VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

R. H. LEASBURG
VICE PRESIDENT
NUCLEAR OPERATIONS

June 11, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 317
PSE&C/cdk/WCS/KSB

Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Gentlemen:

GENERAL DESIGN CRITERIA 17 ANALYSIS
SURRY UNIT NOS. 1 AND 2

The purpose of this letter is to formalize our responses to your questions concerning our General Design Criteria 17 submittal, Serial No. 175, dated March 31, 1982. These responses were discussed with Messrs. D. Neighbors, R. Trevatte, and J. Sealan in a telephone conference on May 20, 1982. The questions and responses are provided in Attachment I entitled "General Design Criteria 17 - Response to NRC Questions".

Additionally, a corrected copy of Attachment I, Appendix H, page 57, from our March 31, 1982 submittal, is included as Attachment II for your records. A typographical error was corrected to indicate that the stub bus tie breaker, component cooling pump, residual heat removal pump, and emergency bus feeder breaker undergo no change of state for a safety injection signal.

The outstanding items identified in this letter will be answered by June 30, 1982.

Very truly yours,

W. L. Stewart
R. H. Leasburg

A001

Attachments

cc: Mr. R. C. DeYoung, Director
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Washington, D.C. 20555

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ATTACHMENT I

GENERAL DESIGN CRITERIA 17

RESPONSE TO NRC QUESTIONS

SURRY UNIT NOS. 1 AND 2

NRC Question 1

"Your analysis indicates that starting of condensate, high pressure heater drain, bearing cooling, component cooling water, reactor coolant, or steam generator feedwater pumps during a safety injection (SI) or consequence limiting situation (CLS) could cause spurious actuation of the second level undervoltage relays for the worst case analyzed. You state that modifications will be made to prevent automatic starting of the condensate, high pressure heater drain, bearing cooling water, and component cooling water pumps during a SI or CLS. Provide design details on this modification. Additionally confirm that plant operating procedures will be in place to prevent manual starting the above motors during an SI or CLS."

Vepco Response

Our detailed design has not been completed. Our present conceptual design is as stated below.

Blocking of the automatic starting of the condensate, high pressure heater drain, bearing cooling, and component cooling pumps will exist for approximately 315 seconds after the occurrence of an SI or CLS. The blocking features will occur in the automatic close path of the pumps' respective 4KV breakers through the use of auxiliary relays initiated from SI contacts. The blocking feature will be disabled and automatic starting enabled at the end of the 315 second period through the use of timing relays. Logic will be employed to ensure this automatic blocking will occur only in cases which would affect an emergency bus of a unit experiencing an SI or CLS.

The starting, either automatic or manual, of either the condensate, high pressure heater drain, bearing cooling, or component cooling pump which occurs after steady state voltages have been achieved will not cause a voltage dip of sufficient duration to cause spurious separation of an emergency bus during an SI or CLS.

The reactor coolant and steam generator feedwater pumps have only manual start capabilities. The starting of either of these pumps during an SI or CLS may cause the spurious separation of an emergency bus.

By July 1, 1982, a caution statement will be inserted into the appropriate Emergency Procedures to ensure the operators are aware of the consequences of starting these pumps while fed from the same source as an affected emergency bus during an SI or CLS. In an effort to maintain maximum operating flexibility, we believe this manual starting capability should not be eliminated.

NRC Question 2 "Transformer overload sensors are placed on the 500/230/36.5 KV autotransformers and the 230/36.5 transformer to actuate an alarm for possible overload conditions. What are the settings for these sensors and what actions are taken upon receiving an alarm?"

Vepco Response The alarm setpoint for the tertiary of each 500/230/36.5 KV autotransformer is set at 85 MVA. The alarm setpoint for the 230/36.5 KV transformer is set at 95 MVA.

Upon receipt of an alarm, the Vepco System Operator Office will notify Surry Power Station of the overload. The load reduction is accomplished by shedding loads depending on the mode of operation of the station. This action is addressed as part of the operating procedure to control transmission voltage at Surry Power Station. A copy of this operating procedure will be submitted to you by June 30, 1982.

NRC Question 3 "Submit a schedule for completing and submitting the following:

(a) MCC control transformer upgrading results and worst case overvoltage and undervoltage analyses (steady state and transient) at the 120 volt contactor level.

(b) Results of the possible upgrading of overload heaters.

