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Enclosures 1 and 3 Contain Proprietary Information
Withhold in Accordance with 10 CFR 2.390

May 29, 2019

Serial: RA-19-0240 10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
Docket Nos. 50-325 and 50-324
Response to Request for Additional Information Regarding Advanced Framatome Methodologies License Amendment Request

Reference:

1. Letter from William R. Gideon (Duke Energy) to the U.S. Nuclear Regulatory Commission Document Control Desk*, Request for License Amendment Regarding Application of Advanced Framatome Methodologies*, dated October 11, 2018, ADAMS Accession Number ML18284A395.

2. NRC E-mail Capture*, Brunswick Unit 1 and Unit 2 Request for Additional Information Related to Transition to Framatome ATRIUM-11 Fuel (EPID: L-2018-LLA-0273)*, dated May 9, 2019, ADAMS Accession Number ML19135A307.

Ladies and Gentlemen:

By letter dated October 11, 2018 (i.e., Reference 1), Duke Energy Progress, LLC (Duke Energy), submitted a license amendment request (LAR) for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2. The proposed license amendment revises Technical Specification 5.6.5.b to allow application of Advanced Framatome Methodologies for determining core operating limits in support of loading Framatome fuel type ATRIUM 11.

On May 9, 2019, by electronic mail (i.e., Reference 2), the NRC provided a request for additional information (RAI) regarding the LAR. Duke Energy will provide two sets of RAI responses; this letter provides the first set which includes responses to NRC RAIs 1-10, 23, 24, 28, and 30-32. The second set will provide responses to the remainder of the NRC RAIs and will be submitted by June 18, 2019.

Enclosures 1 and 3, and files “100P85F_BOC_ATWS.xlsx” and “100P104F_EOC_LRNB.xlsx” contain information considered proprietary to Framatome. Proprietary information in Enclosures 1 and 3 has been denoted by brackets. Files “100P85F_BOC_ATWS.xlsx” and “100P104F_EOC_LRNB.xlsx” are proprietary in their entirety. As owner of the proprietary information, Framatome has executed the affidavit contained in Enclosure 5 which identifies the information as proprietary, is customarily held in confidence, and should be withheld from public disclosure in accordance with 10 CFR 2.390. Enclosures 2 and 4 provide non-proprietary versions of the reports contained in Enclosures 1 and 3.

No new regulatory commitments are contained in this letter.

Please refer any questions regarding this submittal to Mr. Jerry Pierce, Manager – Nuclear Support Services, at (910) 832-7931.

I declare, under penalty of perjury, that the foregoing is true and correct. Executed on May 29, 2019.

Sincerely,

William R. Gideon

SBY/sby

Enclosures:

1: ANP-3782P, *Brunswick ATRIUM 11 Advanced Methods Response to Request for Additional Information,* Revision 1 **[Proprietary Information – Withhold from Public Disclosure in Accordance with 10 CFR 2.390]**
2: ANP-3782NP, *Brunswick ATRIUM 11 Advanced Methods Response to Request for Additional Information,* Revision 1
3: DPC-NE-1009Q1-P, *Duke Energy Responses to RAIs on the Advanced Framatome Methods LAR,* Revision 0 **[Proprietary Information – Withhold from Public Disclosure in Accordance with 10 CFR 2.390]**
4: DPC-NE-1009Q1, *Duke Energy Responses to RAIs on the Advanced Framatome Methods LAR,* Revision 0
5. Affidavit for Report DPC-NE-1009Q1-P, Report ANP-3782P, File "100P104F_EOC_LRNB.xlsx", and File "100P85F_BOC_ATWS.xlsx"

Data Files Supporting RAI Response 10:

Filename	File Size	Sensitivity Level	Submittal Method
100P85F_BOC_ATWS.xlsx	46 KB	**Proprietary Information – Withhold from Public Disclosure in Accordance with 10 CFR 2.390**	NRC Electronic Information Exchange System
100P104F_EOC_LRNB.xlsx	46 KB	**Proprietary Information – Withhold from Public Disclosure in Accordance with 10 CFR 2.390**	NRC Electronic Information Exchange System

cc (with all Enclosures):

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ANP-3782NP, *Brunswick ATRIUM 11 Advanced Methods Response to Request for Additional Information,* Revision 1

