UNITED STATES
NUCLEAR REGULATORY COMMISSION
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WESTINGHOUSE ELECTRIC COMPANY, LLC. EVINCI™ – SAFETY EVALUATION OF TOPICAL REPORT "NUCLEAR DESIGN METHODOLOGY TOPICAL REPORT," REVISION 0 (EPID L-2024-TOP-0020)

SPONSOR AND SUBMITTAL INFORMATION

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Brief Description of the Topical Report: By letter dated May 15, 2024 (Reference 1), Westinghouse Electric Company, LLC (Westinghouse) submitted the EVR-LIC-RL-002-P/NP, "Nuclear Design Methodology Topical Report," Revision 0, for the U.S. Nuclear Regulatory Commission (NRC) staff's review. The topical report (TR) describes the methodology intended to evaluate neutronics-related characteristics of the eVinci™ microreactor. The methodology relies on the Serpent Monte Carlo code (Serpent) to simulate the behavior of the reactor core for steady-state and depletion analyses. It is intended to contribute to eVinci™'s important core parameters for the safety analysis evaluation model, which is to be described in a future licensing submittal. Serpent is a computer code used for Monte Carlo simulation of neutronics that incorporates continuous-energy cross-sections, reactor component and fuel geometries, temperature effects, and fuel depletion effects, amongst others, to model the neutron interactions in the core and determine criticality and kinetics parameters of interest. The subject TR provides an overview of the eVinci™ microreactor design, a core design description, modeling and calculational details and assumptions used in Serpent, and plans for its verification and validation (V&V).

Enclosure 2

REGULATORY EVALUATION

Regulatory Basis:

The regulations under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," provide general design criteria for water-cooled nuclear power plants similar to those historically licensed by the NRC. Under the provisions of 10 CFR Part 50 and Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," applicants for a construction permit (CP), operating license (OL), design certification (DC), combined license (COL), standard design approval (SDA), or manufacturing license (ML) must include the principal design criteria (PDC) for the proposed facility.

Regulatory Requirements

The following regulatory requirements are applicable to the NRC staff's review of EVR-LIC-RL-002-P:

- Paragraph 50.34(a)(4) of 10 CFR requires, in part, that each application for a CP shall include a preliminary safety analysis report. The minimum information to be included shall include a preliminary analysis and evaluation of the design and performance of structures, systems, and components (SSCs) of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of the SSCs to provide for the prevention of accidents and mitigation of the consequences of accidents.

- Paragraph 50.34(b)(4) of 10 CFR requires, in part, that applications for a CP include PDCs for the facility. An OL would reference a CP and therefore would include the PDCs.

- Paragraph 50.34(a)(8) of 10 CFR requires, in part, that an applicant for a CP describe the research program to resolve any safety questions associated with safety features or components. Such research and development may include obtaining sufficient data pertaining to the safety features of the design to assess the analytical tools used for safety analysis in accordance with 10 CFR 50.43(e)(1)(iii).

- Paragraph 50.43(e)(1)(iii) of 10 CFR requires, in part, that sufficient data exist on the safety features of the design to assess the analytical tools used for safety analyses over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions.

- Paragraph 52.47(a)(3)(i) of 10 CFR requires, in part, that the application for a DC includes the PDC for the facility.

- Paragraph 52.79 (a)(4)(i) of 10 CFR requires, in part, that the application for a COL includes the PDCs for the facility.

- Paragraph 52.137(a)(3)(i) of 10 CFR requires, in part, that the application for an SDA includes the PDCs for the facility.

- Paragraph 52.157(a) of 10 CFR requires, in part, that the application for an ML includes the PDCs for the reactor to be manufactured.

The eVinci™ microreactor core design methods and analyses provide input to the eVinci™ microreactor safety analyses.

