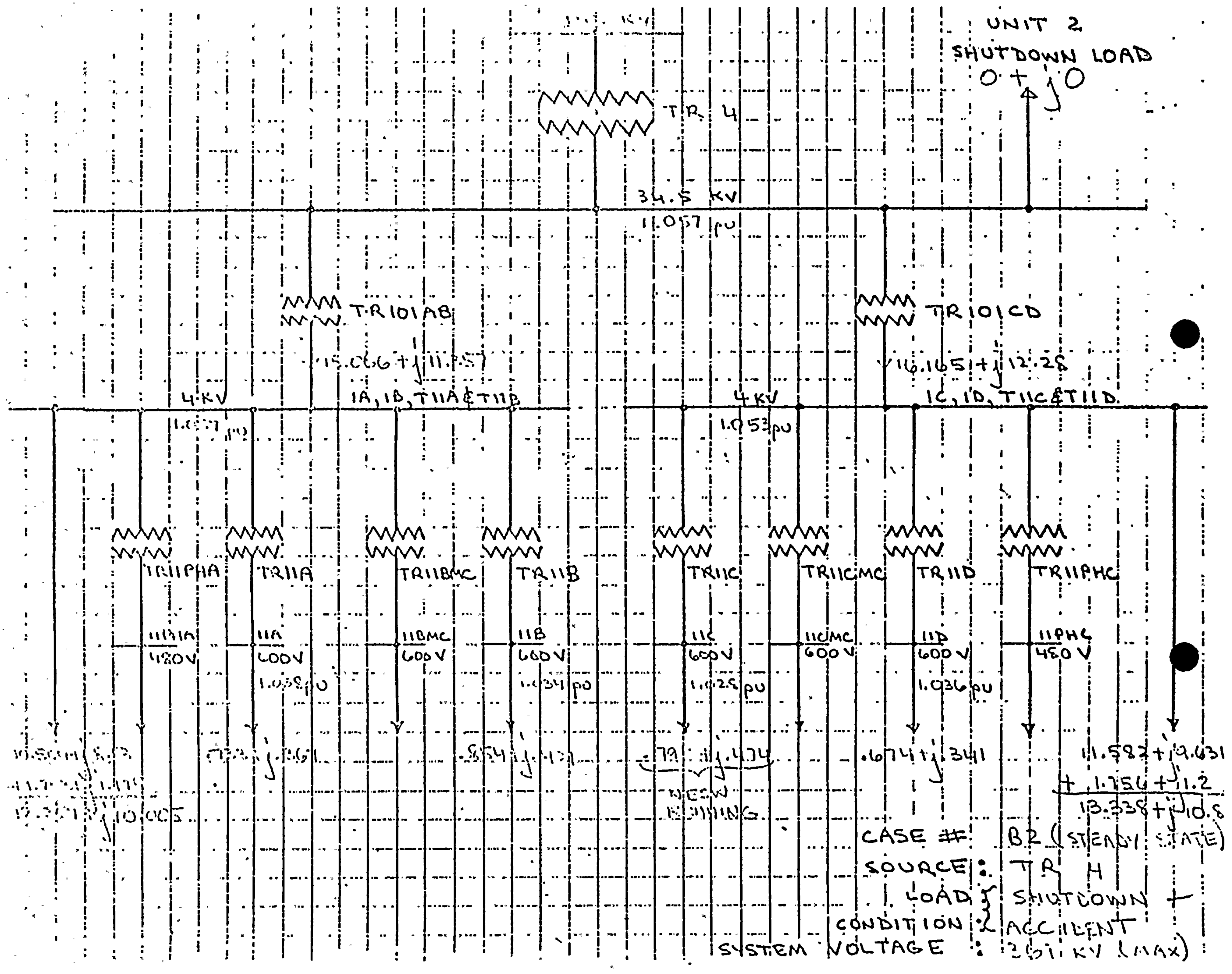


CASE #: B1 (STEADY STATE)

