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REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

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AUTH.NAME AUTHOR AFFILIATION
TUCKER,H.B. Duke Power Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director
STOLZ,J.F. Operating Reactors Branch 4

SUBJECT: Forwards responses to Questions 1-5 re adequacy of electric distribution sys voltages, in response to 820608 request,per 821022 commitment.

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DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

November 8, 1982

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

Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Adequacy of Station Electric Distribution Systems Voltages

Dear Sir:

Enclosed are the responses to further questions concerning the "Adequacy of Station Electric Distribution Systems Voltages" for the Oconee Nuclear Station that were requested by your June 8, 1982 letter addressed to Mr. William O. Parker, Jr. My letter of October 22, 1982 addressed the delay in preparation of this report.

Very truly yours,

H. B. Tucker / BD

Hal B. Tucker

JCP/php
Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Mr. W. T. Orders
NRC Resident Inspector
Oconee Nuclear Station

Mr. Philip C. Wagner
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

A015

ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGE

OCONEE NUCLEAR STATION

RESPONSES TO ENCLOSURE OF JOHN F. STOLTZ LETTER TO W. O. PARKER DATED JUNE 8, 1982

QUESTION #1

Is it possible to automatically connect a Lee Station turbine to the Class 1E distribution system at the Oconee Station (consider the possibility of the standby buses being energized by the Lee Station turbine)? Is it then considered an onsite or an offsite source? If offsite, then provide analysis cases for maximum and minimum steady-state voltages and minimum transient voltages for all voltage levels of the Class 1E distribution system.

RESPONSE TO QUESTION #1

During the operation of Oconee Nuclear Station when both Keowee Hydro Station units are in service, the Lee Station gas turbine generator cannot be automatically connected to the Class 1E distribution system at Oconee.

Whenever either one or both of the Keowee Hydro Station units are not in service, the Lee Station turbine functionally serves as an alternate onsite source. When serving as an alternate onsite source, the Lee gas turbine and the interconnecting 100KV transmission circuit are electrically isolated from the system grid and from all offsite non-safety-related loads. While serving as an onsite source, the Lee gas turbine generator continuously energizes the 4160 volt Class 1E standby buses at Oconee, and provision is made for automatic transfer of the Class 1E distribution system to this source during this mode of operation.

QUESTION #2

The Oconee Final Safety Analysis Report indicates that each unit has a second delayed source of offsite power. This is with the generator links removed, and backfeeding the main transformer from the 230 kV grid (525 kV grid for Unit 3), through the unit auxiliary transformer to the main feeder bus to the Class 1E buses. Per the requirements of Reference 1, this source of offsite power must also be analyzed. Provide the analyzed voltages for all voltage levels in the Class 1E distribution system for maximum and minimum steady-state voltage and minimum transient voltage, utilizing both the 230 and the 525 kV grids.

RESPONSE TO QUESTION #2

The submittals on Oct. 29, 1979 and Jan. 31, 1980 have demonstrated the ability of the startup transformer to supply full auxiliary loads + LOCA with degraded voltage. The adequacy of the voltages when backfeeding can be demonstrated by comparisons of the startup supply with the backfeed supply.

When Oconee is supplied power via the Unit Auxiliary Transformer with the generator disconnect links removed (backfeeding), the Unit is shutdown. Hence, the auxiliary load is much less than in the submittals listed above with the startup transformer supplying power. It can be demonstrated that the voltages are satisfactory with grid voltage at historical maximum and with minimum unit auxiliary load using the following data:

Supply	Impedance from System to 4160v Bus (100MVA Base) (P.U.)	Voltage Ratio (HV/LV)	230 or 525KV System Voltage Range	4.16KV System No Load Voltage Range
Startup CT1, CT2 or CT3	0.416	52.524	.9435 to 1.004 pu	.993 to 1.057 per unit (pu)
230kV MSU Transformer Backfeed (Units 1 & 2)	0.449	52.566	.9435 to 1.004	.993 to 1.056 pu
525kV MSU Transformer Backfeed (Unit 3)	0.451	119.988	.941 to 1.013	.99 to 1.066 pu

Note that the maximum no load voltage is greatest (1.066 pu) when backfeeding on Unit 3. This voltage on Unit 3 of 1.066 per unit is just 6.6% above the 4.16KV switchgear nominal voltage. Under lightly loaded conditions, the maximum voltage will be slightly less than 6.6% above the nominal. The plant equipment can operate continuously at this voltage. Therefore auxiliary system voltages are satisfactory under maximum transmission system voltage conditions.