(c) MOV rerating and/or replacement."

Vepco Response

(a) The MCC control transformers are still being analyzed at this time. The MCC transformer analysis will be complete by August 1, 1982 and we will submit our schedule for MCC transformer replacement, if required, by September 15, 1982. Vepco remains committed to correct any MCC control transformer problems in accordance with our analysis.

(b) We have completed our review of overload heaters protecting MOV's which start on either SI or CLS. The results indicate the overload heaters allow adequate MOV starting time. Minimum operating time of an overload heater is 9 seconds at a continuous locked rotor current based on 80% voltage at the MOV. MOV acceleration time is approximately 0.5 seconds at rated starting voltage. Based on a review of the voltage profile summary sheets, overload heater modifications are not required.

(c) Staggered receipt of information from the valve manufacturer is expected over the next three (3) months. Review by the MOV manufacturers is ongoing and will continue as additional information is supplied by the valve manufacturer. Vepco will advise the NRC of the status of the MOV review by August 1, 1982. A schedule for all MOV's requiring rerating or replacement based on our analysis results at that time will be provided by September 15, 1982. Vepco remains committed to rerate or replace MOV's in accordance with our analysis.

NRC Question 4

"In the computer model verification, clarify the relationship between the two columns entitled "Measured" and "Voltmeter Reading." Also, submit details of the test method used, plant operating mode, bus loading conditions (load percentages), distribution voltage, etc., and verification that the percentage errors presented in Appendix H are applicable to both steady state and transient analysis conditions."

Vepco Response

The voltage profile test was conducted during the start-up of Unit 1 by the Measurements and Diagnostics Engineering Services Department of General Electric Co., based in Atlanta, Georgia. The purpose of the voltage profile test was to monitor voltage and current conditions on the reserve system. Test logs were used to record values from 70 panel meters on a once-an-hour basis for the duration of the start-up. Additionally, 27 channels of data were recorded on strip chart recorders at selected times to provide extremely accurate values for use in the computer model verification.

Vepco monitored Surry's 500 KV and 230 KV bus voltages and autotransformers' loads through its System Operators' Office and monitored the 34.5 KV buses' voltages and loads on strip charts.

Voltages listed in the column entitled "Measured" were recorded with General Electric strip chart recorders. The voltages listed in the column entitled "Voltmeter Reading" were read by General Electric personnel from voltmeters permanently installed at the station and recorded on the test logs.

The reserve system loading and voltages used in the computer model verification were recorded on strip charts as follows:

4 KV Bus	Load Current (Amps)	Load as a % of Maximum Bus Load	Bus Voltage (Volts)
1A	1328	65	4135
1B	1260	65	4330
1C	1220	61	4245
1H	210	44	4205
1J	132	29	3855
2H	180	39	4285
2J	48	11	4245

The results presented in Appendix M are based on a steady state condition. Given the conservatism of these results and the fact that starting currents are modeled at a power factor of 0.0 in our analysis program, we believe the computer results modeling the motor starting transient conditions are conservative representations of the actual events. On this basis, we have not performed a computer model verification study for a transient condition.

NRC Question 5

"Submit draft proposed Technical Specifications changes to address limiting conditions for operation, testing, calibration, and surveillance requirements for the proposed undervoltage protection schemes. Also, a test is required to be included in the Technical Specifications to demonstrate the operability of the automatic bypassing and auto-reinstatement of the undervoltage relays when the diesel generators are supplying the Class 1E buses (see NRC letter dated June 3, 1977)."

Vepco Response

The draft Technical Specifications are not completed at this time. They will be submitted by June 30, 1982.

The loss of voltage/degraded voltage protective setpoints are listed in Table I along with allowable values for these setpoints. These values will be included in the Technical Specifications.

The emergency motors will not experience thermal damage if operated at 75% voltage for 60 seconds. In the event of an SI or CLS, an emergency bus subjected to 75% voltage will separate from the off-site source at T = 7 seconds and load to its emergency diesel generator to ensure proper voltage is supplied to all emergency loads.

In the event of loss of voltage, an emergency bus separates from its off-site source at T = 2 seconds and loads to its diesel generator within the 10 second FSAR requirement for accident conditions.

NRC Question 6

"Are the following viable source connections?

