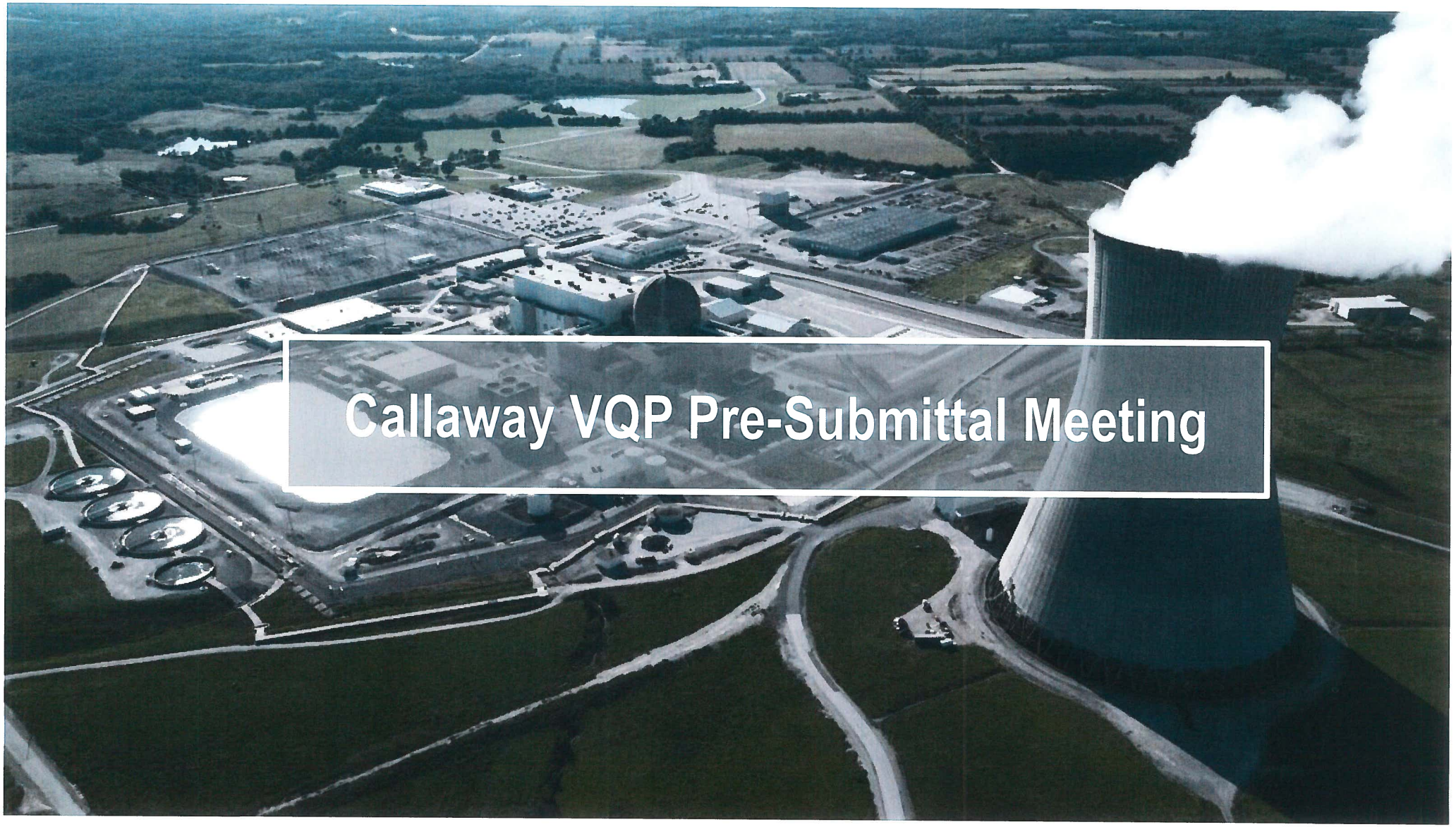
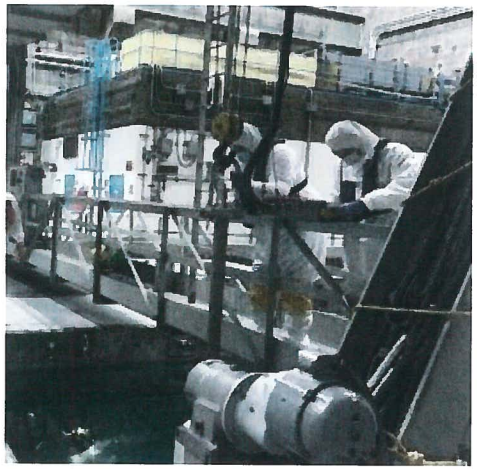
Enclosure 1 to
ULNRC-06716