Brunswick ATRIUM 11 Advanced Methods Response to Request for Additional Information

ANP-3782NP
Revision 1

May 2019

Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	3-7	Provided updated files for RAI response 10 (change highlighted)

Contents

List of Tables

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1.0 INTRODUCTION

By letter dated October 11, 2018, Duke Energy submitted a license amendment request for Brunswick Steam Electric Plant, Units 1 and 2 (Brunswick) to allow application of the Framatome analysis methodologies necessary to support a planned transition to ATRIUM 11 fuel under the currently licensed Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating domain, Reference 1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18284A395). Upon review of the submittal, the NRC staff provided requests for additional information (RAIs) in an email dated 5/9/19 (ML19135A307, Reference 2). This report provides responses to a subset of these RAIs.

The proprietary information in this document is marked with double brackets such as **[[ ]]**.

2.0 ANTICIPATED TRANSIENT WITHOUT SCRAM WITH INSTABILITY (ATWS-I)

NRC RAI 2. Discuss how the gap conductance sensitivity will be addressed when fuel design changes occur and provide results for ATRIUM-11 fuel.

Response 2:

An ATRIUM 11 gap sensitivity study has been performed. For this study, **[[**

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In the future, if a fuel design beyond ATRIUM 11 is introduced, the gap conductance for the new fuel design will either be justified to be sufficiently similar to the ATRIUM 11 (i.e. minimal rod changes) or a new gap conductance sensitivity will be performed.

Table 2-1 ATRIUM 11 Gap Conductance Sensitivity Study

Figure 2-1 ATRIUM 11 PCT versus Gap Conductance Sensitivity

NRC RAI 3. Confirm that the steam line and valve modeling options accurately capture the expected plant-specific system performance during ATWS-I events.

Response 3:

The steam line and SRVs were modeled consistent with expected performance.
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It is also noted that the modeling of these valve characteristics can have a noticeable effect on the onset of instability which can impact the timing of the event. For Brunswick, **[[**

]] The overall impact on the PCT for Brunswick due to the cycling of the valves is minimal **[[**
]].

NRC RAI 4. Provide a justification that the ATWS-I analyses based on the reference core will bound all expected future core designs. As part of this discussion, address transition cores and core design specific considerations that may affect local stability characteristics, such as nodal variations, control rod patterns, and operating strategies.

Response 4:

For ATWS-I analyses the most conservative result will occur when **[[**

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Therefore, the ATRIUM 11 ATWS-I analysis for Brunswick contains sufficient conservatism to bound follow-on cycles.

NRC RAI 5. Two events are considered potentially limiting in the ATWS-I transient scenario: two reactor pump trip (2RPT) and turbine trip with bypass (TTWB). Brunswick analyzed the TTWB event and, since instability and dryout/rewet occurred, the 2RPT event was unanalyzed per the Calculational Procedure in Section 8.0 of the submittal. In order to assure the limiting event was analyzed, provide results for the 2RPT ATWS-I event, with justification given for the operator action time assumptions used. Certain changes in plant design or operation may affect stability behavior for these events. Discuss how the TTWB event will be confirmed to remain limiting relative to the 2RPT event if changes are made to the plant design or operation that may affect stability behavior during anticipated transient without scram (ATWS), such as: turbine bypass capability, fraction of steam-driven feedwater pumps, and changes expected to increase core inlet subcooling during ATWS events.

Response 5:

Section 7 of ANP-3694P (Attachment 14a of the subject LAR) provides Brunswick TTWB and 2RPT results for ATRIUM 10XM. A review of the results shows **[[**

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NRC RAI 6. Justify that the selected settings and modeling options are appropriate, including core and vessel nodalization, time step control parameters, and noise parameters. Discuss how the modeling is consistent with the characteristics of Brunswick and the validation basis for the proposed RAMONA5-FA ATWS-I methodology.

Response 6:

All benchmarks and analyses provided in ANP-3694P utilized consistent vessel nodalization and time step control parameters. Since these values were used in the benchmarking of the code, and the benchmarks showed good agreement with the data, then these values are appropriate.

