NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

DOCKET NUMBER 50-269/270/287

FILE NUMBER

NRC DISTRIBUTION FOR PART 50 DOCKET MATERIAL

TO: Edson G. Case

FROM: Duke Power Co.
Charlotte, NC
W. O. Parker

DATE OF DOCUMENT 7/21/77

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DESCRIPTION

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ENCLOSURE

Enclosed info on the design of the emergency power systems as compared to the NRC staff positions on degraded voltage conditions and interaction between offsite and onsite systems indicate that the current design is comparable to that described in the staff's positions. Proposed amendment to this effect will be submitted by 9/15/77.
1p+11p

PLANT NAME: Oconee Nuclear Power Station
Unit No. 1, 2, and 3
RBT 7/27/77

FOR ACTION/INFORMATION

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DUKE POWER COMPANY
POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
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50-269/270/287

July 21, 1977

Regulatory File Cy

RECEIVED JUL 26 1977 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

Mr. Edson G. Case, Acting Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. A. Schwencer, Chief
Operating Reactors Branch #1

Dear Mr. Case:

Your letter of June 3, 1977 requested that we compare the design of the Oconee Nuclear Station emergency power systems with the staff positions to assess the susceptibility of safety-related electrical equipment with regard to (1) sustained degraded voltage conditions at the offsite sources, and (2) interaction between the offsite and onsite emergency power systems. It is our conclusion, as documented in the attached analysis, that the design of the Oconee emergency power system has equivalent capabilities and protective features to those described in the staff's position.

Your letter requested that an amendment to the Facility Operating License be proposed to incorporate comparable Technical Specifications to those provided in the staff position. This amendment will be submitted by September 15, 1977.

Very truly yours,

William O. Parker, Jr.

MST:vr

772080332

OCONEE NUCLEAR STATION

Response to NRC Staff Position on Degraded System Conditions

The design of the Oconee Nuclear Station onsite emergency power system has been reviewed and compared with the Staff position as requested. It has been determined that the existing protection system, relating to degraded offsite system conditions, has equivalent capabilities and protection features to those described in the Staff's position.

The voltage protection incorporated in the design consists of two-out-of-three conincident undervoltage relay logic monitoring the offsite power system. The undervoltage relays in this logic have inverse time characteristics that will protect the onsite distribution system from the effects of varying degraded offsite system conditions. The undervoltage protection will initiate separation of the onsite emergency buses from the offsite power systems immediately upon complete loss of offsite power or at a time delay depending on the extent of the degraded condition.

For the postulated conditions when the emergency buses must be separated from the offiste power systems due to some degraded condition, emergency power is supplied from the onsite Keowee Hydro Station. Two 87.5 MVA hydro-electric generating units are available to serve the emergency buses as described in FSAR Section 8.2.3. Due to the enormous capacity of these onsite emergency power sources, load shedding and sequencing of the emergency loads is not required. Therefore, the present protection system incorporates all levels of protection required for degraded offsite power system conditions due to the inherent capabilitites of the inverse time undervoltage relay.

The following discussion addresses the comparison of the design of the Oconee Nuclear Station emergency power systems with the stated Staff positions:

Position 1

a) In response to the August 12, 1976 NRC request for information, an analysis of the Oconee electrical distribution system was performed, documented, and submitted to the Staff. A summary of this report is enclosed as Attachment I. This analysis, covering the voltage requirements of the electrical equipment under degraded conditions, defined the undervoltage trip setpoint for the inverse-time undervoltage protection relays as 88% of the rated bus voltage. This setpoint will initiate tripping at the following voltage levels and time delays, thereby providing protection over the full range of voltage decays:

Percent of Setpoint	Time Delay
99%	> 5 sec
95%	5.0 sec
90%	3.6 sec
80%	2.0 sec
50%	1.0 sec
<35%	≤0.8 sec

This setting provides adequate margin sufficient to assure the operability of the emergency loads under short-time or long-time voltage degradation within the capability of the equipment and within the setpoint limits.

b) The design of the voltage protection system conforms to this position in that it provides two-out-of-three coincident undervoltage relay logic to preclude spuriously separating the emergency buses from the offsite power sources.

c) The time delays associated with the setpoints which are listed in the preceding response to Position 1(a) were selected based on the following considerations:

   1) The allowable time delay, including margin to trip offsite power and to provide emergency onsite power, does not exceed the 23 seconds period for a LOCA condition or the 23 minute period for a non-LOCA condition that is assumed in the FSAR accident analysis.

