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October 17, 2016

Subject: Submittal of Executive Summary for Topical Report WCAP-18124-NP, Revision 0, "Fluence Determination with RAPTOR-M3G and FERRET," expected November 2016 (Non-Proprietary).

Enclosed is the non-proprietary "Executive Summary for Topical Report WCAP- 18124-NP, Revision 0, 'Fluence Determination with RAPTOR-M3G and FERRET.' " This information is being provided in advance of an anticipated pre-submittal meeting in October to support a November 2016 submittal.

This submittal does not contain proprietary information of Westinghouse Electric Company LLC.

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Attachment

cc: Ekaterina Lenning
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TOID
NRR

Executive Summary of the Topical Report on Fluence Determination with RAPTOR-M3G and FERRET

Executive Summary

In the assessment of the state of embrittlement of reactor pressure vessels, an accurate evaluation of the neutron exposure for significant reactor pressure vessel materials is required. Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," identifies procedures acceptable to the NRC staff for determining reactor pressure vessel neutron exposure (fluence). Westinghouse seeks approval to employ the methodology described in WCAP-18124-NP, "Fluence Determination with RAPTOR-M3G and FERRET," in order to determine neutron fluence in accordance with Regulatory Guide 1.190.

Neutron fluence has traditionally been quantified with discrete ordinates radiation transport calculations. The approved Westinghouse fluence methodology, described in Section 2.2 of WCAP-14040-A, Revision 4, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," discusses the use of either the two-dimensional (2D) DORT code or the three-dimensional (3D) TORT code for calculating the transport of radiation from the reactor core to the reactor vessel wall and beyond.

Westinghouse developed RAPTOR-M3G in order to overcome limitations associated with the TORT code. RAPTOR-M3G is a 3D, parallel-processing discrete ordinates radiation transport code that follows essentially the same calculational methodology as TORT. The parallel-processing feature of RAPTOR-M3G allows large, 3D radiation transport calculations to be divided across networks of workstations and solved simultaneously. This allows RAPTOR-M3G to perform calculations that would be prohibitively time consuming or impossible with TORT.

Regulatory Guide 1.190 stipulates that neutron fluence calculations must be validated by comparisons to measurements. Measurement data for benchmarking neutron fluence calculations is typically collected from in-vessel surveillance capsule dosimetry and/or ex-vessel dosimetry systems. Included in WCAP-18124-NP is a description of the least squares adjustment process used to reconcile the measured sensor reaction rate data, dosimetry reaction cross-sections, and the calculated neutron energy spectrum within their respective uncertainties. This allows for the establishment of best estimates of key exposure parameters with reduced uncertainties at the measurement locations.

The least squares adjustment procedure described in WCAP-18124-NP is the same as the procedure previously described and approved in WCAP-16083-NP-A, Revision 0, "Benchmark Testing of the FERRET Code for Least Squares Evaluation of Light Water Reactor Dosimetry." The discussion in WCAP-18124-NP has been updated to consider the characteristics of Nb-93, which is increasingly being used as a replacement for fission monitors such as U-238 and Np-237. There are no changes to the underlying least squares adjustment software or processes.

This methodology for fluence determination was previously submitted on an application-specific basis for the Catawba Unit 1 Measurement Uncertainty Recapture (MUR) Power Uprate. Per ADAMS Accession No. ML16081A333, the NRC staff determined that the methodology adequately addressed the criteria in Regulatory Guide 1.190, and was therefore acceptable.

This methodology was also previously applied to the South Texas Unit 2 Capsule W evaluation. Per ADAMS Accession No. ML14357A136, the NRC staff compared RAPTOR-M3G-generated fluence values to previously-generated values and determined that the comparisons support compliance with 10 CFR Part 50, Appendix H requirements. However, the following text was included in the correspondence:

The results of the NRC staff's review, however, should not be construed as NRC approval of RAPTOR-M3G as a method of evaluation. Should future evaluations employ fluence methods that have not been NRC reviewed and approved, adequate justification regarding the application and qualification of those methods should be provided. RG 1.190 provides guidance for acceptable fluence methods.

The current submittal, WCAP-18124-NP, provides such justification, and seeks to obtain a generic approval to use this methodology for LWR fluence determination. WCAP-18124-NP is planned for submittal to the NRC in November 2016.