Duke Energy EPU/24 MFC/LEU+ Licensing Tabletop

December 11, 2025

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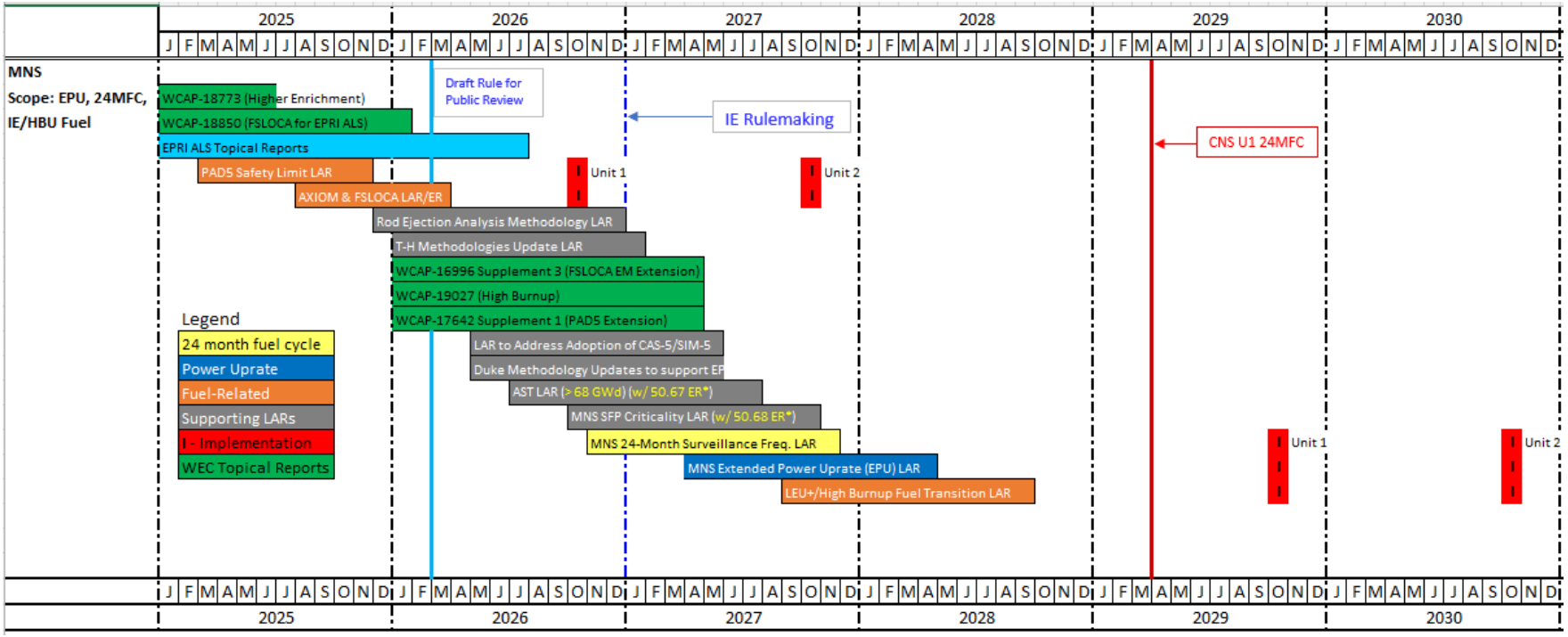
Tabletop Agenda

- Submittal Sequencing including EPU and 24-Month Fuel Cycles (24 MFC)
- Licensing Basis Updates
  - Westinghouse and EPRI Topical Adoption
    - ALS and FFRD
  - Transportation and Delivery
  - Spent Fuel Pool Criticality
  - Duke Energy Methodologies
  - Alternative Source Term (AST)
  - EPU and 24MFC Surveillance Requirement Extension
  - Increased Enrichment/High Burnup Fuel Transition
- Regulation vs Exemption

