EVR_LTR_240168
Enclosure 1

WAAP-13009, Revision 0
"**eVinci™** Microreactor Westinghouse TRISO Fuel Design Methodology Topical Report NRC Pre-submittal Meeting"
(Non-Proprietary)

Westinghouse Electric Company
51 Bridge Street
Pittsburgh, PA 15223

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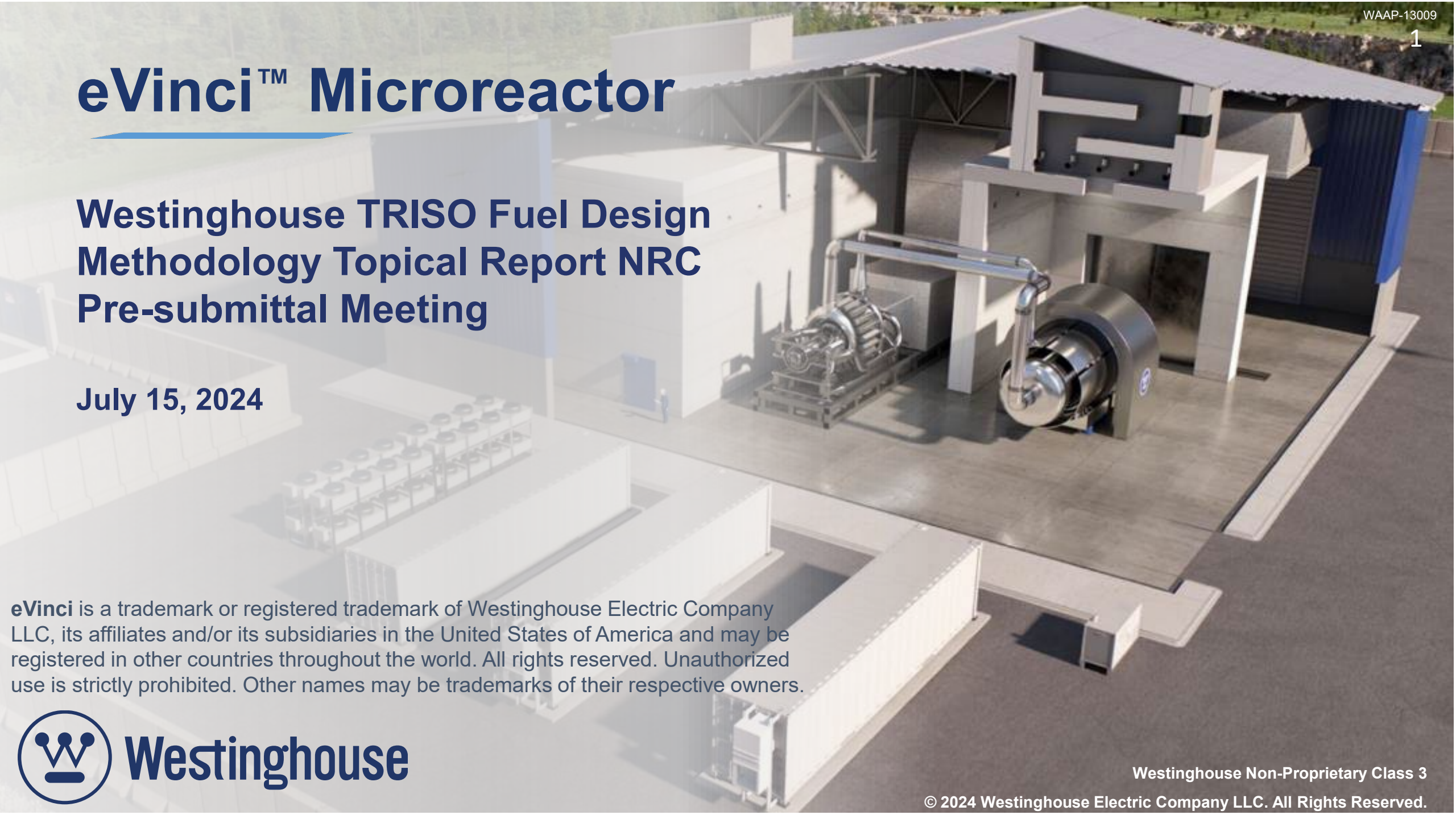
eVinci™ Microreactor