(a) A single 500/230/36.5 KV autotransformer supplying both 34.5 KV buses 5 and 6 (i.e., breaker LT22 open and LT12 closed (or vice versa), T562 closed and both L402-5 and L402-6 open).

(b) The 230/36.5 KV transformer supplying both 34.5 buses 5 and 6 (i.e., breakers LT12 and LT22 open, T562 closed and L402-5 closed and L402-6 open (or vice versa)).

If these are not viable connections, are there interlocks to prevent these breaker alignments?"

Vepco Response

(a) A single 500/230/36.5 KV autotransformer may supply 34.5 KV buses 5 and 6 at the same time. However, with normally open disconnects on both sides of the 34.5 KV bus tie breaker T562, manual switching action is required to achieve the arrangement in question. No electrical interlocks exist to prevent one 500/230/36.5 KV autotransformer from supplying both 34.5 KV buses at once.

(b) The 230/36.5 KV transformer may supply 34.5 KV buses 5 and 6 with T562 closed and either L402-5 or L402-6 closed. Manual switching action is required to achieve this arrangement, also. No electrical interlocks exist to prevent this arrangement.

We are presently conducting a voltage profile analysis of these arrangements to ensure their compliance with GDC-17. A summary of the results will be submitted to you by June 30, 1982.

<u>NRC Question 7</u> "Are there interlocks to prevent closure of both the 34.5 KV low side breakers on the 230/36.5 KV transformer?"

<u>Vepco Response</u> Closure of both 34.5 KV low side breakers, L402-5 and L402-6, may occur during an overlapping time period. No electrical interlocks exist to prevent the 230/36.5 KV transformer from supplying both 34.5 KV buses at the same time. This arrangement is more probable than either arrangement discussed in item 6 because it may occur automatically and does not require manual action.

We are presently conducting a voltage profile analysis of this arrangement to ensure its compliance with GDC-17. A summary of the results will be submitted to you by June 30, 1982.

NRC Question 8 "Appendixes I, J and K of Attachment 1 to Reference 1 show simultaneous starting of the containment spray, charging, and low head safety injection pumps at T=0. The discussion on these events in section V.H indicates that during a transient voltage condition the above motors will start sequentially. Clarify the above contradictory information."

Vepco Response Appendixes I, J and K consist of summaries of the voltage profile analyses completed for various postulated scenarios. One convention assumed in running the computer studies was that all non-MOV motors, would be modeled as running loads at T=5 seconds. In several voltage profile studies, the results indicate that on one emergency bus sequential starting of certain 1E motors may occur in extremely conservative worst case conditions when voltages at T=0 seconds are not sufficient to begin acceleration of all motors. As the charging pump accelerates and the LTC begins corrective action the voltage profile improves, resulting in voltage which successfully accelerates the containment spray and low head safety injection pumps. This is not in perfect agreement with the assumed modeling convention and is explained below.

Discussion, in section V.G., of the summaries in Appendix I does not indicate sequential starting of either the charging, containment spray, or low head safety injection pumps.

Discussion, in section V.H., of the summaries in Appendix J indicates that only in cases with 2 units transferring station service loads to the reserve system at the same instant a CLS occurs on one unit will sequential starting of the charging, containment spray, and low head safety injection pumps occur. This occurs on one emergency bus only. The other emergency bus has acceptable voltage to start these motors at T = 0 seconds. The sequential starting results when initial voltages are below minimum starting requirements. The voltages indicated at T=5 seconds are not an exact worst case representation of this sequential starting, but the instantaneous LTC correction is not modeled either. The voltage profile summaries provide results close enough to worst case that the worst case can be estimated. As such, the voltage profile summaries provide good bases for non-MOV motor acceleration analysis, spurious separation analysis, and MOV acceleration analysis, which are the critical transient analysis concerns. A more rigorous analysis would not change the conclusions submitted on March 31, 1982.

Discussion, in section V.I., of the summaries in Appendix K indicates that only in the case with 2 units transferring station service loads to the reserve system at the same instant a CLS occurs on one unit will sequential starting of the charging, containment spray, and low head safety injection pumps occur on one emergency bus. Although the instantaneous LTC correction has been considered in this case, a more detailed modeling of the sequential starting would not change the conclusions submitted on March 31, 1982.

