CP&L
A Progress Energy Company

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BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING
REQUEST FOR LICENSE AMENDMENTS - EXTENDED POWER UPRATE
(NRC TAC NOS. MB2700 AND MB2701)

Ladies and Gentlemen:

On August 9, 2001 (Serial: BSEP 01-0086), Carolina Power & Light (CP&L) Company requested a revision to the Operating Licenses (OLs) and the Technical Specifications for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. The proposed license amendments increase the maximum power level authorized by Section 2.C.(1) of OLs DPR-71 and DPR-62 from 2558 megawatts thermal (MWt) to 2923 MWt. Subsequently, on November 8, 2001, the NRC provided an electronic version of a Request For Additional Information (RAI) concerning the impact of the BSEP extended power uprate on the spent fuel pool and associated systems. The response to this RAI is enclosed.

Please refer any questions regarding this submittal to Mr. David C. DiCello, Manager - Regulatory Affairs, at (910) 457-2235.

Sincerely,

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for

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Enclosure:
Response to Request For Additional Information (RAI) 7

Jeffery J. Lyash, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, and agents of Carolina Power & Light Company.

Kenneth M. Nicely
Notary (Seal)

My commission expires: MAY 18, 2003

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ENCLOSURE

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Response to Request For Additional Information (RAI) 7

Background

On August 9, 2001 (Serial: BSEP 01-0086), Carolina Power & Light (CP&L) Company requested a revision to the Operating Licenses (OLs) and the Technical Specifications for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. The proposed license amendments increase the maximum power level authorized by Section 2.C.(1) of OLs DPR-71 and DPR-62 from 2558 megawatts thermal (MWt) to 2923 MWt. Subsequently, on November 8, 2001, the NRC provided an electronic version of a Request For Additional Information (RAI) concerning the impact of the BSEP extended power uprate (EPU) on the spent fuel pool and associated systems. The responses to this RAI follow.

NRC Question 7-1

As a result of plant operations at the proposed extended power uprate (EPU) level, the decay heat load for any specific fuel discharge scenario will increase. In Section 6.3.1 of the Safety Analysis Report (SAR) for Brunswick Steam Electric Plant (BSEP) EPU, Carolina Power & Light Company (CP&L), stated that EPU does not adversely affect the capability of the fuel pool cooling and cleanup system (FPCCS) to keep the spent fuel pool (SFP) temperature at or below the design temperature and maintain adequate SFP cooling during normal refueling outages under partial and full-core offload conditions. However, CP&L did not provide the detailed discussion of its SFP cooling evaluations in the SAR, please provide the following information for both pre-EPU and EPU conditions:

a. SFP heat loads and the corresponding peak calculated temperatures during planned (normal) refueling outages under partial and full-core offload conditions, and unplanned (abnormal) full-core offload outages for pre-EPU and EPU conditions.

b. Assumptions used in the SFP thermal-hydraulic analysis (i.e. fuel assemblies "in-reactor" hold time, number of the previously discharged spent fuel assemblies (SFAs) in the SFP, ultimate heat sink temperature, etc.) for each scenario.

c. For the planned refueling outages under partial and full-core offload conditions, discuss how the most severe single failure (e.g. failure of: a FPCC system train, a residual heat removal system train, EDG, etc.) has been identified and accounted for in the SFP thermal-hydraulic analyses. (A single failure need not be assumed for the unplanned full-core offload events.)

d. Since the residual heat removal (RHR) system and the supplemental SFP cooling (SSFPC) system provide supplemental cooling, when needed, to maintain the SFP below 150°F, prior to a planned or unplanned full-core offload event, how many trains of FPCC system, and RHR or SSFPC system are required to be operable and available for SFP cooling?

e. For the planned refueling outages under partial and full-core offload conditions, if the calculated peak SFP temperature is above 150°F, provide the duration during which the SFP temperature is above 150°F and the thermal stress analyses to demonstrate that the SFP structure and the FPCC system can withstand the new high temperature.

