June 10, 1997

Mr. C. S. Hinnant, Vice President
Carolina Power & Light Company
H. B. Robinson Steam Electric Plant,
Unit No. 2
3581 West Entrance Road
Hartsville, South Carolina 29550

SUBJECT: ADEQUACY OF THE DELAYED OFFSITE POWER CIRCUIT FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 (TAC NO. M97957)

Dear Mr. Hinnant:

The NRC staff has reviewed Carolina Power & Light Company's (licensee or CP&L) March 27, 1997, response to our February 14, 1997, request for additional information (RAI) regarding the adequacy of the delayed offsite power circuit for the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBR). The NRC staff's findings differ from those provided in your response that HBR need not verify the adequacy of its delayed offsite power circuit. Based on our review of your response and a review of additional docketed correspondence between CP&L and the NRC, we have determined that the current licensing basis for HBR requires that offsite power be available from the delayed offsite power circuit in approximately 4 hours. Therefore, we have determined that the licensee of HBR should verify the adequacy of its delayed offsite power circuit. A copy of our evaluation is enclosed.

We are aware of your plans to perform on-line maintenance of the emergency diesel generators. Without two adequate offsite power circuits, the NRC staff does not consider HBR a candidate for on-line maintenance. We are prepared to meet with you in the next 3 weeks to discuss your plans to resolve this matter. Please contact me to negotiate a mutually agreeable time for this meeting. Should you have any questions, do not hesitate to contact me at 301-415-2020, or by email at blm@nrc.gov.

Sincerely,

(Original Signed By)

Brenda Mozafari, Project Manager
Project Directorate II-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosure: Evaluation

cc w/enclosure: See next page

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NRC STAFF

EVALUATION OF THE DELAYED OFFSITE POWER CIRCUIT

FOR THE

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NO. 50-261

1.0 BACKGROUND

One of the lessons learned from the Maine Yankee Independent Safety Assessment was that some older plants licensed prior to codification of the General Design Criteria were not explicitly required by Technical Specifications (TS) to have two offsite power circuits during power operation. The licensing basis for Maine Yankee was two immediate offsite power circuits and one delayed offsite power circuit that is backfed through the main and unit auxiliary transformers. The two immediate offsite power circuits were fully capable of performing their safety function at the time of initial licensing; however, due to load growth in the region around Maine Yankee, one of the immediate offsite power circuits was no longer capable of performing its safety function. The Maine Yankee TS did not require both immediate offsite power circuits to be available during power operations, and as a result, Maine Yankee operated for an extended period of time without an adequate second offsite power circuit available. This finding prompted the NRC staff to examine whether any other plants might be operating without two adequate offsite power circuits.

2.0 DESCRIPTION OF THE ISSUE

The NRC staff identified that the Carolina Power & Light Company (the licensee or CP&L) might be operating the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBR), with only one adequate offsite power circuit. Therefore, by letter dated February 14, 1997, the NRC staff requested information regarding the adequacy of the delayed offsite power circuit for HBR. The licensee responded to the request for information by letter dated March 27, 1997. In its response, the licensee stated that an analysis has not been performed to demonstrate the adequacy of HBR's delayed offsite power circuit to be made available in sufficient time following a loss of Startup Transformer #2 to preclude exceeding fuel design limits and design conditions of the reactor coolant pressure boundary. The licensee further indicated in its response that it would take significantly longer than the minimum time of 4 hours stated in the updated Final Safety Analysis Report (FSAR) to restore offsite power following a loss of Startup Transformer #2.

3.0 SUMMARY OF FINDINGS

Based on our review of the licensee's response and a review of additional docketed correspondence between the licensee and the NRC, we have determined that the current licensing basis for HBR requires that offsite power be available from the delayed offsite power circuit in approximately 4 hours.

ENCLOSURE

Thus, to address the case of a loss of Startup Transformer #2 and the need to power plant safety buses E1 and E2 for nuclear safety considerations, we request that the licensee for HBR verify the adequacy of its delayed offsite power circuit by accomplishing one of the following:

a. Demonstrate that offsite power can be made available in approximately 4 hours and verify that this time is sufficient to prevent exceeding fuel design limits and design conditions of the reactor coolant pressure boundary; or

b. Perform an analysis to confirm that the time available to reestablish offsite power can be greater than 4 hours without exceeding fuel design limits and design conditions of the reactor coolant pressure boundary.

