Attachment 4 to

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Revision 0

Waterford Unit 3 Summary Report for the Fuel Design / Fuel Management Assessments to Demonstrate MRP-227-A Applicability

PA-MSC-0983, Revision 1, Task 7

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1 MRP 2013-025 GUIDELINES TO DEMONSTRATE MRP-227-A APPLICABILITY FOR WATERFORD UNIT 3 REACTOR INTERNALS AGING MANAGEMENT FUEL DESIGN / FUEL MANAGEMENT ASSESSMENTS

Applicant/Licensee Action Item 1 from the U.S. Nuclear Regulatory Commission (NRC) staff's final safety evaluation of MRP-227-A, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A)," [1] states that:

> "*The Materials Reliability Program indicated that each applicant/licensee was responsible for assessing its plant's operating history and demonstrating that the approved version of MRP-227 is applicable to the facility. Each applicant/licensee shall refer, in particular, to the assumptions regarding plant design and operating history made in the FMECA and functionality analyses for reactors of their design (i.e., Westinghouse, CE, or B&W) which support MRP-227, and each applicant/licensee shall describe the process used for determining plant-specific differences in the design of their reactor vessel integrity components or plant operating conditions, which result in different component inspection categories.*"

In the Reference 2 Request for Additional Information (RAI) 2, the NRC provided the following question to Entergy Operations, Inc. regarding the reactor vessel internals aging management program submitted for Waterford Unit 3 (WF3).

> **RAI-2-B:**
>
> *"Please explain if WF3 has ever utilized atypical design or fuel management that could make the assumptions of MRP-227-A regarding core loading/core design non-representative for that plant, including power changes/uprates such as the extended power uprate implemented in 2005. ... "*

1.1 WATERFORD UNIT 3 EVALUATION FOR QUESTION 2

Westinghouse has evaluated the Waterford Unit 3 reactor internals components with regard to fuel designs and fuel management according to industry guideline MRP 2013-025 [3].

Waterford Unit 3 has not utilized atypical fuel designs or fuel management that could make the assumptions of MRP-227-A regarding core loading/core design non-representative, including power changes/uprates that have occurred over the operating lifetime of the unit. This conclusion is based on comparisons of the Waterford Unit 3 core geometry and operating characteristics with the MRP-227-A applicability guidelines for CE-designed reactors specified in MRP 2013-025 [3].

Performing the MRP 2013-025 [3] guideline assessment using a calendar years basis is not required but would provide bounding results. Demonstrating that the fluence guideline compliance requirement is met based on effective full-power years, as was done in this evaluation, is acceptable and provides a technically robust and accurate assessment of plant-specific historical operating conditions.

Specifically, the following comparisons with the MRP-227-A applicability guidelines in MRP 2013-025 [3] were established for the key reactor internals components at Waterford Unit 3.

1.1.1 Components Located Beyond the Outer Radius of the Reactor Core

Guideline 1 - The reactor has been operated with out-in fuel management for 30 effective full-power years or less and all future operation will use low-leakage fuel management.

Comparison - Waterford Unit 3 initiated low-leakage fuel management strategy in the third fuel cycle following 2.0 effective full-power years of operation and has been implementing low-leakage core designs since that time.

Guideline 2 - For operation going forward, the average power density of the reactor core (as defined in MRP 2013-025 [3]) shall be less than 110 W/cm^3.

Comparison - For the last five operating fuel cycles (Cycles 15 through 19), Waterford Unit 3 has been operating at a rated power level of 3716 MWt. For the 217 fuel assembly Waterford Unit 3 core geometry, the 3716 MWt power level corresponds to a core power density of 104.1 W/cm^3. This level of power generation is also representative of anticipated future operation.

Guideline 3 - For operation going forward, the nuclear heat generation rate figure of merit (HGR-FOM) (as defined in MRP 2013-025 [3]) shall not exceed 68 W/cm^3.

Comparison - For the last five operating fuel cycles at Waterford Unit 3, the HGR-FOM at key baffle locations has ranged between [ ]^{a,c}. This range of HGR-FOM is representative of anticipated future operation.

1.1.2 Components Located Above the Reactor Core

Guideline 1 - Considering the entire operating lifetime of the reactor, the average power density of the core (as defined in MRP 2013-025 [3]) shall be less than 110 W/cm^3 for a period of more than two effective full-power years.

Comparison - Over the operating lifetime of the Waterford Unit 3 reactor, the rated core power level, including power uprates, has varied between 3390 MWt and 3716 MWt. This variation of rated power level corresponds to a power density range of 95.0 W/cm^3 to 104.1 W/cm^3.

Guideline 2 - Considering the entire operating lifetime of the reactor, the distance between the top of the active fuel stack and the bottom of the fuel alignment plate (FAP) shall be greater than 12.4 inches for a period of more than two effective full-power years.

Comparison - For the Waterford Unit 3 reactor internals and fuel assembly geometry, the nominal distance between the top of the active fuel stack and the bottom of the FAP averaged over the first 19 fuel cycles of operation was [ ]^{a,c}. During that period of time, the nominal distance between the FAP and the top of the active fuel was greater than 12.4 inches.

1.1.3 Components Located Below the Reactor Core

Based on the discussion provided in MRP 2013-025 [3], plant-specific applicability of MRP-227-A for components located below the reactor core with no further evaluation required is demonstrated by meeting the MRP-227-A, Section 2.4 criteria.

2 REFERENCES

1. *Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A).* EPRI, Palo Alto, CA: 2011. 1022863.
2. U.S. NRC Letter, "Waterford Steam Electric Station, Unit 3 - Request for Additional Information Regarding the Reactor Vessel Internals Aging Management Program (TAC No. MF3247)," October 21, 2014. (NRC ADAMS Accession No. ML14232A023)
3. EPRI Letter MRP 2013-025, "MRP-227-A Applicability Template Guideline," October 14, 2013. (NRC ADAMS Accession No. ML13322A454)