Regulatory Guide (RG) 1.231, Revision 0, "Acceptance of Commercial-Grade Design and Analysis Computer Programs Used in Safety-Related Applications for Nuclear Power Plants," (ML16126A183) provides methods that the NRC staff considers acceptable in meeting the regulatory requirements for acceptance and dedication of commercial-grade design and analysis computer programs used in safety-related applications for nuclear power plants. This RG endorses Revision 1 of Electric Power Research Institute (EPRI) Technical Report 1025243, "Plant Engineering: Guideline for the Acceptance of Commercial-Grade Design and Analysis Computer Programs Used in Nuclear Safety-Related Applications," with respect to the acceptance of a commercial-grade design and analysis computer programs associated with basic components for nuclear power plants.

Guidance associated with the performance demonstration requirements of 10 CFR 50.43(e) for advanced non-light water reactors is provided by the NRC in an enclosure to "A Regulatory Review Roadmap for Non-Light Water Reactors," (ML17312B567) and Interim Staff Guidance (ISG) DANU-ISG-2022-01, "Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications - Roadmap" (ML23277A225).

<u>Principal Design Criteria</u>

The TR EVR-LIC-RL-001-A, Revision 1, "Principal Design Criteria Topical Report," (ML24353A097) dated December 17, 2024, provides PDCs for the eVinci™ microreactor design that were reviewed and approved by the NRC staff in the associated safety evaluation (SE) (ML24283A133). The PDCs that have been identified as relating to the methodologies described in TR EVR-LIC-RL-002 include:

- PDC 1, "Quality Standards and Records" - Safety significant SSCs shall be designed, fabricated, erected, and tested to quality standards commensurate with the safety significance of the functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the safety significant function. A quality assurance program shall be established and implemented in order to provide reasonable assurance that these SSCs will satisfactorily perform their safety significant functions. Appropriate records of the design, fabrication, erection, and testing of safety significant SSCs shall be maintained by or under the control of the nuclear power unit licensee for an appropriate period of time.

- PDC 10, "Reactor Design" - The reactor system and associated heat removal, control, and protection systems (along with any SSCs supporting the reactor system and associated heat removal, control, and protection system's safety function(s)) shall be designed with appropriate margin to ensure that specified acceptable system radionuclide release design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences (AOOs).

- PDC 11, “Reactor Inherent Protection” - The reactor core and associated SSCs that contribute to reactivity feedback shall be designed so that, in the power operating range, the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity.

- PDC 12, “Suppression of Reactor Power Oscillations” - The reactor core; associated structures; and associated coolant, control, and protection systems shall be designed to ensure that power oscillations that can result in conditions exceeding specified acceptable system radionuclide release design limits are not possible or can be reliably and readily detected and suppressed.

- PDC 16, “Functional Containment” - A functional containment shall be provided to control the release of radioactivity to the environment and to ensure that the safety significant functional containment design conditions are not exceeded for as long as licensing basis event (LBE) conditions require.

- PDC 25, “Protection System Requirements for Reactivity Control Malfunctions” - The protection system shall be designed to ensure that specified acceptable system radionuclide release design limits are not exceeded during any AOO, accounting for a single malfunction of the reactivity control systems.

- PDC 26, “Reactivity Control” - Reactivity control shall be provided. Reactivity control shall provide:

  (1) A means of inserting negative reactivity at a sufficient rate and amount to assure, with appropriate margin for malfunctions, that the specified acceptable system radionuclide release design limits and the reactor helium pressure boundary design limits are not exceeded, and safe shutdown is achieved and maintained during normal operation, including AOOs.

  (2) A means, which is independent and diverse from the other(s), shall be capable of controlling the rate of reactivity changes resulting from planned, normal power changes to assure that the specified acceptable system radionuclide release design limits and the reactor helium pressure boundary design limits are not exceeded.

  (3) A means of inserting negative reactivity at a sufficient rate and amount to assure, with appropriate margin for malfunctions, that the capability to cool the core is maintained and a means of shutting down the reactor and maintaining, at a minimum, a safe shutdown condition following an LBE.

  (4) A means for holding the reactor shutdown under conditions that allow for interventions such as fuel loading, inspection, and repair.

