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Increased Burnup – LOCA Evaluation Models and FFRD Rupture Analyses (Closed)

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Introduction & Background

LOCA Evaluation Models

FFRD Rupture Analyses

Summary and Next Steps

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Introduction and Background

AFM Increased Burnup with FFRD

- AFM Goal: 24-month fuel cycles with economical core designs with respect to batch size, gad loading, and enrichment

- AFM project goals also introduce new FFRD aspects of the cladding rupture
  - Difference in core loading patterns, higher burnup, with potentially higher peaking and higher internal pressure

    → Potential for more high burnup fuel assemblies, centrally located, with ruptured fuel pins

    → Potential for increased fuel dispersal into the RCS
  - Significant fuel dispersal could inhibit core coolability, changing the previously assumed cooling geometry

LOCA Evaluation Models

LOCA Evaluation Models

Methodology overview

- Base methodologies
  - SBLOCA: EMF-2328 Rev. 0 + EMF-2328 Supplement 1
  - RLBLOCA: EMF-2103 Rev. 3
- Fuel Rod Code
  - ANP-10323P-A Rev. 1, GALILEO

  - ANP-10349P-A Rev. 1, GALILEO Implementation into LOCA

LOCA Evaluation Models

Methodology overview

- SBLOCA is an Appendix K model with built-in conservatism
  - EMF-2328 Supplement 1 approved in 2016

LOCA Evaluation Models

Methodology overview

- RLBLOCA is a best estimate + uncertainty method
  - EMF-2103 Rev. 3 approved in 2016

LOCA Evaluation Models

Existing models must be assessed for impacts from high burnup fuel operation

- EM Decay Heat Models

➢ **Decay heat is not unique to LOCA. The effects of high burnup are universal, but Framatome will address the impacts as they relate to each method.**

LOCA Evaluation Models

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LOCA Evaluation Models

- **Today we will discuss the building blocks of Framatome's approach for evaluating the rupture of high burnup, dispersal-susceptible fuel rods**

FFRD Rupture Analyses

FFRD Rupture Analyses

Summary and Next Steps

Summary

Next Steps – Increased Burnup

- Additional meetings on FFRD issues

- Topical report submittal
- NRC approval

Questions?

Acronyms

AFM – Advanced Fuel Management

AO – Axial Offset

AOR – Analysis of Record

BC – Boundary Conditions

CE – Combustion Engineering

CWO – Core Wide Oxidation

CP-ECR – Maximum allowable time at temperature (expressed as calculated local oxidation)

DBA – Design Basis Accident

ECCS – Emergency Core Cooling System

EOC – End of Cycle

FFRD – Fuel Fragmentation, Relocation, and Dispersal

HBU – High Burnup

LBLOCA – Large Break Loss of Coolant Accident

LB - Large Break

LOCA – Loss of Coolant Accident

MLO – Maximum Local Oxidation

NRC – U.S. Nuclear Regulatory Commission

PCT – Peak Cladding Temperature

PDC – Power Distribution and Control

PWR – Pressurized Water Reactor

RCS – Reactor Coolant system

RIL – Research Information Letter

SCIP – Studsvik Cladding Intergrity Project

tFGR – transient Fission Gas Release

TH – Thermal Hydraulic

RLBLOCA – Realistic Large Break Loss of Coolant Accident

SBLOCA – Small Break Loss of Coolant Accident

W - Westinghouse

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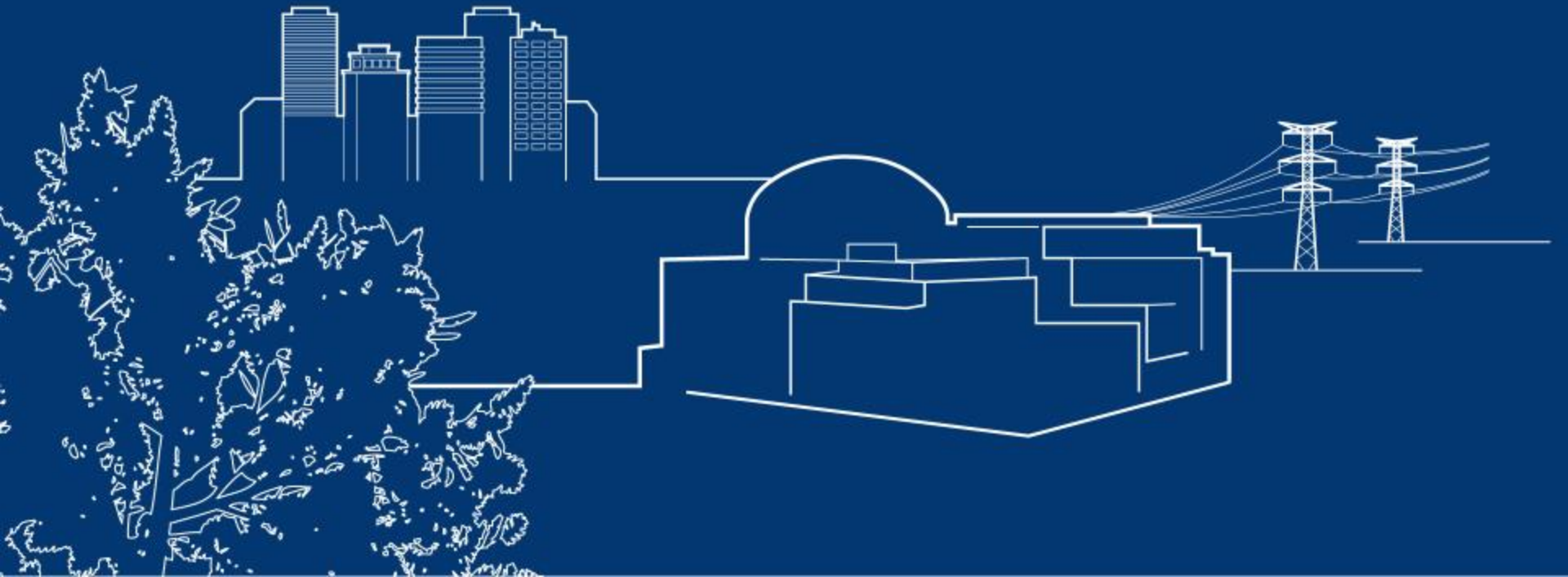
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