The noise parameters were **[[**

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NRC RAI 7. Understanding that both **[[**

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Response 7:

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Figure 7-1 [[ ]]

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NRC RAI 8. Tables 7-1 and F-1 of ANP-3694P indicate a trend of **[[**

]]. *Provide an explanation for this observed trend.*

Response 8:

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3.0 ANTICIPATED OPERATING EVENT (AOO) AND ATWS

NRC RAI 9. *ANP-3702P provides a subset of the events analyzed in the Brunswick Chapter 15 Updated Final Safety Analysis Report (UFSAR) and covered by the AURORA-B AOO/ATWS methodology. To ensure the methodology is implemented appropriately for the events not covered in ANP-3702P and to ensure that the analysis of these events is sufficient to meet GDCs 10, 13, 15, 20, 25, and 26 and ATWS acceptance criteria, provide the following:*

a. Describe how each Chapter 15 UFSAR event (that is covered by the AUORAB-AOO/ATWS methodology) will be analyzed in the AURORA B AOO methodology framework (e.g., a table identifying FSAR Section/Event Name/Disposition)

b. Describe how the methodology is implemented (including steps prior to the execution of the uncertainty analysis) to ensure there is appropriate coverage of operational power/flow statepoints, equipment-out-of-service conditions, time-in-cycle, etc.

Response 9 a.:

A disposition of events is created for a reactor to establish or re-establish the licensing basis in situations like vendor transitions, fuel transitions, and significant plant configuration modifications (i.e., extended power uprate (EPU) or MELLLA+). For each transient event in the final safety analysis report (FSAR) this disposition identifies which events 1) require cycle-specific analyses, 2) are analyzed for the initial reload, and 3) are non-limiting based on first principles. The Chapter 15 disposition of events for the transition to ATRIUM 11 is given in Table 9-1.

Table 9-1 Brunswick ATRIUM 11 Disposition of Events

FSAR Section	Event Name	Disposition Status	Comments
15.1.1	Loss of Feedwater Heater (LFWH)	Address each reload	Potentially limiting AOO.
15.1.2	Feedwater Controller Failure (FWCF) - Maximum Demand	Address each reload	Potentially limiting AOO.
15.1.3	Inadvertent HPCI or RCIC Pump Start	No further analysis required	Consequences bound by the FWCF.
15.1.4	Pressure Regulator Failure Open (PRFO)	No further analysis required	The PRFO event causes no significant threat to the fuel thermal margins. The peak heat flux and fuel surface heat flux do not exceed the initial power and no fuel damage occurs. This event can result in a turbine trip and the resulting core pressurization and reactor scram. While the steam flow at the time of the TSV closure may be higher than the initial steam flow, the turbine bypass valves are open prior to the turbine trip and will therefore remain open to provide some pressure relief during the turbine trip. The consequences of this event are bound by the TTNB.
15.1.5	Inadvertent Opening of a Relief Valve or Safety Valve	No further analysis required	The event causes a mild depressurization. The peak heat flux and fuel surface heat flux do not exceed the initial power and no fuel damage occurs. This event is benign.
15.1.6	Inadvertent RHR Shutdown Cooling Operation	No further analysis required	This is a benign event without fuel damage and without any measurable nuclear system pressure increase.
15.2.1	Generator Load Rejection with and without bypass (LRNB)	Address each reload	Potentially limiting AOO with bypass inoperable. Below 50% power, the effects of the PLU device need to be addressed.
15.2.2	Turbine Trip with and without bypass (TTNB)	Address for initial reload	Potentially bound by LRNB.

Table 9-1 Brunswick ATRIUM 11 Disposition of Events (continued)

FSAR Section	Event Name	Disposition Status	Comments
15.2.3	Main Steam Isolation Valve (MSIV) Closure	No further analyses required	The fuel thermal transient resulting from this event is bounded by other more limiting pressurization events, such as the LRNB or TTNB event which have a much faster valve closure time.
15.2.4	Loss of Condenser Vacuum	No further analyses required	In the most extreme case of an "instantaneous" loss of vacuum, this transient is equivalent to a TTNB. Therefore, this transient is bounded by the TTNB and LRNB and no further analysis is required.
15.2.5	Loss of Auxiliary Power	No further analyses required	The loss of auxiliary power long-term water level response is bound by the loss of feedwater flow event. If complete connection with the external grid is lost, the reactor will experience a generator load rejection. The coastdown of the recirculation and feedwater pumps will reduce the severity of the event compared to the generator load rejection event, by reducing core power. Therefore consequences are bound by the LRNB event.
15.2.6	Loss of Feedwater Flow	No further analysis required	This event does not pose any direct threat to the fuel in terms of a thermal power increase from the initial conditions. The fuel will be protected provided the water level inside the shroud does not drop below the TAF. Previous evaluations for a different fuel design showed that the lowest level following a loss of feedwater event remained above Low Level 3. Based on this, MSIV closure, ADS timer start and Low Pressure ECCS initiation are not expected. The long term water level transient is dependent upon the decay heat which is **[[** **]]**. This is a benign event.