- PDC 28, “Reactivity Limits” - Any SSCs that provide reactivity control shall be designed with appropriate limits on the potential amount and rate of reactivity increase to ensure that the effects of postulated reactivity accidents can neither: (1) result in damage to the reactor system greater than limited local yielding nor (2) sufficiently disturb the core, its support structures, or other reactor system components to significantly impair the capability to cool the core.

The NRC staff's SE on the eVinci™ microreactor PDCs includes a condition that applications referencing the TR must confirm that the PDCs remain appropriate for the design (ML24283A133). Therefore, the NRC staff determined that the list of PDCs identified above also needs to be confirmed to ensure conformance with the TR on eVinci™ microreactor PDCs. Accordingly, the NRC staff imposed Condition 1 requiring an applicant referencing EVR-LIC-RL-002 to confirm or update the regulatory basis relevant to the use of the described methods.

TECHNICAL EVALUATION

Scope of NRC Review

As reflected in TR section 1.4, "Request for NRC," this SE focuses on the NRC staff's review of the software and analysis methods described in TR section 5.0, "Analysis Methods and Assumptions," the code and solution verification plan described in TR section 6.1, "V&V Plan Verification," and the existing benchmark data combined with the proposed experiments discussed in TR section 6.2, "V&V Plan Validation." Specifically, the NRC staff evaluated the acceptability of Serpent, its application, and the plans for V&V as appropriate means to perform nuclear physics analysis and to provide inputs, as described, for future eVinci™ microreactor safety analyses. The methods described in the TR are preliminary and V&V of these models has not been completed at the time of this review. Therefore, the NRC staff makes no finding concerning the results of the analyses performed using these methods, including the use of those results to demonstrate conformance with PDCs or any other regulatory requirements. The NRC staff will review those, as requested, as part of future TRs or license applications. As such, the NRC staff imposes Limitation 1 in the SE section, Limitations and Conditions. Further, TR section 1.0, "Introduction"; section 2.0, "Summary of the eVinci™ Microreactor Design and Facility Description"; section 3.0, "Background on Nuclear Design Analysis"; section 4.0, "eVinci™ Microreactor Core Design Description"; section 7.0, "Summary"; appendix A, "Demonstration of Core Analysis"; appendix B, "Demonstration of Verification"; and appendix C, "Demonstration of Validation"; which include the description of the eVinci™ microreactor design, were considered by the NRC staff to inform aspects of the review of section 5.0, "Analysis, Methods, and Assumptions," and section 6.0, "V&V Plan," but were not within the scope of this SE.

eVinci™ Microreactor Design Overview

As discussed in TR section 2, the proposed conceptual design for the eVinci™ microreactor is a high temperature, heat pipe-cooled, thermal spectrum, 15 MW_{th} reactor. The reactor core is fueled with high-assay, low-enriched uranium tri-structural isotropic (TRISO) fuel and consists of horizontal hexagonal graphite blocks with channels for fuel, burnable absorbers, alkali metal heat pipes, and shutdown rods. The core is surrounded by a radial reflector that houses control drums designed to manipulate core reactivity and allow the otherwise subcritical core to achieve criticality when the drums are specifically oriented. The control drums and shutdown rods provide independent, diverse means of achieving sub-criticality (shutdown).

The reactor core and reflector are contained within a canister that makes up an element of the functional containment design, with the layers of the TRISO fuel particles representing the other physical barriers. The vessel is filled with helium gas to enhance decay heat removal, which can be accomplished through the core block, radial reflector, core containment system (vessel), and shielding. Reactor heat produced for power generation (15 MW_{th}) will be removed through alkali metal heat pipes and a primary heat exchanger (PHX) and will be converted to electric power (~5MW_e) through an open-air Brayton cycle power conversion system (PCS).

