



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001**

December 19, 2019

MEMORANDUM TO: Peter Riccardella, Chairman  
Advisory Committee on Reactor Safeguards

FROM: Jose March-Leuba, Chair */RA/*  
Thermal Hydraulics Subcommittee  
Advisory Committee on Reactor Safeguards

SUBJECT: PRELIMINARY REVIEW OF FRAMATOME TOPICAL REPORT  
ANP-3753P "APPLICABILITY OF FRAMATOME BWR METHODS  
TO SUSQUEHANNA WITH ATRIUM™ 11 FUEL REPORT"

The staff is reviewing a license amendment request (LAR) submitted by Talen Energy for Susquehanna Steam Electric Station (Susquehanna) Units 1 and 2 to operate with ATRIUM™ 11 fuel and adopt Framatome methods for core reload evaluations. Associated with this LAR are several licensing topic reports (LTRs), the most significant of which is ANP-3753P, "Applicability of Framatome BWR Methods to Susquehanna with ATRIUM™ 11 Fuel Report," May 2019.

In response to the ACRS request during our meeting, November 9, 2019, I completed my review of the LTRs associated with this LAR. This memo provides my recommended course of action concerning further ACRS review of this LAR.

### **Conclusions and Recommendation**

The Susquehanna LAR application is very thorough and detailed. It uses advanced Framatome methodologies that have been approved by the staff and reviewed by ACRS for other licensees. Unless the staff finds some unusual condition during their review, I recommend that no additional ACRS review is required when the staff SER is complete.

### **Background**

Susquehanna Units 1 and 2 are of the BWR/4 design with Mark II containments. These units began operation in 1983 (Unit 1) and 1985 (Unit 2), NRC has granted these units an extended power uprate (EPU) with a thermal power of 3952 MW<sub>th</sub>. They have been operating with ATRIUM™ 10 fuel since 1997. On July 15, 2019, Talen Energy submitted a LAR to adopt advanced Framatome methods and transition to ATRIUM™ 11 fuel. Talen Energy is not requesting, at this point, approval to operate Susquehanna Units 1 or 2 in the expanded power-flow domain.

To demonstrate applicability of their methods to Susquehanna, Framatome relies heavily on two Brunswick-specific LTRs: ANP-3108P, Revision 1, "Applicability of AREVA BWR Methods to

Brunswick Extended Power Flow Operating Domain,” July 2015, which was approved for use with ATRIUM™10 in both the EPU and Extended Flow Window (EFW) domains; and ANP-3705P, Revision 1, “Applicability of Framatome BWR Methods to Brunswick with ATRIUM™11 Fuel,” November 2018. In November 2019, we completed our review of the Brunswick report and concurred with the staff conclusion for approval.

In prior years, we’ve reviewed MELLLA+ LARs that have covered the spectrum of BWR and containment designs, including a LAR for Brunswick to operate in the MELLLA+ operating domain using GEH thermal hydraulic methods applied to ATRIUM™ 10XM fuel. In April 2019, we completed our review of the Browns Ferry MELLLA+ LAR for use with ATRIUM™10XM, and issued a letter stating that no additional ACRS review of expanded power to flow domain applications is required unless substantive differences in plant designs and conditions warranted it. In November 2019, we completed our review of the ATRIUM™11 Brunswick LAR and issued a letter concurring with the staff SE approving the use for ATRIUM™11, which is the first application of chromium-doped fuel and Framatome methodologies for operation in the expanded power to flow domain.

## Discussion

Table 2.1 of ANP-3753P lists the applicable Framatome approved methodologies. Most notably, these include: the AURORA-B code; the ACE CPR correlation for ATRIUM™11 fuel; and ANP-10340PA, "Incorporation of Chromia-Doped Fuel Properties in AREVA Approved Methods," May 2018, which includes methods for thermal conductivity degradation. These methodologies are similar to those used in the Brunswick LAR we reviewed in November 2019. The Talen Energy application applies the same Framatome methods for Susquehanna operation with ATRIUM™11 fuel with two exceptions: Susquehanna operation is limited to the EPU domain, and they plan to implement BEO-III using the BWROG Option III stability solution instead of DSS/CD. These differences are not significant to the applicability of Framatome methods.