   2) The time delays selected prevent short term transient conditions from reducing the availability of the offsite power sources and minimize the effects of these disturbances.

   3) The inverse-time characteristic of the undervoltage relays used for voltage protection is well within the allowable limits established for the safety systems equipment. This protection will, therefore, separate the emergency buses from the offsite power sources before any voltage level is reached which may be detrimental to the safety systems or components.

d) The undervoltage protection logic automatically initiates the disconnection of the offsite power sources from the emergency buses whenever the voltage setpoint and time delay have been exceeded.

e) Although designed prior to the issuance of IEEE 279-1971, the undervoltage protection logic satisfies the requirements of this standards.

f) Technical Specifications will be revised to make provisions for the voltage protection monitors.

Position 2

The onsite emergency power for the Oconee Nuclear Station is supplied by the Keowee Hydro Station as described in the FSAR Section 8.2.3. Because of the ample capability of the two Keowee units (87.5 MVA each), no load shedding or sequencing of emergency loads is required. Therefore, no preventive interlocks, automatic bypasses, or re-instatement features are required.

Position 3

The Technical Specifications will be revised as appropriate to include test requirements that demonstrate the full functional operability and independence of the onsite power sources at least one per 18 months.

ATTACHMENT I

Summary of the Analysis of Oconee Emergency Power Distribution System

I. INTRODUCTION

The following analysis evaluates the Oconee emergency power distribution system to determine if the operability of safety-related equipment, including associated control circuitry and instrumentation is adversely affected by short term or long term degradation in grid system voltage. The evaluation has been directed toward identifying all possible voltage conditions (i.e., normal and degraded) that can exist on the plant distribution system and comparing equipment operating limits to these voltage conditions.

II. EVALUATION

Figure 1 shows a one-line diagram of the Oconee Unit 3 distribution system which is the basis of our analysis of voltage profiles throughout the distribution system. Since the distribution systems for Units 1 and 2 are similar to Unit 3, the results of this analysis are applicable to all units.

In performing the analysis on the Oconee system, the limitations of the safety-related equipment, including associated control circuitry and instrumentation, were defined to establish the voltage range over which the components could operate continuously in the performance of their design function. These continuous operating voltage ranges are:

Component	Voltage Rating	Limiting Voltage Range
Motors	4000 V	(±10%) 4400/3600V
	575 V	(±10%) 633/518V
	200 V	(±10%) 220/180V
M O Valves	575 V	(±10%) 633/518V
	200 V	(±10%) 220/180V
Motor Controllers	600 V	(≥85%) 510V
	208 V	(≥85%) 177V

The voltage ranges defined for motor continuous operation are the most restrictive operating conditions and, therefore, establish the bounds of continuous system operation.

This analysis adresses the condition when the normal auxiliary loads are being supplied by offsite power from Duke's 230 kV system. These normal auxiliary loads are supplied from the offsite power system during refueling, plant startup, plant shutdown, and abnormal trip of the unit. During accident conditions the offsite source is the preferred source to supply the required safety loads also. This source of supply in either normal or accident conditions is available through startup transformer CT3 which supplies the 4.16 kV distribution buses.

Since the normal operating voltage range (i.e., 227 kV to 217 kV) for the grid system is below the nominal 230 kV system voltage, startup transformer CT3 is set on the 218,500 volt tap in order to optimize voltage profiles throughout the auxiliary system. All load center transformers as shown in Figure 1 are set on nominal taps. In order to determine the voltage profiles at the safety-related buses for full-load and no-load conditions and the range of normal grid voltages defined above, computer studies were run for the following two cases:

Case 1: With the grid voltage assumed operating at 227 kV and the auxiliary system under minimum loading conditions, the voltage profiles for the safety-related buses were calculated. This case provides the highest expected voltages of 4252/613/212V on the safety-related buses for the highest normal operating grid voltage. It should be noted that since a no load condition does not practically exist on the auxiliary system, the condition of minimum loading during cold shutdown has been used instead. Figure 2 summarizes the results of this case.