The eVinci^{TM} microreactor concept is designed such that the reactor canister and core, and the support and PCS, can be transported in shipping containers by truck, rail, or waterway to an approved reactor site that has been appropriately constructed and prepared. Following installation at the site, criticality testing and subsequent operation will commence and continue under remote monitoring with limited on-site operations, maintenance, and security staff until the core reaches end-of-life. Following a reactor's operation, a replacement reactor can be shipped to and installed at the site in its place, while the spent reactor is allowed to cool until it is ultimately removed from the site for refurbishment, refueling, and/or decommissioning, as appropriate.

1.0 Overview of Nuclear Design Methodology

Section 5 of the TR presents the nuclear design methodology proposed for analyzing the eVinci^{TM} microreactor. The Serpent code, which is used for analysis of the eVinci^{TM} microreactor, is introduced and the Serpent eVinci^{TM} microreactor simulation configuration is described. Details for calculating important reactor core physics parameters and key safety parameters (e.g., keff, control drum worth, reactivity coefficients, and power distribution) are described.

The NRC staff reviewed the information provided and assessed TR section 5.1, "Serpent Monte Carlo Computer Code"; section 5.2, "eVinci^{TM} Microreactor Serpent Simulation Configuration"; section 5.3, "Types of Analyses Performed"; and consolidated subsections. The following SE sections detail the NRC staff's review of the methodology described.

1.1 Serpent Monte Carlo Computer Code

The NRC staff reviewed the use of Serpent to perform reactor physics calculations, as well as to perform neutron and photon transport calculations for dose rate and shielding calculations. Particularly, the NRC staff assessed Serpent's capabilities for geometry and particle tracking, interaction physics, and depletion calculation.

With respect to geometry and particle tracking, the NRC staff considered that Serpent allows for flexibility in 2D and 3D spaces, and that it contains an independent routine to randomly distribute fuel particles within a fixed volume, which enables modeling of fuel components containing TRISO fuel. The NRC staff finds that Serpent provides modeling flexibility with adequate spatial specificity to accurately represent the eVinci^{TM} microreactor core design. Serpent aligns with well understood principles of nuclear physics and engineering. Therefore, Serpent will provide accurate core performance calculations.

The interaction physics in Serpent are based on classical collision kinematics, evaluated nuclear data file (ENDF) reaction laws, and probabilistic tables. Continuous-energy cross-sections are read from an ACE (A Compact ENDF) formatted data library. The NRC staff noted that Serpent also includes a coupled neutron-photon transport mode which allows for the calculation of heat deposition in coolant and structural materials. The NRC staff finds that ENDFs provide adequate accuracy in core calculations as well as repeatability and reliability. Additionally, the use of the built-in doppler-broadening routine and target motion sampling techniques are reasonable to describe the temperature dependence of resonance regions.

Serpent includes the ability to automatically sub-divide a problem into depletion zones based on common zoning schemes. Serpent can then use an integral Bateman equation solver to describe changes in material composition through depletion. Important nuclides such as Xe-135 and Sm-149 can be handled separately to determine equilibrium concentrations. The NRC staff notes that the ability to sub-divide a depletion calculation provides greater accuracy and can more accurately describe core behaviors throughout the core lifetime. Fission product chain calculations provide a detailed description of isotope production and behavior in the core, and separate handling of important isotopes which provides greater accuracy.

Serpent outputs provide eigenvalue estimations, depletion calculations, and heterogenous and homogeneous group constants. User-defined detectors can be utilized to output neutron and photon reaction rates and dosimetry data. The NRC staff finds that the calculation of homogenous and heterogenous group constants provides diverse calculation methods. User-defined detectors and response functions support dosimetric calculations which are consistent with well understood principles of nuclear engineering and health physics.

1.2 eVinci™ Microreactor Serpent Simulation Configuration

The NRC staff reviewed the simulations performed to characterize the reactor physics behavior of the core at normal operating conditions throughout core life, which are necessary to quantify the core reactivity and burnup characteristics, power distributions, reactivity coefficients, kinetics parameters, and control component worths as a function of core lifetime. Particularly, the NRC staff evaluated the model input and simulation parameters and the model assumptions.