Response to Question 7-1a

The pre-EPU thermal analysis of the SFP is provided in BSEP Updated Safety Analysis Report (UFSAR) Section 9.1.2.3.2.3, Section 9.1.2.3.2.4, Tables 9.1.2-4 through 9.1.2-9, and Figures 9.1.2-12 through 9.1.2-17. The BSEP UFSAR does not evaluate unplanned offloads. Actual conditions would be evaluated for unplanned outages to ensure that the available cooling systems would maintain the SFP temperature below the 150°F maximum allowed temperature. For a typical unplanned offload, sufficient RHR capacity would be available to allow offload to start, without delay, any time after the required 24 hour minimum in-reactor hold time specified in Section 9.1.2.3.2.3 of the UFSAR and Section 3.23, "Decay Time," of the BSEP Technical Requirements Manual (TRM). The following table provides head loads and peak SFP temperatures for the analyzed cases.

CASE	Pre-EPU	EPU
Full Core Offload Offload starts 24 hours after shutdown, FPCCS and RHR provide cooling. Heat Load Peak Temperature	 29.31×10^6 Btu/hr 139.2°F	 35.5×10^6 Btu/hr 147.1°F
Partial Core Offload - Illustration Case Only(1) Offload starts 24 hours after shutdown, only FPCCS provides cooling. Heat Load Peak Temperature	 17.31×10^6 Btu/hr 161.4°F	 N/A 169.1°F

CASE	Pre-EPU	EPU
Partial Core Offload Offload starts 96 hours after shutdown for pre-EPU analysis and 190 hours after shutdown for EPU analysis, only FPCCS provides cooling.		
Heat Load	13.85 x 10^6 Btu/hr	14.1 x 10^6 Btu/hr
Peak Temperature	150°F	149.9°F

(1) This illustration case is not allowed by plant procedures and is not considered a credible case given the maximum SFP temperature limit of 150°F established in the UFSAR. No EPU maximum decay heat load was documented for this case since it is not used to support actual plant operations.

<u>Response to Question 7-1b</u>

The following table provides the key assumptions used in the pre-EPU and EPU thermal-hydraulic analyses.

ASSUMPTION	Pre-EPU	EPU
Full Core Off Load In-Reactor Hold Time	24 hours	24 hours
Partial Core Off Load In-Reactor Hold Time	96 hours	190 hours
Number Of Previously Discharged Spent Fuel Assemblies Note: The Unit 2 SFP inventory was used since the resulting heat load bounds that of Unit 1	**Partial Core Offload** UFSAR Table 9.1.2-6 **Full Core Offload** UFSAR Table 9.1.2-8	**Partial Core Offload** One batch of 256 fuel bundles offloaded to an almost full SFP (i.e. pool loaded with 1167 bundles, 144 of which are Pressurized Water Reactor (PWR) bundles) with sufficient reserve for an additional full core offload (i.e., 560 cells). The 1023 Boiling Water Reactor (BWR) bundles are offloaded in four batches, discharged at 24 month intervals. **Full Core Offload** Partial core offload as described above plus a full core which has operated for 24 months
Ultimate Heat Sink Temperature (i.e, Service Water) And FPCCS Heat Sink (i.e., Reactor Building Component Cooling Water (RBCCW))	**Service Water** 95°F **RBCCW** 100°F	**Service Water** 95°F **RBCCW** 100°F

Response to Question 7-1c

UFSAR Section 9.1.2.3.2.4.2 and Table 9.1.2-9 describe postulated equipment failures for the pre-EPU conditions. Equipment failures were also evaluated for EPU. The results are summarized below.

