VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
APPENDIX R ENGINEERING EVALUATIONS

Based on telephone conversations with your staff, two issues concerning Appendix R engineering evaluations were identified as requiring additional information for resolution. These issues were reentry time into an affected fire area and multiple high impedance faults.

We have reassessed the time assumption used in previous evaluations and have been able to extend the period described in the evaluation from thirty to sixty minutes. This information was documented in Virginia Power's letter dated July 26, 1990 (Serial No. 90-404). It is our understanding that this modification to the entry time assumption resolves this issue.

The second issue concerned documentation of our evaluation of multiple high impedance faults. Attached is Appendix A of Chapter 9, Electrical Distribution System Coordination Study, of the Appendix R Report. This appendix summarizes our review of the issue of multiple high impedance faults. It is our understanding that with the inclusion of this documentation into the Appendix R Report that this issue is also completed.

If you have any questions regarding this matter, please contact us.

Very truly yours,

W. L. Stewart
Senior Vice President - Nuclear

Attachment

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ATTACHMENT
10 CFR 50 APPENDIX R
CHAPTER 9
APPENDIX A

CHAPTER 9

APPENDIX A

MULTIPLE HIGH IMPEDANCE FAULTS EVALUATION

SURRY POWER STATION - UNITS 1 and 2

PREPARED BY VIRGINIA POWER

SUMMARY

Generic letter 86-10 indicates that high impedance faults should be considered for all associated circuits located in the fire area of concern to meet the separation criteria of Sections III.G.2 and III.G.3 of Appendix R. In this case, associated circuits are defined as circuits not required for safe shutdown but powered by necessary power supplies. The concern is that a fire expected to result in the loss of an Appendix R power supply will also result in the loss of the redundant power supply as a result of simultaneous high impedance faults (below the trip point for the breaker on each individual circuit) of associated circuits routed into that same fire area. GL-86-10 states that the phenomenon should be considered for impact on the plants' safe shutdown capability and addressed by either a circuit coordination study or by assuming the shutdown capability will be disabled and provide written procedures to clear the faults.

Virginia Power has performed an evaluation of each Appendix R power supply and determined that the probability of loss due to simultaneous high impedance faults is either impossible in some cases or highly improbable in others for the reasons discussed in this evaluation. Therefore, no further circuit coordination study has been performed or written procedures developed.

Surry Power Station consists of two "mirror image" units. For fire scenarios in critical plant areas, it is necessary to depend on mechanical cross connects, etc. and shutdown both units with equipment from only one unit. Therefore, redundant equipment often comprises equipment from the opposite unit rather than from redundant channels. Because both units contain similar power supplies, it is not typically necessary to route an abundance of Unit 1 cable into Unit 2 areas and vice versa. This is particularly true for the emergency electrical distribution system utilized for safe shutdown. This natural separation is used as a basis in this report to state that it is assumed that a sufficient number of associated circuits are not routed into fire areas of concern and that the probability of this occurring is low.

Generally, the following sections of this evaluation will provide additional analysis to supplement this reasoning.

4160V SWITCHGEAR

The 4160V switchgear buses (1H, 1J, 2H, and 2J) are not susceptible to tripping due to multiple high impedance faults. The sum of all overcurrent relay trip devices (phase and ground) on the buses' circuits is lower than that of the buses' main, offsite supply, circuit breakers. The same is true when the buses are supplied by their respective emergency diesel generator (phase only, the EDGs are ungrounded) due to the load shed of the "stub" bus supplying the Component Cooling and Residual Heat Removal pumps. The stub bus would be returned to service later to achieve cold shutdown, but this should be after clearing of any other potentially faulted circuits on the buses. Any 4160V high impedance fault(s) would be expected to have developed into a lower impedance fault by that time and be selectively cleared.

480V SWITCHGEAR

The 480V switchgear (load center) buses (1H-1, 1J-1, 2H-1, 2J-1) are not subject to tripping due to multiple high impedance faults on associated circuits. Each 480V load center consists of one feeder breaker and, typically, six load breakers. Of the six two supply Appendix R required MCCs. Some are spared or provide only contingency service. Therefore, there are very few (0-2) energized associated circuits originating from each Appendix R required 480V load center. As a result, the sum of the overcurrent trip devices on the Appendix R 480V load center associated circuits, including back-up, contingency breakers is less than the feeder device trip setting.

480V MOTOR CONTROL CENTERS

Numerous 480V motor control centers (MCCs) are required for Appendix R, as shown on the Appendix R Evaluation Electrical One Line Diagrams for Surry Units 1 and 2. The required MCCs are located in either the Emergency Switchgear Rooms (Fire Areas 3, 4) or the cable vaults and tunnels (Fire Areas 1, 2) of the respective unit. For a fire in either of those areas of either unit, in general, the other unit's electrical distribution system is utilized for safe shutdown of both units.

