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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Brunswick Steam Electric Plant, Unit No. 1
Docket No. 50-325
Response to Request for Additional information Regarding the Core Operating Limits Report for Unit 1 Cycle 19

References:

Letter from Annette H. Pope (CP&L) to the U.S. Nuclear Regulatory Commission, Unit 1 Cycle 19 Core Operating Limits Report, Thermal-Hydraulic Design Report, and Reload Safety Analysis Report, dated March 30, 2012, ADAMS Accession No. ML121000138.

By letter dated March 30, 2012, Carolina Power & Light Company (CP&L) submitted the Core Operating Limits Report (COLR) applicable to Cycle 19 operation for the Brunswick Steam Electric Plant (BSEP), Unit 1. The letter also provided a copy of the Thermal-Hydraulic Design Report and the Reload Safety Analysis Report. On August 9 and August 30, 2012, by electronic mail, the NRC provided a request for additional information regarding the March 30, 2012, submittal. CP&L's response to the request is enclosed.

This document contains no regulatory commitments.

Please refer any questions regarding this submittal to Mr. Lee Grzeck, Manager – Regulatory Affairs, at (910) 457-2487.

Sincerely,

for

Annette H. Pope
Manager – Organizational Effectiveness
Brunswick Steam Electric Plant

A001
NRR

WRM/wrm

Enclosure: Response to Request for Additional Information

cc (with enclosure):

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Response to Request for Additional Information

By letter dated March 30, 2012, Carolina Power & Light Company (CP&L) submitted the Core Operating Limits Report (COLR) applicable to Cycle 19 operation for the Brunswick Steam Electric Plant (BSEP), Unit 1. The letter also provided a copy of the Thermal-Hydraulic Design Report and the Reload Safety Analysis Report. On August 9 and August 30, 2012, by electronic mail, the NRC provided a request for additional information regarding the March 30, 2012, submittal. CP&L's response to the request is provided below.

<u>**NRC Question 1**</u>

With respect to the section number in accordance with the Generic Letter 88-16 guidance, please provide clarification and justification given as follows:

(1) there are no section numbers specified in the entire COLR report;

(2) there are no specific Technical Specification (TS) section numbers for all the cycle-specific parameter listed in the TS 5.6.5.a.

(3) References section should be listed corresponding to the approved methodologies listed in TS 5.6.5.b to support cycle-specific parameters listed in TS 5.6.5.a.

<u>Response to NRC Question 1</u>

NRC Generic Letter 88-16 provided guidance on the process for removing cycle-specific parameters from the Technical Specifications (TSs); however, the generic letter did not include any guidance regarding the format for Core Operating Limits Reports (COLRs).

The B1C19 COLR includes a matrix of applicable TS section numbers (i.e., refer to B1C19 COLR page 8) that are related to the core operating limits listed in TS 5.6.5.a. An enhanced version of this matrix is provided below which better cross-references the core operating limits listed in TS 5.6.5.a and the NRC-approved methodologies listed in TS 5.6.5.b that were used to determine these core operating limits. Please note that B1C19 COLR References 1 through 21 correspond one-for-one with the NRC approved methodologies 1 through 21 listed in TS 5.6.5.b.

Required Core Operating Limit (TS 5.6.5.a)	NRC Approved Methodology (TS 5.6.5.b)	Related TS Items
1. The Average Planar Linear Heat Generation Rate (APLHGR) for TS 3.2.1.	1, 2, 6, 7,16, 17	– TS 3.2.1 (APLHGR) – TS 3.4.1 Limiting Condition for Operation (LCO) (Recirculation loops operating) – TS 3.7.6 LCO (Main turbine bypass out of service)