Table II lists minimum starting voltages for the containment spray and low head safety injection pumps in comparison with voltages at T = 0 seconds for the cases in which sequential starting of these motors may occur. The charging pump is not listed because, in all cases, it receives adequate starting voltage at T = 0. Review of the deficiency margins in these studies indicates they are small and, based on their occurrence probability, do not require modification. Presented below are conservatisms used in our voltage profile analysis to support our conclusions. The conservatisms are:

1. For all turbine and reactor trips, with the exception of electrical abnormalities, the generator breakers (the generator breakers refer to the two 230 KV breakers on unit 1 and the two 500 KV breakers on unit 2) will be tripped 60 seconds afterwards. The station service buses transfer from the SST's to the RSST's when the generator breakers of their respective unit are opened. Our studies assume that the station service bus loads are transfered to the RSST's immediately upon the occurrence of the condition being analyzed. This is a conservative approach to the

voltage analysis, even for a single unit loading to the RSST's. The conditions which indicate sequential starting may occur assume that both units' station service loads transfer to the RSST's at the same instant a CLS occurs. This is a very improbable event. It would require the occurrence of a CLS at the same instant electrical abnormalties forced both units to trip.

2. For two unit loading of the RSST's, three possibilities of the timing of the second unit load transfer to the RSST's were considered. The station service bus loads of the second unit were assumed to transfer 60 seconds prior to, simultaneous with, and 60 seconds after, the occurrence of a CLS on the first unit. After initial analysis indicated that the second unit transfer at 60 seconds after the CLS provided a worse case than the 60 second transfer prior to the CLS, the offset cases were limited to transfers 60 seconds after the CLS. Analysis for the second unit load transfer with a 60 second offset on either side of the first unit CLS is equivalent to analysis of the second unit load transfer at any time greater than 60 seconds. On the basis of the time spans covered, the 60 second offset occurrences are of a much higher probability than the simultaneous occurrence of a CLS with transfer of two units'

station service loads to the RSST's. All of the results from the 60 second offset cases have been adequate. Sequential starting, as discussed above, is not a possibility in these cases.

3. To ensure worst case motor starting results, all motors receiving an SI or a CLS signal were assumed to be not running just prior to the accident, even if some would be running under normal operation (e.g., a charging pump). At the time of the accident all of these motors were assumed to start. Additionally, worst case station service bus loadings were used in the analysis based on the specific condition in question (e.g., analysis of a unit 2 CLS concurrent with a unit 1 trip requires that the 1B, 1C, 2A, and 2B condensate pumps be modeled as those running at the time of the accident since these pumps are not shed as a result of the installed load shedding scheme).

4. Starting loads were modeled at a power factor of 0.0.

5. Unfavorable system conditions were assumed to exist (e.g., low system voltage, reactors off prior to accident, high autotransformer power flow from 500KV to 230KV).

6. The 15 KV drop in 500KV voltage, which is assumed to occur at the instant an accident occurs, is approximately 3KV greater than the maximum drop expected with inertial pick-up of load by other generating units.

7. The results from the computer model verificaton study indicate conservative results are obtained from our computer model. On average, these results were 4.6% conservative. The conservatism of the 480V emergency bus results exceeded the average value. The 480 V emergency buses are the only buses on which sequential starting due to voltage profile is a possibility.

<u>NRC Question 9</u> "In section 8 you state that the feeder cables from the Reserve Station Service transformers (RSST's) to the inplant distribution system busses will be replaced. Confirm with detailed drawings and description that this modification will comply with GDC-17 requirements regarding physical separation and independence."

<u>Vepco Response</u> Neither the conceptual nor the detailed design for the 4 KV cable modification is complete at this time. The most likely alternative to replacing the cable in the ductbank is to run overhead bus from the RSST's to the turbine building wall. The probable routing is indicated on the attached drawing, Attachment III. The routing of the cables from the wall to the transfer and station service buses has not been determined but will, at a minimum, maintain the physical separation and independence provided by the overhead bus.