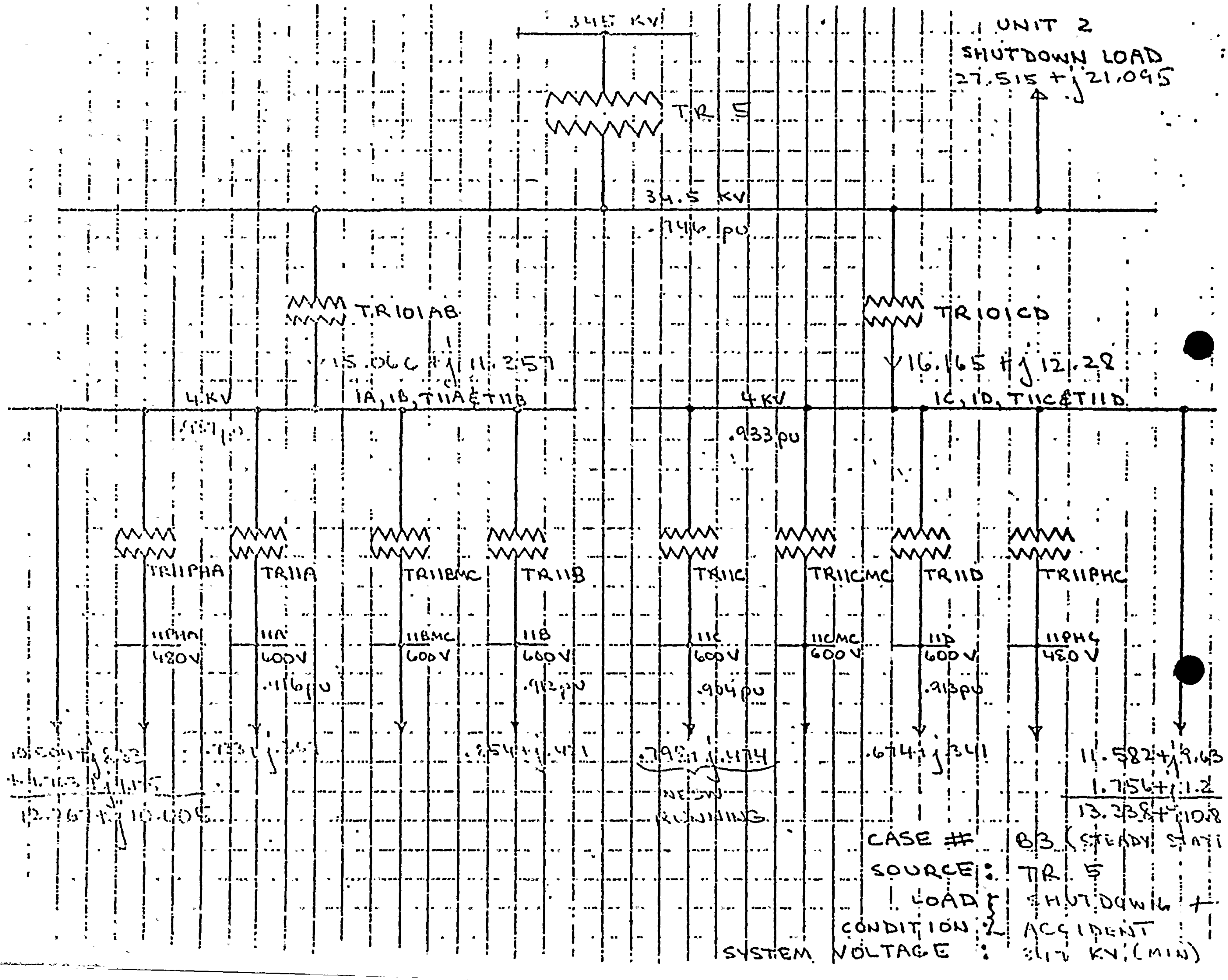
SOURCE: TR 4

LOAD & CONDITION: START UP plus ACCIDENT

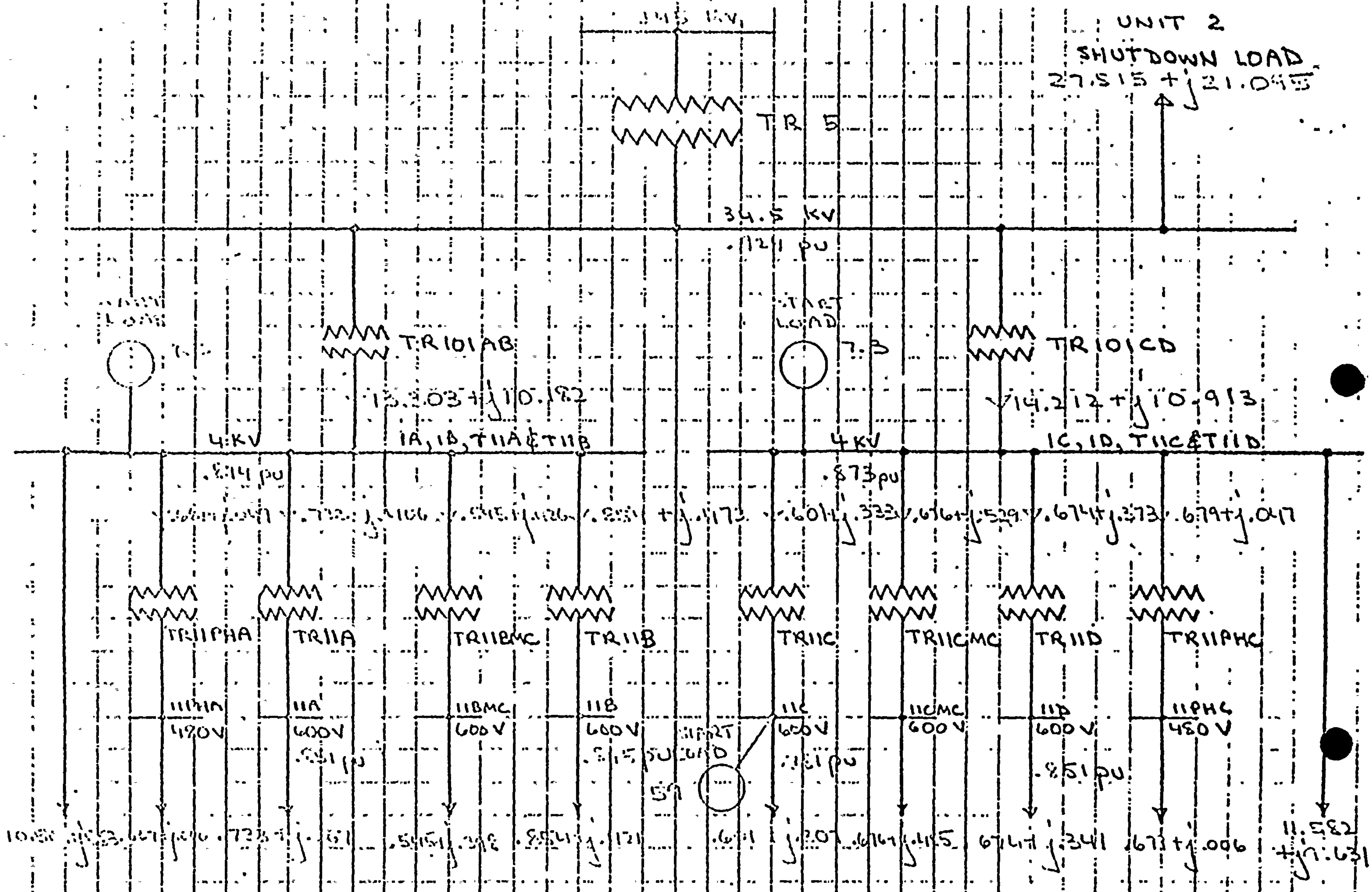
SYSTEM VOLTAGE: (MAX)



