



**Duquesne Light**

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February 22, 1980

Director of Nuclear Reactor Regulation  
United States Nuclear Regulatory Commission  
Attn: A. Schwencer, Chief  
Operating Reactors Branch No. 1  
Division of Operating Reactors  
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1  
Docket No. 50-334  
Station Service Bus Voltage Study

Gentlemen:

In response to your request for information on station service bus voltages, the attached results of the voltage study are submitted. Based on the results of the study, we have concluded that 6.3 MVAR capacitor banks should be added to the 4160V normal buses 1A and 1D. This will ensure that for a minimum credible sustained undervoltage condition and any accident condition, the emergency bus voltages will be maintained at or above 90%.

Our preliminary investigation for addition of these capacitor banks indicates that we may not be able to procure and install the capacitors prior to the plant startup following the present refueling and modification outage. Therefore, in lieu of having the capacitors in service, we will establish administrative controls to provide an adequate voltage from the system. These controls will require that within 4 hours after station startup and the station service has been transferred to the unit station service transformers, the taps on the system station service transformers will be changed to provide a minimum available voltage from the system. This action will ensure that following a reactor trip and automatic transfer back to the system station service transformers, no undervoltage condition will exist. The administrative controls will also require that during a normal station shutdown, the taps on the system station service transformers will be returned to their original position prior to switching buses from the station transformers to the system transformers.

We plan to complete the installation of the new undervoltage relays during the current major modification and refueling outage. The proposed Technical Specifications associated with these new undervoltage relays on the Class 1E 4160 volt and 480 volt buses will be submitted upon completion of review by the Onsite Safety Committee and the Offsite Review Committee.

Very truly yours,

*C. N. Dunn, RAI*

C. N. Dunn

Vice President, Operations

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## 1.0 Introduction

We have completed computer studies referred to in our letters of October 15, 1979 and January 17, 1980. The primary purposes of the studies were:

1. To determine if a third 4160/480V transformer should be added to the emergency busses or if capacitor banks should be added to the normal 4160V busses to maintain the emergency bus voltage at or above 90% for the minimum credible sustained undervoltage condition.
2. To determine the rating of capacitor banks, if required.
3. To determine the effect of motor starting transient voltages on the emergency equipment and undervoltage protection circuits.

## 2.0 Conclusion Drawn From Studies

Based on the results of the studies, we have concluded that 6.3 MVAR capacitor banks should be added to 4160V normal busses 1A and 1D. (These are the normal busses that supply the 4160V and 480V emergency equipment.) More detail on this application is given in Section 4.0.

## 3.0 Study Results

Referring to our letter of October 15, 1979, page 3, the following compares the previous values for the two worse case conditions (called case 3 and case 1) with the results obtained using the capacitor banks:

### 3.1 Case 3 Loading Condition

	<u>138kV Offsite Source</u>	<u>4160V Em. Bus</u>	<u>900 KVA Load 480V Em. Bus</u>	<u>460V Emerg. Motor Terminals</u>
Without Capacitors	134,964V (97.8%)	3941V (94.7%)	417V (90.7%)*	407.4V (88.6%)*
With Capacitors	135,240V (98.0%)	4143V (99.6%)	441V (95.9%)*	431.4V (93.8%)*

\* 460V Base

Also, for this case with capacitors, the largest motor (Reactor Coolant Pump - 6000 HP) was started and the voltage transient studied. The voltage on the 4160V emergency bus drops to a minimum of 84% and on the heaviest loaded 480V emergency bus, the voltage drops to a minimum of 78.5%. The voltage returns to normal in approximately 22 seconds.

### 3.2 Case 1 Loading Condition

	<u>138kV Offsite Source</u>	<u>4160V Em. Bus</u>	<u>1500 KVA Load 480V Em. Bus</u>	<u>460V Emerg. Motor Terminals</u>
Without Capacitors	134,964V (97.8%)	4024V (96.7%)	406V (88.3%)*	396.4V (86.2%)*
With Capacitors	135,240V (98.0%)	4227V (101.6%)	432V (93.9%)*	422.4V (91.8%)*

\* 460V Base

This particular case does not require the starting of the reactor coolant pump. The above values include that pump running, however.

Other cases were studied considering the starting of the reactor coolant pump and the results are less severe than occurs in Case 3 discussed previously.

The steady state voltages obtained from the studies that include capacitors are illustrated on the attached graphs #1 and #2. These are the same graphs that were attached to our October 15, 1979 letter except curve #4 has been revised on each to reflect our latest results.

