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**Enclosure 1 Contains Proprietary Information  
Withhold in Accordance with 10 CFR 2.390**

o: 910.832.3698

December 31, 2019

Serial: RA-19-0479

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  
Supplement to Request for License Amendment Regarding Application of  
Advanced Framatome Methodologies

**Reference:** 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.

Ladies and Gentlemen:

By letter dated October 11, 2018 (i.e., Reference), 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.

Framatome has identified a coding error in the RODEX4 software which was used in analyses supporting the Advanced Framatome Methodologies LAR. Enclosure 1 contains a report that describes the identified issue and evaluates the impact on the LAR analyses. As shown in Enclosure 1, impacts to the analyses provided to the NRC as part of the Advanced Framatome Methodologies LAR are negligible and no methodology topical reports are impacted by the error.

Enclosure 1 contains information considered proprietary to Framatome. The proprietary information in this report has been denoted by brackets. As owner of the proprietary information, Framatome has executed the affidavit contained in Enclosure 3 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. Enclosure 2 provides a non-proprietary version of this report.

No new regulatory commitments are contained in this letter.

Please refer any questions regarding this submittal to Ms. Sabrina Salazar, Manager – Nuclear Support Services, at (910) 832-3207.

I declare, under penalty of perjury, that the foregoing is true and correct. Executed on December 31, 2019.

Sincerely,

  
John A. Krakuszeski

for J. KRAKUSZESKI

SBY/sby

Enclosures:

- 1: FS1-0047694, *Brunswick LAR Supplement for RODEX4 Axial PCMI Onset Error (Proprietary)*, Revision 1 **[Proprietary Information – Withhold from Public Disclosure in Accordance with 10 CFR 2.390]**
- 2: FS1-0047695, *Brunswick LAR Supplement for RODEX4 Axial PCMI Onset Error (Non-Proprietary)*, Revision 1
- 3: Affidavit for FS1-0047694, *Brunswick LAR Supplement for RODEX4 Axial PCMI Onset Error (Proprietary)*, Revision 1

cc (with all Enclosures):

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FS1-0047695, *Brunswick LAR Supplement for RODEX4  
Axial PCMI Onset Error (Non-Proprietary)*, Revision 1

<b>IDENTIFICATION</b>  <div style="border: 1px solid black; padding: 5px; text-align: center; font-weight: bold;">FS1-0047695</div>	<b>REVISION</b>  <div style="border: 1px solid black; padding: 5px; text-align: center; font-weight: bold;">1.0</div>	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <b>Framatome Fuel</b> </div> <div style="text-align: center;">  </div> </div>
<b>TOTAL NUMBER OF PAGES: 8</b>		

## Brunswick LAR Supplement for RODEX4 Axial PCMI Onset Error (Non-Proprietary)

**ADDITIONAL INFORMATION:**

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REVISIONS

REVISION	DATE	EXPLANATORY NOTES
1.0	See 1 <sup>st</sup> page release date	New document This is the non-proprietary version of FS1-0047694

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**1. INTRODUCTION**

An issue has recently been identified that has minimal impact on reports (References 1 - 6) which have been provided in support of the Brunswick (BSEP) License Amendment Request (LAR) (Reference 7) and plant specific reload licensing campaign to utilize Framatome advanced methods in support of loading ATRIUM 11 fuel. [ ]

**2. ISSUE DESCRIPTION**

**3. ISSUE IMPACT EVALUATION**

While the purpose of this report is to evaluate the impacts on the BSEP Advanced Framatome Methods LAR, many of the impacts are being quantified with respect to the first BSEP unit and operating cycle containing reload quantities of ATRIUM 11 which is BSEP Unit 1 Cycle 23 (B1C23) as the cycle-specific analyses go beyond the methods demonstration contained in the BSEP Advanced Framatome Methods



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LAR. As shown in the sections below, the negligible impacts for B1C23 demonstrate that this error does not impact the representative nature of the demonstration reports provided in the LAR.

### 3.1. STEADY-STATE OPERATION (LHGR LIMITS)

RODEX4 is used to validate the linear heat generation rate (LHGR) Fuel Design Limit (FDL) for ATRIUM 11 fuel. Evaluations have been performed which showed the variations in results remain within the statistical variation of the method. Therefore the ATRIUM 11 LHGR limits for B1C23 remain applicable and there is no impact on the BSEP Advanced Framatome Methods LAR analyses.