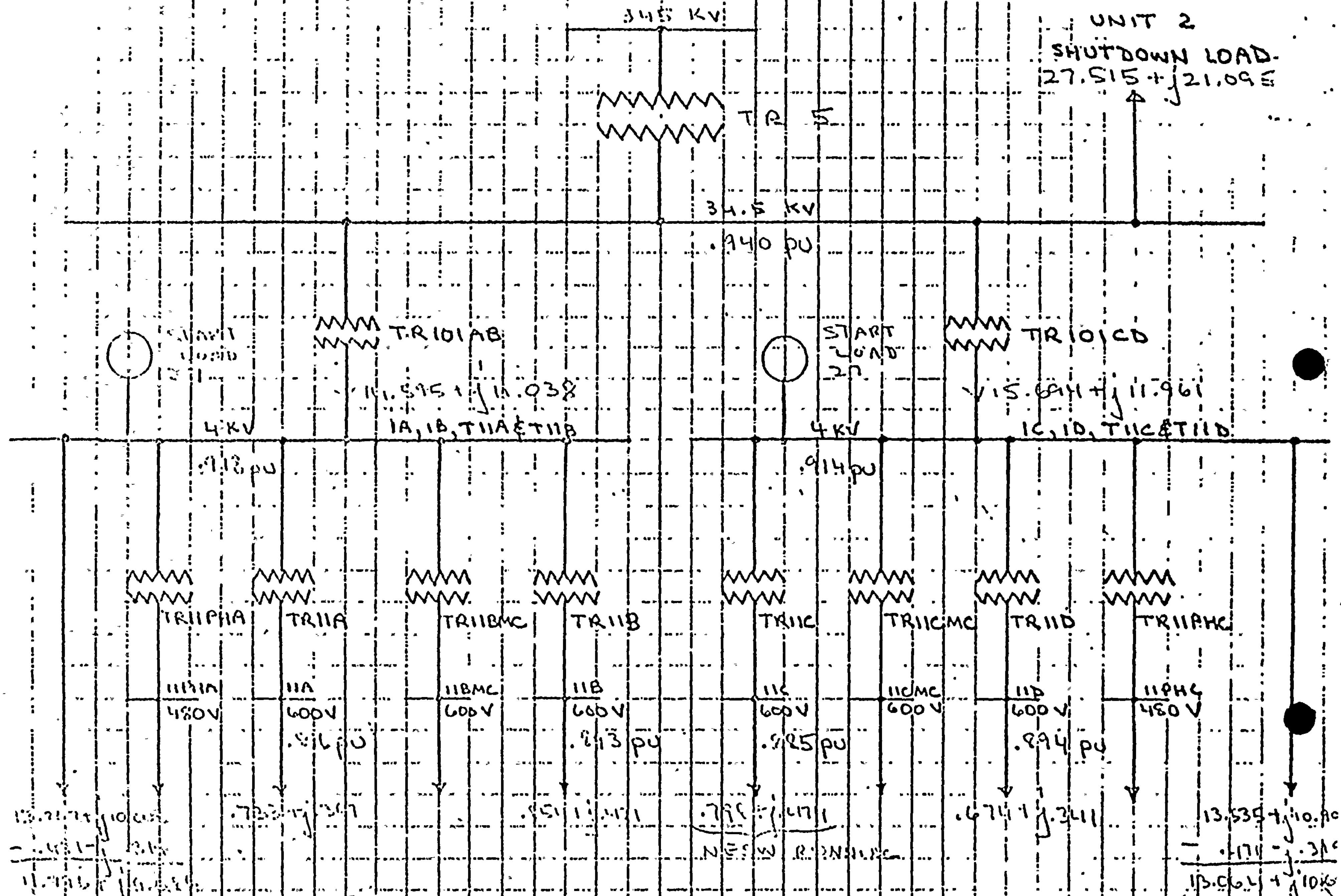
UNIT 2
SHUTDOWN LOAD
0 + j0
TR 4
34.5 KV
1.057 pu
TR101AB
15.066 + j11.857
TR101CD
16.165 + j12.28
4 KV
1A, 1B, T11A & T11B
4 KV
1.053 pu
1C, 1D, T11C & T11D
TR11PHA
TR11A
TR11BMC
TR11B
TR11C
TR11CMC
TR11D
TR11PHC
11A
600V
11BMC
600 V
11B
600 V
1.034 pu
11C
600 V
11CMC
600 V
11D
600 V
1.036 pu
11PHC
480 V
.674 + j.341
11.582 + j9.631
+ 1.756 + j1.2
13.338 + j10.8
NEW
CASE #: B2 (STEADY STATE)
SOURCE: TR H
LOAD
CONDITION
SHUTDOWN +
ACCIDENT
SYSTEM VOLTAGE



345 KV
UNIT 2
SHUTDOWN LOAD
27.515 + j 21.095
TR 5
34.5 KV
.746 pu
TR101AB
15.066 + j 11.257
TR101CD
16.165 + j 12.28
4 KV
1A, 1B, T11A & T11B
4 KV
.933 pu
1C, 1D, T11C & T11D
TR11PHA
TR11A
TR11BMC
TR11B
TR11C
TR11CMC
TR11D
TR11PHC
11PHA 480V
11A 600V
.916 pu
11BMC 600 V
11B 600 V
.912 pu
11C 600 V
.904 pu
11CMC 600 V
11D 600 V
.913 pu
11PHC 480 V
.793 + j .474
NESW RUNNING
.674 + j .341
11.582 + j 9.63
1.756 + j 1.2
13.338 + j 10.8
CASE #: 83 (STEADY STATE)
SOURCE: TR 5
LOAD CONDITION: SHUTDOWN + ACCIDENT
SYSTEM VOLTAGE: 317 KV (MIN)