Case 2: With the grid voltage assumed operating at 217 kV and the auxiliary system under maximum loading (i.e., full load) conditions, the voltage profiles for the safety-related buses were calculated. This case provides the lowest expected voltages of 3802/548/189V on the safety-related buses for the lowest normal operating grid voltage. Figure 2 summarizes the results of this case.

For all other possible auxiliary system loading conditions with the 230 kV grid system operating between 227 kV and 217 kV, the voltage profiles for the safety-related buses will be within the range established by Case 1 and Case 2 defined above.

Under normal conditions the Oconee Unit 3 auxiliary loads are carried by the Unit 3 generator through unit auxiliary transformer 3T as shown in Figure 1. The normal operating range for the generator terminal voltage is 18.94 kV to 17.68 kV. In analyzing the voltage profiles at the safety-related buses, computer studies were run for normal generator operating voltages (i.e., Cases 3 and 4) as defined above and for degraded conditions (i.e., Cases 5 and 6) requiring generator trip. The case studies are as follows:

Case 3: With the generator voltage at its normal maximum value of 18.94 kV and the auxiliary system under minimum loading conditions corresponding to the condition of the unit tied to the transmission system and under load, the voltage profiles for the safety-related buses were determined. This provides the highest expected voltages of 4397/633/219V on the safety-related buses for the highest normal generator operating voltage. Figure 3 summarizes the results of this case.

Case 4: With the generator voltage at its normal minimum value of 17.68 kV and the auxiliary system under maximum loading conditions, the voltage profiles for the safety-related buses were determined. This provides the lowest expected voltages of 3978/573/198V on the safety-related buses for the lowest normal generator operating voltage. Figure 3 summarizes the results of this case.

Case 5: With the generator voltage assumed at the overvoltage setpoint of 19.91 kV requiring generator trip and the auxiliary system under minimum loading conditions corresponding to the Unit tied to the transmission system and under load, the voltage profiles for the safety-related buses were determined. This provides the highest possible operating voltages of 4626/667/230V on the safety-related buses with the generator voltage at the overvoltage setpoint of the Volts/Hertz protective relaying. Figure 4 summarizes the results of this case.

Case 6: With the 230 kV transmission system operating at its normal minimum value of 217 kV and with the generator assumed operating in a degraded loading condition (i.e., under-excited condition) corresponding to the loss-of-excitation relay setpoint, the voltage profiles (i.e., 3952/569/197V) for the safety-related buses were determined. Figure 4 summarizes the results of this.