Table 9-1 Brunswick ATRIUM 11 Disposition of Events (continued)

FSAR Section	Event Name	Disposition Status	Comments
15.2.7	Loss of RHR Shutdown Cooling	No further analyses required	Benign event.
15.2.8	Pressure Regulator Failure-Closed	No further analyses required	If the controlling regulator fails in a closed direction, the backup regulator takes over control of the turbine control valves preventing a serious transient. The disturbance is mild, similar to a pressure setpoint change and no significant thermal margin reductions occur. This is a benign event.
15.3.1	Recirculation Pump Trip	No further analyses required	The reduction in core flow is accompanied by an increase in core voiding and a decrease in core power. While the decrease in core flow can result in a degradation of the thermal margins, the decrease in core power helps to mitigate that effect. This is a benign event.
15.3.2	Recirculation Flow Control Failure - Decreasing Flow	No further analyses required	Benign event and bound by single pump trip.
15.3.3	Recirculation Pump Seizure	No further analyses required	Consequences of the pump seizure event are bound by other limiting rated power AOO events.
15.4.1	Rod Withdrawal Error during Low Power Operation	No further analyses required	Benign event.
15.4.2	Rod Withdrawal Error at Power	Address each reload	Potentially limiting AOO.
15.4.3	Startup of Idle Recirculation Loop	No further analyses required	The consequences of the idle loop startup event are benign and non-limiting compared to other AOO events.
15.4.4	Recirculation Flow Control Failure - Increasing Flow	No further analyses required	The event is non-limiting relative to the slow flow runup.
15.4.5	Fuel Assembly Error during Refueling	No further analyses required	Non-limiting or benign event.

Table 9-1 Brunswick ATRIUM 11 Disposition of Events (continued)

FSAR Section	Event Name	Disposition Status	Comments
15.4.6	Control Rod Drop Accident	Address each reload	Potentially limiting event. Verification that deposited enthalpy is less than 230 calories per gram and to determine the number of rods exceeding the PCMI and high temperature failure thresholds for the given fuel cladding. (It is assumed that criteria similar to that in DG-1327 will be applied for the ATRIUM 11 fuel.) Evaluation of ATRIUM 11 with AST is required.
15.6.3	Main steam line break accident	No additional analysis required	The consequences of a large main steam line break are non-limiting with respect to 10 CFR 50.46 acceptance criteria. Although a main steam line break may be limiting with respect to reactor vessel, containment, or radiological limits, current evaluations are not significantly impacted by fuel or core design characteristics. The consequences of a main steam line break on the core and fuel are bound by the recirculation line break analyses.
15.6.4	Loss of Coolant Accident (LOCA)	Address for initial reload	Potentially limiting accident. The break spectrum analysis needs to be addressed for the initial reload of ATRIUM 11 with the AURORA-B LOCA method. Evaluation of ATRIUM 11 with AST is required.
15.7.1	Refueling Accident	Address for initial reload	Potentially limiting accident. Evaluation of ATRIUM 11 with AST is required.

Table 9-1 Brunswick ATRIUM 11 Disposition of Events (continued)

FSAR Section	Event Name	Disposition Status	Comments
15.8	Anticipated Transient Without Scram	Address each reload	Peak pressure evaluation needs to be addressed each reload. Long term ATWS evaluations for suppression pool temperature and containment pressure requires **[[** **]]**. PCT and MWR are bound by other analyses. For MELLLA+, ATWS with core instability evaluations will be needed at least for the initial reload.
15.9	Analytical Methods for Evaluating Radiological Effects with Alternative Source Term	Address for initial reload	Evaluation of ATRIUM 11 with AST is required.