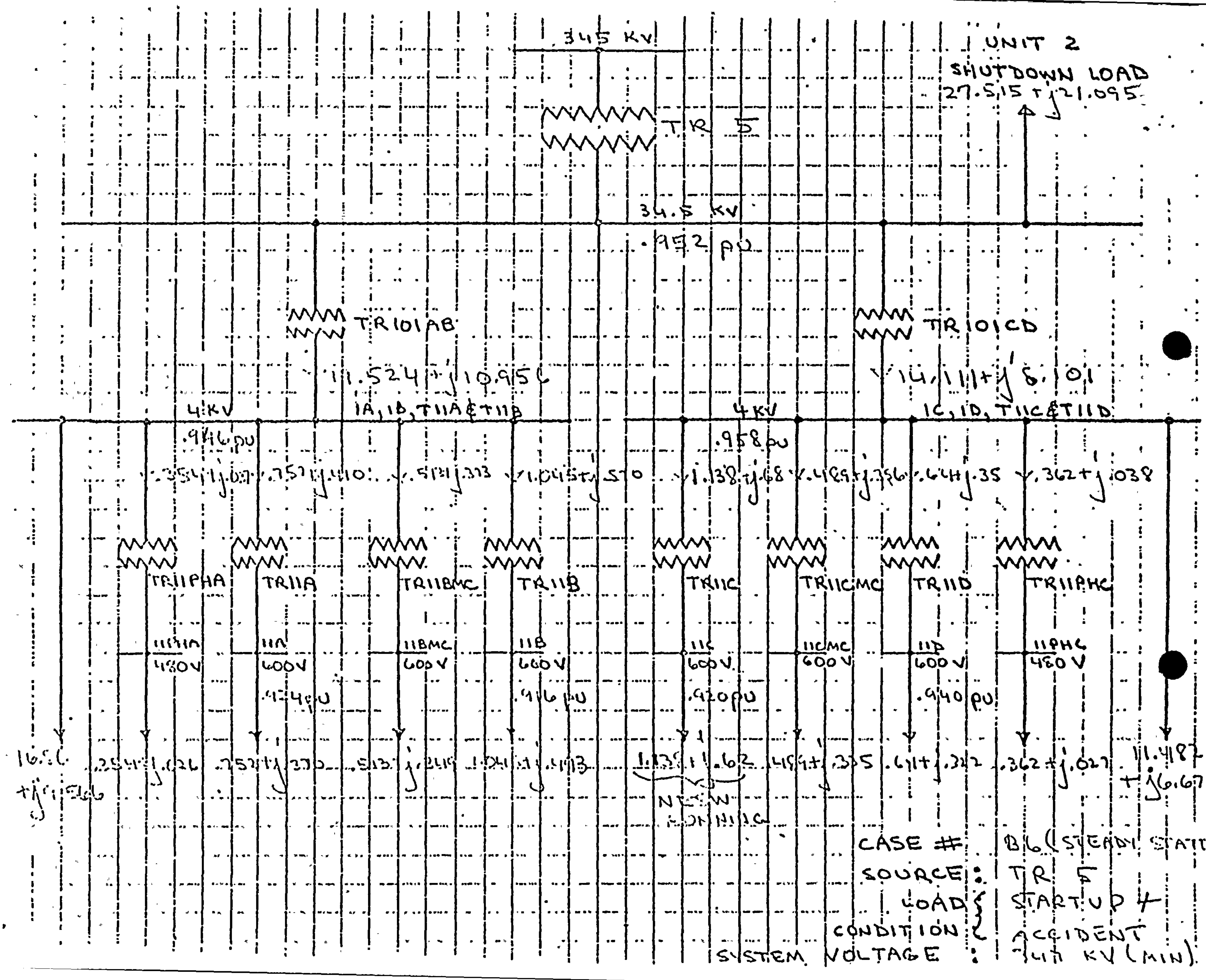


CASE #: BH (TRANSIENT)
SOURCE: TR 5
LOAD CONDITION: SHUTDOWN + ACCIDENT
SYSTEM VOLTAGE: 347 KV (MIN)



SEQUENTIAL LOADING:
START CONTAINMENT SPRAY PUMPS
ON BUSES T11A & T11D AT SAME
TIME

CASE #: B5 (TRANSIENT)
SOURCE: TR 5
LOAD / CONDITION: SHUTDOWN + ACCIDENT
SYSTEM VOLTAGE: 347 KV (MIN)



345 KV
TR 5
UNIT 2
SHUTDOWN LOAD
27.515 + j21.095
34.5 KV
.972 PU
TR101AB
11.524 + j10.956
TR101CD
14.111 + j8.101
4KV
.946 PU
1A, 1B, T11A & T11B
4KV
.958 PU
1C, 1D, T11C & T11D
.354 + j.027
.757 + j.410
.513 + j.373
1.045 + j.570
1.138 + j.68
.489 + j.356
.64 + j.35
.362 + j.038
TR11PHA
TR11A
TR11BMC
TR11B
TR11C
TR11CMC
TR11D
TR11PHC
11PHA 480V
11A 600V
11BMC 600V
11B 600V
11C 600V
11CMC 600V
11D 600V
11PHC 480V
.924 PU
.916 PU
.920 PU
.940 PU
16.56 + j11.566
.354 + j.026
.752 + j.370
.513 + j.249
1.041 + j.493
1.135 + j.62
NEW RUNNING
.499 + j.335
.611 + j.342
.362 + j.027
11.487 + j6.67
CASE #: B6 (STEADY STATE)
SOURCE: TR 5
LOAD: STARTUP 4
CONDITION: ACCIDENT
SYSTEM VOLTAGE: 341 KV (MIN)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
2 BROADWAY
NEW YORK

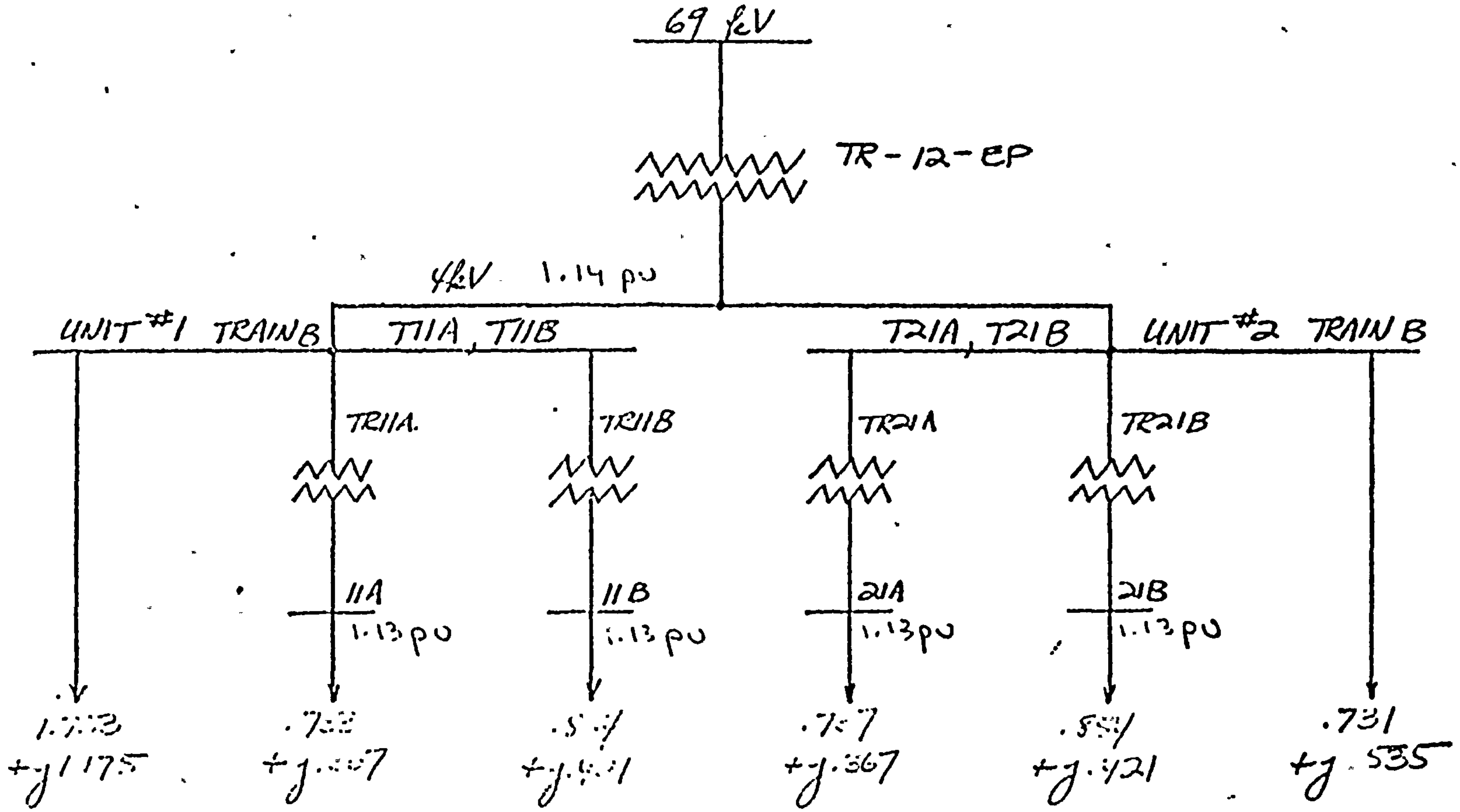
SUBJECT Calc Voltage - [illegible]

