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PWR Chromia-doped Fuel – Pre-submittal Meeting

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Agenda

Introduction and background ……..	Jerry Holm
Topical Report Table of Contents	Yusen Qi
Adaptation of GALILEO models ……	Yusen Qi
Qualification database ……	Yusen Qi
Qualification of GALILEO for Chromia-doped Fuel …….	Yusen Qi
Sample problems	
Mechanical ……..	Yusen Qi
LOCA …….....	Nathan Hottle
Non-LOCA ……	Buck Barner
Summary ……	Jerry Holm
Next steps ……...	Jerry Holm

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Objectives

Present plans for Chromia-doped fuel in PWRs

Provide an opportunity for NRC feedback

Introduction and Background

Jerry Holm

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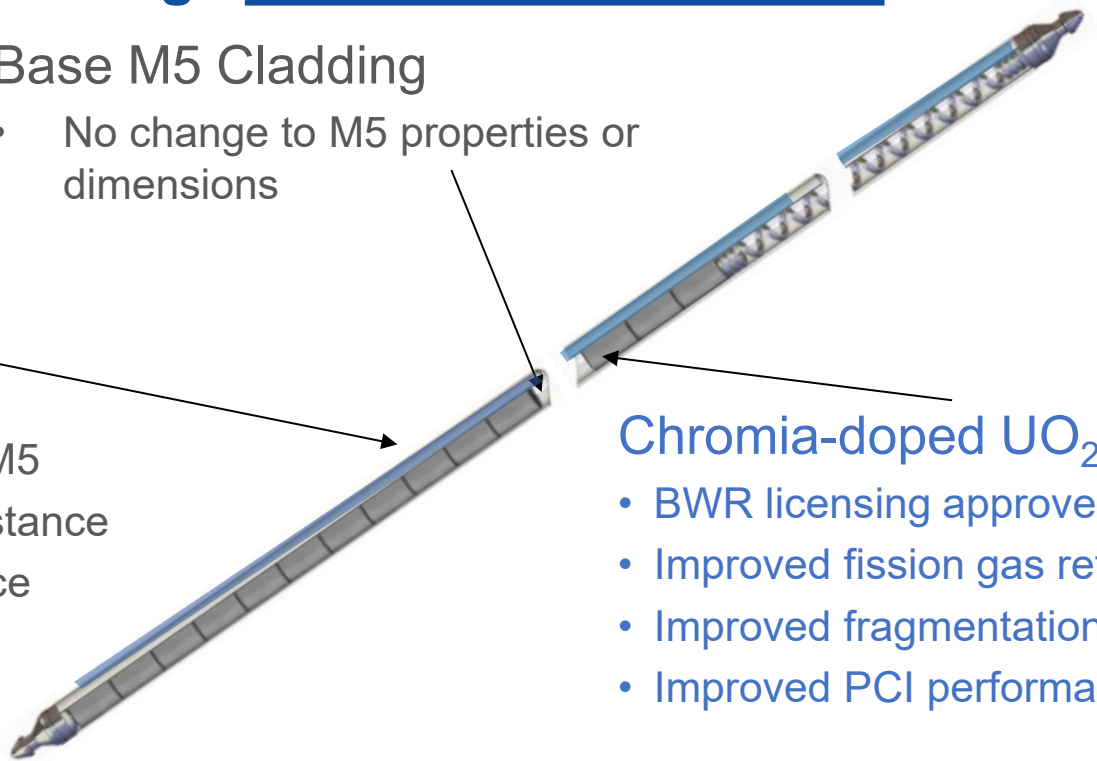
EATF Solution
Cr-Coated Cladding / Chromia-doped Pellets

Base M5 Cladding

- No change to M5 properties or dimensions



Cr-coating

- 10-20 µm
- Does not change base M5
- Improved oxidation resistance
- Improved wear resistance
- Reduced LOCA rupture

Chromia-doped UO_2 pellets

- BWR licensing approved
- Improved fission gas retention
- Improved fragmentation behavior
- Improved PCI performance

Background

ANP-10340PA “Incorporation of Chromia-Doped Fuel Properties in AREVA Approved Methods”

- Base topical report – approved May 2018
- Basic properties
- Implementation into BWR methods

ANP-10340, Supplement 1P “Incorporation of Chromia-Doped Fuel Properties in Framatome PWR Methods”

Table of Contents

Yusen Qi

Topical Report Table of Contents

Introduction

Summary

Applicability of Base Topical Report

Qualification of GALILEO for Chromia-doped Fuel

Qualification of Methods

Licensing Criteria Assessment

Adaptation of GALILEO Models

Qualification Database

Qualification of GALILEO for Chromia-Doped Fuel

Yusen Qi

Adaptation of GALILEO Models

Revised Models

Fuel thermal conductivity model

Fission gas release model

Intragranular gaseous swelling model

Fuel theoretical density

Fuel melting point

Fuel Thermal Conductivity Model

Fission Gas Release Model

Intragranular Gaseous Swelling Model

Theoretical Density Model

Fuel Melting Point

Qualification Database

Qualification Data in Supplement

Qualification of GALILEO for Chromia-Doped Fuel

Thermal Conductivity

Temperature

Temperature

Fission Gas Release

Fuel Rod Internal Pressure

Free Volume

Transient Strain

Density

Sample Problems

Yusen Qi

Sample Problems

The supplement will present sample analyses using PWR methods to illustrate the impact of chromia-doped fuel.

- Thermal mechanical evaluation
  - Fuel rod internal pressure
  - Fatigue
  - Creep collapse
  - Fuel rod oxidation
- Safety analysis
  - LOCA criteria – SBLOCA and RLBLOCA
  - Non-LOCA criteria – ARITA
  - Control rod ejection criteria – AREA

Sample Problems – Normal Operation

Yusen Qi

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Licensing Criteria Assessment – Normal Operation – Preliminary Results

Sample Problems - LOCA

Nathan Hottle

Sample Problems - LOCA

LOCA evaluation models

- ANP-10349P, GALILEO Implementation in LOCA Methods, incorporates GALILEO into Framatome's evaluation models for LBLOCA (EMF-2103 Rev. 3) and SBLOCA (EMF-2328 including Supplement 1)
- For chromia-doped fuel, evaluation models in ANP-10349P will be augmented to include GALILEO version with chromia-doped fuel models

LOCA sample problems

- One LBLOCA and one SBLOCA sample problem to exercise EM and illustrate impact of chromia-doped fuel on LOCA figures of merit

Sample Problems – Non-LOCA

Buck Barner

Sample Problems– Non-LOCA

ARITA – Non-LOCA Safety Analysis

- Perform Uncontrolled Bank Withdrawal from Part Power sample problem to demonstrate impact of chromia-doped fuel on FCM and TCS criteria
- The impact of chromia-doped fuel on the neutronics solution and DNB are negligible.
  - This is based on arguments already presented in the topical for BWR which remain applicable to PWRs.

AREA – Rod Ejection Accident

- Perform sample problem to demonstrate impact of chromia-doped fuel in the AREA method

Licensing Criteria Assessment – AOO – Preliminary Results

Summary and Next Steps

Jerry Holm

Summary

ANP-10340, Supplement 1P

- The supplement will disposition material in base topical report that is not affected by PWR methods.
- The supplement will present the details of required new models for use in PWR methods.
  - Model description
  - Model assessment results
- PWR methods
  - GALILEO – fuel rod thermal mechanical evaluation
  - ARITA – non-LOCA safety analysis
  - AREA – ARCADIA Rod Ejection Accident
  - SBLOCA
  - RLBLOCA

Next Steps

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