Callaway Unit 1 Presentation Information for Planned Pre-Application Meeting (Public Meeting)


Callaway VQP Pre-Submittal Meeting



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Callaway VQP Pre-Submittal Meeting

Stephanie Banker – Ameren - Vice President Nuclear Engineering & Support

- Welcome
- Meeting Purpose – to provide the NRC with information on the upcoming License Amendment Request (LAR) for the Vendor Qualification Program (VQP) of Framatome as a supplier of nuclear fuel to Callaway Energy Center

Team Members

Presenters in Bold

Ameren Team Members	Titles
Stephanie Banker	**Vice President Nuclear Engineering & Support**
Steve Meyer	Manager, Regulatory Affairs
Keith Mills	Director, Regulatory Performance
Tom Elwood	**Supervising Engineer, Regulatory Affairs**
Jim Kovar	Regulatory Affairs Engineer
Don Rickard	**Regulatory Affairs Engineer**
Brian Richardson	**Supervising Engineer, Reactor Engineering / Safety Analysis / Fuels**
Jim Knaup	Reactor Engineer / Core Design
Justin Vinyard	Reactor Engineer / Fuels
Jim McInvale	Consultant Reactor Engineer
Larry Russell	Consultant Project Manager

Framatome Team Members	Titles
Rick Williamson	Contract Manager
Tom Gardner	Project Manager
Christy White	**Technical PM**
Greg Borza	**Thermal-Hydraulics**
Morris Byram	Licensing
Kevin Segard	**Neutronics**
Michael Harris	**Thermal-Mechanics**
Tim Lindquist	**Safety Analysis**
Gordo Wissinger	**LOCA Analysis**
Pam Reed	Mechanical Design
Brian Painter	**Mechanical Analysis**

Agenda

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• Purpose of Meeting / Desired Outcomes	Callaway
• Background	Callaway
• GAIA Fuel Assembly Design Description	Framatome
• Summary of NRC Approved Methods	Framatome
• Analyses	Framatome
• Technical Specification Changes	Callaway
• Schedule	Callaway

Background

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- Callaway LFA / VQP Program for Framatome Fuel
  - Lead Fuel Assemblies (LFA) – 4 Fuel Assemblies
    - 3 cycles (Cycles 25, 27, 28)
    - Non-Limiting Operation (Cycle 25 only)
  - Vendor Qualification Program (VQP)
    - Fuel Transition Licensing Submittal
  - VQP Lead Fuel Assemblies – 4 Additional Fuel Assemblies
    - 3 cycles (Cycles 27, 28, 29)
    - Fully Licensed Operation
- GAIA Fuel Design
- Based on currently approved methods (with some changes)
- Technical Specification changes to add Framatome methods

Fuel Assembly Design Description

(ANP-10342P-A Revision 0, GAIA Fuel Assembly Mechanical Design)

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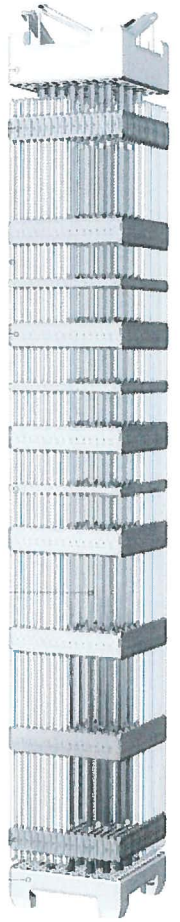
- Standard Reconstitutable Top Nozzle
- M5 Fuel Rods
- M5 GAIA Mixing Grid (6x)
- M5 Intermediate GAIA Mixer (IGM) Grids (3x)
- Alloy 718 HMP Top (Relaxed) and Bottom Spacer Grids
- Q12 MONOBLOC Guide Tubes (24x)
- Q12 Instrument Tube
- GRIP Bottom Nozzle