DATE 12-9-77 BY [illegible] CK. SHEET 1 OF 1
COMPANY G.O.
PLANT

69kV Offsite Power*

BUS	MACHINE [illegible]	HIGH VOLTAGE CASE #C1			LOW VOLTAGE STEADY STATE CASE #C2			LOW VOLTAGE MOTOR START CASE #C3		
		[illegible]/436	68.8/436	67/436	[illegible]/43.	68/436	67/436	70.6/436	[illegible]/436	67/436
7HA 7HB 7HC 7HD	4kV	1.09	1.11	1.14	.97	1.00	1.02	.94	.96	.99
11A 21A	575V	1.07	1.10	1.13	.95	.98	1.00	.92	.94	.97
11B 21B	575V	1.07	1.10	1.13	.95	.97	1.00	.92	.94	.96

* 69kV/4kV transformer is presently on the 67kV/4.36kV tap

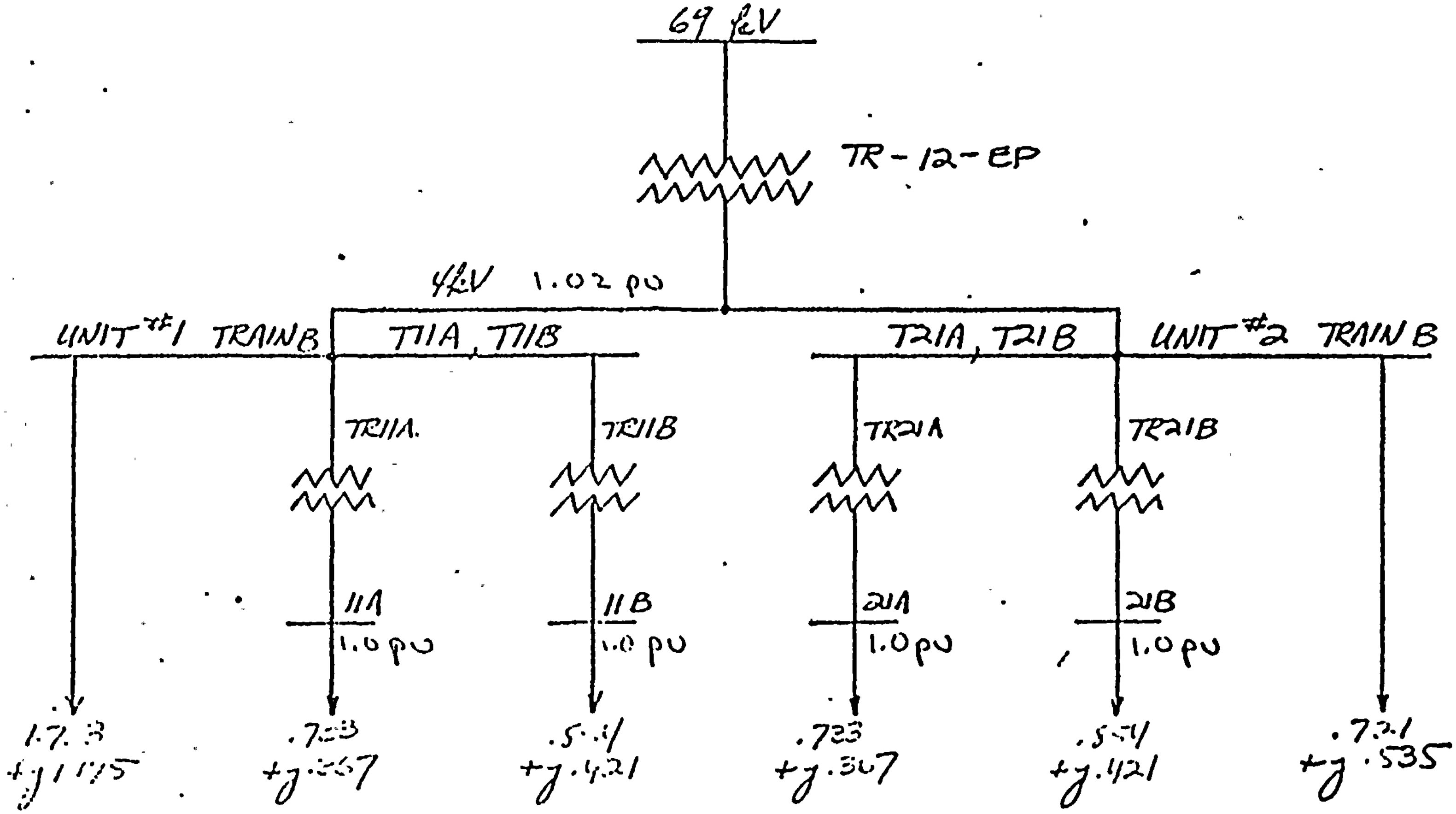


LOAD GIVEN IN MVA

UNIT #2 SHUTDOWN
UNIT #1 SHUTDOWN + ACCIDENT

MOV PICKING UP ONE TRAIN
ON EACH UNIT

CASE # C1
SOURCE: 69 kV
LOAD CONDITION { SHUTDOWN (STEADY STATE) + ACCIDENT
SYSTEM VOLTAGE: 72.45 kV

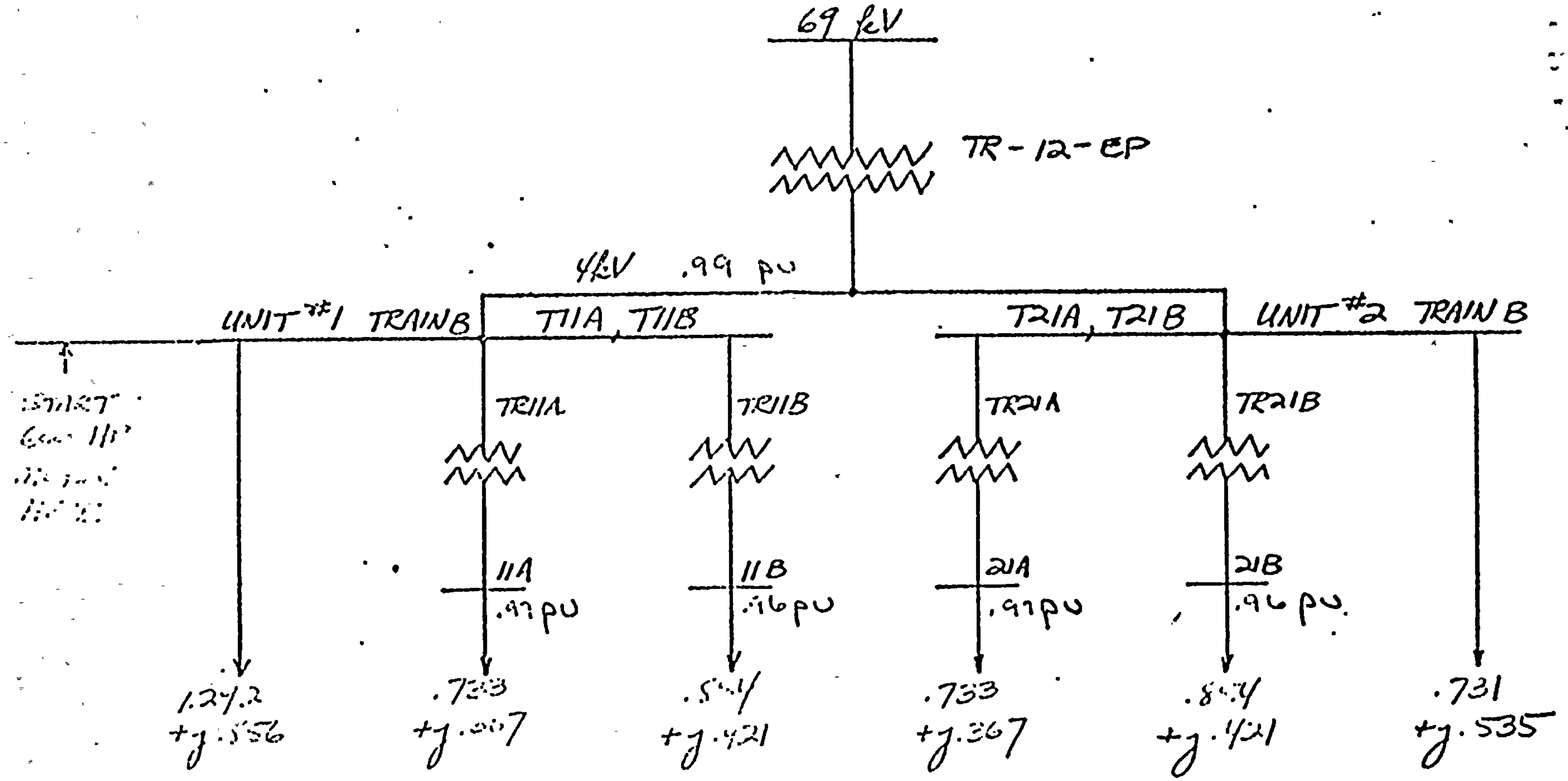


LOAD GIVEN IN MVA

UNIT #2 SHUTDOWN
UNIT #1 SHUTDOWN + ACCIDENT

69 kV PICKING UP ONE TRAIN
ON EACH UNIT

CASE # C2
SOURCE: 69 kV
LOAD CONDITION { SHUTDOWN (STEADY STATE) + ACCIDENT
SYSTEM VOLTAGE: 64.86 kV



LOAD GIVEN IN MVA

CASE #: C3
SOURCE: 69 kV
LOAD CONDITION: SHUTDOWN (TRANSIENT) + ACCIDENT
SYSTEM VOLTAGE: 64.56 kV

UNIT #2 SHUTDOWN
UNIT #1 SHUTDOWN + ACCIDENT
START CONTAINMENT SPRAY

69 kV PICKING UP ONE TRAIN ON EACH UNIT

ATTACHMENT NO. 6

TABLE I: TRANSFORMERS' CAPACITY AND IMPEDANCE VALVES.

TABLE II: TRANSFORMERS' CAPACITY AND LOAD DEMAND FOR EACH OFFSITE POWER SOURCE.

TABLE I

UNIT	TRANSFORMER	QUANTITY	IMPEDANCE
1	1300 mva, 345/26-kv Unit 1 step-up transformer TR-1	1	11.5% 1300 mva base
1	18/24/30 mva, 26/4-kv Transformers 1 AB and 1 CD	2	9.6% 18 mva base
1	18/24/30 mva, 34.5/4-kv Transformers 101 AB and 101 CD	2	6.48% 18 mva base
2	1300 mva, 765/26- kv (3-433 mva) Unit 2 step-up transformer TR-2	1	16.5% 1300 mva base
2	18/24/30 mva, 26/4-kv Transformers 2 AB and 2 CD	2	9.6% 18 mva base
2	18/24/30 mva, 34.5/4-kv Transformers 201 AB and 201 CD	2	6.48% 18 mva base
