



**Monticello License Amendment Request
To Adopt Advanced Framatome Methods
March 25, 2021**

Agenda

- Purpose
- Background
- LAR Licensing Approach
- Apply Approved Methodologies
- Methodologies Discussion
- LAR Content Overview
- TS Changes
- Summary

Purpose

Discuss proposed License Amendment Request (LAR) for the Monticello Nuclear Generating Plant (MNGP) to adopt Framatome advanced fuel analysis methods.

Background

- Xcel Energy intends to transition to the Framatome ATRIUM 11 fuel design (Cycle 32, spring 2023)
- Advanced Framatome methods are needed to support ATRIUM 11 fuel deployment

Background

- ATRIUM 10XM fuel operated at MNGP since 2017
- ATRIUM 11 fuel provides following benefits:
 - 11x11 array reduces Linear Heat Generation Rate (LHGR) – improving safety margin
 - Improved debris protection features (fuel failure risk reduction)
 - Improved fuel channel performance
 - Improved economics

LAR Licensing Approach

- Core Operating Limits Report (COLR) Technical Specifications (TS) revised to include advanced methods
- Best Estimate Enhanced Option III (BEO-III) methodology to be utilized for stability protection
- Reactor Protection System TS revised to reflect BEO-III
- Demonstrate new methods application with an equilibrium cycle Monticello ATRIUM 11 core

LAR Licensing Approach

- Xcel Energy can provide implementation cycle reports post-LAR approval for information
 - Fuel Cycle Design Report
 - Nuclear Fuel Design Report
 - Fuel Rod Thermal and Mechanical Report
 - Reload Safety Analysis Report
 - Safety Limit MCPR Report

Apply Approved Methodologies

- All advanced Framatome methodologies used will have NRC approval (BEO-III topical report approval near)
- NRC approved generic reports:
 - ANP-10332P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios,” Revision 0, March 2019
 - ANP-10333P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Control Rod Drop Accident (CRDA),” Revision 0, March 2018
 - ANP-10300P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios,” Revision 1, January 2018

Apply Approved Methodologies

- NRC approved generic reports (continued):
 - ANP-10335P-A, “ACE/ATRIUM 11 Critical Power Correlation,” Revision 0, May 2018
 - ANP-10340P-A, “Incorporation of Chromia-Doped Fuel Properties in AREVA Approved Methods,” Revision 0, May 2018
 - ANP-10346P-A, “ATWS-I Analysis Methodology for BWRs Using RAMONA5-FA,” Revision 0, January 2020
 - ANP-10344P, “Framatome Best-estimate Enhanced Option III Methodology,” Revision 0, [est. April 30, 2021]

Apply Approved Methodologies

- NRC approved generic reports (continued):
 - BAW-10247PA, Revision 0, Supplement 1P-A, Revision 0, “Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors Supplement 1: Qualification of RODEX4 for Recrystallized Zircaloy-2 Cladding, April 2017
 - BAW-10247P-A, Supplement 2P-A, Revision 0, “Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors Supplement 2: Mechanical Methods,” August 2018

Methodologies Discussion

- New Monticello Long Term Stability Solution consisting of the Framatome Best-estimate Enhanced Option III Methodology (ANP-10344P)
- BEO-III utilizes a best-estimate plus uncertainty analysis approach over the entire event to ensure margin to the SLMCPR at the time of the SCRAM
 - Will allow for single loop operation (SLO) outside the EFW region
 - Monticello is not licensed for reduced feedwater heating or feedwater heater operation out-of-service (FWHOOS)
 - No changes to plant NUMAC hardware

Methodologies Discussion

- NRC approved AURORA-B CRDA method (ANP-10333P-A) topical report methodology applied on a cycle-specific basis
 - Demonstration analysis based on ATRIUM-11 equilibrium core
- AURORA-B, CRDA NRC SE, Section 3.0 addressed reactivity insertion accident (RIA) criteria and need to evaluate to verify no changes beyond clarification associated with DG-1327
- Regulatory Guide (RG) 1.236, “Pressurized-Water Reactor Control Rod Ejection and Boiling-Water Reactor Control Rod Drop Accidents,” later issued – and to address hydrogen pick-up model
 - Multiplier on approved Framatome hydrogen model will be used to address hydrogen in oxide layer per RG 1.236, Item 2.3.4.2

