U.S. NUCLEAR REGULATORY COMMISSION

REQUEST FOR ADDITIONAL INFORMATION

OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE REVIEW OF WESTINGHOUSE ELECTRIC COMPANY

TOPICAL REPORT WCAP-16260-P/WCAP-16260-NP, REVISION 2,

"THE SPATIALLY CORRECTED INVERSE COUNT RATE (SCICR) METHOD

FOR SUBCRITICAL REACTIVITY MEASUREMENT"

EPID L-2017-TOP-0064

1.0 INTRODUCTION

By letter dated December 14, 2017, Westinghouse Electric Company (Westinghouse) submitted Topical Report (TR) WCAP-16260-P/WCAP-16260-NP, Revision 2, "The Spatially Corrected Inverse Count Rate (SCICR) Method for Subcritical Reactivity Measurement," for U.S. Nuclear Regulatory Commission (NRC) review and approval. The NRC staff is reviewing the TR and has determined that additional information is required to complete its review.

2.0 REGULATORY BASIS

Section 50.34, "Contents of Applications; Technical Information," of Title 10, "Energy," of the *Code of Federal Regulations* (10 CFR), requires that safety analysis reports be submitted that analyze the design and performance of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents. As part of the core-reload-design process, licensees or supporting vendors perform reload safety evaluations to ensure the safety analyses remain applicable to the as-designed cycle. Testing provides further assurance that the cycle will operate in conformance with its design, and hence within the constraints of the safety analyses and supporting evaluations.

Section XI, "Test Control," of 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," requires that a test program be established to ensure that structures, systems, and components will perform satisfactorily in service. All functions necessary to ensure that the specified design conditions are not exceeded during normal operation and anticipated operational occurrences must be tested. This testing is an integral part of the design, construction, and operation of the plant.

3.0 REQUEST FOR ADDITIONAL INFORMATION

1) The Standard Technical Specification (STS) BASES identify five distinct tests required for startup physics testing. **[**

   ] Please describe how the SCICR method addresses testing for critical boron concentration with control rods inserted.

Alternatively, discuss whether this testing parameter is not considered within the scope of SCICR, or provide a justification as to why such testing is unnecessary.

2) In the TR's **[ ]** Westinghouse states that the factor includes a **[ ]** function, which "can be calculated **[ ]** as described in WCAP-13360-P-A, "Westinghouse Dynamic Rod Worth Measurement Technique."[1] **[ ]**

   a. Explain how the spatial **[ ]** is determined in greater detail, including discussion that describes what ensures that the **[ ]** function does not inadvertently introduce calculational error or bias, or if such potential exists, how it is accounted for in the overall SCICR methodology.

   b. Provide, as an illustrative example, a description of how the **[ ]** was calculated for use in one of the demonstrations provided in Chapter 4.

   c. The TR notes that, **[ ]** *W* **[ ]** is fixed." Explain whether this means that *W* is calculated specifically:

      i. for each plant where SCICR is applied,

      ii. on a cycle-specific basis, or

      iii. generically for each plant type in which SCICR is applied.

   d. Regardless of the approach taken for Item 2.c, above, provide a justification that the approach provides a valid spatial **[ ]** in all cases it is applied.

3) **[ ]** Westinghouse notes that the presence of an extraneous source is typically omitted from routine core design calculations, but that its presence can be included in order to determine this factor. Provide additional information about the modeling of the extraneous source for this purpose:

   a. Provide a brief summary that explains whether the NRC staff review for the nuclear design codes currently in use (e.g., PHOENIX-P/ANC)[2] specifically considered modeling subcritical conditions and the presence of an extraneous source.

   b. Explain whether any code changes or software modifications were required, subsequent to NRC approval, either to provide a capability to model extraneous sources, or to facilitate, more generally, the use of the nuclear design codes to support the SCICR methods.

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[1] Agencywide Documents Access and Management System (ADAMS) Accession No. **[ ]** (Proprietary)

[2] WCAP-11596-P-A, ADAMS Accession No. **[ ]** (Proprietary)

c. If code changes were required, provide a summary of the quality assurance methods used to establish that the codes have an adequate predictive capability to model the extraneous sources. Include specific information that demonstrates such modeling capabilities are adequate.

4) Reviewing **[ ]** in Section 3.1 of WCAP-16260-P/WCAP-16260-NP, Revision 2, it is suggested that the state points that a core progresses through during an approach to criticality are known ahead of time and **[ ]** Describe whether a plant could proceed through SCICR testing with deviations in the planned approach that may not be reflected in the calculations **[ ]**

5) Chapter 4 of WCAP-16260-P/WCAP-16260-NP, Revision 2, provides details and results of several subcritical physics testing (SPT) applications. The discussion for some of the tests notes that the initial results are normalized. **[ ]** Without further qualification, this statement implies that the measured inverse count rate ratios may be somehow adjusted, **[ ]** Explain why the normalization is appropriate and necessary, and describe how it is performed. Confirm that the normalization is precluded from introducing, or is unlikely to introduce, a **[ ]** effect **[ ]**

6) The comparison of measured-to-predicted ICRR data **[ ]** requires an assumption that the predicted values contain zero or negligible error. However, it is understood that there are various sources of uncertainty associated with these predicted values, which could be introduced either by the core design modeling, **[ ]** used to determine the predicted detector responses. The uncertainties have the potential to introduce error in the predicted ICRR values. Provide an estimate of the analytic uncertainty associated with the predicted ICRR data and demonstrate that this uncertainty is sufficiently small as to be neglected.

7) A complete understanding of the process **[ ]** requires synthesis of material described in Sections 1.6, 2.3, 3.1, and 3.2.2 of the TR. An example of the process is necessary to ensure that a complete understanding can be obtained from the material referenced above, and to ensure that the calculation **[ ]** represents a valid implementation of the spatial correction theory described in Chapter 2 of the TR. For one of the demonstrations addressed in Chapter 4, provide a step-by-step description of the calculational procedure employed **[ ]** Describe the computer codes used, explain how many reactivity changes were modeled, explain the extent to which the predicted detector responses changed, describe whether the measured detector responses required any adjustment or renormalization, and explain whether other regression parameters changed **[ ]**

8) The basis for acceptability of SCICR includes detailed comparisons of the proposed testing to prior testing methods for 4-loop Westinghouse plants. Additional demonstrations of the testing methods for 2- and 3-loop Westinghouse plants, and for a Combustion Engineering (CE) 217-fuel assembly plant are provided, **[**

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Consider a revised limitation that applies a more general set of evaluation and data retention requirements for first-use implementation. **[**

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