1 and 2	345 mva testiary, 765/345/34.5-kv Transformer No. 4	1	LV-testiary + reactor-17.5% 345 mva base
1 and 2	150 mva, 345/34.5-kv Transformer No. 5	1	16,2% 150 mva base
1 and 2	7.5 mva, 69/4-kv Transformers 12 EP-1, 12 EP-2	2	7% 7500 kva base
1 and 2	1.5 mva 4 kv/600-volt Transformers TR11A, TR11B, TR11C, TR11D, TR21A, TR21B, TR21C, TR21D	8	8% 1500 kva base

TABLE 1 (CONTINUED)

UNIT	TRANSFORMER	QUANTITY	IMPEDANCE
1 and 2	1 mva, 4-kv/600-v Transformers TR11BMC, TR11CMC, TR21BMC, TR21CMC	4	5.83% 1000 kva base
1 and 2	1 mva, 4-kv/480-volt Transformers TR11PHA, TR11PHC, TR21PHA, TR21PHC	4	8.83% 1000 kva base

<u>TABLE II</u>

UNIT	SOURCE	TRANSFORMER CAPACITY	SHUTDOWN LOAD (MVA)	STARTUP LOAD (MVA)
1*	Normal Aux Power	30 MVA, TR1AB 30 MVA, TR1CD	15.066 + j 11.357=18.9 16.165 + j 12.28 =20.3	19.524 + j 10.956=22.4 14.111 + j 8.101=16.3
1*	Preferred Offsite Power	30 MVA, TR101AB 30 MVA, TR101CD	15.066 + j 11.357=18.9 16.165 + j 11.28 =20.3	19.524 + j 10.956=22.4 14.111 + j 8.101=16.3
1 and 2	Preferred Offsite Power	345 MVA, TR 4 150 MVA, TR 5	58.746 + j 44.732=73.8 58.746 + j 44.732=73.8	61.15 + j 40.152=73.2** 61.15 + j 40.152=73.2**
1 and 2	Alternate Offsite Power	7.5 MVA, TR 12EP	5.672 + j 3.286= 6.56	-
1*	Auxiliary Power Distribution Trf's	1.5 MVA, TR11A TR11B, TR11C, TR11D	.854 + j .421= 0.952	1.138 + j .62 = 1.296
1*	Auxiliary Power Distribution Trf's	1.0 MVA TR11BMC, TR11CMC	.676 + j .485= 0.832	.513 + j .349= 0.620
1*	Pressurizer Heaters Trf's	1.0 MVA TR11PHA, TR11PHC	.679 + j .006= 0.679	.362 + j .027= 0.363

* Same for Unit 2

** Startup & Accident in one Unit, Shutdown in other Unit

ATTACHMENT NO. 7 TO
AEP:NRC:00268

STATION ELECTRIC DISTRIBUTION SYSTEM UNDER VOLTAGE PROTECTION MODIFICATIONS

PROPOSED MODIFICATIONS

1. Install 4 kV safety bus under voltage protection at buses A and D Units 1 and 2.

   Voltage setting = 89.9%

   Time setting = 2 min.