Westinghouse TRISO Fuel Design Methodology Topical Report NRC Pre-submittal Meeting

July 15, 2024



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Agenda

- Purpose and Review Request
- eVinci Microreactor Design Overview
- eVinci Microreactor Deployment Model Overview
- eVinci Microreactor Nuclear Regulatory Commission (NRC) Pre-Application Engagement to Date
- Overview of Westinghouse Tristructural Isotropic (TRISO) Fuel Design Methodology Topical Report
- Topical Report Submittal Schedule
- NRC Review Request
- Questions

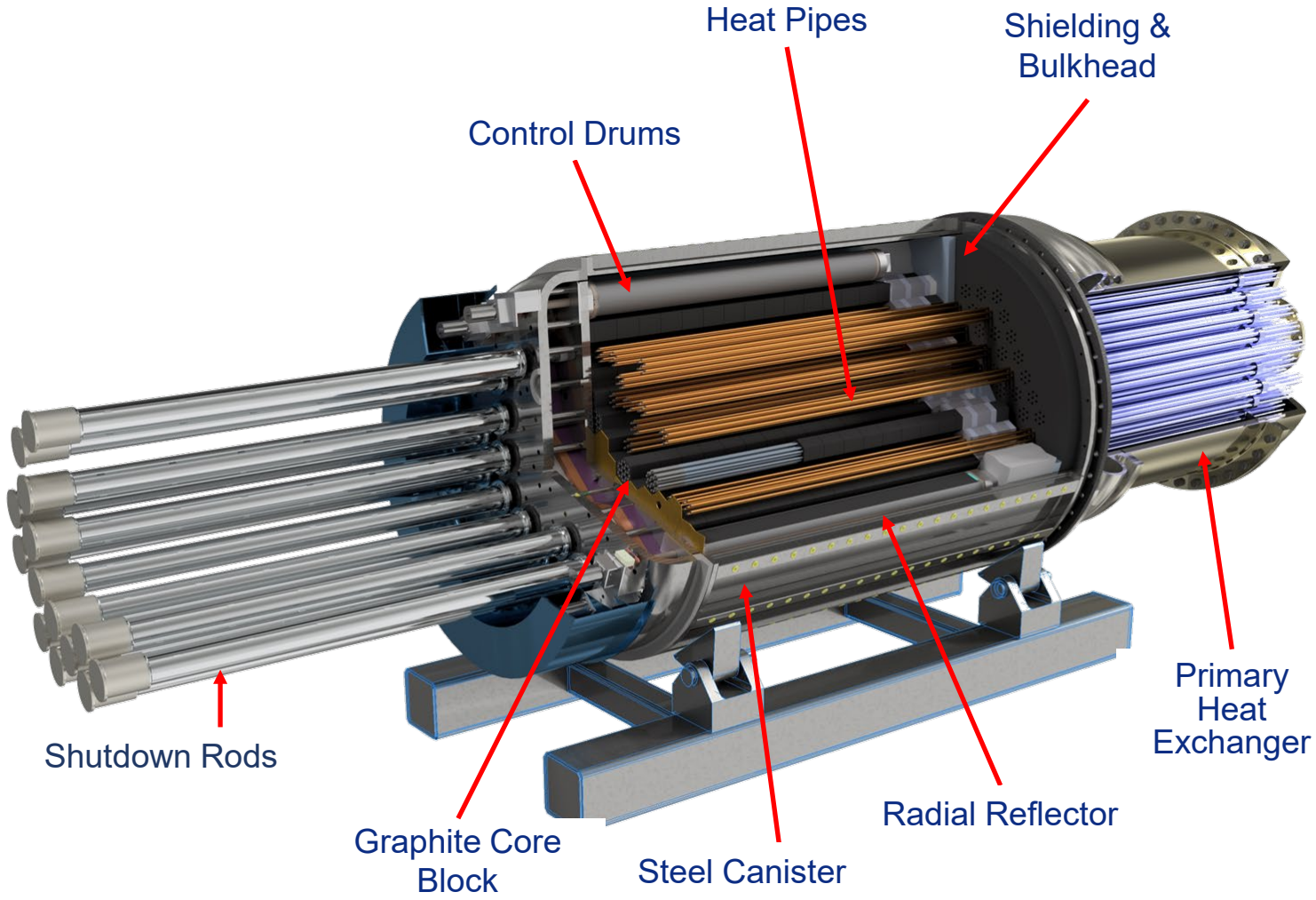
Purpose and Review Request

- To engage NRC staff in a pre-submittal meeting for the Westinghouse TRISO Fuel Design Methodology Topical Report (TR) for the eVinci microreactor
  - Provide an overview of the Westinghouse TRISO Fuel Design Methodology TR
  - Receive NRC staff feedback
- Westinghouse is requesting NRC review and approval for the following:
  - Westinghouse TRISO fuel design methodology for the eVinci microreactor core under normal operation, anticipated operational occurrences (AOOs), and design basis accidents (DBAs), including the following key elements:
    - Fuel manufacturing and quality control
    - Software and analysis methods
    - Plans for code verification and validation (V&V)
    - Uncertainty quantification (UQ)
    - Transient fuel capsule testing

eVinci Microreactor Design

Safety through passive heat pipe technology, enabling a very low-pressure reactor

Parameter	eVinci Microreactor
Power	15 MWt
Fuel Cycle	8 years
Fuel (Enrichment)	TRISO (19.75%)
Coolant	Heat Pipes
Reactor Pressure	~1 atm
Moderator	Graphite
Power Conversion	Open-Air Brayton
Efficiency	34%
Decay Heat Removal	Radial Conduction



eVinci Microreactor Site Layout

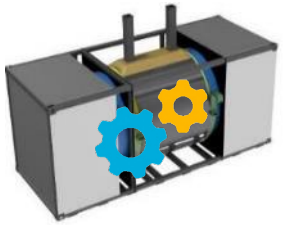
Site and Facility shown for single unit

- All buildings & systems **above ground**
- Reactor site footprint: **< 3 acres**
- Building footprint: <**0.5 acres**

eVinci Microreactor Deployment Model

1 Test reactor for safety feature performance demonstration

Test reactor – testing, data collection and analysis



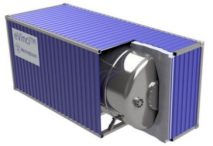
2 eVinci microreactor licensing approval

eVinci Microreactor Deployment