[[redacted]] The NRC staff finds the model boundary to be generally acceptable as it properly encapsulates all relevant phenomena. The [redacted]] boundary condition has been commonly used within the nuclear industry. The NRC staff concludes that the use of [redacted]] for depletion calculations is sufficient and supports further study of material depletions.

Westinghouse made several assumptions for the simulations including:

- [redacted]

- [redacted]
- [redacted]
- [redacted]]]

The NRC staff finds that the assumptions are acceptable for the purpose of demonstrating the modeling approach and capability of the software. Consistent with Limitation 1, however, the NRC staff does not make any conclusions concerning the results of analyses using these assumptions, and notes that Westinghouse states that it will perform further analyses regarding the impact of model assumptions. The NRC staff notes that the model [[redacted],]] are not fully accounted for. This would be addressed in subsequent submittals by [[redacted]]. Currently Westinghouse [[redacted]]. As such, the NRC staff imposes Condition 2 in the SE section, Limitations and Conditions.

1.3 Types of Analyses Performed

Westinghouse uses Serpent to calculate key reactor physics parameters. The NRC staff notes that analyses can be performed at any operating condition of interest. In the future, the same techniques may be used for other analyses and may require reactor physics data at different operating conditions of interest, such as [[redacted]]. The NRC staff reviewed the analytical approach, as described by Westinghouse, for core depletion, reactivity worth, control rod worth and shutdown margin, reactivity coefficients, and kinetics parameters.

1.3.1 Core Depletion

[[redacted]]. The NRC staff finds this to be sufficient for the preliminary design stage and captures the most expected operational core conditions.

[[redacted].]] The NRC staff finds that both methods for determining the CDP are sufficient. Both methods will accurately converge to the CDP for a particular core condition and provide relevant information for operational parameters.

[[redacted]

[redacted]]]
The NRC staff finds this to be adequate for flux profiles and power distributions.

1.3.2 Reactivity Worth

[[redacted]]] The NRC staff reviewed the formulations used to determine the control drum worth and determined that they are based on well understood principles of nuclear physics and engineering. These are acceptable because they can provide accurate results for the eVinci™ microreactor design.

1.3.3 Reactivity Coefficients

Reactivity coefficients are calculated to understand the impact of changes in component temperatures on core reactivity during normal operation, AOOs, and design basis and beyond design basis accidents. Reactivity coefficients can be evaluated for the following components:

- [[redacted]]]

The NRC staff finds the reactivity coefficients of interest that are listed sufficiently capture relevant reactivity effects in the core. The NRC staff reviewed the formulations used for the various reactivity coefficients and determined that they are based on well understood principles of nuclear physics and engineering. These are acceptable because they can provide accurate results for the eVinci™ microreactor design.

1.3.4 Kinetics Parameters

Kinetics parameters are necessary for certain downstream transient accident analyses and are output from Serpent calculations by default. There are several different approaches that can be taken to estimate these parameters in Monte Carlo codes. The approach used in Serpent is to tabulate and output these values using the iterated fission probability methodology similar to Monte Carlo N-Particle Transport Code. The NRC staff reviewed the iterated fission probability methodology and determined that the methodology is based on well understood principles of nuclear physics and engineering. These are acceptable because they can provide accurate results for the eVinci™ microreactor design.

Calculation of other quantities using Serpent may be required by other areas of analysis. This could include, for example, xenon worth curves, total power defect, or total temperature defect. These quantities will be calculated when it is determined that there is a need. Furthermore, safety analyses that use the results of the core analysis may require quantities (e.g., power distributions and drum worths) to be calculated at [[redacted]

[redacted].]] The NRC staff notes that it is reasonable to expect that these additional parameters can be calculated based on Serpent code capabilities and underlying calculational methods. These calculations will be reviewed by the NRC staff as they are submitted to the NRC for approval.

2.0 Verification and Validation Plan

TR section 6.0, “V&V Plan,” provides an overview of the V&V Plan that will be used to qualify Serpent for modeling the eVinci™ microreactor nuclear core.