4.0 EVALUATION

Based on a review of correspondence between the licensee for HBR and the NRC, we ascertained that the licensing basis for offsite power was modified from the original licensing requirements by the licensee during the NRC staff's review of MPA B-48, "Adequacy of Station Electric Distribution System Voltages." The current licensing basis for HBR offsite power is one immediately available offsite power circuit (the 115-kV source via Startup Transformer #2) and one delayed offsite power circuit (backfeeding through the main and unit auxiliary transformers). The delayed offsite power circuit must be established to power plant auxiliary loads in approximately 4 hours following a loss of Startup Transformer #2. The transfer of Safety buses E1 and E2 to the delayed offsite power sources is not required until HBR reaches cold shutdown; however, if nuclear safety considerations require these buses to be powered from offsite power prior to HBR reaching cold shutdown, offsite power must be available from the delayed offsite power circuit.

4.1 Original Licensing Basis

The original licensing basis for emergency power at HBR is found in the original HBR Final Safety Analysis Report (FSAR), Chapter 8. As stated in Chapter 8, the design criterion proposed by the licensee is as follows:

> An emergency power source shall be provided and designed with adequate independence, redundancy, capacity, and testability to permit the functioning of the engineered safety features and protection systems required to avoid undue risk to the health and safety of the public. This power source shall provide this capacity assuming a failure of a single active component. (GDC 39)

This licensee-proposed design criterion, identified in the FSAR as GDC 39, is different than the Draft GDC 39 published in the *Federal Register* on July 11, 1967. Draft GDC 39 states that:

> Alternate power systems shall be provided and designed with adequate independent, redundancy, capacity, and testability to permit the functioning of required engineered safety features. As a minimum, the onsite power system and offsite power system shall each, independently, provide this capacity assuming a failure of a single active component in each power system.

The published Draft GDC 39 differed from the licensee's proposed criterion in that it separated the onsite and the offsite power system requirements and explicitly stated that redundancy in each power system is required. Therefore, it is not clear in the licensee's version of GDC 39 whether the emergency power source refers to onsite, offsite, or both power system requirements.

The NRC staff's Safety Evaluation dated May 18, 1970, states:

> [S]hould a loss-of-coolant accident occur following transformer failure, the engineered safety features would be dependent on the redundant diesel generators for power until disconnect links could be removed from the station generator to permit the backfeeding of offsite power to the auxiliary electrical system through the station main transformer. This would require about 8 hours to accomplish.

This statement in the original NRC staff Safety Evaluation confirms that the design of the offsite power system for HBR was accepted on the basis that the plant had a backfeed capability in the event of a transformer failure. Therefore, the NRC staff maintains that the ability to backfeed offsite power to the auxiliary electrical system through the station main transformer was an original licensing requirement for HBR.

4.2 Multi-Plant Action (MPA) B-48, "Adequacy of Station Electrical Distribution System Voltages"

Multi-Plant Action B-48, "Adequacy of Station Electrical Distribution System Voltages," was initiated by the NRC to determine if the onsite distribution system in connection with offsite power sources had sufficient capacity and capability to start and operate all required safety loads within equipment voltage ratings. During the NRC staff's MPA B-48 review of HBR, the NRC staff raised concerns regarding the adequacy of HBR's delayed offsite power circuit.

By letter dated October 5, 1979, the licensee for HBR responded to the NRC staff concerns regarding the delayed offsite power circuit by stating:

> H. B. Robinson was constructed prior to the issuance of General Design Criteria 17. Therefore, a single startup transformer connects the multiple sources of off site power to the on site electric distribution system. Should a failure of the startup transformer occur, an installed spare startup transformer would be jumpered into service. During the time that the startup transformer was out of service, the unit auxiliary transformer could supply power to the on site distribution system by back-feeding the main transformer from the 230 kV switchyard. Prior to back-feeding the main transformer from the 230 kV switchyard, the generator must be disconnected from the main transformer by removing the connecting straps.