Required Core Operating Limit (TS 5.6.5.a)	NRC Approved Methodology (TS 5.6.5.b)	Related TS Items
2. The Minimum Critical Power Ratio (MCPR) for TS 3.2.2.	1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 14, 21	– TS 3.2.2 (MCPR) – TS 3.4.1 LCO (Recirculation loops operating) – TS 3.7.6 LCO (Turbine bypass out of service)
3. The Linear Heat Generation Rate (LHGR) for TS 3.2.3.	2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 20	– TS 3.2.3 (LHGR) – TS 3.4.1 LCO (Recirculation loops operating) – TS 3.7.6 LCO (Turbine bypass out of service)
4. The Period based Detection Algorithm (PBDA) setpoint for Function 2.f, Oscillation Power Range Monitor (OPRM) Upscale, for TS 3.3.1.1.	8, 14, 18, 19, 21	– TS Table 3.3.1.1-1, Function 2.f (OPRM Upscale) – TS 3.3.1.1, Condition I (Alternate instability detection)
5. The Allowable Values and power range setpoints for Rod Block Monitor Upscale Functions for TS 3.3.2.1.	6, 8	– TS Table 3.3.2.1-1, Function 1 (RBM upscale and operability requirements)
The required core operating limits and setpoints listed in TS 5.6.5.a are presented in the COLR, have been determined using NRC approved methodologies (COLR References 1 through 21) in accordance with TS 5.6.5.b, and are established such that all applicable limits of the plant safety analysis are met in accordance with TS 5.6.5.c.		

NRC Question 2

With respect to the average planar linear heat generating rate (APLHGR) Limits, footnotes 17, 18, and 19 in Table 18 provide that: (1) the ATRIUM-10 and ATRIUM 10XM $MAPFAC_p$ and $MAPFAC_f$ multipliers have a constant value of 1.0 under all conditions; (2) ATRIUM-10 maximum APLHGR (MAPLHGR) limits must be adjusted by 0.85 multiplier when in single-loop operation (SLO). SLO not permitted for FHOOS, TBVOOS or MSIVOOS; and (3) ATRIUM 10X MAPLHGR limits must be adjusted by a 0.8 multiplier when in SLO. SLO not permitted for FHOOS, TBVOOS or MSIVOOS.

Please provide: (1) approved methodologies to support the statements in the footnotes 17, 18, and 19 in Table 18; and (2) explanation for how these analytical results are applied in daily plant operation to ensure the monitored reactor condition remains within, or conservative relative to, the analytical results (i.e., the limits).

Response to NRC Question 2-1

The table in CP&L Response 1 provides a list of NRC approved methodologies, listed in TS 5.6.5.b, used to determine Maximum Average Planar Linear Heat Generation (MAPLHGR) limits.

COLR Table 18, Footnote 17

In recent cycles, Brunswick has transitioned from General Electric (GE) fuel to AREVA fuel. GE's methodology required the use of power- and flow-dependent multipliers to adjust the MAPLHGR limits for off-rated conditions. AREVA's methodology does not require similar multipliers for MAPLHGR limits. Conversely, GE's methodology does not require the use of power- and flow-dependent multipliers to adjust LHGR limits for off-rated conditions, as do AREVA LHGR limits. The presentation of the MAPLHGR limits, as shown on Page 9 of the B1C19 COLR, standardizes the presentation of the Brunswick MAPLHGR limits by adopting pseudo power and flow dependencies for AREVA MAPLHGR limits. For AREVA MAPLHGR limits, the power- and flow-dependent multipliers are always 1.0. This provides COLR users with a systematic way of selecting the appropriate MAPLHGR limits from the various COLR tables. Although the last of the GE fuel was discharged at the end of the previous cycle (i.e., B1C18), this COLR formatting was retained in order for the B1C19 COLR to remain consistent in appearance and format with the current Unit 2 COLR, which does contain GE14 core operating limits.

COLR Table 18, Footnotes 18 and 19

During SLO, the pump in one recirculation loop is not operating. A break may occur in either loop, but results from a break in the inactive loop would be similar to those from a two loop operation (TLO) break. If a break occurs in the inactive loop during SLO, the intact active loop flow to the reactor vessel would continue during the recirculation pump coastdown period and would provide core cooling similar to that which would occur in breaks during TLO. The system response would be similar to that resulting from an equal-sized break during TLO. A break in the active loop during SLO results in a more rapid loss of core flow and earlier degraded core conditions relative to those from a break in the inactive loop. Therefore, only breaks in the active recirculation loop are analyzed. A break in the active recirculation loop during SLO will result in an earlier loss of core heat transfer relative to a similar break occurring during TLO. This occurs because there will be an immediate loss of jet pump drive flow. Therefore, fuel rod surface temperatures will increase faster in an SLO loss-of-coolant accident (LOCA) relative to a TLO LOCA. Also, the early loss of core heat transfer will result in higher stored energy in the fuel rods at the start of the heatup. The increased severity of a SLO LOCA can be accommodated by applying an SLO multiplier to the TLO MAPLHGR limits. The TLO MAPLHGR limits presented in the COLR, when adjusted by the multiplier, bound the MAPLGHR limits needed for SLO.