Summary of Methods (1 of 2)

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Functional Area	Topical Report
Neutronics	ARCADIA (ANP-10297P-A and ANP-10297P-A Supp. 1P-A, Revision 1)
Thermal–Hydraulic	XCOBRA-IIIC (XN-NF-82-21P-A and XN-NF-75-21P-A Revision 2), COBRA-FLX (ANP-10311P-A Revision 1)
Non-LOCA	S-RELAP5 (EMF-2310P-A Revision 1)
DNBR Correlation	GAIA (ANP-10341P-A)
Control Rod Ejection	AREA (ANP-10338P-A) GALILEO (ANP-10323P-A)
SB LOCA	S-RELAP5 (EMF-2328P-A and S1P-A)
LB LOCA	S-RELAP5 (EMF-2103P-A Revision 3)

These NRC Approved Methods will be added to the Callaway Tech Specs / COLR

Summary of Methods (2 of 2)

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Functional Area	Topical Report
Fuel Performance Code	COPERNIC (BAW-10231P-A), CROV (BAW-10084PA Revision 3)
External Loads	ANP-10337P-A
GAIA Mechanical Design	ANP-10342P-A
Cladding	BAW-10240PA, BAW-10227P-A Revision 1
Statistical Setpoints	EMF-92-081P-A
Fuel Rod Bow	XN-75-32P-A
DNB Propagation	XN-NF-82-06P-A

These NRC Approved Methods will be added to the Callaway Tech Specs / COLR

Recently Approved LARs for Framatome Fuel

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- Palo Verde Fuel Transition – ML20031C947
- St. Lucie 2 Fuel Transition – ML16063A121
- Calvert Cliffs Fuel Transition – ML110390263
- Calvert Cliffs Accident Tolerant Fuel LTAs – ML20363A242
- St. Lucie 1 Extended Power Uprate – ML12181A019
- Shearon Harris GAIA Implementation - ML21047A470

VQP Analyses

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- Analyses were completed in the following disciplines, using methods discussed on the subsequent pages:
  - Fuel rod thermal-mechanical
  - Fuel assembly mechanical
  - Neutronics
  - Thermal-hydraulics
  - Non-LOCA
    - Rod Ejection Analysis – Method meets new RG 1.236 (analysis underway)
  - LOCA (Large and Small Break)

VQP Analysis Details

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- Fuel Rod Thermal-Mechanical

Analysis / Basis	Method	Results / Comments
Fuel Rod Analyses*	ANP-10342P-A BAW-10231P-A BAW-10084P-A, Rev. 3	Acceptable, accounts for TCD
Cladding Performance / Properties	BAW-10240P-A BAW-10227P-A, Rev. 1	Acceptable, M5 cladding

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Fuel Assembly Mechanical

Analysis / Basis	Method	Results
Mechanical Compatibility	N/A	Acceptable, compatible with reactor and resident fuel/components
Structural Design Evaluations	ANP-10342P-A	Acceptable
Seismic / LOCA Mechanical Faulted Analysis	ANP-10337P-A and	Acceptable, coolable geometry and RCCA insertion requirements met

VQP Analysis Details

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- Neutronics

Analysis / Basis	Method	Results
Core Design (ARTEMIS)	ANP-10297P-A, Revision 0 ANP-10297P-A, Revision 0, Supplement 1P-A Revision 1)	Acceptable, - Modeled cycles 13-24 - Created representative transition cycles - Generated power histories, axial shapes and other safety inputs
Power Distribution Control*	Defined in LAR	Acceptable
Rod Ejection	AREA (ANP-10338P-A) GALILEO (ANP-10323P-A)	Expected to be acceptable, meets requirements from RG 1.236