The NRC staff requested that the licensee provide the times needed to jumper the spare startup transformer into service and to enable backfeeding through the unit auxiliary transformer. In that request the NRC staff explained that the times to complete these actions should be consistent with the core uncovering time from the accident analysis and the discharge time of the class 1E battery. The licensee response to the NRC staff stated:

> The spare Startup Transformer for Unit 2 is not an installed spare. It is a spare unit stored on site and has no wiring connections other than a cabinet heater to prevent accumulation of condensate in the control panel. A minimum of twenty-four (24) hours is the estimated time required to temporarily connect the spare transformer for service. The type of failure of the normal startup transformer (i.e., fire, loss of duct bank, etc.) could cause this time to be greater. A minimum time of four (4) hours is estimated to disconnect the generator straps to enable backfeeding through the unit auxiliary transformer.
>
> The reference to the core uncovering time and the discharge time of the batteries in this item is not considered relevant because no source of off-site power is assumed necessary during these events. Either of the two emergency diesel generators which are considered in the accident analysis, is adequate for safe shutdown.

After additional letters between the NRC staff and the licensee about the scope and methods to be used to complete the MPA B-48 review for HBR, the licensee told the NRC staff that an analysis was not required to demonstrate the adequacy of voltages when backfeeding through the unit auxiliary transformer since its capacity rating is the same as the start-up transformer. The NRC staff did not agree with this licensee position, and stated that when backfeeding, the main transformer would be in series with the unit auxiliary transformer, which results in a higher impedance, and the higher impedance path needed to be evaluated. The NRC staff requested that the licensee submit an analysis to demonstrate the adequacy of the delayed offsite power circuit.

The licensee responded that an analysis was not required because no credit was taken in the FSAR for the backfeed source of offsite power. The issue regarding the adequacy of the delayed offsite power circuit raised by the NRC staff during its MPA B-48 review was closed after the licensee committed to only use the delayed offsite power circuit to power non-safety plant loads until HBR reached cold shutdown and plant loads could be reduced to ensure adequate voltage would be available to power safety buses E1 and E2. However, if nuclear safety consideration requires safety buses E1 and E2 to be powered from offsite power before HBR reached cold shutdown, then the delayed offsite power must be available so that these buses can be powered within approximately 4 hours of losing Startup Transformer #2. Because the licensee had not evaluated the adequacy of the delayed offsite power circuit, the NRC staff required the licensee to submit a TS change to ensure that the delayed offsite power circuit would only be used to power buses E1 and E2 in cold shutdown, unless essential during hot shutdown to protect public health and safety.

In a letter to the NRC staff dated March 9, 1984, the licensee stated:

> Backfeeding the E1 and E2 safety related buses through the main and unit auxiliary transformer will only occur during cold shutdown when no other power sources are available, unless nuclear safety considerations require it to be done during hot shutdown. Changes to the FSAR will be included in its annual update. The changes to the TS will be requested by May 1984. In addition, the requirement to be in cold shutdown prior to backfeeding the safety-related buses through the main and unit auxiliary transformer has been added to the HBR operating procedure.
>
> Based on the information provided above and pending approval of the requested TS changes to be submitted to NRC by May 1984, CP&L believes that the offsite and onsite electrical distribution system at HBR is adequate to meet the requirements of General Design Criteria 17 and that this issue should be closed for HBR.

Because the licensee had not demonstrated its adequacy, the delayed offsite power circuit cannot be used prior to cold shutdown unless needed to protect public health and safety. However, its availablity is required. The TS requirement prohibiting use the delayed offsite power circuit to power safety buses before HBR reaches cold shutdown does not eliminate HBR's licensing basis requirement to have two offsite power circuits.

4.3 <u>Current FSAR, Chapter 8</u>

The current updated FSAR for HBR states the following regarding the times needed to restore offsite power following a loss of Startup Transformer #2:

> The spare Startup Transformer for Unit 2 is a spare unit stored on site and has no wiring connections other than a cabinet heater to prevent accumulation of condensate in the control panel. A minimum of twenty-four hours is the estimated time required to temporarily connect the spare transformer for service. The type of failure of the normal startup transformer (i.e., fire, loss of duct bank, etc.) could cause this time to be greater. A minimum time of four hours is estimated to disconnect the generator straps to enable backfeeding through the unit auxiliary transformer.