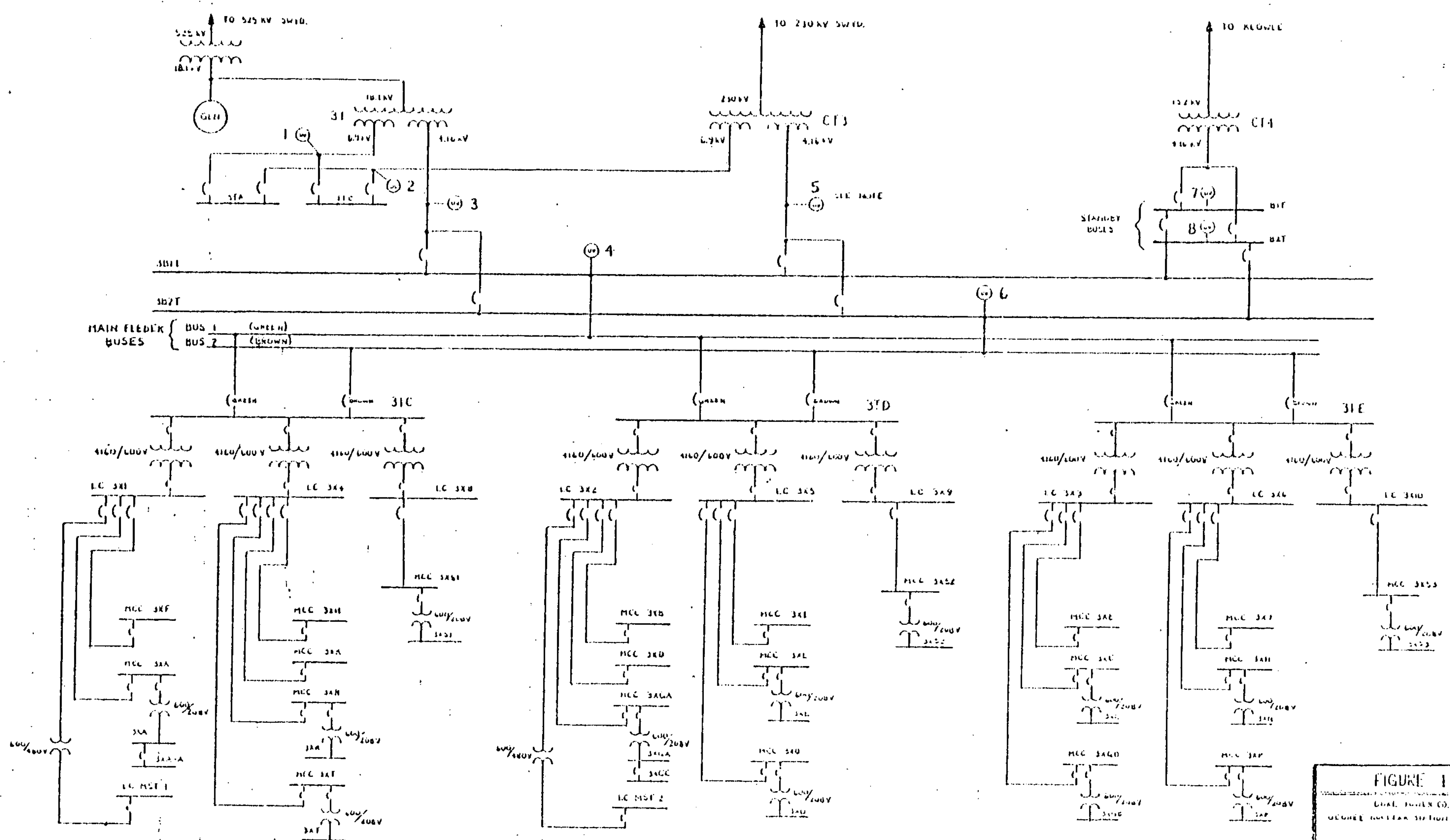
III. CONCLUSIONS

All pertinent combinations of operating conditions were evaluated for the Oconee auxiliary system, and it was determined that all safety-related loads, including associated control circuitry and instrumentation, will perform their safety functions as required.

To ensure that the operability of system components is not adversely affected by short term or long term degradation in system grid voltage, the undervoltage relays that monitor the offsite power system are set at 88% (3660V). This ensures that an acceptable voltage level required for continuous operation of non-safety and safety-related equipment will exist. The time delay inherent in these relays will eliminate spurious trips and ensure that degraded undervoltages are detected and cleared before they can adversely affect safety-related loads.

Figure 5 shows the results of Case 7 which provides the voltage profiles on the safety-related buses under degraded offsite power conditions corresponding to the undervoltage relay setpoint of 88% (3660V).

This Case demonstrates that voltages below the continuous operating limits of the safety-related loads cannot exist without causing a separation from the degraded condition.



NOTE: (UV) indicates undervoltage relay sensor locations.

