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LTR-NRC-19-20

April 25, 2019

Subject: Submittal of Presentation "Pre-Submittal Meeting on: Updated NEXUS Cross-Section Methodology, Topical Report WCAP-10965-P-A Addendum 3" (Proprietary/Non-Proprietary)

Enclosed are the proprietary and non-proprietary versions of the presentation, "Pre-Submittal Meeting on: Updated NEXUS Cross-Section Methodology, Topical Report WCAP-10965-P-A Addendum 3" for a meeting to be held on April 29, 2019.

This submittal contains proprietary information of Westinghouse Electric Company LLC ("Westinghouse"). In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Nuclear Regulatory Commission's ("Commission's") regulations, we are enclosing with this submittal an Affidavit. The Affidavit sets forth the basis on which the information identified as proprietary may be withheld from public disclosure by the Commission.

Correspondence with respect to the proprietary aspects of the Westinghouse Affidavit should reference AW-19-4888, and should be addressed to Camille T. Zozula, Manager, Infrastructure & Facilities Licensing, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 1, Suite 165, Cranberry Township, PA 16066.

Korey L. Hosack, Manager
Product Line Regulatory Support

cc: Ekaterina Lenning (NRC)
Dennis Morey (NRC)

Enclosures:

1. Affidavit AW-19-4888
2. Proprietary Information Notice and Copyright Notice
3. LTR-NRC-19-20 P-Attachment, Pre-Submittal Meeting on: Updated NEXUS Cross-Section Methodology, Topical Report WCAP-10965-P-A Addendum 3 (Proprietary)
4. LTR-NRC-19-20 NP-Attachment, Pre-Submittal Meeting on: Updated NEXUS Cross-Section Methodology, Topical Report WCAP-10965-P-A Addendum 3 (Non-Proprietary)

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

COUNTY OF BUTLER:

(1) I, Korey L. Hosack, have been specifically delegated and authorized to apply for withholding and execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse).

(2) I am requesting the proprietary portions of LTR-NRC-19-20 be withheld from public disclosure under 10 CFR 2.390.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.

(4) Pursuant to 10 CFR 2.390, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse and is not customarily disclosed to the public.

(ii) Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

(5) Westinghouse has policies in place to identify proprietary information. Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

AFFIDAVIT

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage (e.g., by optimization or improved marketability).

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(6) The attached documents are bracketed and marked to indicate the bases for withholding. The justification for withholding is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (5)(a) through (f) of this Affidavit.

AFFIDAVIT

I declare that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 20190425

Korey L. Hosack, Manager
Product Line Regulatory Support

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of a document, furnished to the NRC in connection with Westinghouse development and licensing of Updated NEXUS Cross-Section Methodology.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

COPYRIGHT NOTICE

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.390 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

Enclosure 4
LTR-NRC-19-20 NP-Attachment

Pre-Submittal Meeting on:
Updated NEXUS Cross-Section Methodology
Topical Report WCAP-10965-P-A Addendum 3

(Non-Proprietary)

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

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Pre-Submittal Meeting on: Updated NEXUS Cross-Section Methodology Topical Report WCAP-10965-P-A Addendum 3