It can be demonstrated that the voltages are satisfactory under low system voltages by noting that the transformers are tapped to deliver essentially the same voltage to the 4.16KV system whether fed from the startup transformer source or the delayed offsite source (backfeeding). This is illustrated in the data presented above, as the voltage ratios from the HV System to the LV System are essentially the same through both sources, and the equivalent impedance through all sources is not significantly different. In the Oct. 29, 1979 submittal, for the case where the startup transformer was supplying the load (Figure 3), the maximum load included power operation plus LOCA loads. When backfeeding, the unit will be off line and the normal load will be the cold shutdown loads (less than 25% of the power operation plus LOCA loads). This lower auxiliary load will result in higher voltages than those in the submittal dated Oct. 29, 1979 for Figure 3. Hence, the auxiliary system voltages for this mode of operation are certainly satisfactory.

QUESTION #3

Describe the loss-of-voltage and degraded voltage relaying, including location of relays, coincidence logic and search scheme. Provide a graph that shows two plots (relay characteristics (including tolerances) and the worst case analyzed voltage transient). This should show that there is no possibility of spuriously tripping the offsite source due to minimum analyzed conditions.

RESPONSE TO QUESTION #3

Oconee has two undervoltage relaying systems (Figure 1) which will separate the auxiliaries from an unacceptable offsite supply. These systems are the Emergency

Power Switching Logic (EPSL) and the External Grid Trouble Protection (EGTP) Systems and are described in the following paragraphs.

The characteristics of the Emergency Power Switching Logic undervoltage relays which will separate a unit from the offsite source are shown in Figure 2. Also plotted in Figure 2 are the transient voltages during starting of the unit LOCA loads plus starting a large non-safety motor (Condensate Booster Pump Motor) following a LOCA, with the grid voltage at its historic low and the startup supplying the load. Figure 2 demonstrates sufficient margin exists between the worst case analyzed voltage transients and the undervoltage relay (CV-7) to preclude the possibility of spuriously tripping the offsite source.

A description of the EPSL and the EGTP Systems follows:

A. 4.16V Undervoltage Relaying associated with the Emergency Power Switching Logic (EPSL)

Oconee has undervoltage relaying associated with the Emergency Power Switching Logic at four functional locations on the 4.16KV system (See Figure 1, locations 3, 4 & 6, 5, 7 & 8). In all cases, two out of three relay logic is used. The function of the relays are described below:

1. Unit Auxiliary Transformer Undervoltage Relaying (Location 3)

The undervoltage relays associated with the unit auxiliary transformer serve to separate the 4.16KV system from an unacceptable voltage supply during unit power operation or when backfeeding the unit auxiliaries through the main stepup and auxiliary transformer with the generator disconnect links removed. The CV-7 relay characteristics are shown in Figure 2.

2. Startup Transformer Undervoltage Relaying (Location 5)

The undervoltage relays associated with the startup transformer serve to separate the 4.16KV System from an unacceptable voltage supply. They also prevent closing of the 4.16KV bus into the startup supply when the voltage is too low. The CV-7 relay characteristics are shown in Figure 2.

3. Main Feeder Bus Monitor Undervoltage Relaying (Locations 4 & 6)

The main feeder bus monitor undervoltage relaying detects loss of voltage to the main feeder buses in a condition such as a blackout or low voltage. If voltage is not restored in 20 seconds the undervoltage relay logic of both main feeder buses is satisfied, then a load shed occurs 1 second later. Keowee is started and approximately 11 to 25 seconds later, power is supplied form Keowee. If power becomes available at an acceptable voltage through the startup supply during the 20 second time delay period or the subsequent 11 second time delay period, power will be automatically restored from the startup supply. The Main Feeder Bus Monitor Relays are Cutler Hammer D23 series relays. The relay will indicate an undervoltage for voltages less than 42% of rated voltage. The above undervoltage relaying is not safety related.