2.1 Verification

Planned verification activities are described in TR section 6.1, “Verification.” Specifically, two components to the verification process are described: code verification and solution verification.

For code verification, Westinghouse developed a testing suite to test the critical characteristics of the code, as described in EVR-RXS-GL-008, Revision 0, “Commercial Grade Dedication for Serpent 2 for Nuclear Design Analysis;” [[[redacted].]] The NRC staff reviewed the verification methodology described in the Westinghouse supporting document EVR-RXS-GL-008, and agreed that it appears to be consistent with Verification Method 1 described in EPRI 1025243, Revision 1, endorsed by the NRC in RG 1.231. The NRC staff finds the specific verification tests described in EVR-RXS-GL-008 to be acceptable to support the qualification of Serpent for modeling the eVinci™ microreactor nuclear design.

Three aspects of solution verification are described in section 6.1.2, “Solution Verification,” of the TR: verification of the input data, verification of the output data processing tools, and the estimation of numerical errors in the solution. Solution verification, as described in TR section 6.1.2, will be performed for the eVinci™ microreactor model, as well as [[[redacted]]] The NRC staff notes that the error minimization tools outlined in the TR are widely used throughout the nuclear industry and can provide a moderate degree of protection against human performance errors; thus, the NRC staff finds the descriptions of error minimization tools to be adequate.

TR section 6.1.2.2, “Estimation of Numerical Error,” explains how numerical errors will be estimated during solution verification. Important metrics to be evaluated for numerical errors include [[[redacted]

[redacted]]]

The NRC staff notes that the methods to estimate the numerical errors described in TR section 6.1.2.2, "Estimation of Numerical Error," are commonly used within the nuclear industry to assess the impact of various modeling approximations. As such, the solution verification plan described in TR section 6.1 is adequate to support the qualification of Serpent for modeling the eVinci™ microreactor nuclear design.

2.2 Validation

Planned validation activities are described in TR section 6.2. Westinghouse plans to use existing validation experimental data as well as to create validation test plans that include first-of-a-kind materials and components for which specific tests are planned to validate modeling capabilities and demonstrate the safety and operability of the eVinci™ microreactor. [[redacted]] and two tests which include a comparison to a criticality test using prototypic eVinci™ microreactor fuel and geometry (eDeimos Criticality Test) as well as a [[redacted]] eVinci™ nuclear test reactor (NTR) to be operated at Idaho National Laboratory.

[[redacted].]]

The [[redacted]] are [[redacted]] to the eVinci™ microreactor design: [[redacted]]. However, the NRC staff notes that the [[redacted]] have been analyzed to have [[redacted]]. The NRC staff finds this acceptable as one aspect of the validation methodology, to be used along with the other described validation activities.

The eDeimos Criticality Test setup [redacted]]] The test will provide validation data [[redacted]]

The NRC staff finds that the [[redacted]] demonstrates [[redacted]] is based on the current designs of the eVinci™ microreactor and eDeimos, which have not been finalized. Thus, consistent with Limitation 1, Westinghouse should determine the similarity coefficient of the finalized designs to demonstrate the applicability of the eDeimos Criticality Test.

The NTR is a scaled version of the eVinci™ microreactor, with a maximum power of **[[**[redacted].**]]** The NTR test is intended to validate Serpent modeling capabilities for many analyses of the eVinci™ microreactor, such as **[[**[redacted]**]]**. The test will provide validation data **[[**[redacted].**]]**

The NRC staff finds that a scaled version of the eVinci™ microreactor can reasonably be expected to provide insights to support eVinci™ microreactor operation for both steady-state and **[[**[redacted]**]]**. The NRC staff notes that a **[[**[redacted]**]**, indicates that the NTR should demonstrate **[[**[redacted]**]]**. The **[[**[redacted]**]]** is based on the current designs of the eVinci™ microreactor and NTR, which have not been finalized. Thus, consistent with Limitation 1, Westinghouse should analyze the similarity coefficient of the finalized designs to demonstrate the applicability of the NTR for validation purposes.