April 29, 2019

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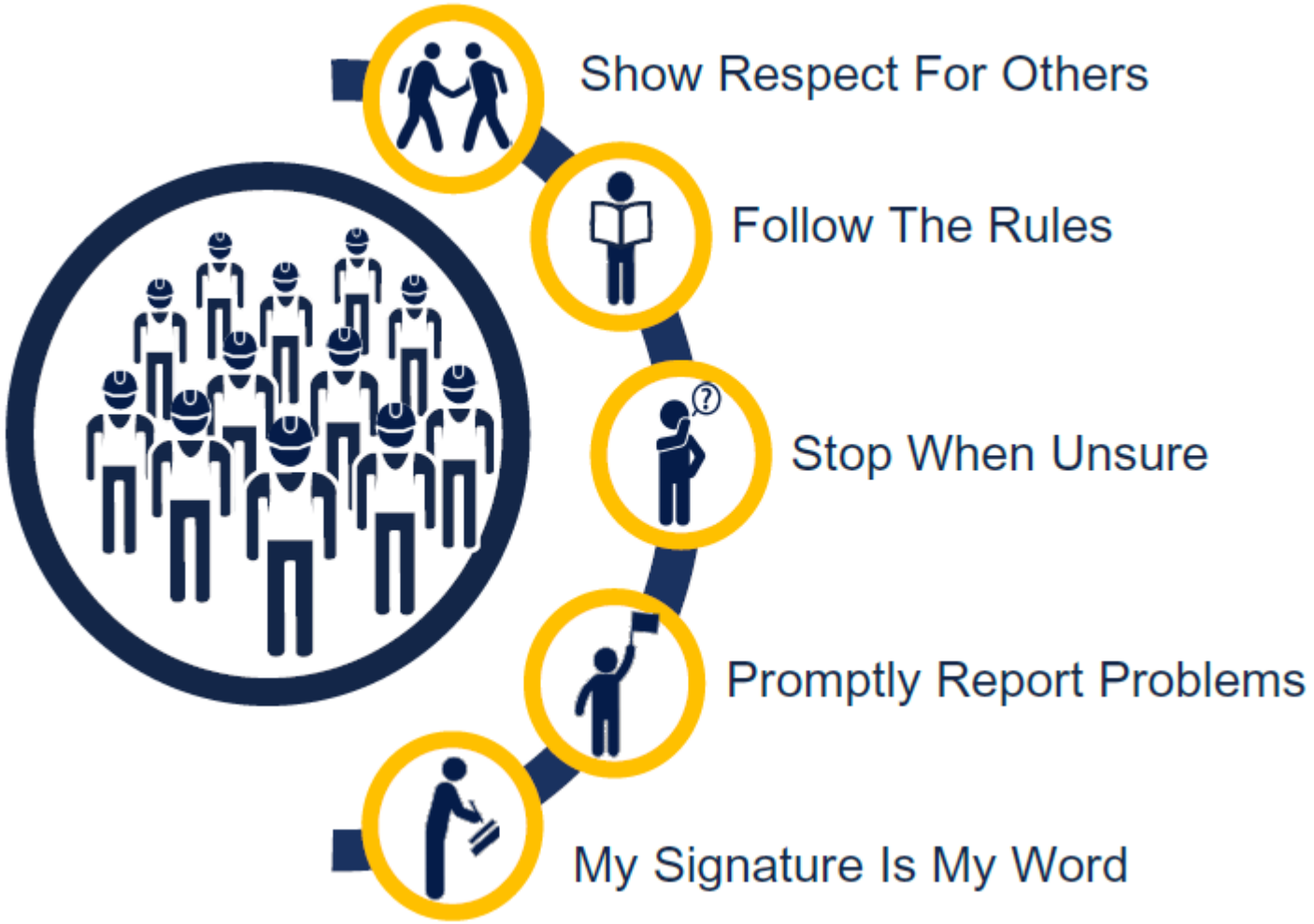

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AGENDA

- Introductions
- Technical Acronyms
- Current NEXUS Methodology
- Challenges and Opportunities for Improvement
- Purpose and Scope
- Technical Review: Updated NEXUS Methodology
- Intended Applications
- Recommended SER Conditions
- Topical Report Outline
- Customer Needs and Engagement
- Summary

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Technical Acronyms

- AO Axial Offset
- HZP Hot Zero Power
- PWR Pressurized Water Reactor
- SER Safety Evaluation Report
- SI Spectrum Index
- Sm Samarium
- TR Topical Report

Summary of Current NEXUS Methodology

- NEXUS is a cross-section methodology based on the PARAGON/ANC neutronics code system
- Current NEXUS cross-section methodology model
  - Uses moderator temperature (*Tm*), fuel temperature (*Tf*), and spectrum index (*SI*) as parameters to capture the spectrum effect on both micro and macro cross-sections, along with fuel history and component corrections
- Current NEXUS methodology
  - Qualified and licensed by the NRC in 2007
  - Implemented as part of the NEXUS/ANC9 code system
  - Provides accurate results in core calculations for a wide range of operating conditions

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Challenges and Opportunities for Improvement

- Current NEXUS methodology provides accurate results; however, several changes and improvements will enhance the capability and function of the model:
  - Improve code efficiency and the capability to determine the impact of individual parameters
  - Enhanced capability to model accident conditions with high local voids
  - Calculation of the moderator pressure coefficient
  - Improve accuracy for mixed core conditions
  - Improved thermal expansion implementation

Purpose and Scope

- Updated NEXUS methodology introduced changes to the currently licensed NEXUS, that can potentially increase margin, NRC review and approval is requested
- Replace the SI with physical state parameters
- Improve void prediction by explicitly modeling moderator temperature and density
- Add cross-section rehomogenization model to capture environmental effect
- Improved thermal expansion capability to model geometry differences between hot and cold conditions
- Support advanced applications and continuous development
  - Support perturbation calculations and other advanced applications
- Enhance calculation efficiency and code system stability

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Technical Review: Updated NEXUS Methodology