The ATRIUM™ 11 fuel performance is evaluated using the same methodology used in Brunswick: BAW-10247PA Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," February 2008.

Thermal hydraulic methods are also unchanged from those used in the Brunswick LAR. They include validated void fraction and loss coefficient models; the use of the ACE CPR correlation; and the safety limit MCPR methodology, which uses the approved LTR ANP-10307PA Revision 0, “AREVA MCPR Safety Limit Methodology for Boiling Water Reactors,” June 2011.

Both Susquehanna units will continue to implement stability Option III for the NRC approved EPU operating domain. For calculations of the DIVOM-based setpoints, they will use the approved RAMONA5-FA methodology. Since Susquehanna will remain at EPU conditions (i.e., not EFW) they can retain the conventional Option III approach and do not need to upgrade to DSS/CD. All reactor stability benchmarks were reanalyzed with the Cr-doped fuel-rod properties and gap conductance. Good agreement is observed.

During the review of the RAMONA5-FA stability methodology, the staff reviewed data provided by Framatome that supported the removal of the OLMCPR penalty in both the EPU and EFW domains. Susquehanna, therefore, proposes to remove this penalty once these methods are implemented.

The approved AURORA-B methodology is used for the ATWS short-term over-pressurization analysis. With respect to long-term containment heat up during ATWS, the Susquehanna LAR provides sensitivity analyses to demonstrate that the transition to ATRIUM™11 does not impact the results negatively with respect to the resident ATRIUM™10 fuel, which is the basis for the ATWS analysis of record.

With respect to shutdown margin, the Susquehanna LAR states that the ATRIUM™11 part length rod in the corner of the assembly improves the shutdown margin performance of the fuel design because of the flux trap that is created in the vacant rod. The heterogeneous solution of CASMO-4 accurately models the vacant rod position and the associated reactivity. CASMO-4 calculations are used to define shutdown margin requirements on cycle-specific basis.

Susquehanna is currently subject to a SLMCPR pin power distribution uncertainty and bundle power correlation coefficient restriction/penalty. Since the analysis and core monitoring at Susquehanna will be based on the CASMO-4/MICROBURN-B2 methodology, there is no need for any restrictions/uncertainty penalties when using AURORA-B methods per section 3.3.2.4.5 of the AURORA-B safety evaluation. Susquehanna, therefore, proposes to remove this penalty.

Appendix A of ANP-3753P documents the methodology for mixed cores, which uses approved methods that have been previously applied to other reactors.

The LAR includes detailed design reports, including:

- ANP-3761P, Susquehanna Units 1 and 2 Thermal-Hydraulic Design Report for ATRIUM™11 Fuel Assemblies
- ANP-3745P, ATRIUM™11 Fuel Rod Thermal-Mechanical Evaluation for Susquehanna LAR

### **Summary**

The Susquehanna LAR application is very thorough and detailed. It uses advanced Framatome methodologies that have been approved by the staff and reviewed by ACRS for other licensees. Unless the staff finds some unusual condition during their review, I recommend that no additional ACRS review is required when the staff SER is complete.

December 19, 2019

SUBJECT: PRELIMINARY REVIEW OF FRAMATOME TOPICAL REPORT ANP-3753P "APPLICABILITY OF FRAMATOME BWR METHODS TO SUSQUEHANNA WITH ATRIUM™ 11 FUEL REPORT"

Package No.: ML19353A021

Accession No: ML19353A019

Publicly Available Y

Sensitive N

Viewing Rights:  NRC Users or  ACRS Only or  See Restricted distribution \*via email

OFFICE	ACRS/TSB	SUNSI Review	ACRS/TSB	ACRS
NAME	WWang	WWang	LBurkhart	JMarch-Leuba ( <i>LBurkhart for</i> )
DATE	12/19/2019	12/19/2019	12/19/2019	12/19/2019

OFFICIAL RECORD COPY