

Increased Burnup – focus on Coolability and Criticality

Morris Byram, John Klingenfus & Glen Seeburger

September 15, 2020

Objectives

- Recall Framatome's High Burnup Licensing plan
- Discuss Framatome's progress evaluating FFRD effects
- Focus on Coolability and Criticality for the Increased Burnup Topical Report
- Provide an opportunity for NRC feedback

Agenda

Introduction and background

Core Cooling Following FFRD (closed)

Criticality Following FFRD (closed)

Summary and Next Steps (closed)

Introduction and Background

Morris Byram

Introduction and Background

High Burnup topical pre-submittal meeting to date

Advanced Codes and Methods topical reports

Scope of future topical report submittals – Increased Burnup

High Burnup Topical Report Pre-Submittal Meetings

- Overall High Burnup Topical Report Pre-submittal.....12/18/2020
- FFRD - Use of GOTHIC for Fuel Particle Transport.....2/24/2021
- High Burnup Topical Report Content (Topics and Expected Sample Problems) and Radiological Dose.....5/25/2021
- FFRD – Core Coolability and Criticality..... 9/15/2021

Background – Advanced Codes and Methods

| | |
|----------------------------|---|
| Neutronics | ARCADIA (ANP-10297P-A and S1P-A) |
| Thermal-Hydraulic | COBRA-FLX (ANP-10311P-A Revision 1) |
| CHF | GAIA CHF (ANP-10341P-A) |
| Non-LOCA | ARITA (ANP-10339P) and AREA (ANP-10338P-A) |
| SB LOCA | S-RELAP5 (EMF-2328P-A and S1P-A) |
| LB LOCA | S-RELAP5 (EMF-2103P-A Revision 3) |
| GALILEO in SB and LB LOCA | ANP-10349P |
| Fuel Performance Code | GALILEO (ANP-10323P-A Revision 1) |
| External Loads | ANP-10337P-A and Supplement 1P |
| Fuel Design topical report | GAIA (ANP-10342P-A) with Q12 (ANP-10334P-A) |
| M5Framatome | BAW-10227P Revision 2 |
| Liftoff | BAW-10243P-A (statistical holdown) |
| Cladding Collapse | BAW-10084P-A Revision 3 (CROV) |
| Bow Penalties | XN-75-32P-A |

Scope of Future Submittal - Increased Burnup

Scope

- Umbrella report to address all issues outside of:
 - ANP-10323P-A (GALILEO) &
 - BAW-10227P Rev 2 (M5Framatome)

Range of Applicability

- Burnup – max
- Enrichment – max
- Advanced codes and methods – see previous slides for definition
- Fuel designs - Standard designs (HTP (W15x15, CE14x14, CE16x16) and GAIA 17x17)
- Plants (Westinghouse and Combustion Engineering)

Acronyms

AFM – Advanced Fuel Management

ANS – American Nuclear Society

ANSI – American National Standards Institute

AREA – ARCADIA Rod Ejection Accident

CE – Combustion Engineering

CHF – Critical Heat Flux

DG – Draft Guidance

ECCS – Emergency Core Cooling System

FFRD – Fuel Fragmentation, Relocation, and Dispersal

FPC – Fuel Performance Code

HPU – Hydrogen Pickup

ICSBEP – International Criticality Safety Benchmark Evaluation Project

LBLOCA – Large Break Loss of Coolant Accident

LB - Large Break

LCT – LEU-COMP-THERM

LOCA – Loss of Coolant Accident

NRC – U.S. Nuclear Regulatory Commission

PIE – Post Irradiation Examination

PNNL – Pacific Northwest National Laboratory

PWR – Pressurized Water Reactor

RAI – Request for Additional Information

RCS – Reactor Coolant system

RIA – Reactivity Insertion Accident

RLBLOCA – Realistic Large Break Loss of Coolant Accident

SB – Small Break

SBLOCA – Small Break Loss of Coolant Accident

SRP – Standard Review Plan

W - Westinghouse

Trademarks

ARCADIA, AREA, ARITA, COPERNIC, GAIA, GALILEO, M5_{Framatome}, PROtect, and S-RELAP5 are trademarks or registered trademarks of Framatome or its affiliates, in the USA or other countries.

DOE Acknowledgment and Disclaimer

Acknowledgment: "This material is based upon work supported by the Department of Energy under Award Number DE-NE0008818."

Disclaimer: "This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."

Any reproduction, alteration, transmission to any third party or publication in whole or in part of this document and/or its content is prohibited unless Framatome has provided its prior and written consent.

This document and any information it contains shall not be used for any other purpose than the one for which they were provided. Legal action may be taken against any infringer and/or any person breaching the aforementioned obligations.

framatomē

Thank You!