Response to NRC Question 2-2

The MAPLHGR limits presented in the COLR are used by the Plant Process Computer (PPC) and the POWERPLEX-III Core Monitoring System (PPX3) to calculate margin to thermal limits. By plant procedure, the Operators must periodically perform a check of various core parameters, including thermal limit compliance. Normally, a thermal limit compliance check is performed using edits from the PPC/PPX3. Should the Operators so desire, this plant procedure and the COLR can be used to determine if the PPC/PPX3 is applying the correct

MAPLHGR limit. Please note that this would be a manual check of only the applied operating limit since the PPC/PPX3 must be relied upon to provide the core power, core flow and exposure distributions from which the margin relative to the limit is calculated.

To apply the thermal limits in daily plant operation, the PPC/PPX3 is provided, through its basic input, the cycle and operating condition specific thermal limits in "sets" for the various allowed and anticipated operating states. The "set" selection is based on various defining parameters such as exposure, equipment out of service condition, TLO or SLO, and control rod scram speed (i.e., nominal scram speeds (NSS) and Technical Specification scram speeds (TSSS)). Each "set" includes thermal limit adjustments for normal power and flow ranges. Plant procedures dictate the proper selection of thermal limit sets. The PPC/PPX3 provides near-continuous thermal limit monitoring of the core's current operating state and likewise provides predictive tools to ensure planned changes to the operating state will preserve conditions that continue to retain margin to the thermal limits. Furthermore, plant procedures provide Operators with instructions on actions to take to restore thermal limit margin, should it ever be challenged.

NRC Question 3

With respect to minimum critical power ratio (MCPR) Limits, the MCPR limits presented in Tables 5 through 11 support any two-loop operation safety limit MCPR (SLMCPR) value ≤ 1.11 and any SLO SLMCPR value ≤ 1.12.

Please provide: (1) a list of approved methodologies used in this application; (2) justification that 0.01 adder is conservative; and (3) description of the real applications of the data listed in Tables 5 through 11 to the daily reactor operations such as NSS insertion times versus TSSS insertion times and the instrumentations operators rely for the safety operations corresponding to the emergency operating procedures (EOPs) requirements.

Response to NRC Question 3-1

The table in CP&L Response 1 provides a list of NRC approved methodologies, listed in TS 5.6.5.b, used to determine MCPR limits.

Response to NRC Question 3-2

The $MCPR_P$ response ($\Delta MCPR_P$) is determined for the limiting transient events for both TLO and SLO. The limiting $\Delta MCPR_P$ from these analyses is used to set the operating limit minimum critical power ratio (OLMCPR). This limiting $\Delta MCPR_P$ bounds the $MCPR_P$ response irrespective of whether TLO or SLO is assumed at event initiation. The limiting $\Delta MCPR_P$ is combined with the SLMCPR to give the $OLMCPR_P$. When using the TLO OLMCPR (i.e., COLR Tables 5 through 10) to determine the SLO $OLMCPR_P$, the +0.01 adder arises because the SLO SLMCPR is 0.01 greater than the TLO SLMCPR.

The intent of the $MCPR_f$ limit is to protect the SLMCPR during a Slow Flow Runup event starting from off-nominal conditions. The $MCPR_f$ limits shown in COLR Table 11 do not have a 0.01 adder for determining SLO limits, as do the $MCPR_p$ limits in COLR Tables 5 through 10. The TLO slow runup event is always more limiting than the same event in SLO because, in TLO, a greater increase in recirculation flow is possible. The $MCPR_f$ limits are based on TLO and will always bound SLO. Therefore, applying the TLO based $MCPR_f$ limits to SLO is conservative.

Response to NRC Question 3-3

The MCPR limits presented in the COLR are used by the PPC/PPX3 to calculate margin to thermal limits. By plant procedure, the Operators must periodically perform a check of various core parameters including thermal limit compliance. Normally, a thermal limit compliance check is performed using the PPC/PPX3. Should the Operators so desire, this plant procedure and the COLR can be used to confirm the PPC/PPX3 is applying the correct MCPR limit. Please note that this would be a manual check of only the applied operating limit, since the PPC/PPX3 must be relied upon to provide the core power, core flow and exposure distributions from which the margin relative to the limit is calculated.