There is a safety related undervoltage relay (CV-7) associated with each main feeder bus (27B1 and 27B2). If on either main feeder bus the normal and startup breakers are open and an ESG signal is present, a load shed will occur 1 second after the associated CV-7 relay picks up. The CV-7 relay characteristics are shown in Figure 2.

4. Standby Bus Undervoltage Relays (location 7 & 8)

These undervoltage relays serve to detect an undervoltage condition on the standby buses. They serve to indicate an undervoltage condition when the bus is supplied from CT4 to CT5 and if in the Automatic mode will separate the standby bus from CT5 due to an undervoltage condition on the standby buses. The undervoltage relays also give a close permissive signal to Keowee source breakers when in the Automatic mode if an undervoltage exists on both standby buses.

The relay will also initiate a separation from the CT4 supply on an undervoltage of the CT4 supply.

B. External Grid Trouble Protective (EGTP) System

The External Grid Trouble Protective System monitors the voltage and frequency on both the red and yellow 230KV buses in the switchyard. When a degraded voltage or frequency condition is sensed the system isolates the switchyard from the system grid, starts both Keowee units, and aligns the switchyard to distribute power from the appropriate Keowee unit to the unit startup transformers through the 230KV overhead line.

This relaying system consists of two redundant undervoltage relaying schemes and two redundant underfrequency relaying schemes. Each scheme has the individual ability to initiate a "Grid Separation". These four schemes have been designated as:

1. Undervoltage Channel No. 1

2. Undervoltage Channel No. 2

3. Underfrequency Channel No. 1

4. Underfrequency Channel No. 2

The undervoltage and underfrequency relays in each channel are energized from bus potential devices connected to each phase of the 230KV Red and Yellow Buses. Each of the potential devices has 2 secondary windings, with one feeding Channel 1 relays and the other feeding Channel 2 relays.

The External Grid Trouble Protective System is composed of six undervoltage relays (27B) for each channel, one per phase on each of the two buses. The circuits are arranged such that it takes at least two out of three red and yellow bus phase undervoltages to initiate operation. Undervoltage Channel No. 2 relaying is similar in operation and redundancy to the undervoltage Channel No. 1. The major difference between the two systems is the fact that each utilizes different manufacturers' components to minimize similar type mechanical failures.

The information presented above shows that there is no possibility of spuriously tripping the offsite source due to the minimum analyzed conditions.