CASE	Pre-EPU	EPU
Partial Core Offload With Loss Of One FPCCS Heat Exchanger/Pump		
Offload starts 96 hours after shutdown for the pre-EPU analysis and 190 hours after shutdown for the EPU analysis.		
Maximum Temperature	192°F	184.8°F
Partial Core Offload With Total Loss Of FPCCS		
Offload starts 96 hours after shutdown for pre-EPU the analysis and 190 hours after shutdown for the EPU analysis.		
Maximum Temperature	212°F	212°F
Time To Boil After Loss Of Cooling	13.05 hours	16 hours
Full Core Offload With Loss Of FPCCS And RHR		
Offload starts 24 hours after shutdown.		
Maximum Temperature	212°F	212°F
Time To Boil After Loss Of Cooling	6.72 hours	5 hours

Response to Question 7-1d

The full core offload analysis assumes that FPCCS is operating with both pumps and heat exchangers plus one loop of RHR. The partial core offload analyses assumes that FPCCS is operating with both pumps and heat exchangers. Cycle specific evaluations are performed to confirm that the heat removal capacity is adequate to maintain pool temperatures below 150°F without extending the in reactor hold times beyond the 24 hour minimum required. This evaluation also determines the minimum time, after shutdown, when both loops of RHR can be removed from service without causing pool temperature to exceed the 150°F limit. Typically, the cycle specific evaluation takes credit for the SSFPC system.

Response to Question 7-1e

For both the pre-EPU and the EPU full core offload, RHR is assumed to be used, as needed, to maintain the peak SFP temperature less than 150°F. For both the pre-EPU and EPU partial core offload, the time for starting the core offload is controlled such that the peak SFP temperature does not exceed 150°F. For pre-EPU, the limiting starting time of the partial core offload is 96 hours (i.e., UFSAR Section 9.1.2.3.2.4). For EPU, the limiting starting time of the partial core offload is 190 hours (i.e., Power Uprate Safety Analysis Report (PUSAR) Table 6-3). For both pre-EPU and EPU, the partial core offload can begin prior to this specified starting time, but not prior to 24 hours following shutdown, provided either: (1) analysis shows that the actual decay heat load in the SFP, at the expected completion of the partial core offload, is less than or equal to the maximum decay heat load specified for the partial core offload analysis in the UFSAR (i.e., 13.85 x 10^6 Btu/hr pre-EPU or 14.1 x 10^6 Btu/hr EPU); or (2) a supplemental means of cooling the SFP is available which, when operated by itself or in conjunction with the FPCCS, is capable of maintaining the temperature of the SFP at or below 150°F.

NRC Question 7-2

With regard to the SSFPC system, please provide the following information:

a. A table to show the SSFPC design parameters (e.g. heat removal capacity, coolant temperature and flow rate, system design temperature, etc.).

b. Discussion of the provisions established in plant operating procedures to require the installation and operation of the SSFPC system.

c. Discussion to show: how the SSFPC will be powered (e.g. by a temporary diesel generator); and how the SSFPC will be stored and maintained for readiness.

Response to Question 7-2a

The original nominal design information for the SSFPC system is as follows:

Primary Pumps (2) Flow Rate	1500 gpm per pump
Secondary Pumps (2) Flow Rate	900 gpm per pump
Cooling Towers (2) Nominal Capacity	10 x 10^6 Btu/hr per cooling tower
Cooling Tower Air Flow	83050 cfm per cooling tower

Based on the pump curves, each primary pump is capable of 2600 gpm and each secondary pump is capable of 1116 gpm. Actual operating experience has shown that the primary side pumps operate acceptably at 3000 gpm each and the secondary pumps operate acceptably at 1000 gpm each. The heat removal capacity of the SSFPC system varies depending upon flow rates, ambient air wet bulb temperature and the decay heat load in the SFP.

