UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SUPPLEMENTAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT (10 CFR 50.63)

VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-280 AND 50-281

1.0 INTRODUCTION

The NRC staff's Safety Evaluation (SE) pertaining to the licensee's initial responses to the Station Blackout (SBO) rule 10 CFR 50.63, was transmitted to the licensee by letter dated October 15, 1990. The staff found the licensee's proposed method of coping with an SBO to be non-conforming. The licensee was asked to submit a revised response to the SBO rule which addresses the areas of non-conformance. The licensee responded to staff's SE, and specifically to the areas of non-conformances and recommendations, by letters from W. L. Stewart, Virginia Electric and Power Company, to the Document Control Desk, U.S. Nuclear Regulatory Commission, dated April 30 and July 31, 1991.

2.0 EVALUATION

The licensee's responses to each of the staff's recommendations are evaluated below.

2.1 Station Blackout Duration (SE Section 2.1)

SE Recommendation: None. However, the SE indicated that upon loss of the reserve station service transformer RSST-C, the only method of energizing the second division would be by manually tying the two emergency buses together, which is unacceptable in determining the independence of offsite power classification.

The staff also indicated that the switchyards are electrically connected at two points. The staff determined that the independence of offsite power is Group "I3" and hence the minimum coping duration of 8 hours.

Licensee Response: The licensee has determined a proposed SBO duration of 4 hours based on an offsite power design characteristic group of "P2*," an emergency AC configuration group "D," and an emergency diesel generator (EDG) reliability target of 0.95.

The "P2*" grouping is based on an independence of offsite power classification of Group "I1/2," a severe weather (SW) classification of Group "1," and an extremely severe weather (ESW) classification of Group "4." The licensee

further mentioned that the plant-specific pre-hurricane shutdown requirements and procedures which meet the guidelines of Section 4.2.3 of NUMARC 87-00 had been implemented. The licensee stated that they had modified the switchyards by replacing the two auto-transformers with two two-winding transformers (500 kv to 34.5 kv bus No. 5 and 230 kv to 34.5 kv bus No.6). There are currently no electrical ties between the 500 kv and 230 kv switchyards, therefore, they are electrically independent.

The licensee mentioned that the Updated Final Safety Analysis Report (UFSAR) change requests were developed during the course of these modifications and are currently being processed. Group "D" classification is based on three emergency AC power supplies (two dedicated and one shared) available for two units with two emergency AC power supplies (one per unit) necessary to operate safe shutdown equipment for both units following a loss of offsite power. The target EDG reliability of 0.95 was based on having a nuclear unit average EDG reliability for the last 100 demands greater than 0.95, consistent with NUMARC 87-00, Section 3.2.4. The licensee mentioned that the target EDG reliability selection of 0.95 was based on (1) the addition of two non-safety grade diesels as an alternate AC (AAC) source with sufficient capacity to power the loss of offsite power (LOOP) loads associated with one safety division of each unit, (2) the implementation of proposed design modification to permit the connection of the AAC source to the three transfer buses that supply power to the safety-related buses at the station, and (3) the implementation of both diversity and independence among the AAC and EDGs.

Staff Evaluation: The staff concurs with the licensee regarding the electrical independence of Surry station switchyards based on the switchyard modifications. However, as discussed in SE Section 2.1, upon loss of the reserve station service transformer RSST-C, the only method of energizing the second division would be by manually tying the two emergency buses together. This method of connecting the two emergency buses together is unacceptable in determining the independence of offsite power classification. Therefore, the independence of offsite power is Group "I3."

The staff does not agree with the licensee's determination of the offsite power design characteristic group of "P2*." The staff finds this to be "P2" based on independence of offsite power classification of "I3," a SW classification of Group "1" and ESW classification of Group "4."

The licensee correctly identified the emergency AC configuration group "D." The staff finds the selection of lower EDG target reliability (0.95) than that required by Regulatory Guide (RG) 1.155 to be acceptable, since the proposed AAC source for Surry, Units 1 and 2 is two independent non-safety grade diesel generators which can provide power to the safety-related buses at the station and has sufficient capacity and capability to power one division of the LOOP loads of each unit.