Response 9 b.:

Once the disposition of events has been completed, a calculation plan is constructed. The calculation plan defines the minimum analysis set required to license a given cycle. The events to be analyzed are defined by the disposition of events. The calculation plan will also define all operational flexibility options that are to be supported. These include items such as equipment out-of-service options (EOOS) and exposure windows. The calculation plan is generated on a cycle specific basis and is reviewed and approved by Duke. Note that the calculation plan defines the minimum set of analyses required to license a cycle. Additional analyses may be added during the evaluation process if unexpected trends arise. These are added on an as-needed basis to ensure that the limits are appropriately conservative.

The statepoints to be analyzed are also defined in the calculation plan. The initial transition to AURORA-B methods will include **[[**

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NRC RAI 10. To ensure there is appropriate coverage of the parameters used in the uncertainty analysis and to ensure there is no significant trends with respect to the uncertainty parameters in the results such that the Brunswick implementation of the AURORA-B methodology is sufficient to meet GDCs 10, 13, 15, 20, 25, and 26 and ATWS acceptance criteria, provide the following for the load rejection no bypass (LRNB) event at 100% power / 104.5% flow and main steam isolation valve (MSIV) closure ATWS event at 100% power and 85% flow:

a. The sampled values of the uncertainty parameters for all cases executed in the set

b. The figure of merit (FoM) results for all cases executed in the set

Response 10:

Files containing the requested data have been provided. CKSUM identification is provided below.

```
2647460735 46730 100P104F_EOC_LRNB.xlsx

4082081760 46164 100P85F_BOC_ATWS.xlsx
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4.0 BEST ESTIMATE ENHANCED OPTION-III (BEO-III) WITH CONFIRMATION DENSITY ALGORITHM (CDA)

NRC RAI 23. For cycle operation that differs significantly from the original cycle design, describe and justify the process for evaluating whether the analysis continues to bound actual plant operation or whether additional analysis is necessary.

Response 23:

Cycle operation can differ from the final core design for a variety of reasons. The primary concern of these variations is that the actual cycle operations drifts to the point that the computed operating limits are no longer supported. A process exists between Duke and Framatome in the event there are major modifications such as changes to the licensed core loading pattern or implementation of suppression rods where comparison results are provided to Framatome to evaluate the impact on the reload licensing. With this information, Framatome will either determine the change is minor and has negligible impact or decide to rerun **[[ ]]**. For smaller changes, the RSAR identifies a target end-of-cycle axial power distribution that supports the plant operating limits, such that the integrated impact of minor modifications to rod patterns or operating conditions throughout the cycle can be assessed to determine if the changes invalidate the cycle licensing limits.

To support the evaluation of cycle design deviations, Duke regularly performs projections of plant operation to the end-of-full power cycle exposure to ensure that the RSAR axial power distribution remains bounding. In addition, Duke procedures require this check to be performed in the event that there is a substantial change in the rod pattern from a previously analyzed depletion before the control rod pattern can be implemented at the plant. In the event that a disposition becomes necessary (i.e. RSAR axial power shape no longer bounding), Duke provides Framatome with an up-to-date core follow and depletion to end of full power exposure using appropriate rod patterns. This new target step-through is used to determine **[[**

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In the event that either the major changes or accumulated minor deviations no longer support the established operating limits, Framatome uses the historic operating data and projected depletion steps to end-of-cycle and establishes new operating limits as appropriate.

NRC RAI 24. Provide sensitivity studies on timestep size and vessel nodalization to demonstrate that potential perturbations to discretization would not have an undue impact on calculated figures of merit or change the sensitivities to statistical parameters.

Response 24:

Sensitivity studies were performed on both the time step size and vessel nodalization consistent with the studies performed for the ATWS-I methodology (Reference 5). Both sensitivity studies examined the impact on the linear reactor benchmarks and the 95/95 core MCPR and **[[** **]]** for the MELLLA+ BEO-III analyses reported in ANP-3703P.

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]] The combinations of **[[** **]]** used for the sensitivity are provided in Table 24-2. The reactor benchmarking sensitivities to variations in the time step control parameters are provided in Table 24-3. The variations of key parameters for the Brunswick MELLLA+ BEO-III analyses are presented in Table 24-4. In both the reactor benchmarks and BEO-III analyses there is **[[**

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The sensitivities to variations in the vessel nodalization are **[[ ]]** than the time step sensitivities. The base nodalization for the reactor benchmarks and BEO-III analyses was increased by **[[**

]] The sensitivities to the finer vessel nodalization are presented in Table 24-5 and Table 24-6 for the benchmarks and MELLLA+ BEO-III analyses, respectively.

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]] and therefore the discretization is considered acceptable

Table 24-1 BEO-III Time Step Criteria

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Table 24-2 Time Step Control Parameters for Sensitivity Studies

[[ ]]

Table 24-3 Reactor Benchmark Sensitivity to Time Steps

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Table 24-4 BEO-III MELLLA+ FoM Sensitivity to Time Steps

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Table 24-5 Reactor Benchmark Sensitivity to Vessel Nodalization

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Table 24-6 BEO-III MELLLA+ FoM Sensitivity to Vessel Nodalization

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NRC RAI 30. In Stage 3 of the multistage analysis, **[[**

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Response 30:

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5.0 CONTAINMENT

NRC RAI 31. In section 7.3 of ANP-3705P, the licensee states that fuel design differences may impact the power and pressure excursion experienced during an ATWS event. The licensee further states that ATRIUM-10XM analysis bounds the ATRIUM-11 fuel because **[[**

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a. *Describe the analysis done to justify that* **[[** **]]***?*

b. *Provide quantitative results for the containment pressure and suppression pool temperature response changes due to the change in fuel type. Describe the analyses performed to confirm the ATRIUM-10XM analysis bounds the ATRIUM-11 fuel transition.*