A recent example of the heat removal capacity of the SSFPC system follows:

Ambient Wet Bulb Temperature	60°F
Primary Side Flow (2 Pumps)	4000 gpm
Secondary Side Flow (2 Pumps)	2000 gpm
Cooling Tower Air Flow (1 Tower In Service)	83050 cfm
Cooling Tower Inlet/Heat Exchanger Outlet Water Temperature on the Secondary Side	118°F

Cooling Tower Outlet/Heat Exchanger Inlet Water Temperature on the Secondary Side	94.8°F
Heat Exchanger Inlet Water Temperature on the Primary Side (i.e., SFP Temperature)	124°F
Heat Exchanger Outlet Water Temperature on the Primary Side	112.4°F
SSFPC System Decay Heat Removal	28.08×10^6 Btu/Hr

Response to Question 7-2b

Although not required, commercial considerations, including times allowed for core unload start and RHR outage window schedules, have resulted in regular use of the SSFPC system. Installation, initial startup, operation, and removal of the SSFPC system is controlled via plant procedures.

Plant procedure 0AP-022, "BNP Outage Risk Management," requires outage schedules to be developed through interaction with involved organizations and disciplines to assure that the planning provides defense-in-depth throughout the outage. The outage schedule shall establish systems, structures and components to provide backup for key safety functions which include decay heat removal and fuel pool cooling. The backup capabilities provided will be commensurate with plant conditions.

CP&L's policy with respect to outage safety is to use the defense-in-depth concept to conduct outages which minimize risk to the public, to employees, and to the non-outage unit. This concept uses: (1) systems, structures and components to provide backup of key safety functions using redundant, alternate, or diverse methods; (2) planning and scheduling of outage activities in a manner that will optimize safety system availability; (3) administrative controls to support and/or supplement the above elements; and (4) a defense-in-depth computer analysis as an additional check of the details within the plan. Elements of this review include, but are not limited to, the defense-in-depth and high risk evolutions affecting decay heat removal and fuel pool cooling.

In addition, per procedure 0AP-022, an engineering evaluation is required, prior to every refueling outage, to ensure that the BSEP UFSAR, Section 9.1.2, evaluation for the FPCCS with a partial core unload, bounds the expected heat load conditions for the outage.

The aspects of shutdown risk that are impacted by EPU conditions are items such as longer times before alternative decay heat removal systems can be used, shorter times to boiling, etc. These aspects are generally associated with the increased decay heat generation created by EPU. The BSEP shutdown risk procedure, 0AP-022, requires, as a minimum, a primary and backup means of decay heat removal to be available. Each system must be capable of maintaining fuel pool temperature at 150°F, or less, under the worst anticipated heat load. Heat loads and time to boil information are obtained from the engineering evaluation. Therefore, the aspects of shutdown risk that are impacted by EPU conditions are adequately controlled by the BSEP shutdown risk management process.

Response to Question 7-2c

Power

The primary side of the SSFPC system is powered from the plant's safety related emergency buses. Therefore, upon loss of normal plant power, the emergency diesels will power the primary side of the system. Each primary pump is connected to a motor control center which is powered from a different division. The SSFPC system's primary instrumentation and trip panel can be powered from either division. The secondary side of the SSFPC system is powered from non-safety related offsite power. A temporary diesel provides the backup power for the secondary side of the system.

Storage/Readiness

During periods when the SSFPC system is not used, the various system components are stored either in the area where it is temporarily installed or in storage containers. Prior to each refueling outage, the SSFPC system is installed via a plant procedure. This procedure provides instructions for the installation of the system, preparation of the system for use, and post-installation testing to ensure that the system is ready to support the refueling outage. Pre-use testing also includes testing of the temporary diesel generator.

NRC Question 7-3

In Table 6-3 of the SAR, CP&L, in part, states that:

"To comply with the existing temperature limit of 150°F, the fuel transfer for the batch offload was assumed to start at 190 hours after shutdown for the EPU evaluation. .... For actual shutdowns, offload can start prior to 190 hours provided that the SFP bulk pool temperature is expected to remain below 150°F with actual conditions including use of supplemental decay heat removal provisions."

