Westinghouse

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Direct tel: (412) 374-5130
e-mail: Hosackkl@westinghouse.com

LTR-NRC-19-16

April 10, 2019

Subject: Transmittal of the Executive Summary for WCAP-10965-P-A Addendum 3, "Updated NEXUS Cross-Section Methodology" (Proprietary / Non-Proprietary)

Enclosed are proprietary and non-proprietary versions of the Executive Summary for WCAP-10965-P-A Addendum 3, "Updated NEXUS Cross-Section Methodology." This Topical Report will be submitted for NRC review no later than June 30, 2019. A Pre-Submittal Meeting with the NRC Staff is requested at your earliest convenience.

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 this submittal or the Westinghouse Affidavit should reference AW-19-4885 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-19-4885
2. Proprietary Information Notice and Copyright Notice
3. LTR-NRC-19-16 P-Attachment, Executive Summary for WCAP-10965-P-A Addendum 3, "Updated NEXUS Cross-Section Methodology" (Proprietary)
4. LTR-NRC-19-16 NP-Attachment, Executive Summary for WCAP-10965-P-A Addendum 3, "Updated NEXUS Cross-Section Methodology" (Non-Proprietary)

<u>AFFIDAVIT</u>

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-19-16 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:
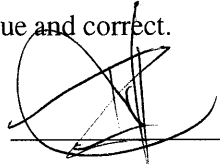
AFFIDAVIT

(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: 2019 04 10

Korey L. Hosack, Manager
Product Line Regulatory Support

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are the proprietary and non-proprietary versions of a document, furnished to the NRC in connection with the upcoming submittal of WCAP-10965-P-A Addendum 3, "Updated NEXUS Cross-Section Methodology," for NRC review.

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).

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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 is 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 version of this report, 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.

Executive Summary for WCAP-10965-P-A Addendum 3, "Updated NEXUS Cross-Section Methodology"

(Non-Proprietary)

April 2019

WCAP-10965-P-A Addendum 3
Updated NEXUS Cross-Section Methodology
Executive Summary

NEXUS is a cross-section methodology code that is based on the Westinghouse PARAGON/ANC code system. NEXUS methodology provides a linkage between the lattice code PARAGON (Reference 1) and the core simulator ANC (Reference 2). PARAGON is a neutron transport code and is approved for use as a stand-alone lattice physics code and as a cross-section generation tool for core simulators. ANC is a core simulator code system which performs calculations based on nuclear data supplied by a lattice code such as PARAGON. The NEXUS methodology is a reparameterization of the PARAGON nuclear data output and a reconstruction approach within ANC that simplifies the use of the PARAGON/ANC code system for design use.

The currently licensed version of NEXUS, approved by the NRC in 2007 (Reference 3), characterized the local spectrum using the Spectrum Index (SI), the fuel temperature, and the moderator temperature. This methodology has been successfully applied to pressurized water reactor core design and safety analysis and provides accurate predictions in steady-state operating conditions. However, in order to expand the NEXUS capability to provide even more accurate cross-sections at any core condition, to precisely model accident conditions with high local void or core pressure change, and to more accurately represent the effects of mixed core situations, Westinghouse has developed an improved version of the NEXUS methodology, referred to herein as Updated NEXUS.

In the currently licensed NEXUS, the SI, representing the overall shape of the neutron spectrum, is a calculated state parameter which is the ratio of fast-to-thermal group node-average fluxes, and is affected by any physical state parameter (e.g., boron concentration, moderator density, temperatures, actual fuel history). Since the SI is a calculated complex quantity and is not separable, the current methodology presents a significant challenge to computational efficiency for the advanced application of NEXUS, especially when [   ]^{a,c} Moreover, as a calculated state parameter rather than a physical one, the SI causes the code to function in a less than optimum manner since extra feedback iterations must be performed to get the right SI in order to reconstruct nodal nuclear data so as to match actual local conditions.

Updated NEXUS replaces the SI approach with a new methodology called cross-section reformulation. In the cross-section reformulation methodology, the local spectrum, even at highly voided conditions, can be represented and parameterized [

                                                                      ]^{a,c} This methodology avoids complex feedback iterations in order to reconstruct nodal nuclear data so as to match actual local conditions. In addition, it allows the accurate treatment of moderator conditions, even with void fractions of [   ]^{a,c} or large changes in core pressure. Additional improvements include the following: [

                    ]^{a,c} that allows a more accurate representation of the effects of the surrounding environment, such as for mixed core conditions.

Much of the methodology used in Updated NEXUS is the same as or quite similar to that used in the currently licensed NEXUS. The so-called feedback-free macroscopic cross-sections are adopted using a process similar to the currently licensed NEXUS. Deconstruction of the nodal macroscopic cross section into a feedback-free cross section and a number of additive feedback correction terms is similar to that used currently in NEXUS, except that the spectrum correction factor is represented in terms of [

]^{a,c} for both feedback-free macroscopic cross-sections and isotopic microscopic cross-sections. 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, just as is currently done in NEXUS. Feedback corrections to the macroscopic and microscopic cross-sections to account for composition differences including [

]^{a,c} of the node also are handled in the same way. In addition to these feedbacks, Updated NEXUS adds [   ]^{a,c} Finally, Updated NEXUS calculates 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, as is currently done in NEXUS.

Qualification of Updated NEXUS is based on a number of assessment calculations. Updated NEXUS was compared directly with calculations performed with a lattice code for various cases including multiple fuel lattice designs to directly validate the NEXUS methodology. Additionally, Updated NEXUS was used to perform calculations for specific operating plant conditions and the results were compared with actual plant data, as well as with calculated results from the currently licensed NEXUS/ANC. Updated NEXUS is intended to replace the currently licensed NEXUS methodology for PWR nuclear core design and safety analysis calculations. While currently licensed NEXUS remains an accurate and applicable cross-section methodology, Updated NEXUS provides a broader range of capabilities and improved computational efficiency.

The planned submittal date for the Updated NEXUS topical report is June 30, 2019.

References:

1. WCAP-16045-P-A (Proprietary) and WCAP-16045-NP-A (Non-Proprietary), Revision 0, "Qualification of the Two-Dimensional Transport Code PARAGON," August 2004.

2. WCAP-10965-P-A (Proprietary) and WCAP-10966-A (Non-Proprietary), Revision 0, "ANC: A Westinghouse Advanced Nodal Computer Code," September 1986.

3. WCAP-16045-P-A Addendum 1-A (Proprietary) and WCAP-16045-NP-A Addendum 1-A (Non-Proprietary), Revision 0, "Qualification of the NEXUS Nuclear Data Methodology," August 2007.