Based on the above, the staff finds the minimum SBO coping duration to be 8 hours rather than 4 hours as determined by the licensee.

2.2 Alternate AC (AAC) Power Source (SE Section 2.2)

SE Recommendation: The licensee should undertake further measures, such as providing an independent AAC power source or a coping analysis, which shows that the plant can cope with and recover from an SBO for the required duration independent of AC power.

Licensee Response: The licensee stated that two non-safety grade diesel generators will be installed as an AAC source which will have sufficient capacity to power the LOOP loads associated with one safety division of each unit. The proposed AAC source will meet the criteria specified in Appendix B to NUMARC 87-00 and specifically the following:

1) The EDG and AAC diesel generators will not share a common structure. The AAC diesel generators will be located in their own building which will be designed to meet or exceed the requirements of the Uniform Building Code and the Building Officials and Code Administrators (BOCA) Code. The building will be designed to limit ambient temperature to 120°F and will also have space heaters to maintain an acceptable temperature when the diesels are not running.

2) The EDGs and AAC diesel generators will not share common support systems (e.g., fuel oil day tanks, cooling, control power, etc.). Fuel oil for each diesel will be stored in a separate day tank in the diesel building. Each tank will be sized to allow the diesel to run for the SBO duration.

3) Power and control cables for the EDGs and AAC diesel generators will be separated.

4) The EDGs and AAC diesel generators will not share electrical and mechanical protective devices.

5) The AAC diesel generators will not normally be connected to the EDG buses or the transfer buses.

6) The AAC power source will have sufficient capacity to operate all systems (one safety division) on each unit necessary for coping with an SBO for the required SBO duration. The AAC power source will be sized similar to the existing EDGs and each will have a net output of approximately 3000 kW.

7) The AAC power source will be capable of being electrically connected to any of the station's four emergency buses. The AAC power source will be available to accept loads within 1 hour from initiation of an SBO event.

8) The licensee is considering an automatic connection of the AAC diesel generators to a pre-selected emergency bus. The existing automatic load sequencing for an emergency bus may be used in connecting loads to the bus once it is powered by the AAC machine.

Staff Evaluation: The staff finds the licensee's proposed addition of two non-safety grade diesel generators as an AAC power source to be acceptable. However, the licensee should provide confirmation that the proposed AAC power source meets the other criteria of Appendix B of NUMARC 87-00, specifically items B.8, B.9, B.10, B.11, B.12, and B.13 and RG 1.155, Position C.3.3.5.5.

The staff does not agree with the SBO duration of 4 hours. The licensee needs to modify the SBO duration from 4 hours to 8 hours (see Section 2.1) and confirm that each day tank will be sized to allow the diesel to run for the SBO duration of 8 hours.

Also, the automatic connection of the AAC diesel generators to a pre-selected emergency bus is not acceptable to the staff since it violates RG 1.155, Section 3.3.5.3. The staff finds the use of existing automatic load sequencing acceptable provided the licensee demonstrates by test that all SBO equipment can be powered from an AAC source within 1 hour.

2.3 Condensate Inventory for Decay Heat Removal (SE Section 2.3.1)

SE Recommendation: The licensee should evaluate the condensate inventory needed for decay heat removal for an 8-hour coping duration and recovery therefrom, and verify that this inventory is available in the condensate storage tank (CST) and that it is enveloped by the Technical Specifications (TS). The licensee should include these analyses and verification in the documentation supporting the SBO submittal that is maintained by the licensee.

Licensee Response: The licensee stated that the minimum permissible emergency CST level as required by the TS exceeds the required quantity for coping with a 4- or 8-hour SBO. No plant modifications and only minor procedure revisions are necessary for condensate inventory.

Staff Evaluation: Based on its review and the results of its consultant's analysis, the staff agrees with the licensee's conclusion that the emergency CST as required by TS will have sufficient water for coping with a 4- or 8-hour SBO event. Therefore, the staff considers this condensate inventory issue resolved.

2.4 Class 1E Battery Capacity (SE Section 2.3.2)

SE Recommendation: The licensee should provide a battery of sufficient capacity to power all normal battery-backed monitoring and electrical systems and controls for the required SBO duration and recovery therefrom, or provide battery charging from an acceptable AAC power source.