c. *Containment heatup is directly impacted by the stored energy within the fuel and the decay heat. Provide a quantitative comparison of the decay heat between the ATRIUM-10XM and ATRIUM-11 fuel.*

Response 31 a.:

Analysis to confirm that **[[**

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Response 31 b.:

The Framatome description of the approach for evaluating containment impacts and results of that evaluation are described in Section 7.3 of Reference 3. This approach is based on [[ ]]. A review of the current licensing basis for Brunswick ATWS containment shows that peak suppression pool temperature for MELLLA+ was 174 °F and the peak containment pressure was 8.4 psig, Section 9.3.1 of Reference 4. [[

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Response 31 c.:

In general, the decay heat results are [[

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Table 31-1 Decay Heat Evaluation

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NRC RAI 32. Regulatory Basis - 10 CFR 50 GDCs 16, 38, and 50

No additional events were listed in the application as having had an impact from the transition to ATRIUM-11 fuel. Explain any changes that were made to any analyses which impact the mass and energy release during an accident or a special event (station blackout or fire event).

Response 32:

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]] No other plant design changes are planned during this transition to ATRIUM 11 fuel. Therefore the analysis of record is not impacted by the introduction of ATRIUM 11 fuel. In the future, plant modifications will be dispositioned for their impact on the licensing basis events and analyses will be updated as necessary.

6.0 REFERENCES

1. William R. Gideon (Duke Energy) to U.S. Nuclear Regulatory Commission, “Brunswick Steam Electric Plant, Unit Nos. 1 and 2 Renewed Facility Operating License Nos. DPR-71 and DPR-62 Docket Nos. 50-325 and 50-324 Request for License Amendment Regarding Application of Advanced Framatome Methodologies,” ML18284A395.

2. Email, Andrew Hon (USNRC) to Stephen Yodersmith (Duke Energy), “Brunswick Unit 1 and Unit 2 Request for Additional Information related Transition to Framatome ATRIUM-11 Fuel (EPID:L-2018-LLA-0273),” ML19135A307, May 9, 2019.

3. ANP-3705P Revision 1, *Applicability of Framatome BWR Methods to Brunswick with ATRIUM 11*, Framatome Inc., November 2018.

4. DUKE-OB21-1104-000(NP), “Safety Analysis Report For Brunswick Steam Electric Plant Units 1 and 2 Maximum Extended Load Line Limit Analysis Plus,” ML16257A411.

5. ANP-10346Q1P Revision 0, “ATWS-I Analysis Methodology for BWRs Using RAMONA5-FA Response to NRC Request for Additional Information,” ML19071A274, March 2019.

DPC-NE-1009Q1, *Duke Energy Responses to RAIs on the Advanced Framatome Methods LAR*, Revision 0

Duke Energy Responses to RAIs on the Advanced Framatome Methods LAR

DPC-NE-1009Q1
Revision 0
May 2019

Statement of Disclaimer

Table of Contents

List of Acronyms

1RPT	One Recirculation Pump Trip
2RPT	Two Recirculation Pump Trip
ATWS-I	Anticipated Transient without Scram with Instability
BEO-III	Best-estimate Enhanced Option-III
CDA	Confirmation Density Algorithm
F/I MCPR	Final-over-Initial Minimum Critical Power Ratio
FoM	Figure of Merit
LAR	License Amendment Request
MCPR	Minimum Critical Power Ratio
MELLLA+	Maximum Extended Load Line Limit Analysis Plus
NRC	Nuclear Regulatory Commission
PBDA	Period Based Detection Algorithm
RAI	Request for Additional Information
RFWT	Reduced Feedwater Temperature
SLO	Single Loop Operation
TTWBP	Turbine Trip with Bypass

1.0 INTRODUCTION

Duke Energy submitted a License Amendment Request (LAR) in Reference 1 to add Advanced Framatome Methodologies to the Brunswick Units 1 and 2 Technical Specifications to support the introduction of ATRIUM 11. As part of the LAR review process, the Nuclear Regulatory Commission (NRC) provided Requests for Additional Information (RAI) in Reference 2. Responses will be provided in this report for a subset of these RAIs in Sections 2.0 and 3.0.

2.0 ANTICIPATED TRANSIENT WITHOUT SCRAM WITH INSTABILITY

NRC RAI 1

Justify the use of a feedwater temperature reduction rate of 1.3°F/s, as well as the initial delay time (if any) before feedwater temperature reduction begins in the ATWS-I analysis.

Duke Energy Response

In response to MELLLA+ SRXB-RAI-8 (Reference 3) Duke Energy provided plant data from four turbine trip events to support the use of a feedwater temperature reduction rate of 0.5°F/s and 1.3°F/s. The ATRIUM 11 ATWS-I Turbine Trip with Bypass (TTWBP) analysis (Reference 5), provided to the NRC as Attachment 14a of the subject LAR (Reference 1), utilized the more conservative rate of 1.3°F/s. No Brunswick plant modifications have been made that affect the conclusion of the NRC in the MELLLA+ Safety Evaluation (Reference 4) that the feedwater temperature reduction rate of 0.5°F/s is acceptable for the ATWS-I TTWBP analyses for Brunswick at MELLLA+ conditions. Consistent with References 3 and 4, no initial delay time before feedwater temperature reduction was used in the ATRIUM 11 ATWS-I TTWBP analysis in ANP-3694P (Reference 5).

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3.0 BEO-III WITH CONFIRMATION DENSITY ALGORITHM

NRC RAI 28

Particular statistical cases were **[[**

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Duke Energy Response

DPC-NE-1009-P (Reference 6) was provided to the NRC as Attachment 16a of the subject LAR (Reference 1). Section 3.2 Items 1.a through 1.c of DPC-NE-1009-P describes the screening criteria for the three limiting pump trip scenarios analyzed. These criteria are established such that sufficient populations of limiting BEO-III cases are evaluated with the CDA independent of future cycle stability behavior.