2. Modify existing under voltage relay blackout setting (at the 4 kV buses) as follows:

   Voltage setting = 79.9%

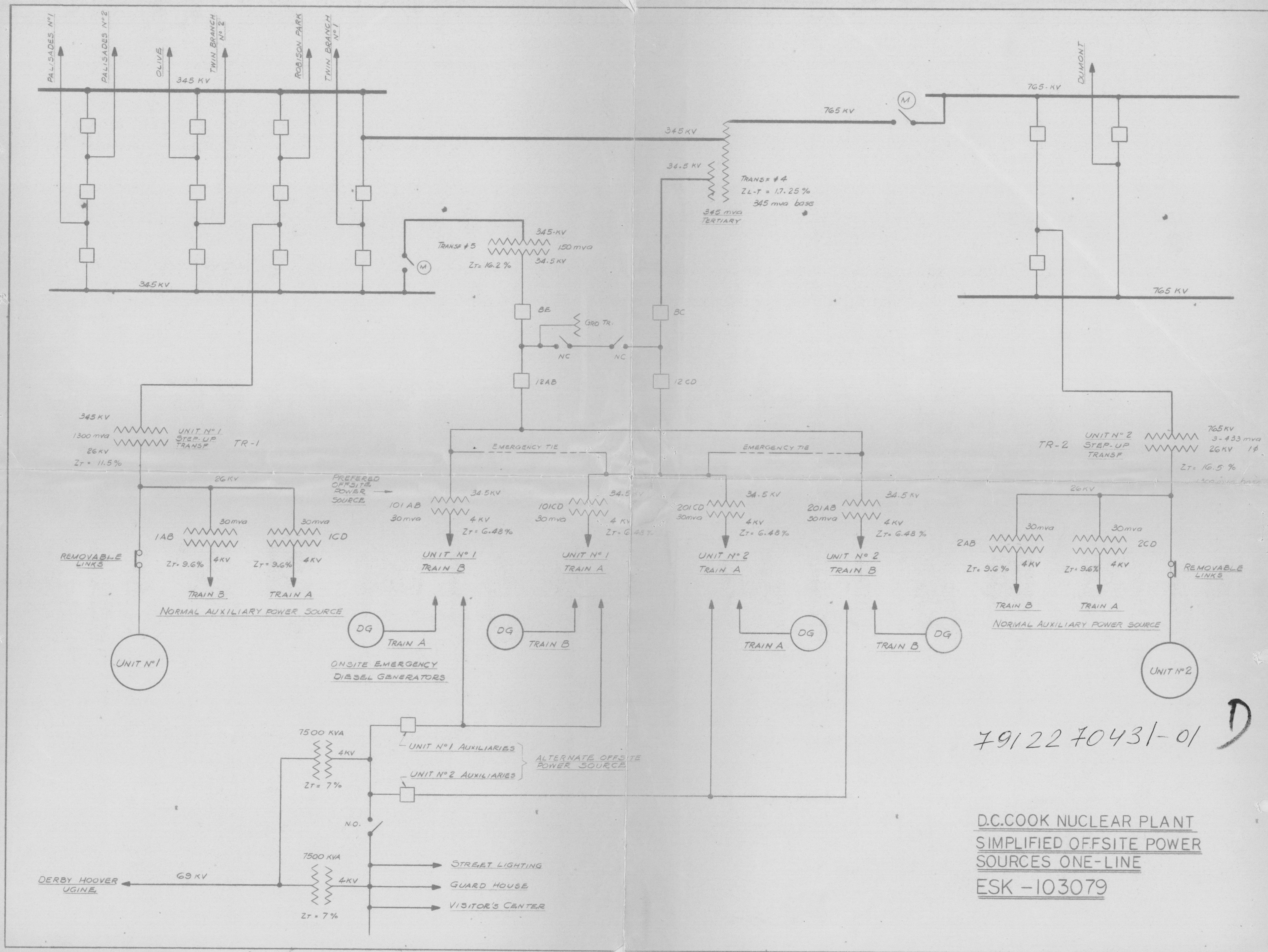
   Time setting = 2 sec.

3. Institute administrative controls to prevent feeding both buses of one safety train from two different offsite power sources.