LIMITATIONS AND CONDITIONS

An applicant may reference the TR for use as applied to the applicant's facility only if the applicant demonstrates compliance with the following limitations and conditions:

Condition 1:

A license application referencing this TR must confirm or otherwise justify the regulatory basis and the PDCs listed in this TR for the assessments that use the described methods.

Limitation 1:

The TR describes analytical methodologies that are still under development. Therefore, the NRC staff's approval of the methods in this TR is limited to the general use of Serpent and the described model assumptions. The acceptability of the implementation of specific models or calculational techniques, model results, and their use to demonstrate conformance with regulatory requirements for the construction and operation of a facility, including PDCs, will be the subject of future reviews or license applications.

Condition 2:

[[[redacted]**]]**. Due to this simplification, certain physical characteristics such as doppler effects on cross-sections are not fully accounted for in the evaluation. Future submittals must address this through coupled calculations of Serpent with a thermal properties analysis code or provide justification as to why thermal properties coupling is not needed. Final acceptability of the nuclear design analysis is subject to the NRC staff's review of future submittals.

CONCLUSION

The NRC staff has determined that Westinghouse's TR provides an acceptable methodology for steady-state and depletion analysis of the eVinci™ microreactor because: (1) the underlying calculational methods and techniques used in the model are acceptable approaches to represent the physical phenomena of interest to be modeled because the calculational methods and techniques rely on sound principles of engineering and adequately reflect the underlying physics being modelled, as appropriate; (2) the discussion includes appropriate consideration of model and design uncertainty; and (3) subsequent development, finalization, verification, validation, and implementation of the described methods and models will be completed in accordance with applicable technical knowledge and expertise. This approval is subject to the limitations and conditions discussed above. Accordingly, the NRC staff concludes that Westinghouse's TR can be used to support reactor licensing applications for permits, licenses, certifications, or approvals under 10 CFR Parts 50 or 52.

REFERENCES

1. Westinghouse Electric Company (Westinghouse). "Submittal of the Westinghouse Nuclear Design Methodology Topical Report for the eVinci™ Microreactor (EVR-LIC-RL-002-P/NP)," Revision 0, (ML24137A245), May 15, 2024.

2. Westinghouse "Submittal of Westinghouse Principal Design Criteria Topical Report (EVR-LIC-RL-001-P-A/NP-A)," Revision 1, (ML24353A097), December 17, 2024.

3. U.S. Nuclear Regulatory Commission (NRC), "Report for the Regulatory Audit regarding Westinghouse Electric Company's Nuclear Design Methodology Report" (ML25184A372), August 29, 2025.

4. U.S. NRC, "Westinghouse Electric Company, LLC. - Final Safety Evaluation for Topical Report EVR-LIC-001-P/NP, Westinghouse Principal Design Criteria Topical Report for the eVinci™ Microreactor" (ML24283A133), October 16, 2024.

5. U.S. NRC, Regulatory Guide 1.231, Revision 0, "Acceptance of Commercial-Grade Design and Analysis Computer Programs Used in Safety-Related Applications for Nuclear Power Plants," (ML16126A183), January 2017.

6. Electric Power Research Institute, 2013 Technical Report Revision 1 of 1025243, "Plant Engineering: Guideline for the Acceptance of Commercial-Grade Design and Analysis Computer Programs Used in Nuclear Safety-Related Applications," (ML14085A084), December 2013.

7. U.S. NRC, "A Regulatory Review Roadmap for Non-Light Water Reactors," (ML17312B567), December 2017.

8. U.S. NRC, "Interim Staff Guidance: Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications – Roadmap," (ML23277A225), 88 FR 33924, May 25, 2023.

9. Westinghouse EVR-RXS-GL-008, "Commercial Grade Dedication of Serpent 2 for Nuclear Design Analysis," Revision 0, (ML25323A314), November 19, 2025.

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