TABLE I

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION TRIP VALUES

FUNCTIONAL UNIT	TRIP VALUE	ALLOWABLE VALUES
LOSS OF POWER		
a. 4.16 kv Emergency Bus Undervoltage (Loss of Voltage)	(75±1)% volts with a (2±.1) second time delay	(75±1)% volts with (6±1) second time delay
b. 4.16 kv Emergency Bus Undervoltage (Degraded Voltage)	(90+.5,-2)% volts with a (60±3) second time delay (non CLS, non SI)	(90+.5,-2)% volts with (60±3) second time delay (Non CLS, Non SI)
	(7±.35) second time delay (CLS or SI condition)	(7±.35) second time delay (CLS or SI condition)

TABLE II

EMERGENCY LOADS	MINIMUM REQUIRED STARTING VOLTAGE AT 480V LOAD CENTER BUS 2H (% of 480V)	JOB 3478 UNIT 2 CLS UNIT 1 TRIP (SIMULTANEOUSLY) 480V BUS 2H VOLTAGE AT T=0 (% of 480V)	JOB 764 UNIT 2 CLS UNIT 1 TRIP (SIMULTANEOUSLY) G BUS TIE BREAKER CLOSED 480V BUS 2H VOLTAGE AT T=O (% OF 480V)	JOB 2299 UNIT 2 CLS UNIT 1 TRIP (SIMULTANEOUSLY) 1 AUTOTRANSFORMER AND 230/36.5 KV TRANSFORMER 480 V BUS 2H at T=O (% OF 480V)	
480V BUS 2H				AUTOTRANSFORMER SUPPLIES 2H	230/36.5 KV TRANSFORMER SUPPLIES 2H
1. Containment Spray Pump	70.9	70.6	69.9	66.8	67.9
2. Low Head Safety Injection Pump	72.0				

480V BUS 1J	MINIMUM REQUIRED STARTING VOLTAGE AT 480V LOAD CENTER BUS 1J (% OF 480V)	JOB 3525 UNIT 1 CLS UNIT 2 TRIP (SIMULTANEOUSLY) 480V BUS 1J VOLTAGE AT T=0 (% OF 480V)
1. Containment Spray Pump	73.3	72.4
2. Low Head Safety Injection Pump	73.6	

ATTACHMENT II

VOLTAGE	BUS	LOAD	SI START	SI TRIP	SI NO CHANGE OF STATE	CLS START	CLS TRIP	CLS NO CHANGE OF STATE	LOSS OF OFFSITE POWER(LOOP)[4] START	LOSS OF OFFSITE POWER(LOOP)[4] TRIP	LOSS OF OFFSITE POWER(LOOP)[4] NO CHANGE OF STATE
KV	1J	Emergency Diesel Generator 3	X			X			X		
		Emergency Diesel Generator 3 Breaker		Unit 2[2]	X		Unit 2[2]	X	X		
		Steam Generator Auxiliary Feedwater Pump	50"	SI		50"	CLS		X[7]		
		Charging Pump	X			X			Bus 1H[3] LOOP		X
		Stub Bus Tie Breaker			X			X		X	
		Component Cooling Pump			X			X		X	
		Residual Heat Removal Pump			X			X		X	
		Emergency Bus Feeder Breaker			X			X		X	
480V	1J	Pressurizer Heaters			X			X			X
		Low Head Safety Injection Pump	X			X					X
		Inside Recirculation Spray Pump			X	120"					X
		Outside Recirculation Spray Pump			X	300"					X
		Containment Spray Pump			X	X					X
		Containment Recirculation Fan			X		X				X
480V	1J1	Filter Exhaust Fan [8, 9]	X or Unit 2 SI			X or Unit 2 CLS					X

NOTES:

1. X's indicate immediate action caused by condition on same unit.
2. "Unit 2" indicates action caused by condition on opposite unit.
3. "Bus 1H" or "Bus 1J" indicate action caused by a condition on an opposite emergency bus of the same unit.
4. Loss of Offsite Power is defined as loss of voltage or degraded voltage of sufficient duration to cause separation of an emergency bus from its offiste source due to operation of the undervoltage protection.
5. Those pumps receiving SI starts will be automatically started for CLS conditions also, and are indicated as starting for CLS conditions.
6. Delayed action is indicated by the time in seconds (e.g. 120" indicates 120 seconds delay from the occurence of a CLS until the inside recirculation spray pump receives a start signal).
7. For loss of offsite power concurrent with either an SI or CLS, the instantaneous auxiliary feedwater pump loop start is defeated and starting occurs at 50 seconds after the accident.
8. Starting of this fan is somewhat delayed because it is based on a pressure change which is caused by SI signals.
9. Provides normally open alternate feed to Unit 2 supplied filter exhaust fan.

June 9, 1982