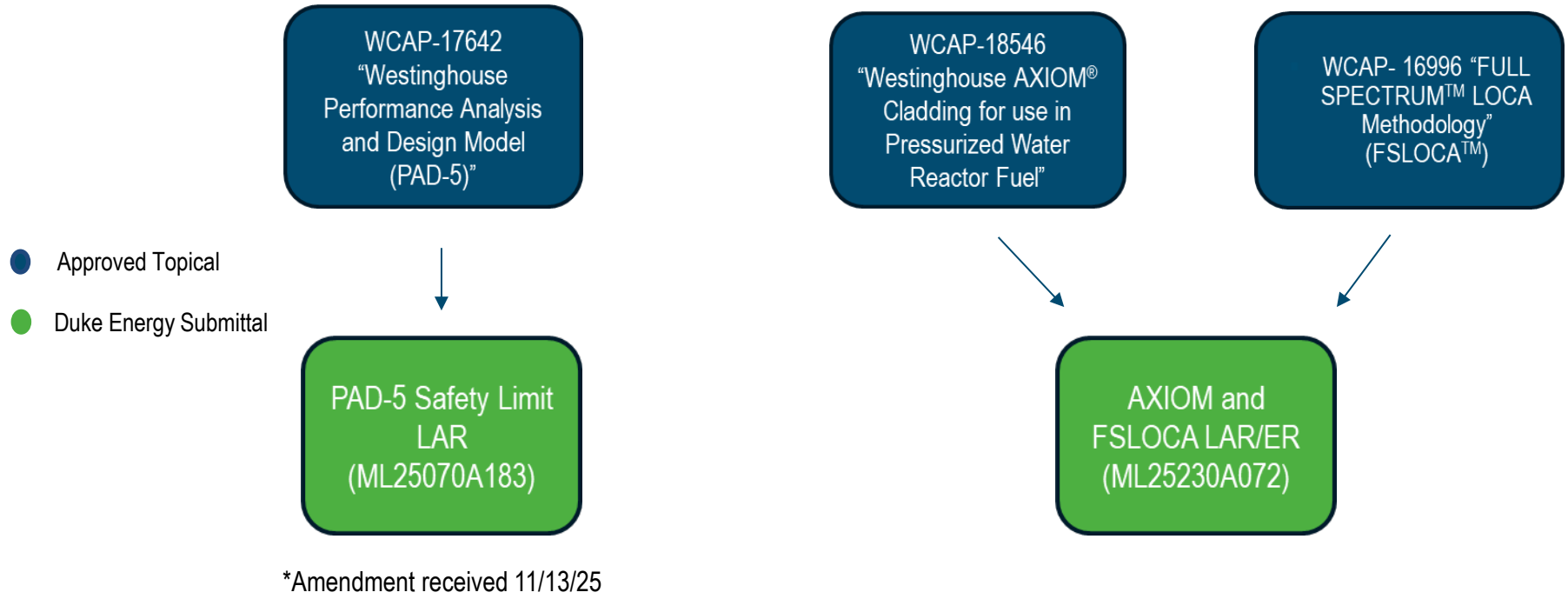
Background

- McGuire Nuclear Station (MNS) Units 1 and 2 are Westinghouse 4-Loop Pressurized Water Reactors (PWRs) with ice condenser containment and Westinghouse fuel.
- Duke Energy is pursuing extended power uprates (EPU) with concurrent fuel cycle extensions from 18 to 24 months for MNS Units 1 and 2 with implementation starting in the Fall of 2029.
- Projects are dependent on plant and fuel licensing changes, including increased enrichment and high burnup
- Fuel licensing strategy includes new or modified in-house methods and adoption of Westinghouse and EPRI topical reports