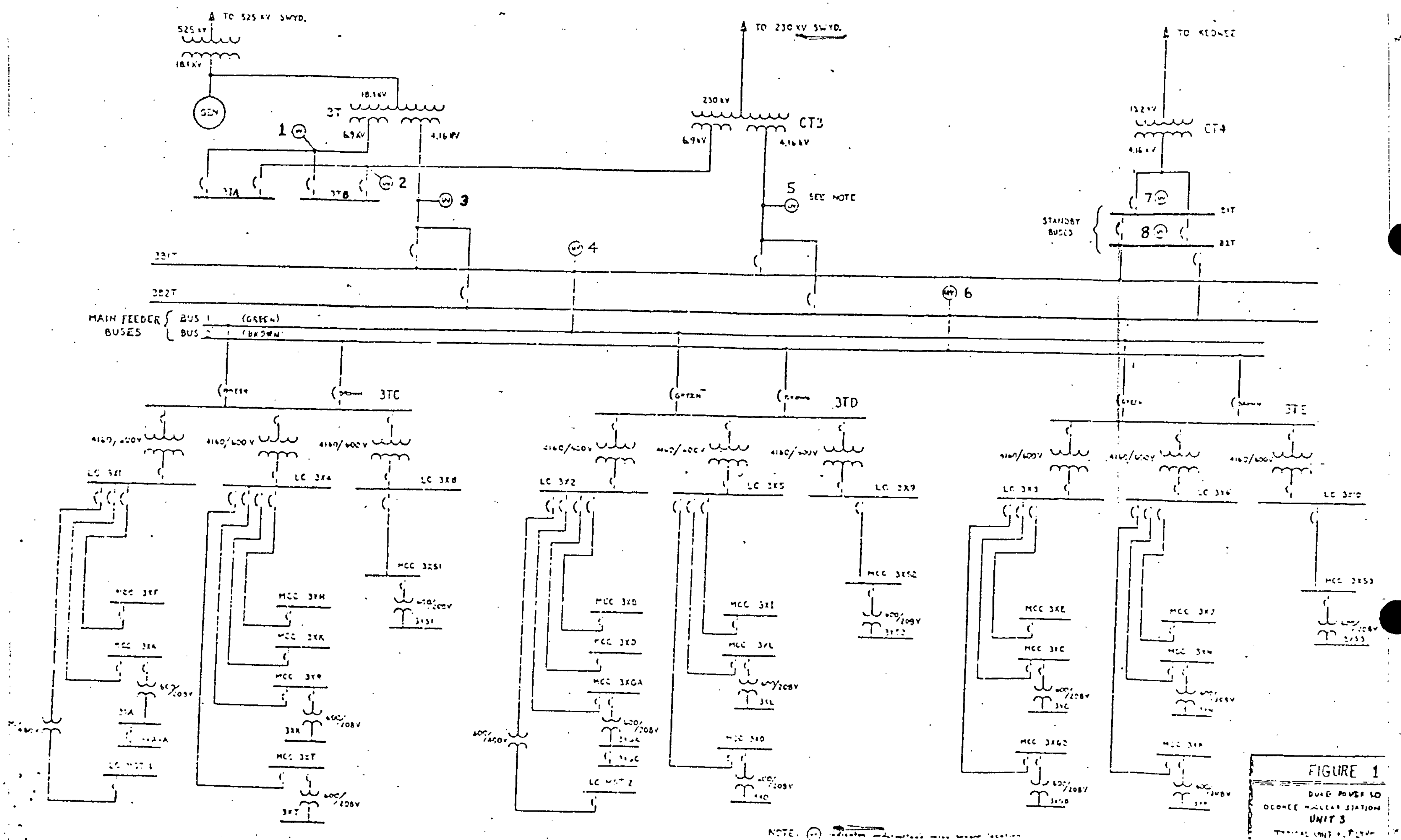