Licensee Response: The licensee stated that a battery capacity analysis had been performed pursuant to NUMARC 87-00, Section 7.2.2 to verify that the Class 1E batteries have sufficient capacity to meet SBO loads for 1 hour.

The licensee indicated that Surry has two Class 1E batteries per unit, one battery per safety train. Each battery provides two instrument channels that provide various low-voltage indication, control and protection functions. The licensee further stated that one battery charger would be available within 1 hour on each blacked-out unit using the proposed AAC sources.

Staff Evaluation: The staff finds this to be acceptable based on the proposed AAC sources and availability of one charger within 1 hour.

2.5 Compressed Air (SE Section 2.3.3)

SE Recommendation: In the SE, the staff indicated that the licensee had proposed to make modifications to provide bottled air supply to atmospheric dump valves in lieu of normal air supply from the plant air compressors during the first hour of the SBO. The staff further concluded that once the proposed modification is completed, adequate compressed air will be available to operate the valves needed for decay heat removal during an SBO event.

Licensee Response: The licensee stated that the compressed air capabilities were presently under review. The licensee also stated that several options exist for resolution of this issue and that they will provide the results of their review at a later date.

Staff Evaluation: Since the compressed air capacity is still under review, the staff finds this issue to be an open item.

2.6 Effects of Loss of Ventilation (SE Section 2.3.4)

SE Recommendation: The licensee should provide an acceptable AAC source, or provide other means to provide the necessary heating, ventilation and air conditioning (HVAC) during an SBO. If the proposed HVAC is not available for 1 hour, the licensee should evaluate the control room, charging pump cubicles, auxiliary feedwater (AFW) pump room, and switchgear room, and confirm that there is reasonable assurance of equipment operability and operator habitability during the first hour of the SBO. The licensee should provide more specific details on the required operator actions and their ability to withstand the high temperatures while opening doors and dampers to limit the heat-up in the AFW pump rooms. The licensee should include in their SBO procedures a provision to open the control room cabinet doors within 30 minutes after the onset of an SBO. Also, these calculations and analyses should be included as part of the documentation maintained by the licensee in support of the SBO submittals.

Licensee Response: The licensee stated that two non-safety related diesel generators will be added to provide a fully capable AAC power source to each of the blacked-out units and the AAC power source will be available within 1 hour. In addition, the licensee has performed analyses to determine the effects of loss of ventilation for the period of time when the AAC power is not available in the control room, computer room, emergency switchgear room, instrument rack room, charging pump cubicle, and auxiliary feedwater pump house. The staff's evaluation of the effects of loss of ventilation in each of these areas is provided below:

a. Control Room and Computer Room (Control Room Complex)

The control room complex consists of an open area which contains the Unit 1 and 2 control boards and individual rooms for each unit's air conditioning equipment, computer equipment, and logic equipment. The licensee stated that the HVAC system for the control room and emergency switchgear room at Surry is presently being modified in accordance with plans that have been previously reviewed with the staff. Upon completion of the modifications, the required air handling and chilled water equipment can be powered from a single emergency bus. Therefore, the control room complex will return to normal temperature when the AAC power becomes available (within 1 hour). The analyses performed for SBO are based on the HVAC system as it will exist upon completion of these modifications. The maximum calculated temperatures during an SBO event in the main control room and computer room are 98.4°F and 99.5°F, respectively. Therefore, the licensee does not consider these areas to be detrimental from an operability or occupational standpoint.

In the analyses for these areas, the licensee used 75°F as the initial temperature. Based on its review, the staff does not find that the 75°F used as an initial temperature is conservative enough for the control room complex heat-up analyses at the Surry plant. For the control room complex heat-up analyses, the licensee should either use as an initial temperature the maximum allowed by the TS or the maximum value allowed under administrative procedures.

In addition, the licensee has not addressed the procedure which will require the operators to take action within 30 minutes after the onset of an SBO event to open the control room cabinet doors in accordance with the guidance described in NUMARC 87-00.

b. Emergency Switchgear Room (ESGR) and Instrument Rack Room

The ESGR complex consists of individual areas for the switchgear and support equipment separated by concrete walls with an open passageway in the wall between the areas. Separate areas are provided for switchgear and relay equipment, instrument racks and battery equipment. Upon completion of the modification discussed in Section 2.6.a above, the required air handling and chilled water equipment can be powered from a single emergency bus on each unit and the ESGR complex will return to normal temperature when the AAC power becomes available within 1 hour. The maximum calculated temperatures during an SBO event to the switchgear room and instrument rack room are 109.7°F and 108.5°F, respectively and are not considered to be detrimental from an operational standpoint.