To apply the thermal limits in daily plant operation, the PPC/PPX3 is provided, through its basic input, the cycle and operating condition specific thermal limits in "sets" for the various allowed and anticipated operating states. The "set" selection is based on various defining parameters such as exposure, equipment out of service condition, TLO or SLO, and control rod scram speed (i.e., NSS and TSSS). Each "set" includes thermal limit adjustments for normal power and flow ranges. Plant procedures dictate the proper selection of thermal limit sets. The PPC/PPX3 provides near-continuous thermal limit monitoring of the core's current operating state and likewise provides predictive tools to ensure planned changes to the operating state will preserve conditions that continue to retain margin to the thermal limits. Furthermore, plant procedures provide Operators with instructions on actions to take to restore thermal limit margin, should it ever be challenged.

Power dependent MCPR limits are determined for NSS and TSSS. Based on the results from periodic scram time testing, the Operators must assess whether or not to use the NSS MCPR limits or the more restrictive TSSS MCPR limits provided in distinct "sets" to the PPC/PPX3. As required, the PPC/PPX3 is ordered to switch to the appropriate set of MCPR limits.

EOPs assume the plant is operating within thermal limits prior to the start of any postulated accident. Thermal limit compliance is provided for by the functions of the PPC/PPX3. Beyond this assumption, there is no interface between MCPR limits and any EOP during accident conditions.

NRC Question 4

With respect to LHGR Limits, steady-state $LHGR_{ss}$ limits are provided for AREVA fuel (Table 12). These steady-state $LHGR_{ss}$ limits must be modified with a core power (Tables 13-16) and core flow (Table 17) dependency.

Provide a detailed description of how the numbers in the Tables applied to the daily plant operations based on the applied LHGR limit determined by the equation of the applied LHGR limit = $LHGR_{ss}$ x $(LHGRFAC_p, LHGRFAC_f)_{min.}$

Response to NRC Question 4

The LHGR limits presented in the COLR are used by the PPC/PPX3 to calculate margin to thermal limits. By plant procedure, the Operators must periodically perform a check of various core parameters, including thermal limit compliance. Normally, a thermal limit compliance check is performed using the PPC/PPX3. Should the Operators so desire, this plant procedure, and the COLR, can be used to determine if the PPC/PPX3 is applying the correct LHGR limit.

Please note that this would be a manual check of only the applied operating limit, since the PPC/PPX3 must be relied upon to provide the core power, core flow, and exposure distributions from which the margin relative to the limit is calculated.

To apply the thermal limits in daily plant operation, the PPC/PPX3 is provided, through its basic input, the cycle and operating condition specific thermal limits in "sets" for the various allowed and anticipated operating states. The "set" selection is based on various defining parameters such as exposure, equipment out of service condition, TLO or SLO, and control rod scram speed (i.e., NSS and TSSS). Each "set" includes thermal limit adjustments for normal power and flow ranges. Plant procedures dictate the proper selection of thermal limit sets. The PPC/PPX3 provides near-continuous thermal limit monitoring of the core's current operating state and likewise provides predictive tools to ensure planned changes to the operating state will preserve conditions that continue to retain margin to the thermal limits. Furthermore, plant procedures provide Operators with instructions on actions to take to restore thermal limit margin, should it ever be challenged.

NRC Question 5

With respect to PBDA Setpoints, BSEP Unit 1 has implemented Boiling Water Reactor Owners Group Long Term Stability Solution Option III (OPRM) with the methodology described in Reference 23. To address the generic DIVOM curve issue, the relative change in CPR as a function of the calculated HCOM were performed with the RAMONA5-FA code in accordance with Reference 26.

Please provide: (1) clarification that the least limiting $MCPR_f$ limit will provide adequate protection against violation of the SLMCPR during a postulated reactor instability; (2) verification of the application of Reference 26 to DIVOM slope calculation with a 10% penalty; and (3) justification that the proposed PBDA Setpoints are conservative.

Response to NRC Question 5-1

Stability analyses were performed at 100% power and 99% flow assuming a two pump trip (2PT), and on the highest rod line power (i.e., 60.5% power at 45% flow) assuming steady-state (SS) conditions. The PBDA setpoints are selected so that the OLMCPR at 100% power, 99% flow and the OLMCPR at 60.5% power, 45% flow will both provide adequate protection against violation of the SLMCPR during a postulated reactor instability.