MNS Submittal Sequencing

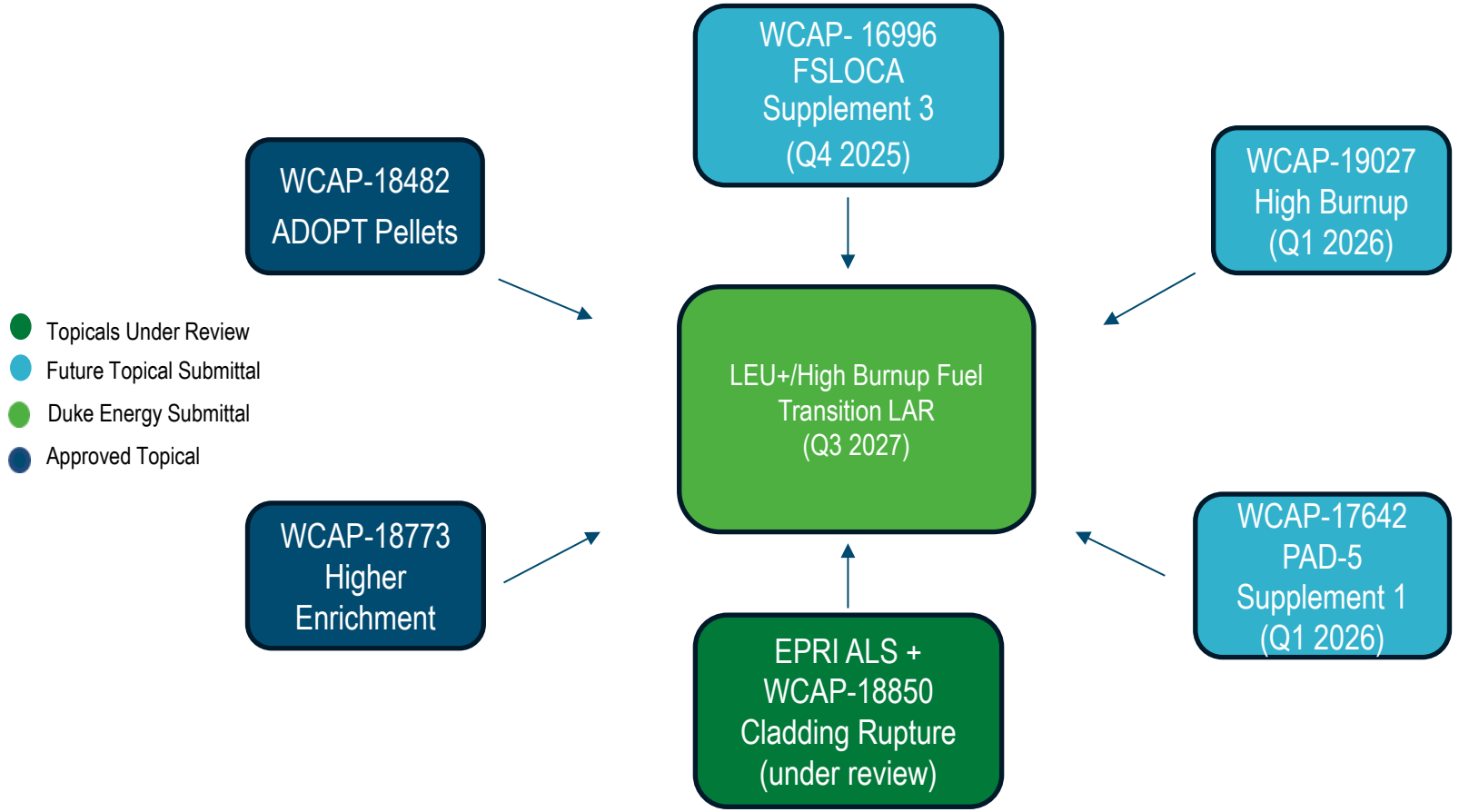


Topical Report Adoption: Submittals in Review



*Amendment received 11/13/25

Topical Report Adoption: Future Submittal



Westinghouse and EPRI Topicals Under NRC Review

Westinghouse Submittal

WCAP-18850: Methodology for Cladding Rupture Calculations

- Submitted February 2024
- Accepted May 2024
- Audited October 2024
- RAI Responses March 2025
- Draft SER July 2025
- ACRS Subcommittee September 2025
- Final SER November 2025

3002028674: LOCA Cladding Rupture Calculations

- RAI Responses Complete
- Draft SER Expected February 2026

EPRI Submittals

3002028673: Alternative Licensing Strategy for Fuel Dispersal

- Submitted April 2024
- Accepted June 2024
- Audits Completed June 2025
- RAI Responses Complete
- Draft SER Expected February 2026

3002023895: xLPR Estimation of PWR LOCA Frequencies

- RAI Responses Complete
- Draft SER Expected February 2026

Westinghouse

ALS Application at MNS

- WCAP-18850 and EPRI ALS reports will be leveraged to address concerns related to fuel dispersal during a postulated LOCA at MNS
  - Demonstration of no cladding rupture for small and intermediate breaks avoids uncertainty associated with assessment of potential consequences from fuel dispersal
- Calculations will follow WCAP-18850 methodology and application described in EPRI Report 3002028674
  - Will utilize McGuire-specific model and operating conditions
    - Examples include uprated power level and T_{cold} upper head temperature

ALS Policy Determination

- Regulatory clarity and predictability on implementation of ALS
  - Uncertainty exists on the need for a Leak Before Break policy exception for site implementation
  - Current understanding is that the NRC will include a policy clarification in the SER for ALS
    - Policy exception will not be required
    - Industry's preferred path for implementation

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Transportation and Delivery

UF6 Delivery:

- Urenco USA has received its license to produce up to 10% enriched uranium
- There are 2 paths currently being pursued for success:
  - Fabrication for the 30B-X cylinder and DN30-X overpack to be used for LEU+. This transport package still needs ANSI certification and DOT approval which is expected sometime between mid 2026 and early 2027.
  - Exemption to allow use of the existing 30B and DN30 transport package.