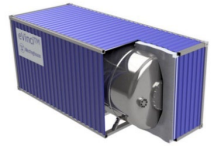
3 Assemble in factory

4 Transport to site

5 Install and operate at site

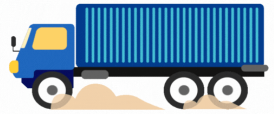


Primary reactor



Replacement reactor

6 Transport away from site



Operated reactor

Remote monitoring station

Limited site staff with remote monitoring

7 Refuel/refurbish

or decommission

8 Fuel storage facility

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Pre-Application Engagement – White Papers

Current Status:
https://www.nrc.gov/reactors/new-reactors/advanced/licensing-activities/pre-application-activities/evinci.html

#	Topic	Submittal Wave	#	Topic	Submittal Wave	#	Topic	Submittal Wave
1	Facility Level Design Description	Submitted - 1	13	Advanced Logic System®(ALS) v2	Submitted - 3	25	Inservice Inspection Program/Inservice Testing Program	Submitted – 5
2	Principal Design Criteria	Submitted - 1	14	Component Qualification	Submitted- 3	26	Post-Accident Monitoring System	Submitted – 5
3	Safety and Accident Analysis Methodologies	Submitted - 1	15	Emergency Plan Zone Sizing Methodology	Submitted - 3	27	Equipment Qualification	Submitted – 5
4	Licensing Modernization Project Implementation	Submitted - 1	16	Physical Security	Submitted - 3	28	Probabilistic Risk Assessment and Transportation Risk Assessment	Submitted – 5
5	Regulatory Analysis	Submitted - 2	17	Heat Pipe Design, Qualification, and Testing	Submitted - 3	29	Fire Protection	Submitted – 5
6	Deployment Model	Submitted - 2	18	Nuclear Design	Submitted - 3	30	Cyber Security	Submitted – 5
7	Safeguards Information Plan	Submitted - 2	19	U.S Transportation Strategy	Submitted - 3	31	Radiation Protection and Contamination Methodology	Submitted – 6
8	Test and Analysis Process	Submitted - 2	20	Phenomena Identification and Ranking Table (PIRT)	Submitted - 4			
9	Functional Containment and Mechanistic Source Term	Submitted - 2	21	Integral Effects and Transient Testing	Submitted - 4			
10	Composite Material Qualification and Testing	Submitted - 2	22	Refueling and Decommissioning	Submitted - 4			
11	Fuel Qualification and Testing	Submitted - 3	23	Seismic Methodology	Submitted - 4			
12	Code Qualification	Submitted - 3	24	Operations and Remote Monitoring	Submitted - 4			