The OLMCPR used in the selection of the PBDA setpoints is based on either the $MCPR_P$ limit or the $MCPR_f$ limit, depending on which is the most limiting. See the CP&L Response 5-3 for an example of OLMCPR selection involving the $MCPR_f$ limit.

Response to NRC Question 5-2

The interim 10% penalty imposed by the Safety Evaluation Limitation and Condition #3 for BAW-10255PA, Revision 2, is only applicable to Extended Flow Window (EFW) conditions. This penalty is not applicable to B1C19 since Brunswick Unit 1 is not approved for EFW operation.

Response to NRC Question 5-3

In terms of PBDA setpoint conservatisms, CP&L's response considers the following: (1) PBDA analysis conservatism and (2) setpoint selection conservatism.

PBDA Setpoint Analysis

The PBDA setpoint analysis included the conservatisms listed in Section 4.5.2 of the NRC approved methodology (i.e., COLR Reference 19). However, as stated in the NRC approved LTR:

> *The Option III licensing methodology described in Sections 4.1 to 4.4* [of NEDO-32465-A], *taken as a whole, is a conservative means of demonstrating with a high probability and confidence that the MCPR SL will not be violated for anticipated oscillations.*

Aside from conservative rounding of numerical results, no additional conservatisms were applied.

PBDA Setpoint Selection

The PBDA setpoints used must bound the expected analysis MCPR responses in order to protect the SLMCPR. For B1C19, the PBDA setpoints were selected as follows:

1. Determine the OLMCPR at 100% power, 99% flow, consistent with the assumed analysis conditions just prior to a two pump trip.
   - 1a. From COLR Tables 5 through 10, it can be determined the least limiting $MCPR_P$ is 1.39 at 100% power during the entire cycle, considering all equipment out-of-service (EOOS) conditions and scram speeds.
   - 1b. From COLR Table 11, it can be determined that $MCPR_f$ is 1.20 at 99% flow.
   - 1c. The OLMCPR at 100% power, 99% flow is 1.39, which is set by $MCPR_P$ determined in Step 1a.
2. Determine the OLMCPR on the highest possible rod line at 45% flow, consistent with the assumed steady-state conditions.
   - 2a. Using any of the Power/Flow Maps (i..e., COLR Figures 1 through 6), the power on the highest rod line at 45% flow is determined to be 60.5% power.
   - 2.b From COLR Tables 5 through 10, it can be determined the least limiting $MCPR_P$ is 1.65 at 60.5% power during the entire cycle, considering all EOOS conditions and scram speeds.
   - 2c. From COLR Table 11, it can be determined that $MCPR_f$ is 1.66 at 45% flow.
   - 2d. The OLMCPR at 60.5% power, 45% flow is 1.66, which is set by $MCPR_f$ determined in Step 2c.
3. Determine the maximum supported OPRM setpoints.
   - 3a. Determine the maximum supported PBDA Amplitude Trip setpoint for which the actual OLMCPR bounds the expected MCPR responses associated with each PBDA Amplitude Trip setpoint shown in COLR Table 3.

3b. It can be seen that a PBDA Amplitude Trip setpoint of 1.11, associated with an OLMCPR(SS) of 1.35 and an OLMCPR(2PT) of 1.38 is the highest PBDA Amplitude Trip setpoint for which OLMCPR determined in Steps 1c and 2d are bounding.

3c. From COLR Table 3, it can be determined that Confirmation Count Trip setpoint associated with a PBDA Amplitude Trip setpoint of 1.11 is 14 counts.

3.d The maximum supported OPRM setpoint pair is a PBDA Amplitude Trip of 1.11 and a Confirmation Count Trip of 14 counts.

The Confirmation Count Trip setpoints associated with Amplitude Trip Setpoints shown in COLR Table 3 are calculated based on the methodology presented in Appendix E of NEDO-32465-A (i.e., COLR Reference 19). For an Amplitude Trip Setpoint of 1.11, a Confirmation Count Trip Setpoint of 14.2 counts is calculated, which is then rounded down to 14 counts, as shown in COLR Table 3, to add further conservatism to the selected PBDA setpoint.