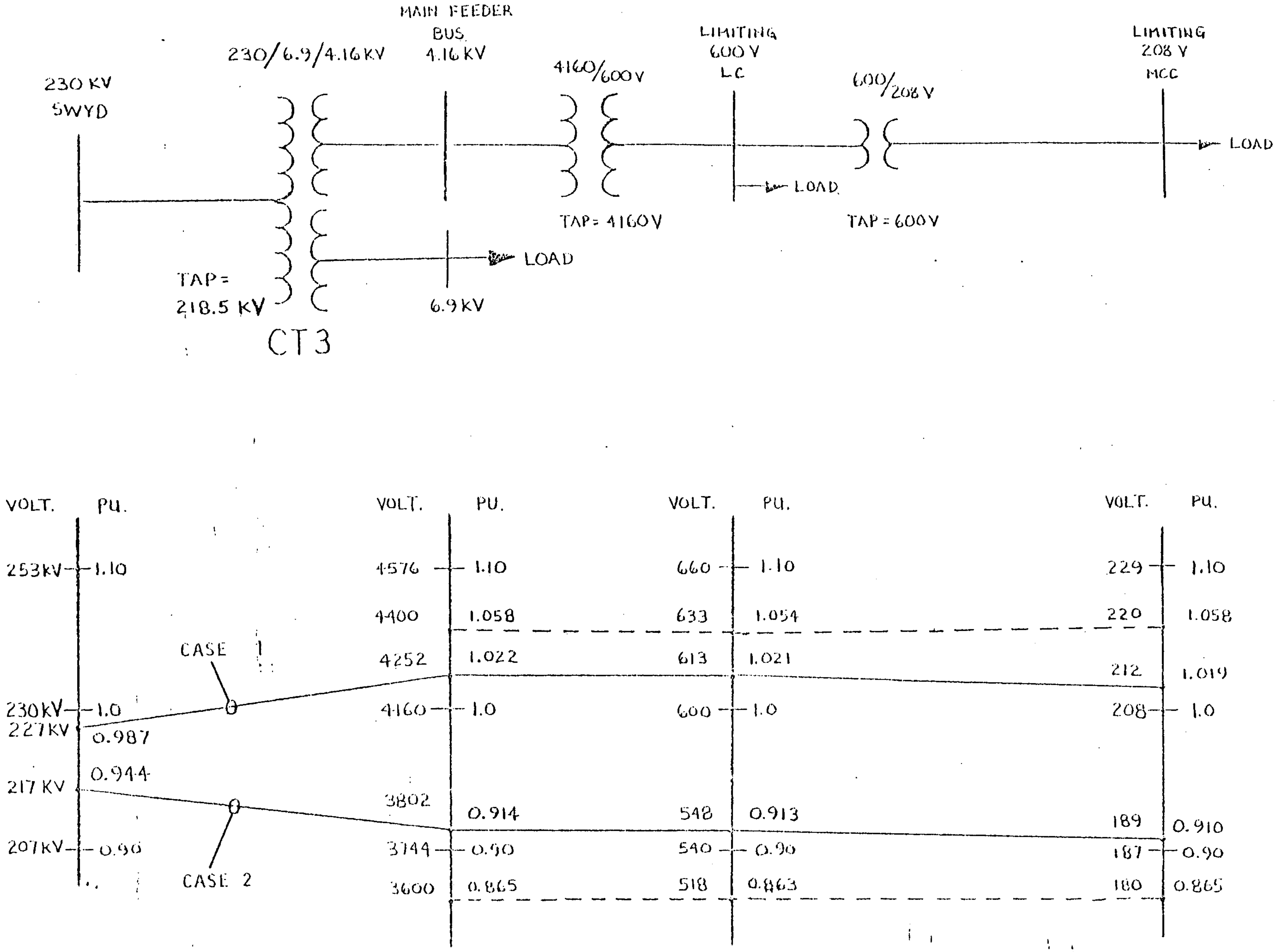
FIGURE 1

DUKE POWER CO.