Previously Submitted and Upcoming Topical Reports

#	Report Title	Submittal Date
1	ALS v2 Platform	Submitted (Dec. 2022)
2	ALS v2 Development Process	Submitted (Dec. 2022)
3	Principal Design Criteria	Submitted (Jun. 2023)
4	ALS v2 Technical Specification Surveillance Requirement Elimination	Submitted (Dec. 2023)
5	Nuclear Design Methodology	Submitted (May 2024)
6	Westinghouse TRISO Fuel Design Methodology	Q3-2024
7	Composite Materials	
8	Functional Containment and Mechanistic Source Term	
9	Inservice Inspection	
10	Graphite Materials	
11	Metallic Materials	
12	Inservice Testing	
13	Physical Security Design	
14	Heat Pipe Qualification Criteria	
15	Testing Program	
16	Component Qualification Methodology	
17	Safety Analysis Methodology	

Westinghouse TRISO Fuel Design Methodology Topical Report Overview

Section 1.0 – Introduction

- Purpose
  - Document methodology and analytical tools employed to design and assess performance of uranium oxycarbide (UCO) TRISO fuel for the eVinci microreactor core design
  - Covers fuel manufacturing process, quality control measures, performance analysis through simulation, and testing to validate the behavior of the Westinghouse TRISO fuel under limiting operation and accident conditions
  - Westinghouse is submitting TR for NRC review and approval to support future license applications for the eVinci microreactor
- Applicable Regulations and Regulatory Guidance
  - Intended to demonstrate compliance with applicable regulations, e.g., 10 CFR 50.43(e)(1), 10 CFR 50.34, 10 CFR 52.47
  - Informed by NRC guidance in Regulatory Guide (RG) 1.253, RG 1.203, NUREG-2246, and DANU-ISG-2022-01
  - Consistent with NRC and Canadian Nuclear Safety Commission (CNSC) joint report on TRISO fuel
  - Demonstrates compliance with applicable eVinci microreactor principal design criteria (PDC) provided for NRC review and approval in PDC TR (EVR-LIC-RL-001-P/NP)