### 3.2. ANTICIPATED OPERATIONAL OCCURRENCES (LHGR SET DOWNS)

The anticipated operational occurrences (AOO) methodology determines power and flow dependent LHGR set downs (LHGRFACp and LHGRFACf multipliers) to ensure the transient strain and centerline melt criteria are met. While the Reference 1 demonstration analysis did not perform these evaluations, they are included in the B1C23 reload analysis (Reference 6). RODEX4 is used to establish these setdowns and an assessment was performed with the corrected development version of the code. The LHGRFACp cases assessed for fast transients were the limiting BSEP licensing analyses. These evaluations showed [

]. Comparison of the [

the LHGR set downs showed the current ATRIUM 11 limits remain bounding for B1C23. As a result, there is no impact on the BSEP Advanced Framatome Methods LAR analyses.

### 3.3. STABILITY METHODOLOGY AND ATWS-I

The Anticipated Transient without Scram with Instability (ATWS-I) methodology supports the confirmation of the LHGR limits to ensure fuel coolability during the event. The Best-estimate Enhanced Option III (BEO-III) methodology is used to determine minimum critical power ratio (MCPR) limits on a cycle specific basis. The ATWS-I and BEO-III methodologies incorporated a [

], the stability methodology is not impacted, the stability analyses of record are unaffected, and there is no impact on the BSEP Advanced Framatome Methods LAR analyses.

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### 3.4. AURORA-B LOCA

The AURORA-B Loss of Coolant Accident (LOCA) methodology supports the determination of the maximum average planar LHGR (MAPLHGR) limits. Comparisons of S-RELAP5 [ ] were performed as part of the AURORA-B LOCA methodology assessment. This assessment produced an impact of  $-5^{\circ}\text{F}$  for the BSEP ATRIUM 11 peak cladding temperature (PCT). This change in PCT is reportable under 10 CFR 50.46 and will be included in Duke Energy's annual 10 CFR 50.46 report. This PCT impact is insignificant as defined by 10 CFR 50.46 and this error results in additional margin to the  $2200^{\circ}\text{F}$  limit.

### 3.5. AURORA-B AOO

The AURORA-B AOO methodology supports the determination of power-dependent MCPR (MCPRp) limits. The AURORA-B AOO methodology assessment consisted of comparisons of the limiting B1C23 licensing analysis cases with and without the RODEX4 correction. The B1C23 limiting licensing analyses show [ ]. This change is within the criteria defined as insignificant which are given in Section 9.3 of the approved AURORA-B AOO topical report (Reference 8). Based on the evaluations of the B1C23 limiting licensing cases and continuity of assessment cases, the MCPRp limits are not impacted by the change and remain appropriate for use. The negligible impacts on B1C23 demonstrate the error can have no significant impact on the transient demonstration report (Reference 1) provided with the BSEP Advanced Framatome Methods LAR.

### 3.6. AURORA-B CRDA

The AURORA-B Control Rod Drop Accident (CRDA) methodology and calculations support the determination of core coolability and radiological consequences for the postulated CRDA. The impacts of the error were minor and resulted in a total enthalpy [

]. The maximum total enthalpy rise remained below the core coolability limit of  $230\text{ cal/g}$  such that the established core coolability for B1C23 remains valid and the representative nature of the demonstration report provided in the LAR is not impacted.

The radiological dose consequences are evaluated based on the number of predicted rod failures which may occur from PCMI failure, fuel melting, or enthalpy greater than the high temperature failure thresholds. There is no increase in fuel rod failures from PCMI or fuel melting as a result of this code correction. The change in the number of rod failures based on the high temperature failure threshold

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which is based on total enthalpy rise and fuel rod differential pressure was minimal. The predicted [ ] rod failures were determined to be [ ] of the of allowed rod failures which defines the dose consequences of the accident. The small change in the total enthalpy would [ ] of the allowed rod failures. Therefore this code correction has no impact on the radiological consequences for B1C23 postulated CRDA.

