VIRGINIA ELECTRIC AND POWER COMPANY
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VICE PRESIDENT
NUCLEAR OPERATIONS

October 26, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. Robert A. Clark, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Serial No. 608
PSE&CS/WCS/KSB:cdk
Docket Nos. 50-338
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License Nos. NPF-4
NPF-7

Gentlemen:

GENERAL DESIGN CRITERIA 17 ANALYSIS
NORTH ANNA UNIT NOS. 1 AND 2
OVERVOLTAGE ANALYSIS

The purpose of this letter is to provide results of an overvoltage analysis performed at the request of Mr. R. L. Prevatte (NRC). The intent of the analysis is to study emergency bus voltages during periods of light electrical loading on the Reserve Station Service System which occur coincident with high system voltages.

For our analysis, we modeled a condition with Unit 1 in refueling and Unit 2 at 100% power. All emergency buses were fed from their respective preferred offsite feeders, not through the normal to emergency bus ties. All station service buses were fed from their respective station service transformers, not from the reserve system. Unit 1 load consisted of 480V emergency loads (heating, ventilation, lights, etc) fed predominantly from motor control centers (MCC's). Unit 2 loading consisted of the circulating water pumps and emergency 4KV and 480V load required at 100% power. The 500KV bus was at 535KV. The 34.5KV reactors were in service. Our analysis did not study the emergency buses fed from the station service buses, through the bus ties, because of the options available to the operator during a high voltage condition. These options include the manual transfer of the affected emergency bus to the reserve system. These options effectively limit the worst case voltages to those possibly experienced while fed from the reserve system.

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The results of our computer study are given in Attachment I. With one exception, all 4KV and 480V load center buses are within 10% of the nominal motor ratings (4000V or 460V). The exception is bus 1H1, which has 110.7% of nominal voltage. The voltage drop to a specific motor, whether it is fed from the 1H1 load center or via an MCC, will exceed 0.7%. The conclusion from this portion of the analysis is that the emergency loads do not experience overvoltage during lightly loaded conditions.

In analyzing the voltages experienced by MCC contactor coils, rated 115V ± 10%, the highest voltage possible on the secondary terminals of the control transformer is 137V or 119% of the contactor coil rating. This figure is based on the 509V indicated for load center bus 1H1 and the voltage ratio of transformers installed for NEMA size 1 and 2 contactors. Using the lowest load center bus voltage indicated (495V on bus 1J) and the voltage ratio of transformers installed for NEMA size 4 contactors, the lowest control transformer secondary voltage will be 129V or 112% of the contactor coil rating. These voltages are higher than actually experienced by the contactor coils due to voltage drops between the load centers and the MCC's and due to voltage drops in the control circuits, neither of which were considered in the above analysis. Voltage drops between the load centers and the MCC's vary from 0.3V to 14.6V (approximately 0.07% to 3.4% on a 115V circuit) depending on the specific MCC under analysis. Additionally, each control circuit has some voltage drop (typically 2 volts or 1.7%) in its transformer and cable, which serves to reduce the overvoltage. Applying the figures given above yields a possible voltage range experienced by the contactor coil from 107% to 117% of the coil rating under worst case light loading conditions.

A number of the contactors involved supply motor operated valves (MOV's). In this application, a coil is energized for a maximum of several minutes while the MOV is changing state. This limited operating time reduces the probability of any insulation damage that could be caused by an overvoltage. Also, a number of the MCC's are located in controlled environments where the ambient temperatures will not reach the 40°C ambient specified for the coils. This reduces the possibility of insulation damage due to heating caused by an overvoltage condition.

In view of the factors stated above, we believe the overvoltage is not a serious concern. Overvoltage may cause a decreased insulation life, but this would develop over a long time period. Presently, resistance and insulation tests are made on each of the coils at each refueling, which serve to monitor for coil failure.