Since the heat removal capability of the SFP cooling system is a function of the ultimate heat sink (Cape Fear River) temperature, and the decay heat load is a function of the SFAs "in-reactor" hold time prior to being discharged from the reactor, CP&L can alternately opt to perform a cycle-specific SFP thermal-hydraulic evaluation prior to every planned offload using the actual conditions at the time of the offload. The "in-reactor" hold time for offload can be adjusted, as long as the time is not shorter than what is assumed for the fuel handling accident.

If CP&L opts to perform a cycle-specific SFP thermal-hydraulic evaluation prior to every planned offload using the actual conditions at the time of the offload, please provide the following information:

a. The calculated SFP peak temperatures at various river water temperatures (i.e. 40°F, 60°F, 80°F, 90°F, 95°F, etc.) and their corresponding SFAs "in-reactor" hold time required; coincident time after reactor shutdown; and coincident decay heat load. For the case with the highest decay heat load, also provide the "time-to-boil" and maximum boil off rate.

b. Discuss the provisions established or to be established in plant operating procedures to require evaluations be performed to determine/establish SFAs "in-reactor" hold time required prior to discharge SFAs from the reactor to ensure that the SFP operating temperature limit of 150°F will not be exceeded.

Response to Question 7-3a

For each refueling outage, CP&L performs an evaluation to ensure that the decay heat load is bounded by Section 9.1.2 of the UFSAR such that the peak SFP temperature will not exceed 150°F. The FPCCS heat sink temperature for this evaluation is not varied and is assumed to be 100°F (i.e., the RBCCW temperature). The variables assumed in the calculations are those associated with the decay heat load for the specific refueling cycle and ambient air temperatures used in the evaluation of the SSFPC system. The required in-reactor minimum hold time of 24 hours is specified by TRM Section 3.23 and UFSAR Section 9.1.2.3.2.3. This is the same time specified for the fuel handling accident in UFSAR Section 15.7.1.3. With offload starting at 24 hours, the bounding generic full core offload analysis shows that the peak heat load will be 35.5×10^6 Btu/hr, the peak temperature will be 147.1°F and the time to boil after a loss of cooling will be at least 5 hours. For partial core offloads, the bounding generic EPU evaluation indicates that a hold time of 190 hours is required if the FPCCS is the only system relied upon.

Response to Question 7-3b

The required in-reactor minimum hold time of 24 hours is specified by TRM Section 3.23 and UFSAR Section 9.1.2.3.2.3. The actual hold time is calculated in accordance with procedure 0AP-022, "BNP Outage Risk Management." The response to NRC Question 7-2b provides additional information regarding the requirements of procedure 0AP-022 and the hold time calculation.

NRC Question 7-4

Discuss the provisions established or to be established in plant operating procedures to monitor and control the SFP water temperature during core offload events. Information should include:

a. How often the SFP water temperature will be monitored during planned and unplanned core off-load outages.

b. Information (such as high SFP water temperature alarm set-point) supporting a determination that there is sufficient time for operators to intervene in order to ensure that the temperature limit of 150°F will not be exceeded.

c. The mitigative actions (e.g. prohibit fuel handing, aligning other systems to provide SFP cooling, etc.) to be taken in the event of a high SFP water temperature alarm.

Response to Question 7-4a

Plant procedures require that the SFP temperatures be monitored at least once per shift. In addition, the operating procedure for the SSFPC system requires that SFP temperature be monitored hourly during its use.

Response to Question 7-4b

BSEP does not have a high SFP water temperature alarm. As indicated in Response to Question 7-4a, plant procedures require that the SFP temperatures be monitored at least once per shift. In addition, the operating procedure for the SSFPC system requires that SFP temperature be monitored hourly when the SSFPC system is in service. Any increase in the SFP temperature of 3°F in an hour is required to be investigated. The procedure requires that, if the SFP temperature exceeds 110°F during SSFPC system operation, (1) the Unit Senior Control Operator (SCO) is to be immediately notified, and (2) more frequent monitoring of SFP temperature will be established with approval from the Unit SCO. If the SFP temperature exceeds 115°F during SSFPC system operation, the Unit SCO is to be immediately notified.