The CRDA demonstration report submitted with the LAR is only used for demonstration purposes and is not intended to be a bounding licensing analysis. Given the negligible impact on core coolability and radiological consequences seen for B1C23 and the margin to these criteria in the demonstration report, it is concluded that this error has no impact on the core coolability or radiological consequences of the CRDA demonstration report.

### 3.7. MASS AND ENERGY RELEASE EVENTS

Decay heat and initial stored energy in the fuel are first order phenomena concerning the mass and energy release during an accident or special event (e.g. fire event). Decay heat is not impacted and corrections in the coding for both the steady-state RODEX4 and the S-RELAP5 RODEX4 kernel calculations show an [ ]

[ ] Therefore, there is no adverse impact on the ATRIUM 11 mass and energy release during an accident or special event from the RODEX4 issue.

### 3.8. AURORA-B OVERPRESSURIZATION

The AURORA-B overpressurization calculation supports the vessel overpressure criteria. The limiting case for the B1C23 licensing analysis was evaluated with and without the RODEX4 correction. The comparison showed [ ] established as insignificant per Section 9.3 of the approved AURORA-B AOO topical report (Reference 8). The negligible impacts on B1C23 demonstrate the error can have no significant impact on the transient demonstration report (Reference 1) provided with the BSEP Advanced Framatome Methods LAR. Based on the insignificant impact on the results, the overpressurization criterion is still met and the BSEP Advanced Framatome Methods LAR analyses are not impacted.

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#### 4. CONCLUSIONS

As shown in Section 3, the error described in Section 2 of this report has a negligible effect on the BSEP LAR submittal which utilized advanced Framatome methods. Given the negligible impacts seen for B1C23, assurance is provided that the demonstration reports provided in the LAR remain representative.

Although the error described in Section 2 of this report is associated with the coding of various methodologies, the error is not with any methodology itself. Therefore, no methodology topical reports, including any related to the BSEP LAR, are impacted by the error.

#### 5. REFERENCES

1. ANP-3702P Revision 0, *Brunswick ATRIUM 11 Transient Demonstration*, Framatome Inc., August 2018.
2. ANP-3703P Revision 0, *BEO-III Analysis Methodology for Brunswick Using RAMONA5-FA*, Framatome Inc., August 2018.
3. ANP-3674P Revision 2, *Brunswick Units 1 and 2 LOCA Analysis for ATRIUM 11 Fuel*, Framatome Inc., May 2019.
4. ANP-3694P Revision 0, *ATWS-I Analysis Methodology for Brunswick Using RAMONA5-FA*, Framatome Inc., June 2018.
5. ANP-3714P Revision 0, *Brunswick ATRIUM 11 Control Rod Drop Accident Analyses with the AURORA-B CRDA Methodology*, Framatome Inc., September 2018.
6. ANP-3808P Revision 0, *Brunswick Unit 1 Cycle 23 Reload Safety Analysis*, Framatome Inc., October 2019.
7. 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, October 11, 2018, ADAMS Accession Number ML18284A395.
8. ANP-10300P-A Revision 1, *AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios*, Framatome Inc., February 2018.

*Affidavit for FS1-0047694, Brunswick LAR Supplement for  
RODEX4 Axial PCMI Onset Error (Proprietary), Revision 1*

## AFFIDAVIT

1. My name is Gayle Elliott. I am Deputy Director, Licensing & Regulatory Affairs for Framatome Inc. (Framatome) 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 Document FS1-0047694, Revision 1.0, entitled "Brunswick LAR Supplement for RODEX4 Axial PCMI Onset Error," dated December 2019, and referred to herein as "Document." Information contained in this Document 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. This Document contains information of a proprietary and confidential nature and is 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 this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document 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 this Document is considered proprietary for the reasons set forth in paragraphs 6(d) and 6(e) above.

7. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in this Document has 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.

  
Gayle Elliott

SUBSCRIBED before me this 30 day of December, 2019.

Heidi Hamilton Elder

A circular notary seal for Heidi Hamilton Elder, a Notary Public in the Commonwealth of Virginia. The seal contains the text: HEIDI HAMILTON ELDER, COMMONWEALTH OF VIRGINIA, REGISTRATION NO. 7777873, MY COMM. EXPIRES 12/31/2022, and NOTARY PUBLIC.