- Updated NEXUS methodology is a reformulation of the currently licensed methodology
- Updated NEXUS methodology uses [ ]^{a,c} to capture spectrum effect on both microscopic and macroscopic cross-sections
  - State parameters: [ ]^{a,c}
  - Use of the spectrum index is a significant challenge to computational efficiency
    - SI is a complex, calculated state parameter affected by physical state parameters such as boron concentration, moderator density, fuel history
    - Effects of individual state parameters are not separable
    - SI leads the code to function less efficiently, especially calculations that involve significant flux (spectrum) re-distribution from case to case

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Technical Review: Updated NEXUS Methodology

- Updated NEXUS [ ]a,c
- Updated NEXUS [ ]a,c
- Updated NEXUS improves the calculation of large local voids
- Updated NEXUS accurately calculates moderator pressure coefficient
- Updated NEXUS [ ]a,c
- Updated NEXUS captures the environmental effects on the assembly homogeneous data through rehomogenization correction
- Updated NEXUS methodology provides similar or better results as compared to the currently licensed NEXUS methodology in regular core design applications while improving ANC performance
- Updated NEXUS methodology improves the accuracy of NEXUS/ANC predictions of power distribution in both radial and axial directions

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Technical Review: Updated NEXUS Methodology

- Much of the methodology used in Updated NEXUS is the same as or quite similar to currently licensed NEXUS.
  - The feedback-free macroscopic cross-sections are adopted using a similar process.
  - Deconstruction of the nodal macroscopic cross section into a feedback-free cross section and a number of additive feedback correction terms, except that **[ ]**^{a,c} are used.
  - When modeled in the nodal code, the feedback-included macroscopic cross sections for each node are reconstructed by correcting the reference feedback-free macroscopic cross section using the actual conditions of the node.
  - Feedback corrections to the macroscopic and microscopic cross-sections to account for composition differences including **[ ]**^{a,c} of the node
  - Calculations of the corrections for these models from data generated by the lattice code through the execution of a standardized set of lattice code calculations called the calculational matrix

Intended Applications

- Introduce an improved methodology and product to be used for the same core design applications as the currently licensed NEXUS
- Implementation requires NO change to the existing core design inputs with the new fuel segment data files corresponding to the updated NEXUS methodology
- Be able to directly and accurately calculate moderator pressure coefficients instead of indirect calculations with current method
- Westinghouse will establish a process along with acceptable Measured vs. Predicted benchmarking criteria (including core reactivity, peaking factors, rod worths) which will be used in the evaluation of methods updates to determine if resubmittal is required

Recommended SER Conditions

- Application of the Updated NEXUS methodology:
  - Is applicable for use in uranium-fueled PWR plants
  - Can be used as an improved product for the same applications as the currently licensed NEXUS

Topical Report Outline

- Report Organization:
  - Introduction & Applicable Regulatory Requirements
  - Description of methodology
  - Qualification using single assembly and mini-core calculations
    - Single assembly normal operation condition
    - Single assembly off-nominal including voided condition
    - Mini-core calculation
  - Qualification for plant calculations
    - At-power depletion calculations
    - Zero power startup test simulations
  - Summary and Conclusions

Topical Report

- Single assembly calculations directly validates the Updated NEXUS methodology and confirms it can reconstruct the lattice code (i.e. PARAGON) results
- Mini-core calculation demonstrates the improvement from rehomogenization methodology for capturing the environmental effect
- Qualification for plant operating condition calculations compared with actual plant data demonstrates the applicability and quality of Updated NEXUS methodology for engineering applications

Customer Needs & Engagement

- Improvement on AO prediction for multiple plants
  - Customers reported [ ]a,c at BOC
  - Updated NEXUS/ANC makes a systematical improvement on AO prediction by [ ]a,c

[ ]a,c

Customer Needs & Engagement

- Improvement on radial power distribution especially for peripheral fuel assemblies
- Our customers are anticipating the improvement in NEXUS/ANC AO prediction, as well as improved performance (expedited assessment of plant conditions)
- Topical Report to be submitted in June 2019
- SER requested by 2020

Summary

- Currently licensed NEXUS remains an accurate and applicable cross-section methodology
- Updated NEXUS enhances currently licensed NEXUS
- Updated NEXUS is fully compatible with current neutronic codes – ANC, PARAGON, and is intended to be used with the same reactor core analyses as the currently licensed NEXUS
- Updated NEXUS improves accident analysis capability
- Improvements will facilitate continuous improvement of NEXUS, as well as integration with other WEC neutronics codes
- Topical report submittal planned for PWR plant applications and product value enhancement