Section 2.0 – Summary of the eVinci Microreactor Design and Facility Description

- See design summary provided in Slides 4-5

Section 3.0 – Background on TRISO Fuel Design

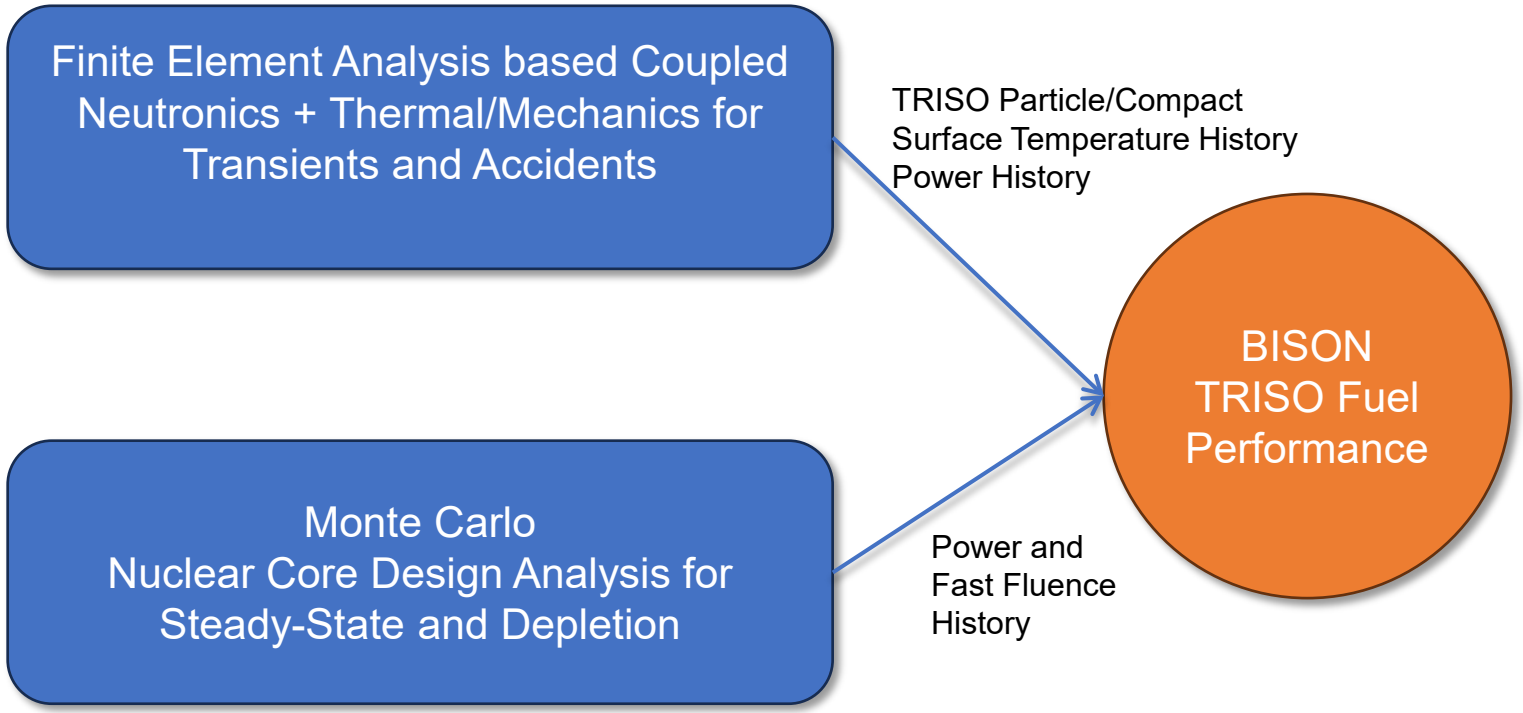
- Provides specifics on Westinghouse TRISO fuel design for use in the eVinci microreactor. Information includes:
  - Fuel particle specification
  - Fuel compact specification
  - Fuel manufacturing and quality control
  - Fuel behavior and failure mechanisms
  - Fuel Capsule Testing
- Provides comparison to Advanced Gas-Cooled Reactor (AGR) TRISO fuel specification and qualification envelope

Section 4.0 – TRISO Fuel Analysis Tool and V&V

- Analysis tool
  - MOOSE-based Bison code and its application to Westinghouse TRISO fuel analysis
  - Material property models
  - Key physical models include:
    - Burnup
    - Fission products production, transport and release
    - Fission gas buildup and internal gas pressure
    - Release/birth ratios for short-lived isotopes
    - TRISO failure mechanisms, including Pd-SiC interaction
- Code V&V and UQ Plan

Section 5.0 – TRISO Fuel Performance Analysis Methodology

- Bison fuel performance analysis
- Single particle model
- TRISO fuel compact model
- Integrated modeling and simulation



Section 6.0 – Technical Specifications Framework and Failed Fuel Monitoring

- Section provided for informational purposes only
  - NRC approval not requested
- PDC 64, Monitoring Radioactive Releases
  - Means shall be provided for monitoring the functional containment performance, effluent discharge paths and facility environs for radioactivity that may be released from normal operations and licensing basis events.
- Online fuel failure monitoring will be provided
- Technical Specifications will be developed to address actions needed in response to fuel failure measurements

Section 7.0 – Summary and Conclusions

- Includes discussion of Limitations and Conditions from NRC Safety Evaluation Report (SER) on Electric Power Research Institute (EPRI) TR
  - Mitigation strategies for Westinghouse TRISO fuel and eVinci microreactor design
- Appendix A – Physical Constants and Conversion Factors

Topical Report Submittal Schedule

- EVR-LIC-RL-003-P/NP, Revision 0, “Westinghouse TRISO Fuel Design Methodology Topical Report” will be submitted in July 2024
- Westinghouse requests Safety Evaluation (SE) within one year of topical report submittal
  - Simplicity of eVinci microreactor design
  - Pre-application engagement to date
    - White paper
    - May 22nd Technical Exchange Meeting

Review Best Practices

- Use of Westinghouse Nuclear Regulatory Affairs Electronic Reading Room to facilitate sharing of information
- Routine clarification calls with NRC reviewers, as needed

Questions

Thank You

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