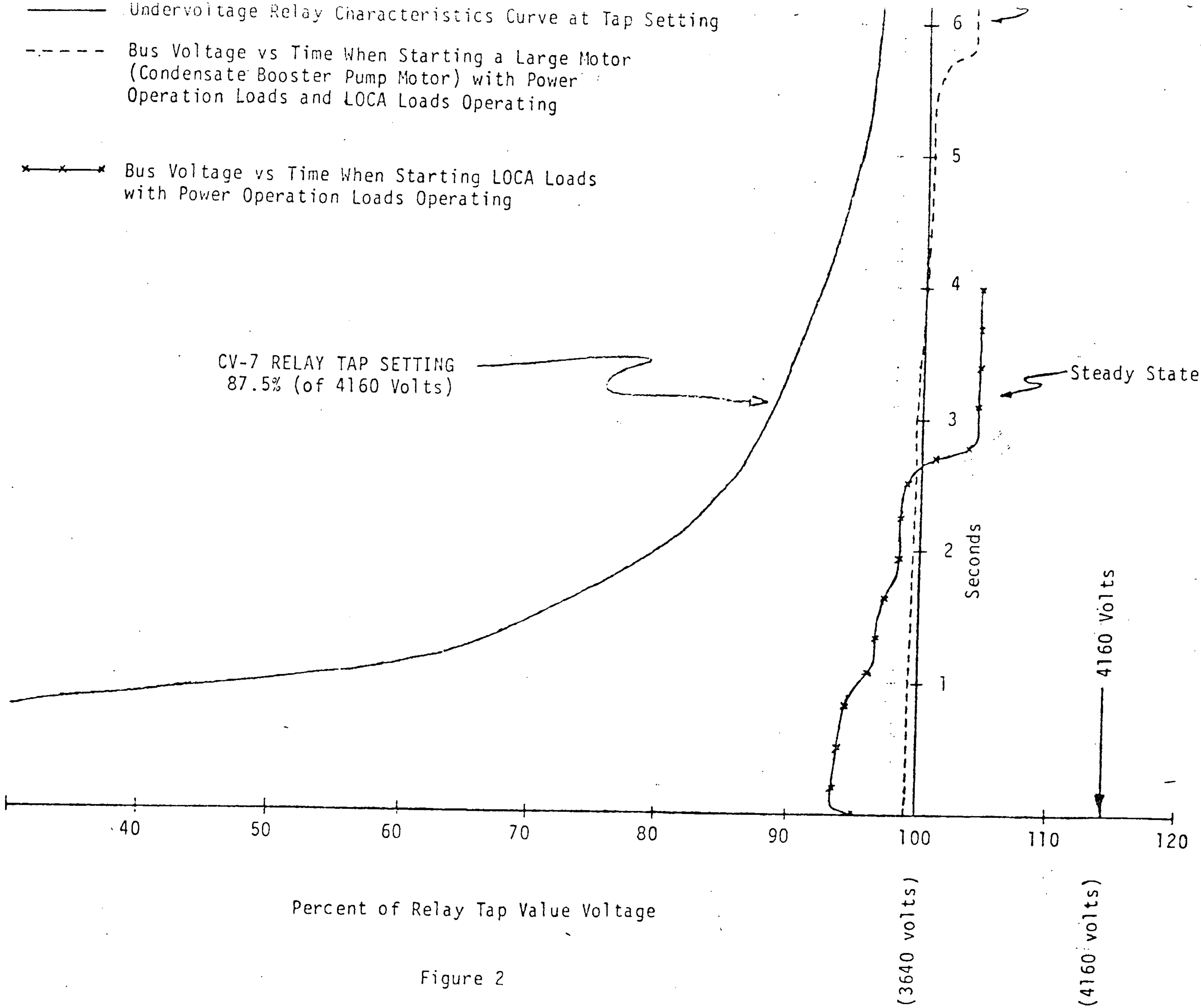