### 4.0 Proposal to Improve Emergency Bus Voltages

We propose to add 6.3 MVAR of capacitors to 4160V normal busses 1A and 1D. They will be automatically controlled. The capacitors will be placed on the bus when the sustained voltage on the normal 4160V bus is approximately 101%. This will insure that for a minimum credible sustained undervoltage condition and any accident condition, the emergency bus voltages will be maintained at or above 90%.

The capacitors will be removed from the bus automatically when the normal 4160V bus voltage reaches or exceeds approximately 108%. This set point is based on not exceeding 110% (of 460V) on the 480V emergency bus for a no load condition on the 4160/480V transformer.

Suitable alarms and manual control of the capacitor banks will be provided the station operator for corrective action if automatic controls fail.

Protection of the capacitor banks will be provided.

### 5.0 Basis for Discussion of Undervoltage Relay Response

The bases for the following discussion concerning undervoltage relay response are:

5.1 6.3 MVAR capacitor banks connected to 4160V normal busses 1A and 1D and switched on at approximately 101% of 4160V on those busses and off at approximately 108% of 4160V on the same buses.

- 5.2 4160V emergency bus sustained undervoltage protection set to operate at 90% of 4160V, time delayed 90 seconds.
- 5.3 480V emergency bus sustained undervoltage protection set to operate at 90% of 480V, time delayed 90 seconds.
- 5.4 4160V emergency bus undervoltage motor trip protection set to operate at 75% of 4160V, time delayed 1.0 second.
- 5.5 480V emergency bus undervoltage motor trip protection set to operate at 75% of 480V, time delayed 41 seconds.

## 6.0 Discussion of Undervoltage Relay Response

### 6.1 Case 3 Loading Conditions

With the normal 4160V bus voltage greater than 98%, capacitors are not needed. The 4160V and 480V emergency bus voltages are maintained above 90%. There will be no undervoltage relay operations.

If the normal 4160V bus voltage falls below 101%, the capacitors will be automatically connected to the bus. The capacitors will provide an increase in bus voltage of approximately 5%. The resulting normal bus voltage will, therefore, become approximately 106%. The capacitors will remain on the bus, since the proposed trip point will be 108%. There will be no undervoltage relay operations.

With the offsite source degraded to a value of 98% and the 1A and 1D normal bus capacitors on, the emergency bus voltages are maintained above 90% and no undervoltage relays will operate. If a reactor coolant pump is started on the 1A bus, the 4160V and 480V emergency bus sustained undervoltage relays will begin timing. The transient will subside in less than 30 seconds. The timing relays, set for 90 seconds, will not time out. The undervoltage motor protection relays will not operate. No emergency equipment will be tripped and the offsite source to this equipment will be maintained.

### 6.2 Case 1 Loading Conditions

With the normal 4160V bus voltage greater than approximately 101%, the capacitors are not needed. The 4160V and 480V emergency bus voltages are maintained above 90%. There will be no undervoltage relay operations.

If the normal 4160V bus voltage falls below approximately 101%, the capacitors will be automatically connected to the bus. The capacitors will provide an increase in bus voltage of approximately 5% giving a resultant voltage of 106%. The capacitors will remain on the bus, since the proposed trip point will be 108%. There will be no undervoltage relay operations.

With the offsite source degraded to a value of 98% and the LA and LD normal bus capacitors on, the emergency bus voltages are maintained above 90% and no undervoltage relays will operate.

7.0 Summary

Based on this proposal and our previous proposal concerning the addition of sustained undervoltage relays, we feel that all of your concerns have been addressed. With these modifications, the emergency bus voltages will be maintained above 90% for the minimum credible sustained undervoltage condition and accident condition loading. In addition, the emergency equipment will not be separated from the offsite source unnecessarily.

