UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 28, 2013

Mr. Kevin Mulligan
Vice President, Site
Entergy Operations, Inc.
P.O. Box 756
Port Gibson, MS 39150

SUBJECT: REQUESTS FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE GRAND GULF NUCLEAR STATION, LICENSE RENEWAL APPLICATION (TAC NO. ME7493) – SET 47

Dear Mr. Mulligan:

By letter dated October 28, 2011, Entergy Operations, Inc., submitted an application pursuant to Title 10 of the *Code of Federal Regulations* (CFR) Part 54, to renew the operating license, NPF-29, for Grand Gulf Nuclear Station, Unit 1, for review by the U.S. Nuclear Regulatory Commission (NRC) staff. The staff is reviewing the information contained in the license renewal application and has identified, in the enclosure, areas where additional information is needed to complete the review.

These requests for additional information, outlined in the enclosure, were discussed with Ted Ivy and Chris Robinson, and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me at (301) 415-3873 or by e-mail at john.daily@nrc.gov.

Sincerely,

Emmanuel Sayoc FOR

John Daily, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure:
Requests for Additional Information

cc w/encl: Listserv

August 28, 2013

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/RA by Emmanuel Sayoc for/

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GRAND GULF NUCLEAR STATION
LICENSE RENEWAL APPLICATION
REQUESTS FOR ADDITIONAL INFORMATION

GGNS RAI 4.2.1-2c

Background:

The applicant has provided information in response to several staff-issued requests for additional information (RAIs) that pertain to the reactor vessel neutron fluence calculations. Although the license renewal application states, "the neutron fluence for the welds and shells of the reactor pressure vessel beltline region was determined using the General Electric-Hitachi method for neutron flux calculation documented in report NEDC-32983P-A and approved by the NRC," an additional method was also used. The applicant stated in a letter dated July 25, 2012, that, "Pre-EPU fluence values were generated from the MPM Technologies, Inc. (MPM) analysis. MPM analysis is consistent with the guidance contained in RG 1.190 and is approved by the NRC in *TAC No. MB6687, Nine Mile Point Nuclear Station, Unit No. 1 – Issuance of Amendment RE: Pressure-Temperature Limit Curves and Tables, October 27, 2003...*" (ML12208A166). The applicant also stated that the uncertainty associated with using a combination of the MPM calculations with the General Electric-Hitachi (GEH) fluence calculations would fall between the uncertainty associated with either method (ML13022A474).

The NRC staff does not agree that this information and evaluation adhere to the guidance contained in NRC Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." Regulatory Position 1.4, "Methodology Qualification and Uncertainty Estimates," provides guidance concerning the qualification of an acceptable fluence method, stating the following:

> The methods qualification consists of three parts: (1) the analytic uncertainty analysis (Regulatory Position 1.4.1), (2) the comparison with benchmarks and operating reactor measurements (Regulatory Position 1.4.2), and (3) the estimate of uncertainty in the calculated fluence (Regulatory Position 1.4.3).

The NRC staff notes that the GEH fluence calculations adhere to a methodology that has received generic NRC staff approval, and is acceptable for referencing in licensing actions. This approval is documented in the NRC staff safety evaluation (SE) approving NEDC-32983P-A. The SE also documents generic adherence of the GEH calculative method to the guidance, listed above, in RG 1.190. The GEH methodology qualification adequately addresses the three aspects noted above and consists of an analytic uncertainty analysis (described in Chapter 7 of NEDC-32983P-A), comparisons to the Oak Ridge National Laboratory Pool Critical Assembly (PCA) benchmark, solution of the generic boiling-water reactor (BWR) benchmark fluence problem documented in NUREG/CR 6115, code-to-code comparisons of the BWR benchmark fluence problem, and an extensive database of comparisons to BWR surveillance capsule dosimetry analyses. The database includes blind benchmark calculations.

The staff also notes that its review of fluence calculations as presented in BWR license amendments have been of the type where one methodology is applied throughout a reactor vessel's life (i.e., from 0 effective full-power year (EFPY) to the desired endpoint EFPY); the staff could not locate any successful amendment where one methodology was used from 0 EFPY to (for example), 32 EFPY, and a different methodology from 32 EFPY to the end of the period of extended operation (typically around 54 EFPY).