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Thermal Hydraulic

Analysis / Basis	Method	Results
XCOBRA-IIIC	XN-75-21(P)(A) Rev 2	XCOBRA-IIIC is used for setpoint verification and Ch. 15 DNB analysis
COBRA-FLX	ANP-10311P-A, Rev 1	COBRA-FLX is used for thermal-hydraulic compatibility analysis and Ch. 15 DNB analysis.
Mixed Core Departure from Nucleate (DNB) Penalty	XN-NF-82-21(P)(A), Rev 1	Penalty applied to MDNBR for mixed cores.
Thermal-Hydraulic Compatibility	N/A	Verified that GAIA is thermal-hydraulically compatible with the co-resident fuel

VQP Analysis Details

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- Thermal Hydraulic (Cont.)

Analysis / Basis	Method	Results
Fuel Rod Bow	XN-NF-75-32P-A Supplements 1-4* Defined in LAR	No rod bow penalties for fresh fuel Gap closure model updated with BAW-10227 Revision 2, Q3P Revision 0
DNB Propagation	XN-NF-82-06P-A Rev 1	No fuel failure predicted for VQP Will be used to quantify fuel failures if necessary
Critical Heat Flux Correlation	ANP-10341P-A Rev 0*	Re-validated in XCOBRA-IIIC and re-validated with PV-Solver in COBRA-FLX
Fuel Centerline Melt Limit (FCM)	EMF-92-081P-A Rev 1* BAW-10231P-A Rev 1	Cycle specific FCM limit calculated RODEX2 replaced with COPERNIC

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Thermal Hydraulic (Cont.)

Analysis / Basis	Method	Results
Statistical Setpoints (OTDT/OPDT/CSLL)	EMF-92-081P-A Rev 1	Verified that the existing setpoints for OTDT, OPDT, and the CSLLs are applicable for GAIA at Callaway
Non-LOCA Chapter 15 Events (DNB/FCM)	EMF-92-081P-A Rev 1 EMF-2310(P)(A) Rev 1*	Acceptance criteria met

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Non-LOCA

Analysis / Basis	Method	Results
Chapter 15 Non-LOCA Events analyzed: - Decrease in FW Temp - Increase in FW Flow - Increase in Steam Flow - Pre-Scram SLB - Post-Scram SLB - Loss of RCP Flow - RCP Shaft Seizure - Uncontrolled Bank Withdrawal - Dropped Rod - Boron Dilution - Inadv. Opening of PORV	EMF-2310P-A Revision 1*	Acceptable

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Non-LOCA (Cont.)

Analysis / Basis	Method	Results
Chapter 15 Non-LOCA Events dispositioned: - Inadvertent opening of a SG relief valve - Turbine Trip - Loss of non-emergency AC power - Partial loss of forced reactor coolant flow - Reactor coolant pump shaft break - Steam generator tube rupture	EMF-2310P-A Revision 1*	Acceptable

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Loss of Coolant Accident - LOCA

Analysis / Basis	Method	Results
Realistic Large Break LOCA	EMF-2103P-A Revision 3*	Acceptable
Small Break LOCA	EMF-2328P-A and S1P-A*	Acceptable

RLBLOCA:
- Best-estimate uncertainty analysis
- Included LOOP and no-LOOP cases

SBLOCA:
- Break spectrum and SI line break analyses
- SI Line break not limiting

} PCT and Oxidation confirmed to meet limits

* Modifications to Approved Methods described on "Methods Changes" slides

VQP Analysis Details

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- Other Analyses Impacted
  - Mass & Energy Release
  - Fuel Assembly Handling
  - Radiological Consequence
  - GSI-191 (Debris Generation and Transport)
  - Spent Fuel Pool Criticality

Technical Specification Change Implications

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- **Cycle 26** – starts late May 2022
  - No Framatome fuel in core
- **Cycle 27** – starts late October 2023
  - 8 Framatome GAIA Assemblies (4 LFAs and 4 VQP) – unrestricted placement
  - Balance of core continues to be Westinghouse-supplied fuel assemblies
  - Presence of Framatome fuel assemblies dictates changes to:
    - TS 2.1.1 - Reactor Core Safety Limits
    - TS 4.2.1 - Fuel Assemblies
    - TS 5.6.5 - Core Operating Limits Report (COLR)
  - Westinghouse methods continue to govern COLR development
    - Framatome evaluations ensure compliance with limits
- *New fuel supplier contract to be established late in Cycle 26 or early in Cycle 27*