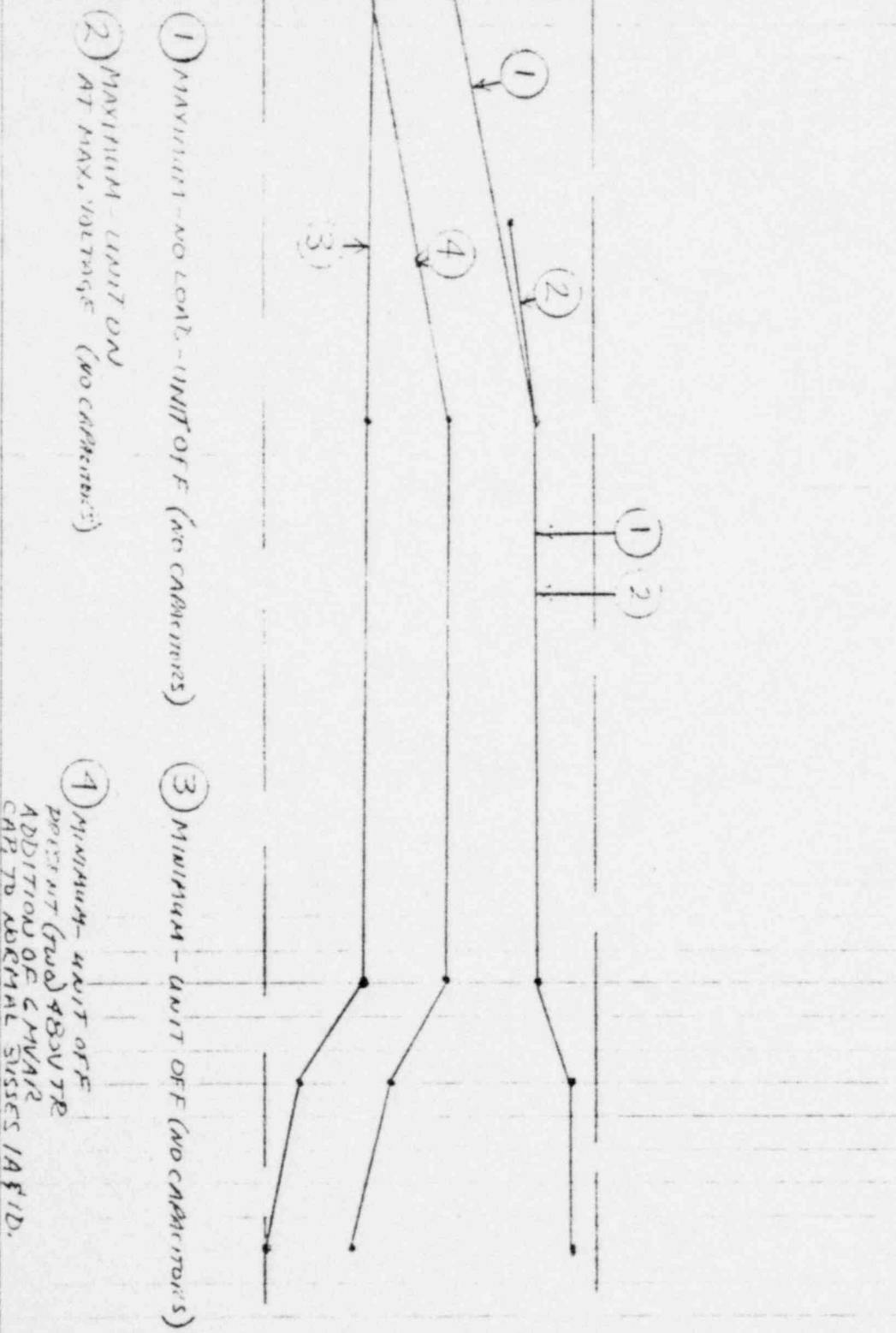
We will proceed to design and install this equipment.

Attachments  
Graph #1 & #2

1	OBJECT TITLE	PROJECT NO.	DATE
2	LOCATION	COMPILED BY	DATE
3	SUBJECT	CHECKED BY	DATE
4	DEPARTMENT	REVISOR	DATE
5	DIVISION		

PER UNIT ON ABOVE BASE

1.12
1.10
1.08
1.04
1.00
.98
.96
.94
.92
.88
.86
.84
.82



- ① MAXIMUM - UNIT ON (NO CAPACITORS)
- ② MAXIMUM - UNIT ON AT MAX. VOLTAGE (NO CAPACITORS)
- ③ MINIMUM - UNIT OFF (NO CAPACITORS)
- ④ MAXIMUM - UNIT OFF (NO CAPACITORS)

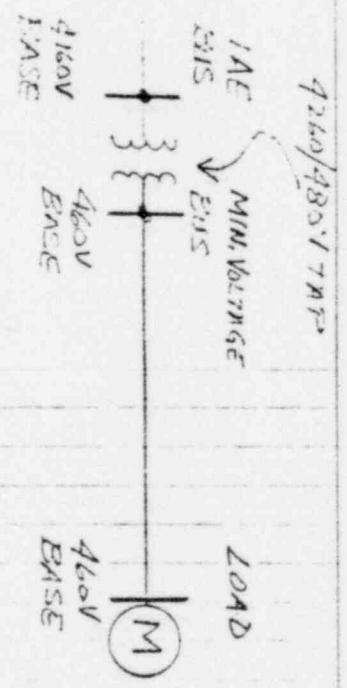
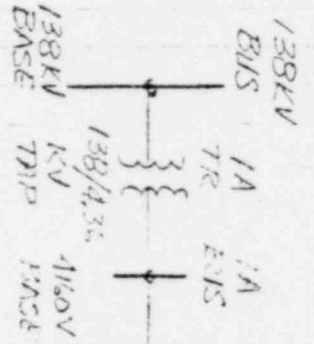
④ MAXIMUM - UNIT OFF  
 PRESENT (TWO) 430V TR  
 ADDITION OF 6 MVAR  
 CAP TO ADDITIONAL BUSSES IAE & I.D.