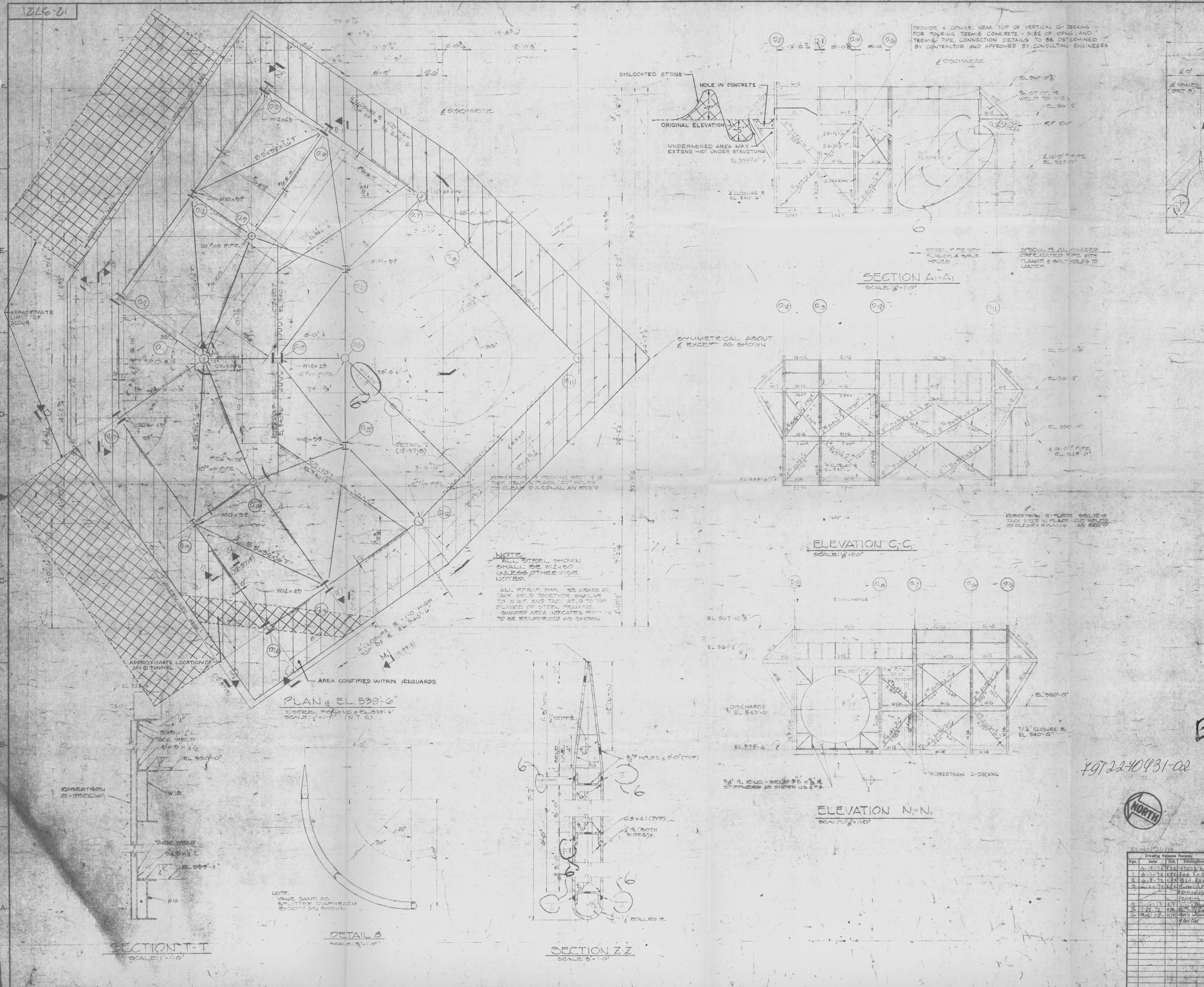
4. Change tap settings on the 69/4 kV alternate power source transformer from 67 kV to 68.8 kV to reduce probability of over voltage conditions at the safety buses due to high voltage conditions on the 69 kV subtransmission system.

[illegible]

[illegible]



D.C.COOK NUCLEAR PLANT
SIMPLIFIED OFFSITE POWER
SOURCES ONE-LINE
ESK -103079



NOTES

REFERENCE DRAWINGS

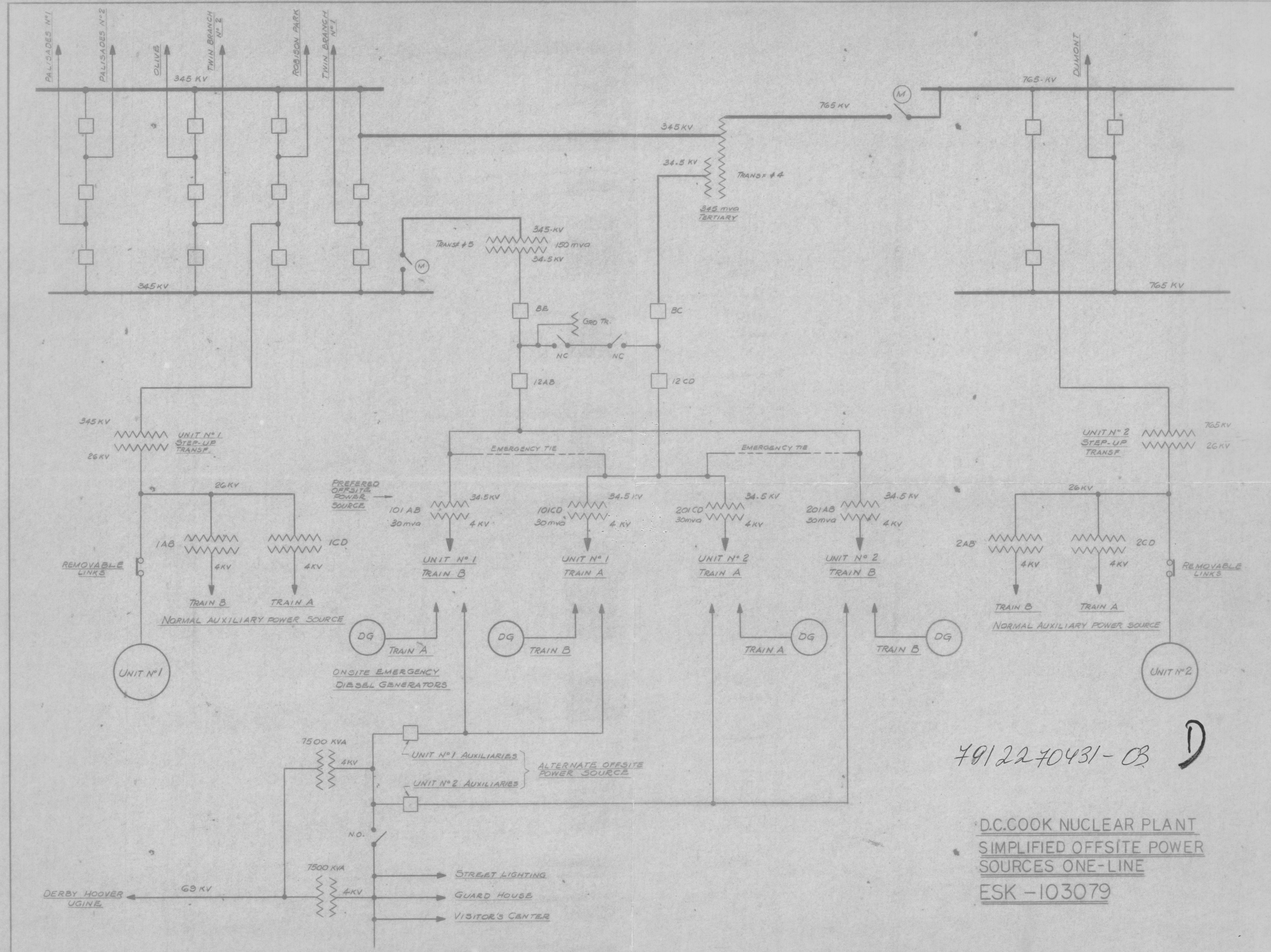
UNIT 1 DISCHARGE STRUCTURE EL 539-6" & SECTIONS

DONALD C. COOK NUCLEAR PLANT
INDIANA & MICHIGAN ELECTRIC CO.
BRIDGMAN, MICHIGAN

SCALE AS NOTED

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 12-3721-6



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D.C.COOK NUCLEAR PLANT
SIMPLIFIED OFFSITE POWER SOURCES ONE-LINE
ESK -103079