TO 525 KV SWYD.
GEN
3T
6.9KV
4.16 KV
TO 230 KV SWYD.
230 KV
CT3
SEE NOTE
TO KEOWEE
CT4
STANDBY BUSES
MAIN FEEDER BUSES
BUS 1 (GREEN)
BUS 2 (BROWN)
3TC
3TD
3TE
DUKE POWER CO
OCONEE NUCLEAR STATION
UNIT 3

FIGURE 1



Undervoltage Relay Characteristics Curve at Tap Setting
Bus Voltage vs Time When Starting a Large Motor (Condensate Booster Pump Motor) with Power Operation Loads and LOCA Loads Operating
Bus Voltage vs Time When Starting LOCA Loads with Power Operation Loads Operating
CV-7 RELAY TAP SETTING
87.5% (of 4160 Volts)
Steady State
Seconds
1
2
3
4
5
6
4160 Volts
40
50
60
70
80
90
100
110
120
Percent of Relay Tap Value Voltage
(3640 volts)
(4160 volts)

Figure 2

QUESTION #4

It appears that there may be sections of your Technical Specifications (i.e., 3.7.2) that will need to be changed besides Section 3.7.1 to permit only one unit's load on a given startup transformer. Provide Technical Specifications that will accomplish this.

RESPONSE TO QUESTION #4

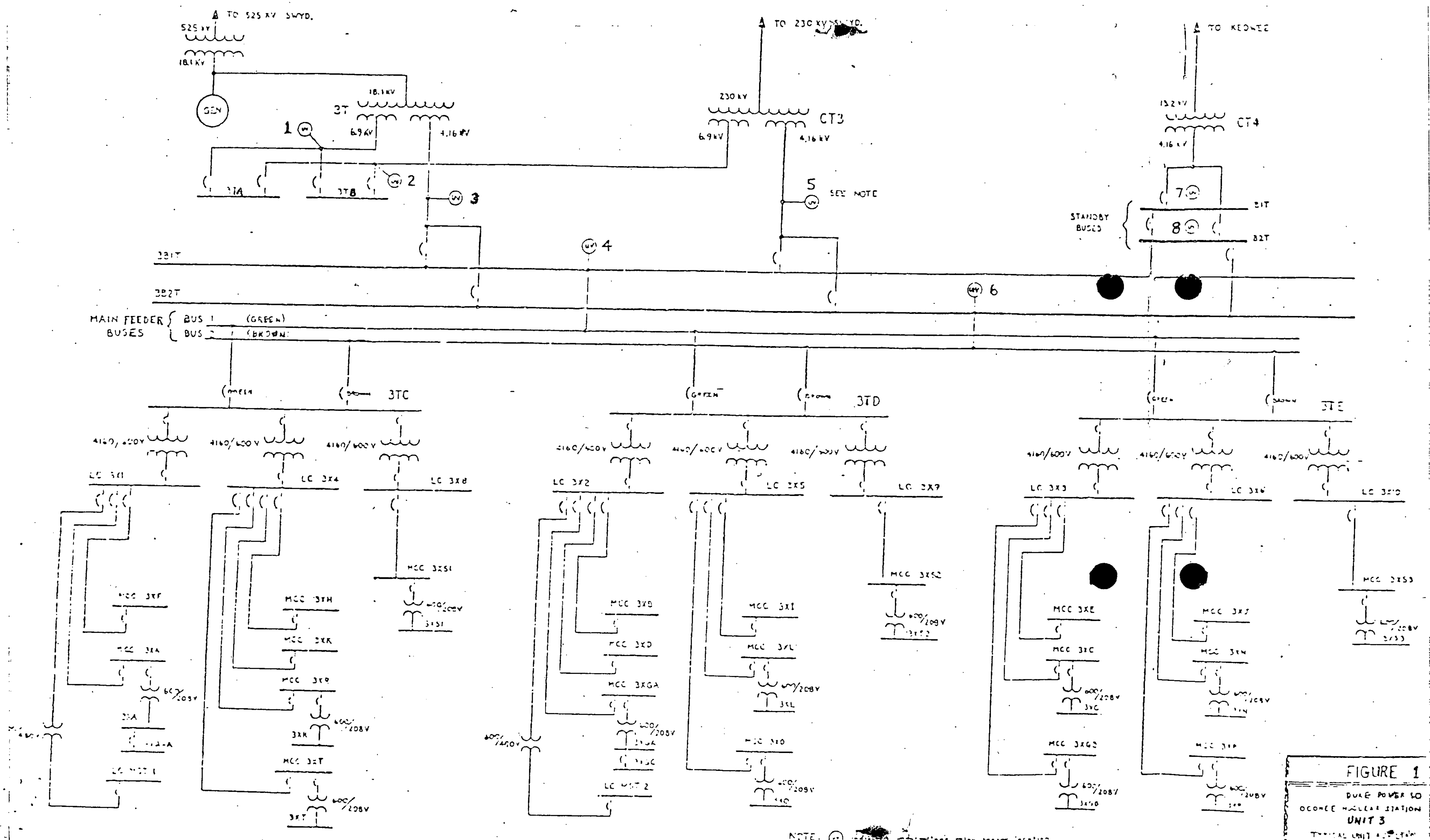
Changes to Technical Specification 3.7 are in preparation and are under review in-house. It is expected that the proposed Technical Specification 3.7 will be provided to you by November 19, 1982.

QUESTION #5

Discussion with your staff indicated that a spare startup transformer might be installed. What is the current status of this proposal?

RESPONSE TO QUESTION #5

Duke Power Company is continuing to evaluate the purchase of a spare transformer. A decision is not expected for some time.



TO 525 KV SWYD.
525 KV
18.1 KV
GEN
18.1 KV
3T
6.9 KV
4.16 KV
1
2
3
3TA
3TB
TO 230 KV SWYD.
230 KV
CT3
6.9 KV
4.16 KV
5
SEE NOTE
TO KEOWEE
13.2 KV
CT4
4.16 KV
7
8
STANDBY BUSES
SB1T
SB2T
3B1T
3B2T
4
6
MAIN FEEDER BUSES
BUS 1 (GREEN)
BUS 2 (BROWN)
3TC
3TD
3TE
4160/600V
LC 3X1
LC 3X4
LC 3X8
LC 3X2
LC 3X5
LC 3X9
LC 3X3
LC 3X6
MCC 3XS1
MCC 3XS2
MCC 3XS3
600/208V
FIGURE 1
DUKE POWER CO
OCONEE NUCLEAR STATION
UNIT 3
NOTE:

FIGURE 1