REVISED CURVE 4 - 2/11/80

1	TITLE: <i>DATA</i>	FILE NO. <i>5-2-11-11</i>
2	LOCATION:	CO. NO.:
3	SUBJECT: <i>VOLTAGE STUDY</i>	COMPILED BY: <i>fxm</i> DATE: <i>10/2/79</i>
4	DEPARTMENT:	CHECKED BY:
5	DIVISION:	REVISED BY: <i>fxm</i> DATE: <i>2/11/80</i>

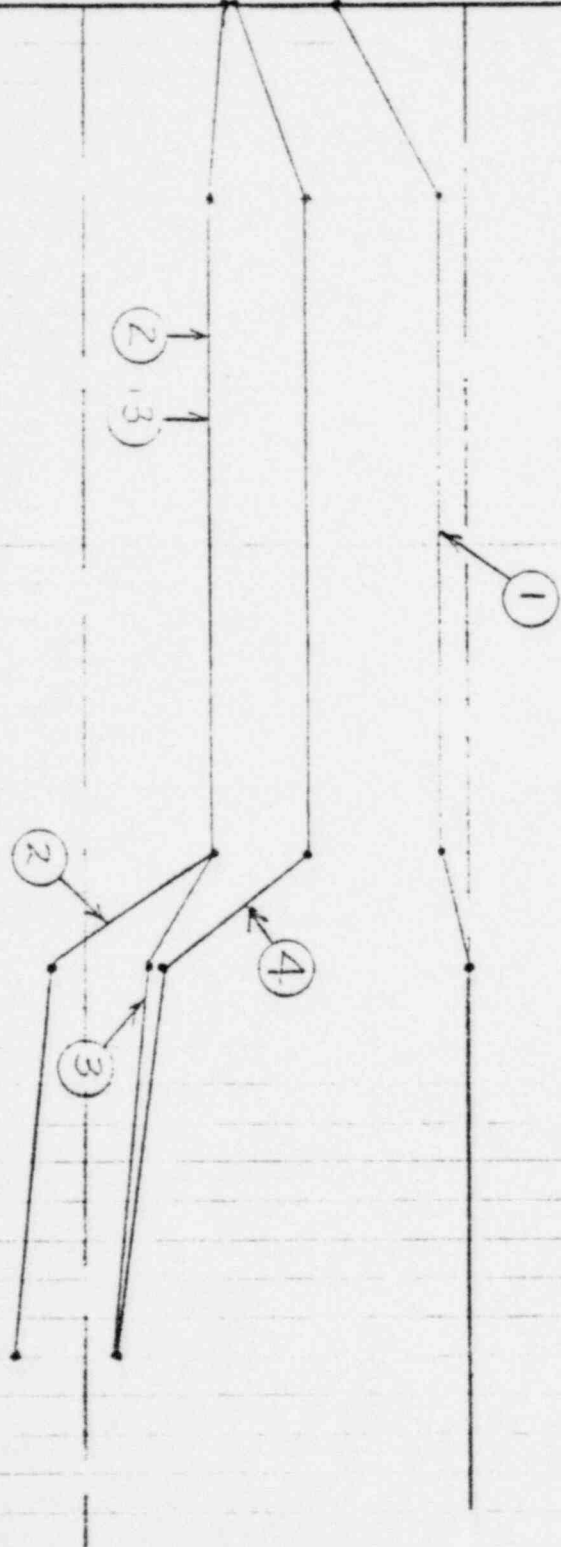
PER UNIT ON ABOVE BASES

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① MAXIMUM - NO LOAD (NO CAPACITORS)  
② MINIMUM - UNIT OF FULL LOAD  
IN 138V TR (NO CAPACITORS)

③ MINIMUM - UNIT OF FULL LOAD  
ADDITION OF THIRD 980V TR (NO CAPACITORS)  
④ MINIMUM - UNIT OF FULL LOAD  
ADDITION OF 6.3MVAR CAP TO NORMAL  
BASES 138V B.



REVISED CURVE 4 - 2/11/80

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