We have discussed this matter with the coil manufacturer. The manufacturer has, in general, agreed with our qualitative analysis of the overvoltage effects on the contactor coils. We are trying to determine, through the manufacturer, the quantitative effects of 120% voltage on the contactor coils. If, by June 1, 1983 we are not able to secure the required data through the manufacturer, Vepco will conduct its own test program. Until the data demonstrating the effects of overvoltage on contactor coils is obtained, we feel that the surveillance program and other considerations outlined above are sufficient to assure continued operability of the contactor coils. Once the results of the analysis/testing are complete, we will forward them to you.

In recent discussions, Mr. Prevatte has indicated a desire for Vepco to either install the 480V bus overvoltage protection during the upcoming refueling outages, rather than during the second refueling outages after September 1, 1982, or reset the existing 4KV overvoltage alarms to protect the 480V buses. The 4KV alarms are presently set at 4400V, which corresponds to 521V, or 113% of 460V, on the secondary of an unloaded 4KV - 480V transformer.

Typical minimum voltage drops in cables feeding 480V motors are in the 1% to 2% range. If an overvoltage exists, it is extremely minor. The attached voltage analysis indicates that under light load conditions, overvoltage on the 480V equipment does not occur. For these reasons, we believe the 480V emergency motors will experience little, if any, degradation due to overvoltage between the first refueling after September 1, 1982 and the second refueling after that date. It is our intent to keep the 480V overvoltage protection installation scheduled for the second refuelings after September 1, 1982. The 4KV overvoltage alarms could be reset to 4275V if required to alarm for 506V (110% of 460V motor rating) at the 480V buses. The 4275V setting is based on an unloaded, lossless transformer, which is the worst case. The reserve station service transformer load tap changers maintain 4317V on their secondaries. Resetting the 4KV alarms from 4400V to 4275V would create nuisance alarms for the operators, while providing minimal benefit. As such, we intend to leave the 4KV overvoltage protection set at 4400V.

Our present schedule for implementing all of the GDC-17 modifications is based on a completion date of the second refueling after September, 1982. The engineering for the overvoltage alarm system on the 480 volt buses is part of this effort. At present, based on budgeting and material acquisition restrictions, Vepco is committed to installing the overvoltage alarm system in 1984. In conclusion, we feel that the analysis, which was based on a number of conservative assumptions, provides acceptable justification for maintaining our present schedule.

Yours very truly,

W. L. Stewart
for R. H. Leasburg

RHL/mrh:0038C
Attachment

cc: Mr. J. P. O'Reilly, Regional Administrator
Region II

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

ATTACHMENT I

5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	

RESULTS OF OVERVOLTAGE RUN (JOB 1218 8/18/82)

BUS	PER UNIT @ BUS (4160 or 480 V BASE)		VOLTS @ BUS		PER UNIT @ BUS (4kV or 460V BASE)
4160V 1H	1.036	x 4160 =	4310	/ 4000 =	1.077
480V 1H	1.036	x 480 =	497	/ 460 =	1.081
480V 1H1	1.061	x 480 =	509	/ 460 =	1.107 *
4160V 1J	1.037	x 4160 =	4314	/ 4000 =	1.078
480V 1J	1.032	x 480 =	495	/ 460 =	1.077
480V 1J1	1.052	x 480 =	505	/ 460 =	1.098
4160V 2H	1.037	x 4160 =	4314	/ 4000 =	1.078
480V 2H	1.045	x 480 =	502	/ 460 =	1.090
480V 2H1	1.045	x 480 =	502	/ 460 =	1.090
4160V 2J	1.036	x 4160 =	4310	/ 4000 =	1.077
480V 2J	1.037	x 480 =	498	/ 460 =	1.082
480V 2J1	1.034	x 480 =	496	/ 460 =	1.079

* VOLTAGE DROP IN FEEDER TO MTR TERMINALS SHOULD BRING THIS BELOW 1.10 p.u. @ MOTOR.

RATINGS

MOTORS ON 4160V BUSES:
NAMEPLATE = 4000V + 10% = 4400V @ MTR TERMINALS

MOTORS ON 480V BUSES:
NAMEPLATE = 460V + 10% = 506V @ MTR TERMINALS

NOTE: RSST LTC SET FOR 4317V (1.033 p.u.)