Methodologies Discussion

- Current licensing basis release for a CRDA event remains bounding
 - Confirmatory dose consequence evaluation considers the steady state release and the transient release criteria
 - Steady state release fractions based on RG 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” (July 2000)
 - Transient release fraction from Draft Guide-1327, “Pressurized Water Reactor Control Rod Ejection and Boiling Water Reactor Control Rod Drop Accidents,” Revision 1 (July 2019)

Methodologies Discussion

- NRC approved AURORA-B transient method utilized for HPCI:
 - ANP-10300P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios,” Revision 1, January 2018
- Limitation and Condition 12 of the topical requires plant specific review of the method used to determine the mixing in the lower plenum during an inadvertent HPCI event
- Inadvertent HPCI will be analyzed for Monticello
 - Will utilize the same method as used for Susquehanna
 - This method will be defined in the Methods Applicability report

Methodologies Discussion

- Section 6.2.8 of the topical contains a sensitivity study on time step size with the following conclusion
 - *Based on the sensitivity, time step sizes larger than 0.0050 sec are acceptable as long as the impact is conservative for the analysis.*
- This is proposed to be amended to
 - *Based on the sensitivity, time step sizes larger than 0.0050 sec are acceptable as long as the impact is negligible or conservative for the analysis*
- This allows for small negligible fluctuations in the temporally converged solution
 - Justification will be identical to that provided for Susquehanna and will be included in the Methods Applicability report

Methodologies Discussion

- NRC approved generic ATWS-I methodology (ANP-10346P-A) to be applied
- ATRIUM 10XM for Monticello used a plant-specific AISHA/SINANO methodology
 - Predecessor to the current generic RAMONA5-FA ATWS-I
 - Contain many simplifications which were compensated by additional conservatisms in the methodology
- RAMONA5-FA generic ATWS-I methodology simulates full event
 - Removes the additional conservatisms from the AISHA/SINANO methodology
 - Peak Cladding Temperature expected to be considerably lower

LAR Content Overview

- Reports submitted with LAR based on Monticello equilibrium cycle ATRIUM 11 fuel design
 - Assembly Mechanical Design reports
 - Methods Applicability Document
 - Thermal Hydraulic Design Report
 - LOCA / MAPLHGR Report
 - BWR Licensing Methodology Compendium

LAR Content Overview

- Reports submitted with LAR based upon Monticello equilibrium cycle ATRIUM 11 fuel design
 - ATRIUM 11 ATWSi Analysis Report
 - AURORA-B Limiting Transient Analysis Uncertainty Demonstration
 - AURORA-B Application for the Control Rod Drop Accident (CRDA)

TS Changes – RPS

- Specification 3.3.1.1 – Reactor Protection System (RPS) TS Changes
 - Remove the Extended Flow Window Stability (EFW) – High trip (Function 2.g) in Table 3.3.1.1-1 and remove the references to the function in the ACTIONS
 - Remove Condition J to reduce Thermal Power to below MELLLA boundary defined in the COLR from the ACTIONS
- Specification 5.6.3 – COLR, Item a.6 – Remove reference to the COLR for Function 2.g EFW setpoints

TS Changes – COLR

- Specification 5.6.5 COLR additions
- Add Framatome licensing methodologies:
 - ANP-10332P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios,” Revision 0, March 2019
 - ANP-10333P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Control Rod Drop Accident (CRDA),” Revision 0, March 2018
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TS Changes – COLR

- Remove superseded licensing methodologies and evaluations:
 - XN-NF-84-105(P)(A) Volume 1, and Volume 1 Supplements 1 and 2, “XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis,” February 1987
 - ANF-913(P)(A) Volume 1 Revision 1, and Volume 1 Supplements 2, 3, and 4, “COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses,” August 1990
 - Engineering Evaluation EC 25987, “Calculation Framework for the Extended Flow Window Stability (EFWS) Setpoints”, as docketed in Xcel Energy letter to NRC L-MT-15-065, dated September 29, 2015

Summary

- Advanced Framatome methods have been previously approved for other licensees
- BEO-III expected to be approved by the targeted date for LAR submittal – so all advanced methods topical reports utilized will have received prior NRC approval
- Projected date for LAR submittal – July 2021
- Requested for the spring 2023 refueling outage