OCONEE NUCLEAR STATION - UNIT 3

TYPICAL UNIT AUXILIARY SYSTEM

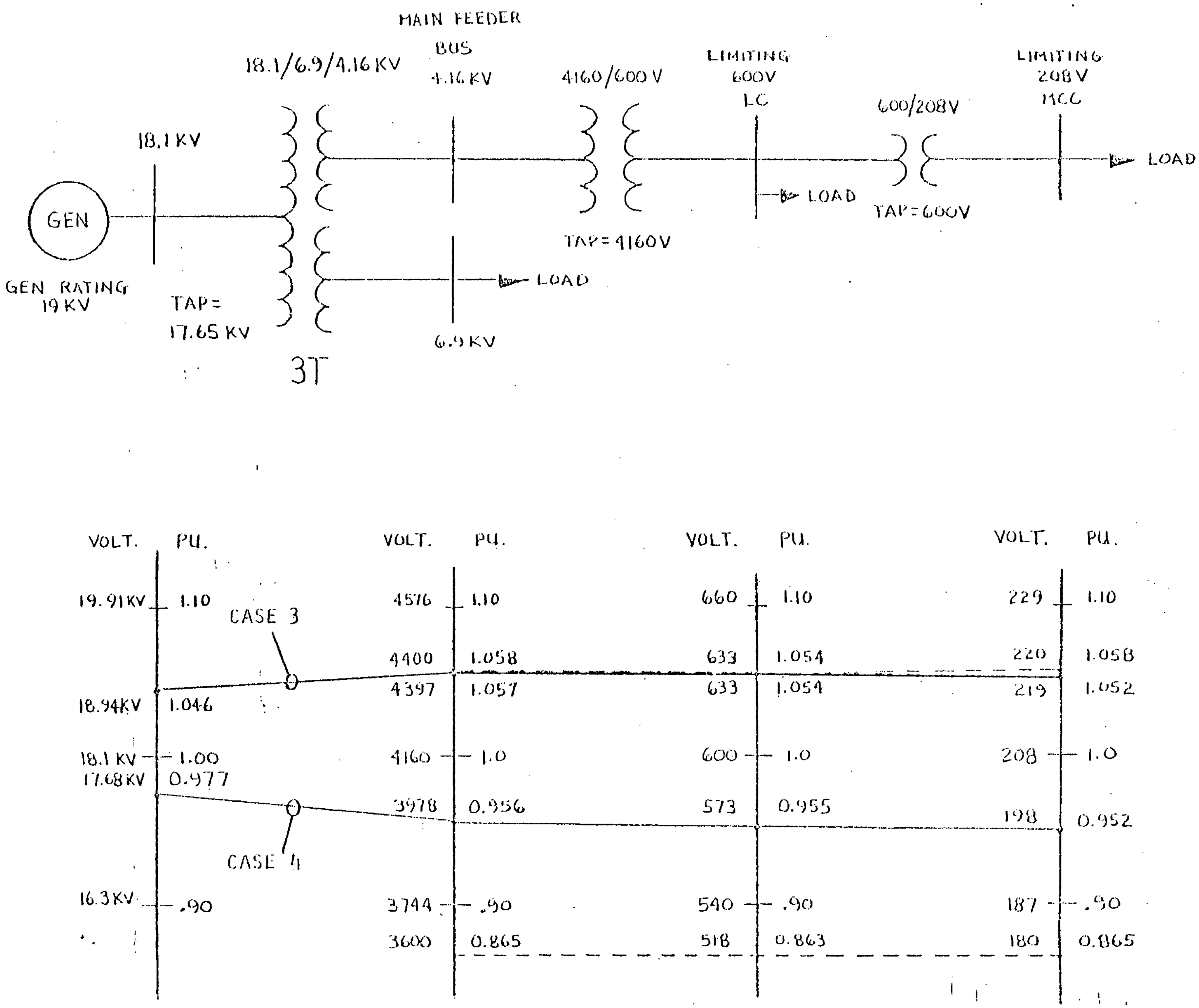
(ESSENTIAL AND NON-ESSENTIAL)



NOTE: The dotted lines represent the bounds of continuous equipment operation.

FIGURE 2 - CASE 1 AND 2

Voltage Profiles on Safety-Related Buses under normal offsite power conditions



NOTE: The dotted lines represent the bounds of continuous equipment operation.

FIGURE 3 - CASE 3 AND 4
Voltage Profiles on Safety-Related Buses
under normal unit power conditions