Transportation and Delivery

Fuel Delivery:

- Traveller-B 71-9380 amendment will be submitted to NRC in March 2026 for review
  - Will request a 12-month review and approval issued prior to April 30, 2027
- Amendment will address package contents of ≤ 8% U-235 with burnable absorber rod requirements, criticality safety index (CSI) = 2.0, no other fuel changes impact the Traveller-B license
- Same Traveller-B as Duke Energy off-spec deliveries. No packaging changes for increased enrichment.
- Standard licensed delivery, no special permit required

Spent Fuel Pool Criticality

- MNS SFP Criticality update in progress with expected submittal 4th Quarter 2026
  - Pre-submittal meeting held (in-person) August 11, 2025
  - Potential for second pre-submittal to address analysis results prior to submission
  - Analyses utilize CASMO-5
    - Pending approval of Studsvik Scandpower's "Supplement for Extended Enrichment, Burnup, and SMRs"
  - Will update criticality safety analysis for new fuel vault and spent fuel pools
- Duke Energy is evaluating including an exemption to 10 CFR 50.68 for increased enrichment limit
  - 10 CFR 50.68(b)(7) - The maximum nominal U-235 enrichment of the fresh fuel assemblies is limited to five (5.0) percent by weight.

Duke Energy Methodologies

- Rod Ejection Accident Analysis Methodology
  - Adoption of Regulatory Guide 1.236
- Implementation of CASMO5/SIMULATE5 (CMS5) neutronic codes
  - Allows for analysis of fuel > 5 wt% U235 and > 62 GWd/MTU rod average burnup
- Core Thermal-Hydraulic Methodologies
  - Update to VIPRE model
- Transient Analysis Methodologies
  - Update to models (RETRAN-3D, RELAP)

Alternative Source Term (AST)

- AST LAR targeted submittal: 3rd Quarter 2026
- Will address burnup greater than 68 GWd/MTU
- Expect to utilize the latest models and methods in Revision 2 of Regulatory Guide (RG) 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors” (DG-1425)
- Environmental Qualification (EQ) Analyses will utilize source term from Technical Information Document (TID) 14844, “Calculation of Distance Factors for Power and Test Reactor Sites”
- Duke Energy is evaluating including an exemption to 10 CFR 50.67 and General Design Criteria (GDC) 19 to allow for a Control Room Dose limit of up to 10 rem
  - Will consider the resulting report from informal assistance request (IAR) NRR-2022-019, “Assessment of Radiation Protection Recommendations for Emergency Workers”

EPU LAR

- EPU LAR targeted submittal: 2nd Quarter 2027
- Uprate to 3700 MWt
  - ~6.7% from current licensed thermal power (3469 MWt)
  - ~8.5% from original licensed thermal power (3411 MWt)
- Will address uprated conditions with 18-month fuel cycles (≤ 62 GWd/MTU)
- Analyses necessary to reflect uprated conditions with 24-month fuel cycles will be contained within the LEU+/ High Burnup Fuel Transition LAR
- Potential overlap with AST LAR utilizing RG 1.183 Rev. 2 (DG-1425)

24 MFC Surveillance Frequency LAR

- Targeted LAR submittal: 4th Quarter 2026
- Update Technical Specification Surveillance Requirement (SR) performance intervals from 18 months to 24 months.
- Timing of submittal allows for adequate resource loading, since the surveillance frequencies can be updated ahead of the actual cycle extension
  - SRs to be performed during refueling outages will still be performed at 18-month frequencies until the point in time when a 24-month fuel cycle can be achieved.
- Will apply the principles of Generic Letter 91-04, “Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle”

Increased Enrichment and High Burnup Fuel Transition LAR

- Bundled submittal to achieve fuel changes needed to support EPU and 24 MFC including:
  - EPRI ALS
  - FSLOCA and PAD5 High Enrichment/High Burnup
  - High Enrichment and High Burnup Topical Reports
  - ADOPT pellets
  - Non-LOCA Chapter 15 Analyses
- Analyses will reflect uprated power conditions for 24-month fuel cycles utilizing the new fuel-related technologies.
  - Will allow the implementation of the power uprate to occur concurrent with the transition to the new fuel technologies and 24 MFC

Regulation vs Exemption

- Potential Exemptions
  - 10 CFR 50.68 for increased enrichment limit
  - 10 CFR 50.67 and GDC 19 for Control Room Dose up to 10 rem
  - Not anticipated that exemption or exception will be needed for adoption of ALS based on the expected policy determination
- Duke Energy's strong desire is for the increased enrichment rulemaking to be approved and issued by January 2027.
  - Based on targeted submission timelines, exemptions may still be submitted with the aforementioned LARs, but completion of rulemaking would provide the clearest path for acceptance and approval

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