ATTACHMENT 2

GEH-PGN-MPLUS-143

Response to Request for Supplemental Information in Support of Brunswick Steam Electric Plant MELLLA+ LAR

Non-Proprietary Information - Class I (Public)

NON-PROPRIETARY NOTICE

This is a non-proprietary version of Attachment 1 of GEH-PGN-MPLUS-143 which has the proprietary information removed. Portions of the document that have been removed are indicated by an open and closed bracket as shown here [[ ]].

In order for the U.S. Nuclear Regulatory Commission (NRC) staff to ensure that with the implementation of Maximum Extended Load Line Limit Analysis Plus (MELLLA+), the operations of the Brunswick Steam Electric Plant, Unit Nos. 1 and 2, will continue to be consistent with General Design Criteria 10 and 12, the applicable acceptance criteria discussed in Chapter 15 of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (NUREG-0800), and the anticipated transient without scram (ATWS) criteria discussed in the approved MELLLA+ Licensing Topical Report, please provide the following information:

1. Appropriate disposition for Limitation and Condition (L&C) 9.5 - Safety Limit Minimum Critical Power Ratio 2, Duke Energy should address experience with AREVA methods in MELLLA+ at high power to flow conditions.
2. Appropriate disposition for L&C 9.23 - MELLLA+ Eigenvalue Tracking. This explanation should address how the use of AREVA methods that are not covered by the General Electric-Hitachi letter will clarify L&C 9.23.
3. Differences between Unit Nos. 1 and 2 that can affect the analysis assumptions needed to be discussed for dual-unit review and approval.
4. ATWS instability (ATWS-I) analysis with Unit No. 2 specific assumptions. (Because of the significant differences in turbine bypass capacities between Unit Nos. 1 and 2 and the potential impact it can have on the competing effects that can lead to the results being more limiting at higher or lower turbine bypass capacities, the NRC staff needs the ATWS-I analysis with Unit No. 2 specific assumptions to conduct its review.)

<u>GEH Response</u>

1. Duke Energy scope.
2. Duke Energy scope.
3. Duke Energy scope.
4. GE Hitachi Nuclear Energy (GEH) performed unit specific analyses as part of the Brunswick Steam Electric Plant (BSEP) MELLLA+ project to compare the response of BSEP Unit 1 and Unit 2, which have different turbine bypass capacities and different fuel support casting orifice diameters, during the bounding ATWS-I event.

   The following bypass capacity data was used as input. BSEP Unit 1 and Unit 2 values are listed for comparison in Table 1:

Table 1 – BSEP Bypass Capacities

Description	Value for BSEP Unit 1	Value for BSEP Unit 2
Turbine Bypass Capacity	15.48% Rated	55.53% Rated

The BSEP core inlet orifices differ from Unit 1 to Unit 2. The Unit 1 orifices are less restrictive to flow than are Unit 2. This orificing difference can also affect the ATWS-I stability characteristics of the units. Typically larger orificed units are less stable than smaller, more restrictive orificed cores.

Table 2 – BSEP Orifice Size

Description	Value for BSEP Unit 1	Value for BSEP Unit 2
Central Orifice Diameter (Inch)	2.43	2.09
Peripheral Orifice Diameter (Inch)	1.488	1.433

The bounding ATWS-I condition is at Beginning of Cycle (BOC) exposure and Regional Mode (RG) channel grouping. The Turbine Trip with Bypass (TTWBP) event is analyzed at both the nominal and the bounding conditions. The resulting Peak Cladding Temperatures (PCTs) are listed in Table 3:

Table 3 – PCT Results for Unit 1 and Unit 2

Event	Case	BSEP Unit 1 PCT (K) / (°F)	BSEP Unit 2 PCT (K) / (°F)
TTWBP	BOC-RG Nominal	[[	
TTWBP	BOC-RG Bounding		]]

The relatively smaller turbine bypass capacity for Unit 1 requires the cycling of the Safety/Relief Valves (SRVs). The cycling of the SRVs repeatedly collapses the voids in the core, which creates a condition of pulses of void reactivity (less negative values). Coupled with the reduction of the feedwater temperature, the total reactivity becomes increasingly positive around 90 seconds. The resulting perturbation of the total reactivity yields the large amplitude power oscillation. The cladding temperature rises with the power oscillation, and the PCT is achieved during this time period. The power oscillation is finally suppressed by the initiation of the feedwater reduction at 120 seconds.

For Unit 2, during the ATWS condition, the turbine bypass valves can discharge all the steam generated in the vessel into the main condenser. Without the cycling of SRVs, the void reactivity remains negative and increases slowly with the reduction of the feedwater temperature. The total reactivity remains close to the critical state, and there is no significant pulsation. The power stays relatively stable and the cladding temperature during this stage remains below the initial PCT achieved in the beginning of the event.

In summary, unit explicit ATWS-I analyses were performed for BSEP. The results indicate that Unit 1 generates the bounding PCT response during the bounding ATWS-I conditions.