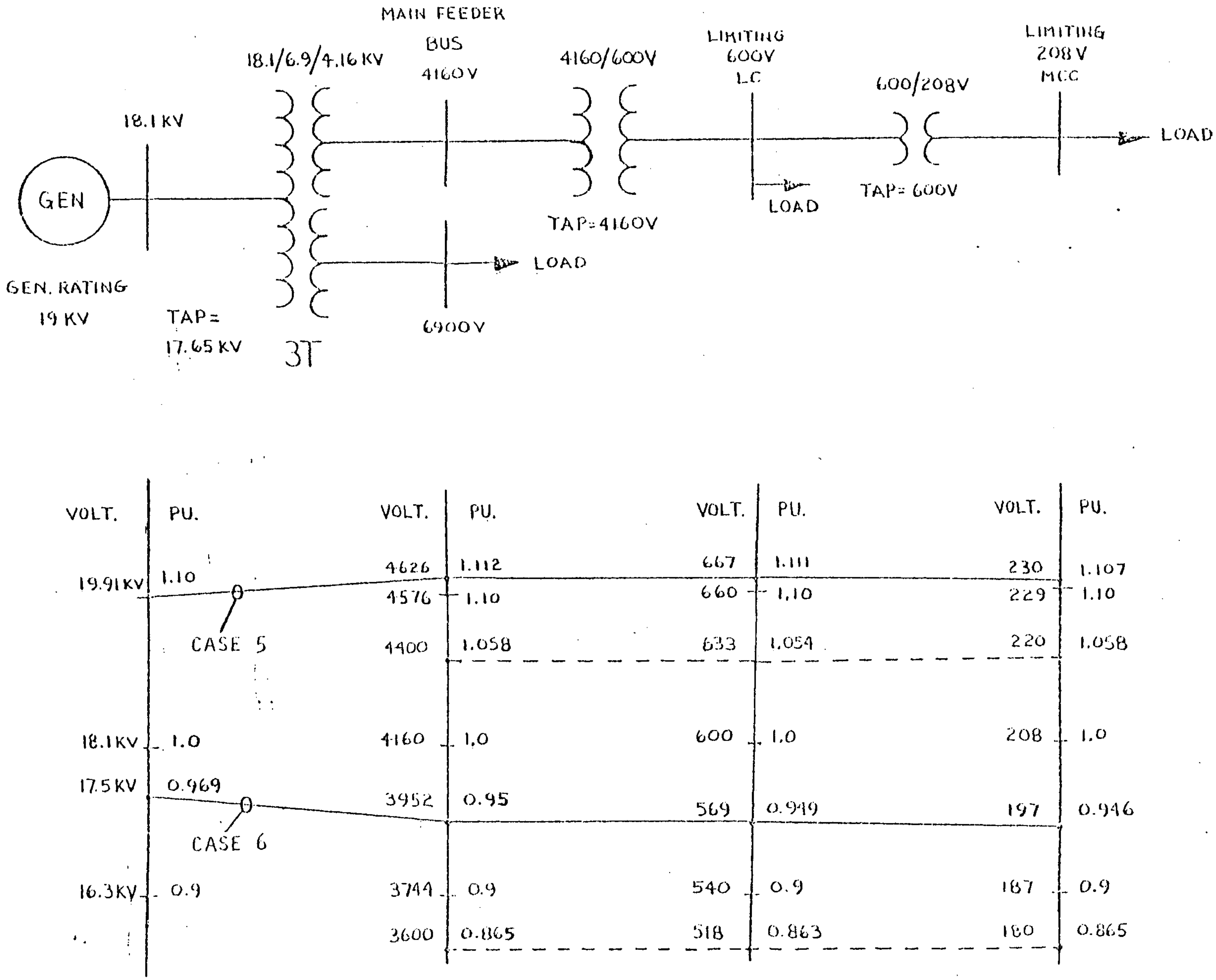


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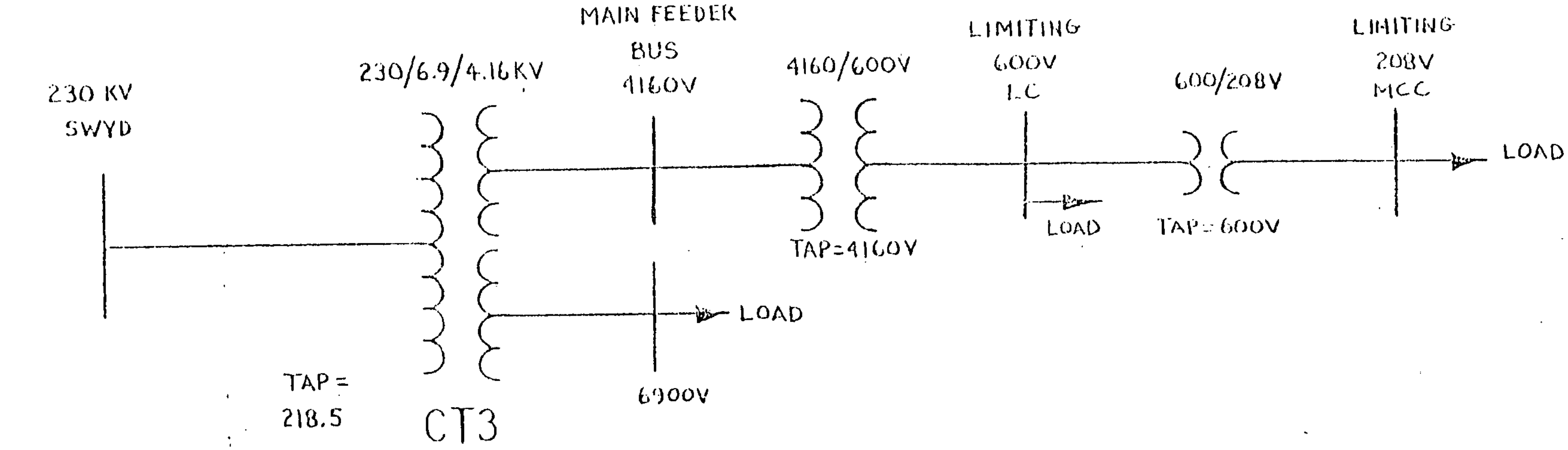
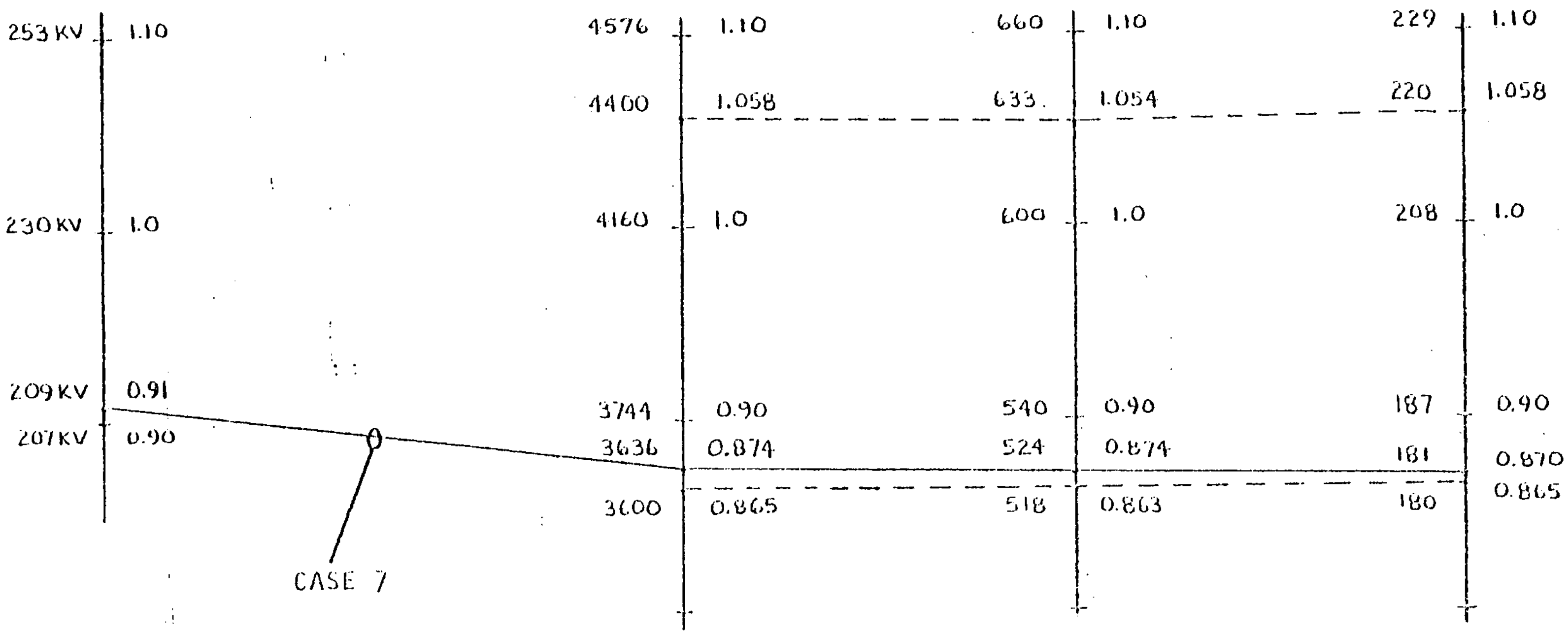
FIGURE 4 - CASE 5 AND 6
Voltage Profiles on Safety-Related Buses
under degraded unit power conditions





NOTE: The dotted lines represent the bounds of continuous equipment operation.

FIGURE 5 - CASE 7

Voltage Profiles on Safety-Related Buses
under degraded offsite power conditions
corresponding to undervoltage trip setpoint.