The MCCs supply a great diversity of loads located in various plant locations. But, it is expected that the Unit 1 and 2 MCCs supply like unit loads located in different plant areas with power often routed in different directions. Also, the MCC loads vary in frequency of operation; some, like MOV's are normally de-energized. It would be difficult to ascertain the physical locations of all MCC circuits and predict their operation. While an analysis has not been done to determine this, Electrical Engineering - Power believes that this diversity and the relatively low (50A or less) trip ratings of many of the MCC breakers limits the potential for tripping due to multiple high impedance faults.

The ungrounded 480V system at Surry warrants that a minimum of two different phase conductors are necessary to produce fault current. A single conductor in contact with a grounded object, such as a conduit or cable tray, would not draw fault current. Two or three phase conductors are routed to each load, and in may cases, multiconductor or triplexed cables are used. To avoid severely derating power circuits, they are sometimes routed in dedicated conduit. The close proximity of the phase conductors would discourage high impedance faults because the little material existing between conductors would burn away quickly producing a lower impedance, high current, fault. The 480V MCCs at Surry have three-phase fault currents of 14,000 - 17,000 A available at the buses. Therefore, some margin typically exists between the available fault current at the end of the circuit and the breaker overcurrent/trip rating. Because of the strong sources and low MCC breaker trip ratings, there should be adequate margin to selectively operate breakers supplying either low or high impedance faults. It is unlikely that a sufficient number of high impedance faults with current lower than the individual breaker trip ratings will exist to cause operation of the MCC feeder breakers.

For these reasons, the probability of multiple high impedance faults causing misoperation is extremely low and no special precautions are necessary.

125VDC DISTRIBUTION SYSTEM

The 125VDC system is an ungrounded system requiring both a positive and negative conductor from the same bus to produce a fault. Faults on this system differ from AC faults because the voltage difference between the two involved conductors is constant rather than cyclic and, therefore, DC faults would tend to be uninterrupted allowing materials between the two conductors to be burned away. This would either clear the fault or, more likely, create a low impedance fault that can be selectively cleared.

Each DC bus is simultaneously supplied by both the battery and charger. The chargers supply limited fault current and, therefore, most is supplied by the batteries. A circuit breaker between the battery charger and the bus will open for an overcurrent condition, but the batteries are connected directly to the bus. Therefore, the absence of a main bus breaker precludes the possibility of loss of power to the bus. Power will continue to be served and the faults(s) would be expected to be cleared. Though the associated DC circuits have not been traced to determine routing, the diversity of DC provided equipment and locations suggests that it is unlikely that a substantial number of circuits would be routed together in such a way to compromise the DC system. The DC distribution cabinets are further limited in exposure to faults because numerous circuits supply other panels or cabinets. Additional levels of protection are provided at those points for circuits originating from those panels, etc.

For these reasons, high impedance faults are not considered a major concern on the 125VDC system and no special precautions have been taken.

120VAC VITAL BUS SYSTEM

The 120VAC Vital Buses are normally supplied by current limiting inverters and alternately by current limiting voltage regulating transformers. The vital buses supply a limited number of loads generally located in the Control Room and Emergency Switchgear Room (including the Instrument Rack Room). Though there are a number of associated circuits, there are expected to be few circuits not directly unit related and, therefore, routed into common areas. From the Control Room and Emergency Switchgear Room circuit destinations, numerous "secondary" circuits are originated; those circuits may be routed into various plant areas but would typically be protected from that origination point decreasing the required protective zone of the Appendix R protective devices. The additional protective devices would increase the chances of interrupting the fault.

The automatic transfer from the UPS inverter to the regulating transformer will increase the available fault current by a factor of five. The additional available fault current may provide the current required to selectively trip faulted branch circuits.

Additionally, at 120VAC, high impedance faults are not certain to be sustained.

For these reasons, it is considered improbable that multiple high impedance faults will result in loss of a 120VAC vital bus and no additional precautions have been taken.

MISCELLANEOUS POWER SUPPLIES

Other than the several categories of Appendix R power supplies already discussed, there are a number of other miscellaneous power supplies that do not fit into those classifications.

A 120VAC "Appendix R Distribution Panel" has been installed for each unit to supply the Remote Auxiliary Monitoring Panels. The Appendix R panels are not subject to multiple high impedance faults because they lack a sufficient number of associated circuits.

Communication equipment is supplied from a Unit 1 120/240VAC Semi-Vital bus, a Unit 1 120/240VAC heat trace panel, and a Unit 2 120VAC communications panel. All of these are, therefore, Appendix R power supplies. These power supplies were chosen, partially, due to the fact that they are located in different areas of the plant. It is expected that many of the associated circuits supplied by these sources are local while others enter many various plant areas. For this reason, it is assumed that a sufficient number of associated circuits from one supply do not enter the redundant power supply fire area to warrant fear of multiple high impedance faults. As in other sections of this report it is expected that most faults will either be extinguished or develop into a lower impedance, high current, fault allowing proper selective tripping.

Therefore, no additional precautions or measures have been taken for any of these power supplies.