In the analyses for these areas, the licensee used 80°F as the initial temperature. Based on its review, the staff does not find that the 80°F used as an initial temperature is conservative enough for the switchgear room and instrument rack room heat-up analyses at the Surry plant. For the heat-up analyses in these areas, the licensee should either use as an initial temperature the maximum allowed by the TS or the maximum value allowed under administrative procedures.

c. Charging Pump Cubicle

The charging pump cubicle contains a charging pump and its associated valves. There are three cubicles in each unit. The cubicle's exhaust ventilation system is handled by the auxiliary building central exhaust fans which are powered from the 1H and 1J emergency buses. The maximum temperature in the cubicle is determined to be 135.6°F based on no charging pump motor operating without the exhaust fan in operation for 1 hour. The temperature will return to 120°F with one fan in operation once the AAC power is restored to the emergency buses within 1 hour. Based on its review, the staff finds that the required SBO equipment in the charging pump cubicle will remain operable during an SBO event.

d. Auxiliary Feedwater Pump House

The licensee performed the temperature profile analysis for the auxiliary feedwater pump area of the combination main steam valve-auxiliary feedwater pump house. For the worst-case condition, with the turbine-driven and one motor-driven auxiliary feedwater (AFW) pump running and without forced ventilation, the temperature at the AFW pump elevation is projected to be 114°F. This is due to the ventilation in the area by a natural circulation system, the outlet of hot air through the open roof vents, and the intake of fresh air through the open wall dampers at the AFW pump elevation. The licensee stated that based on the NUMARC equipment operability database, this temperature is acceptable for all AFW pumps. Based on its review and its understanding that no operator actions will be required to open the roof vents and wall dampers, the staff finds that the required SBO equipment in the AFW pump house will remain operable during an SBO event.

Staff Evaluation: Based on its review and its concerns discussed in the above Sections 2.6.a and 2.6.b, the staff has not been able to conclude that the licensee's analyses of the effects of loss of ventilation in the control room complex and the ESGR complex are acceptable. The staff considers that this issue with respect to the effects of loss of ventilation at the Surry plant is not fully resolved; therefore, this issue is identified as an open item.

2.7 Reactor Coolant Inventory (SE Section 2.3.6)

SE Recommendation: The licensee should provide an acceptable independent AAC source of sufficient capacity and capability to provide power to the supporting systems needed to monitor and maintain adequate reactor coolant system (RCS) inventory.

Licensee Response: The licensee stated that an AAC source will be available within 1 hour following the onset of an SBO event to provide power to the necessary RCS make-up system to maintain adequate reactor coolant inventory to ensure that the core is covered and cooled for 4 hours. The licensee also stated that the adequacy of the RCS inventory to ensure that the core is cooled independent of AC power had been assessed for 1 hour by using plant-specific analysis. The licensee determined that the expected rates for reactor coolant inventory loss under SBO conditions do not result in core uncovery in 1 hour.

Staff Evaluation: The staff finds, based on the availability of AAC power within 1 hour following the onset of an SBO event, that the licensee has adequate coping capability to maintain reactor coolant inventory for an SBO duration of 8 hours.

2.8 Canal Inventory

SE Recommendation: None.

Licensee Statement: The licensee stated that the circulating water system provides cooling water for the main condensers and service water system for both units. In order to conserve canal inventory, one condenser isolation valve which requires AC power for each water box must be closed within 30 minutes. Additionally, any open component cooling water and bearing cooling water valves that have not been re-powered by the AAC sources must be manually closed after 1 hour. The licensee mentioned that the canal inventory will be maintained at a level which is adequate to provide net positive suction head for the heat sinks required for SBO by performing the above actions.