Tech Spec Implications (continued)

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- **Cycle 28 –**
  - Batch load quantities of fresh fuel from selected supplier
  - *If Westinghouse is chosen*:
    - Westinghouse methods continue to govern COLR development
      - Framatome evaluations ensure compliance with limits
    - No additional TS changes are needed (current Power Distribution Specs apply)
    - Follow-up LAR after completion of Cycle 29 to remove changes needed for the Framatome assemblies (present in cycles 27, 28 and 29)
  - *If Framatome is chosen*:
    - Framatome methods will govern COLR development
      - Westinghouse evaluations ensure compliance with limits
    - New Power Distribution Limits Specs (TS 3.2.1 – 3.2.3) need to be in place reflecting Framatome methods
    - Follow-up LAR to remove obsolete Westinghouse specifications

Tech Spec Implications (continued)

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- Ameren Missouri will provide a commitment to have only one fuel vendor in order to eliminate concern regarding "mixed fresh fuel batches."
- The requested License Amendment ensures the revised TS are fully in place to allow use of Framatome fuel at the time that the contracts are established
- Therefore, this License Amendment Request (LAR) will:
  - Revise TS 2.1.1 - Reactor Core Safety Limits; TS 4.2.1 - Fuel Assemblies; TS 5.6.5 – COLR as discussed earlier to accommodate Framatome fuel (needed by 9/30/2023)
  - Retain the current Westinghouse TS 3.2.x Power Distribution Limits TS and COLR methods
    - Required for cycle 27 regardless of vendor; and thereafter, if Westinghouse is selected
  - Add the Framatome TS 3.2.x Power Distribution Limits TS and COLR methods
    - Required for cycle 28 if Framatome is selected
  - LCO Applicability will be mutually exclusive to ensure only one vendor's methods govern COLR development
    - **Both vendors may perform evaluations to ensure compliance with limits**

Technical Specification (TS) Changes

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- TS 2.1.1 – Reactor Core Safety Limits
  - Revise to add Framatome DNBR and fuel centerline temperature limits

*Designate Westinghouse Methods-Based as "**A**"*
(Retains Westinghouse-based COLR Methods)

- TS 3.2.1**A** – Heat Flux Hot Channel Factor ($F_Q(Z)$)
- TS 3.2.2**A** – Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)
- TS 3.2.3**A** – Axial Flux Difference (AFD) (RAOC)

*Designate Framatome Methods-Based as "**B**"*
(Adopts Framatome-based COLR Methods)

- TS 3.2.1**B** – Heat Flux Hot Channel Factor ($F_Q(Z)$)
- TS 3.2.2**B** – Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)
- TS 3.2.3**B** – Axial Flux Difference (AFD)

- TS 3.2.4 – Quadrant Power Tilt Ratio (QPTR)
  - Revise Required Actions to refer to Surveillance Requirements with "A" and "B" designations
- TS 4.2.1- Fuel Assemblies
  - Revise to refer to zirconium clad in lieu of Zircalloy or ZIRLO
- TS 5.6.5 – Core Operating Limits Report (COLR)
  - Revise to add Framatome methods to list of methods used to support COLR

Exemption Request

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- M5 Cladding 10 CFR 50.46 and 10 CFR 50 Appendix K Exemption Request
- Similar to M5 cladding exemption requests for other plants

Separate TS License Amendment Request

- Currently updating the spent fuel pool criticality analyses for GAIA fuel
- May require change to TS 4.3, Fuel Storage
- May require change to TS 3.7.16, Fuel Storage Pool Boron Concentration, and TS 3.7.17, Spent Fuel Assembly Storage

Schedule

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- **LAR submittal** — **March 30, 2022**
  - Pre-submittal Meeting – February 28, 2022
  - Ameren/Framatome can support NRC Audit, if requested
- **Requested NRC approval of LAR** — **September 30, 2023**
  - Supports Fuel Cycle 27, RFO begins October 2, 2023

Questions


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