This statement is the same statement provided to, and relied upon by, the NRC staff to close issues raised during its MPA B-48 review for HBR. It was provided to the NRC staff in response to a concern that the actual time needed to establish the backfeed should be in conformity with the core uncovering time from the accident analysis and the discharge time of the Class 1E battery. Therefore, the "minimum time of 4 hours" estimated by the licensee to disconnect the generator straps to enable backfeeding through the unit auxiliary transformer should be construed to mean "approximately 4 hours," given that the original NRC staff Safety Evaluation stated it would require about 8 hours; this should not be interpreted to mean "9 hours" or "16 hours."

4.4 Loss-of-Offsite-Power Events at HBR

Two loss-of-offsite-power (LOOP) events have occurred at HBR. These two events, as well as a loss of all ac power during pre-operational testing in 1970, illustrate the likelihood of such events occurring at HBR, and the weakness of the HBR offsite power design.

On January 28, 1986, a reactor trip from 80 percent power occurred, followed by a complete LOOP. The event started when the licensee removed the "B" emergency diesel generator from service, as described in Licensee Event Report (LER) 50-261/86-005, causing the loss of Safety Bus E2. This led to a trip of the reactor, and a lockout of Startup Transformer #2. Offsite power was restored 1 hour and 40 minutes later when the startup transformer was reenergized.

A second, complete LOOP and reactor trip from 99 percent power occurred at HBR on August 22, 1992. The licensee took approximately 14 hours to restore offsite power. The cause of the event was a false overpressure signal in the startup transformer. The licensee had to replace the pressure sensor prior to reenergizing the startup transformer and restoring offsite power.

4.5 10 CFR 50.63, "Station Blackout," Review

On July 21, 1988, the NRC amended its regulation in 10 CFR 50 by adding a new section, 50.63, "Loss of All Alternating Current Power." The objective of this rule is to reduce the risk of severe accidents resulting from station blackout (SBO) by maintaining highly reliable ac electric power systems and,

as additional defense-in-depth, ensuring that plants can maintain adequate reactor core cooling and appropriate containment integrity for a required duration. This requirement is based on information developed under the Commission's study of Unresolved Safety Issue A-44, "Station Blackout."

In its initial SBO submittal, the licensee for HBR took credit for removing the main generator disconnect links and backfeeding power from the 230-kV switchyard to qualify as a 4-hour coping plant. The licensee revised its coping duration, however, from 4 to 8 hours when the NRC staff questioned the time needed to actually remove the generator links and backfeed the onsite distribution system.

The objective of 10 CFR 50.63 is to reduce the risk of severe accidents resulting from SBO by maintaining highly reliable ac electric power systems to ensure that plants can maintain adequate reactor core cooling and appropriate containment integrity for a required duration. In the case of HBR, however, only one offsite power circuit has been demonstrated to be adequate and available in time to prevent fuel design limits and design conditions of the reactor coolant pressure boundary from being exceeded. In this respect, HBR does not appear to meet the objective of the SBO rule. The scope of the NRC staff's review of SBO assumed that the design basis of the offsite power system for HBR called for two reliable offsite ac power circuits.

5.0 SUMMARY OF STAFF POSITION

Based on a review of correspondence between the licensee for HBR and the NRC, the NRC staff has noted that the licensing basis for offsite power was modified from the original licensing requirements by the licensee during the NRC staff's resolution of MPA B-48, "Adequacy of Station Electric Distribution System Voltages." The current licensing basis for HBR offsite power is one immediately available offsite power circuit (the 115-kV source via Startup Transformer #2) and one delayed offsite power circuit (backfeeding through the main and unit auxiliary transformers). The delayed offsite power circuit must be established in approximately 4 hours following a loss of Startup Transformer #2 to power Safety Buses E1 and E2, as required for nuclear safety consideration.

Principal Contributors: Virgil L. Beaston, NRR/DE
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Date: June 10, 1997