Staff Evaluation: In order to provide AC power to the condenser isolation valves within 30 minutes, the licensee should consider a 10-minute AAC power source per RG 1.155, Section C.3.3.5.3. The licensee should commit to performing a test to demonstrate that the AAC power source can power the shutdown buses within 10 minutes of the onset of an SBO. In that case, no coping analysis is required. Otherwise, the licensee should provide assurance of net positive suction head for heat sinks by listing the condenser isolation valves and other valves not powered by the AAC source in an appropriate procedure and by identifying actions required to ensure these valves are fully closed by providing positive indication (local, remote, etc.) independent of the Class 1E power source. The supporting documentation should be included with other information to be maintained by the licensee in support of its SBO submittals.

2.9 Proposed Modifications (SE Section 2.5)

SE Recommendation: The licensee should provide an AAC source that meets the requirements of the SBO rule or an alternative method for coping with an SBO. A full description of the proposed modifications, including the nature and objectives of the required modifications to meet the SBO rule, and a proposed schedule for implementation should be provided.

Licensee Response: The licensee stated that two non-safety related diesel generators will be added to provide a fully capable AAC power source to each of the blacked-out units. The licensee further stated that the proposed modification and procedure changes will be completed within about 5 years following receipt of favorable notification by the Director, Office of Nuclear Reactor Regulation. An installation time exceeding 2 years is necessary due to (1) the complexity of the proposed modification, (2) equipment ordering and fabrication lead times, (3) the number of refueling outages required to make the necessary equipment modifications and tie-ins, and (4) the amount of procedure changes and training that will be necessary to ensure proper operation of the new AAC power source.

Staff Evaluation: The staff considers the 5-year time frame to complete the modifications and procedure changes as excessive. The licensee should implement the changes within 3 years, or provide a detailed justification as to why a longer time frame is required. The justification should include a detailed schedule of the different phases of the project. Also, the licensee should consider the receipt of this SSE as the starting time, since the staff has accepted the proposed AAC source.

2.10 Quality Assurance (QA) and Technical Specifications (TS) (SE Section 2.6)

SE Recommendations: The licensee should verify that the SBO equipment is covered by an appropriate QA program consistent with the guidance of RG 1.155. Further, this verification should be documented as part of the package supporting the SBO rule response.

Licensee Response: The licensee did not provide any response to the above SE recommendation.

Staff Evaluation: The licensee needs to address this recommendation.

2.11 EDG Reliability Program (SE Section 2.7)

SE Recommendation: It is the staff's position that an EDG reliability program should be developed in accordance with the guidance of RG 1.155, Section 1.2. Confirmation that such a program is in place or will be implemented should be included in the documentation that is to be maintained by the licensee in support of the SBO submittals.

Licensee Response: The licensee did not provide any response to the above SE recommendation.

Staff Evaluation: The licensee needs to address this recommendation.

3.0 SUMMARY AND CONCLUSION

The NRC staff's SE pertaining to the licensee's initial responses to the SBO rule, 10 CFR 50.63, was transmitted to the licensee by letter dated October 15, 1990. The staff found the licensee's proposed method of coping with an SBO to be non-conforming. The licensee was asked to submit a revised response to the SBO rule addressing the areas of non-conformance. The licensee's responses to the areas of non-conformances and recommendations have been evaluated in this SSE and found to be acceptable contingent upon the licensee's resolution of several open items. These include the SBO coping duration, the AAC source meeting all the criteria of Appendix B of NUMARC 87-00, automatic connection of the AAC source, additional justification for the 5-year time frame to complete the modifications, compressed air capability, administrative procedures revision to maintain the control room and switchgear room temperature at or below 75°F and 80°F respectively, condenser isolation valves, quality assurance and the EDG reliability program. The staff has found the proposed AAC source to be acceptable. Therefore, the licensee should not wait for the open items to be resolved before planning for and purchasing of the two diesel generators.

The licensee should submit, within 30 days of receipt of the SSE, confirmation of the resolution of the open items and present a schedule for their implementation in accordance with 10 CFR 50.63(c)(4). Also, the licensee should maintain all analyses and related information in the documentation supporting the SBO submittal for further inspection and assessment as may be undertaken by the NRC to audit conformance with the SBO rule.

Principal Contributor: A. Pal

Dated: December 6, 1991