The FPCCS has a common alarm in the Control Room which provides, among other things, annunciation for the loss of part or all of the cooling portion of the FPCCS. Annunciation is also available in the Radwaste Control Room for low flow through the system filter-demineralizers The SSFPC system does not have any alarms that provide an indication of a loss of the system. However, during refuelings, the operating procedure specifies that the system be walked down and parameters recorded twice per shift, unless directed otherwise by the Unit SCO.

Response to Question 7-4c

As previously indicated, BSEP does not have a high SFP water temperature alarm. In the event of a loss of SFP cooling or the SFP temperature can not be maintain less than 125°F during a refueling, procedure 0AOP-38.0 "Loss of Fuel Pool Cooling," directs that the SSFPC system be placed in service, if available, or initiates the fuel pool cooling assist mode of RHR. If no cooling systems are available, the procedure directs that corrective actions be taken to restore the systems to operations. If it becomes apparent that the SFP will boil, the following actions are taken:

a. Secondary containment integrity is restored, and

b. Preparations for adding makeup water using the Demineralized Water, Fire Protection, RHR, Core Spray, or Service Water systems are made.

NRC Question 7-5

In the unlikely event that there is a complete loss of SFP cooling capability, the SFP water temperature will rise and eventually reach boiling temperature. Provide the time to boil (from the pool high temperature alarm caused by loss-of-pool cooling to boiling) and the boil-off rate (based on the highest heat load from the planned or unplanned full core off-load). Also, discuss sources and capacity of make-up water and the methods/systems (indicating system seismic design Category) used to provide the make-up water.

Response to Question 7-5

Based upon design information, the time to boil is as follows:

CASE	Pre-EPU(1)	EPU(2)
Partial Core Offload With Total Loss Of FPCCS		
Offload starts 96 hours after shutdown for pre-EPU analysis and 190 hours after shutdown for EPU analysis.		
Initial Starting Temperature	145.2°F	149.9°F
Time To Boil After Loss Of Cooling	13.05 hr	16 hr
Boil Off Rate	28.84 gpm	28.7 gpm
Full-Core Offload With Loss Of FPCCS And RHR		
Offload starts 24 hours after shutdown.		
Initial Starting Temperature	139.2°F	147.1°F
Time To Boil After Loss Of Cooling	6.72 hr	5 hr
Boil Off Rate	61.02 gpm	65 gpm

(1) For the pre-EPU cases, the equipment failure(s) were assumed to occur immediately after the last fuel assembly was placed in the SPF.

(2) For the EPU cases, the equipment failure(s) were assumed to occur coincident with the previously determined peak SFP temperature.

Those conditions specified above are worst case and are based upon design conditions. However, during actual refuelings, the time required for the SFP to boil is greater than those specified. The time required for the SFP to boil is dependent upon the temperature of the pool and the decay heat load in the pool at the time the loss of all SFP cooling capacity occurs. For each refueling outage, CP&L determines daily heat up rates, which are based upon the decay heat load in the reactor, in the SFP, and in reactor cavity and SFP when the SFP gates are removed.

The seismic makeup for the SFP is provided by the RHR system. Seismic backup to the RHR system is provided by a Service Water system cross-tie with the RHR system.

The makeup capacities of these systems far exceed the boil off rates specified above. During periods when the RHR system is removed from service, seismic makeup is provided that meets the requirements of Regulatory Guide 1.13, "Fuel Storage Facility Design Basis." This is accomplished by connecting temporary hoses to the Conventional or Nuclear Service Water systems via plant procedures. Testing has shown that a makeup rate of approximately 75 gpm is available using this temporary hose. This exceeds the pre-EPU boil off rate of 61.02 gpm and the EPU rate of 65 gpm.

The other non-seismic sources of makeup water include the Demineralized Water, Core Spray (i.e. if fuel pool gates are removed), or Fire Protection systems. The makeup capacity of these systems far exceed the boil off rates specified above.