For MELLLA+ 2RPT events, all BEO-III cases with a reduction in BEO-III PBDA MCPR are evaluated with the CDA (i.e., final-over-initial MCPR ratio less than 1.0). As the minimum stability F/I MCPR ratio decreases to become limiting, more cases are evaluated with the CDA to provide a high degree of confidence that excluded cases do not challenge the 95/95 CDA MCPR FoM. For cycles where the stability response is more benign, fewer cases are analyzed with the CDA, so it is possible for some switching in the order between the BEO-III PBDA and CDA MCPR ranking, but this is only credible when the number of cases with a MCPR decrease is small (i.e., a number close to the order statistic). For this hypothetical scenario, the cases analyzed with the CDA will be the limiting tail of the sample population distribution and will be clustered close to a F/I MCPR ratio of 1.0 due to the statistical nature of the BEO-III sampling. Events with the most limiting cases having a F/I MCPR ratio near 1.0 are non-limiting and do not have the potential to challenge the safety limit. As this hypothetical event transitions from benign to limiting, the number of cases with a MCPR decrease will quickly increase such that a potential difference in ranking relative to the order statistic affecting the determination of minimum required stability operating limit is not credible.

For SLO 1RPT and MELLLA RFWT 2RPT events (if analyzed), the minimum population requirement discussed in Item 1.b ensures that sufficiently large populations of limiting BEO-III PBDA MCPR cases are evaluated with the CDA based on the sample size and order statistic regardless of a cycle's stability behavior. This was done to avoid unnecessary analysis of cases ranked far below the order statistic, where any switching in the order between the BEO-III PBDA and CDA MCPR ranking is of no consequence.

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4.0 REFERENCES

1. Duke Energy letter to NRC dated October 11, 2018, Request for License Amendment Regarding Application of Advanced Framatome Methodologies, ADAMS Accession Number ML18284A395.

2. NRC email to Duke Energy dated May 9, 2019, Brunswick Unit 1 and Unit 2 Request for Additional Information related Transition to Framatome ATRIUM-11 Fuel (EPID: L-2018-LLA-0273), ADAMS Accession Number ML19135A307.

3. Duke Energy letter to NRC dated February 5, 2018, Response to Request for Additional Information Regarding Request for License Amendment Regarding Core Flow Operating Range Expansion, ADAMS Accession Number ML18036A665.

4. NRC letter to Duke Energy dated September 18, 2018, Brunswick Steam Electric Plant, Units 1 and 2 – Issuance of Amendment Regarding Core Flow Operating Range Expansion (MELLLA+) (EPID L-2016-LLA-0009), ADAMS Accession Number ML18172A258.

5. ANP-3694P Revision 0, ATWS-I Analysis Methodology for Brunswick Using RAMONA5-FA, June 2018.

6. DPC-NE-1009-P Revision 0, Brunswick Nuclear Plant Implementation of Best-estimate Enhanced Option-III, September 2018.

Affidavit for Report DPC-NE-1009Q1-P, Report ANP-3782P, File “100P104F_EOC_LRNB.xlsx”, and File “100P85F_BOC_ATWS.xlsx”

AFFIDAVIT

STATE OF WASHINGTON)
) ss.
COUNTY OF BENTON)

1. My name is Alan B. Meginnis. I am Manager, Product Licensing, for Framatome Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by Framatome to determine whether certain Framatome information is proprietary. I am familiar with the policies established by Framatome to ensure the proper application of these criteria.

3. I am familiar with the Framatome information contained in the Report DPC-NE-1009Q1-P Revision 0, "Duke Energy Responses to RAIs on the Advanced Framatome Methods LAR," dated May 2019, The Report ANP-3782P Revision 1, "Brunswick ATRIUM 11 Advanced Methods Response to Request for Additional Information," dated May 2019, computer file named, "100P104F_EOC_LRNB.xlsx ," and computer file named, "100P85F_BOC_ATWS.xlsx," and referred to herein as "Documents." Information contained in these Documents has been classified by Framatome as proprietary in accordance with the policies established by Framatome for the control and protection of proprietary and confidential information.

4. These Documents contain information of a proprietary and confidential nature and are of the type customarily held in confidence by Framatome and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in these Documents as proprietary and confidential.

5. These Documents have been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in these Documents be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by Framatome to determine whether information should be classified as proprietary:

(a) The information reveals details of Framatome's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for Framatome.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for Framatome in product optimization or marketability.

(e) The information is vital to a competitive advantage held by Framatome, would be helpful to competitors to Framatome, and would likely cause substantial harm to the competitive position of Framatome.

The information in these Documents is considered proprietary for the reasons set forth in paragraphs 6(b), 6(c), 6(d) and 6(e) above.

7. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in these Documents have been made

available, on a limited basis, to others outside Framatome only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. Framatome policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

SUBSCRIBED before me this 21st

day of May, 2019.

Hailey M Siekawitch
NOTARY PUBLIC, STATE OF WASHINGTON
MY COMMISSION EXPIRES: 9/28/2020

HAILEY M SIEKAWITCH
Commission Expires
NOTARY PUBLIC
Sept. 28, 2020
STATE OF WASHINGTON