Although the applicant stated that the MPM calculation was approved by the NRC, the NRC staff does not agree with this characterization insofar as it applies to Grand Gulf Nuclear Station (GGNS). The approval noted above pertains to a BWR/2 facility. The staff notes that GGNS is a BWR/6 design.

Issues:

Regulatory Position 1.4.2.1, "Operating Reactor Measurements," of RG 1.190 states, in part, "Comparisons of measurements and calculations must be performed for the specific reactor being analyzed or for reactors of similar design." The BWR/2 design lacks jet pumps and cannot be considered to be similar in design to a BWR/6 such as GGNS[1]. Therefore, the basis on which the NRC staff approved the reactor vessel pressure temperature limits revision at Nine Mile Point Station, Unit 1, does not pertain to GGNS. Furthermore, since the method used to perform the MPM calculations is not documented in an NRC-approved methodology, a detailed description of the calculative methods, and their qualification, as both pertain to GGNS, must be submitted for NRC staff review and approval for referencing in the license renewal application. This will enable the staff to reach a determination regarding whether the MPM fluence calculations are adherent to RG 1.190, or are otherwise acceptable.

Similarly, the NRC staff has determined that the applicability of the GEH fluence methodology to GGNS should also be established. This effort may include plant-specific dosimetry comparisons, or establishing that the existing qualification contained in NEDC-32983P-A is adequate.

The use of a combined method — using fluence from two separate methods — requires an additional analytic uncertainty analysis and an extensive amount of further validation and verification. The staff is not aware of any such combined method being approved in the past, and therefore such a proposal would require significant review to determine whether this approach could be found to comply acceptably with NRC guidance or not. For example, any co-dependent terms in the uncertainty associated with either method must be appropriately treated in the analysis, and any uncertainties associated with either method that could propagate must be investigated. In addition, the significant difference in flux values associated with each method (limiting location flux values differ by approximately 70 percent) warrants a thorough investigation of the causes, and GGNS would need to provide extensive justification. The results of this investigation need to be adequately explained in order to establish that both calculations are reasonably accurate.

In addition, the staff noted that the applicant's response to RAI 4.2.1-2b dated January 18, 2013, did not clearly address why the modeling variation between the MPM and GEH methods resulted in the MPM method yielding conservative bounding-case flux values for core shroud welds H1, V1, V2, V3, and V4.

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[1] The presence or lack of jet pumps is not the only defining characteristic. Other relevant design considerations, including but not limited to vessel diameter and material composition, number of jet pumps, locations of welds, nozzles and other appurtenances, must also be addressed in establishing a valid calculational benchmark.

Section 5.2 of MPM-402781, Revision 1, "Benchmarking of Nine Mile Point Unit 1 and Unit 2 Neutron Transport Calculations," September, 2003 (ADAMS Accession Number ML032681023), indicates that in neutron flux calculations using the MPM method, the region above the reactor core may be approximated using water without modeling the stainless steel top guide so that the MPM method generates conservative values of high-energy neutron flux for the locations above the bottom of the top guide. Therefore, the staff needs further clarification whether each of the applicant's analyses (i.e., MPM and GEH methods) approximates the region above the reactor core as water without explicitly modeling the stainless steel top guide.

Finally, the applicant's response dated January 18, 2013, indicates that the fluence values for the reactor vessel internals are calculated by using several different calculational methods depending on the availability of pre-EPU fluence values, the internal components' locations, and the perceived validity of the chosen methods. The staff needs additional information to determine whether the use of these different calculational methods is adequate to calculate the fluence values of reactor vessel internals.

Request:

1) Provide the following information regarding reactor vessel fluence:

   (a) Provide a detailed description of the MPM fluence calculations. Include a description of the methods and data sets used to perform the calculations, describe the analytic representation of the reactor geometry, and provide a detailed description of the problem setup, execution, and post-processing. Also provide detailed results from the analysis.

   (b) Provide a description of the qualification of the MPM fluence calculational methods in sufficient detail to establish adherence to RG 1.190 as it applies to the BWR/6 design and GGNS in particular, or provide sufficient details to demonstrate to the staff that the calculations are otherwise acceptable for use at GGNS.

   (c) Provide information to demonstrate that the GEH analytic method is suitably qualified for analysis of the GGNS reactor vessel.

   (d) Provide a detailed, analytic uncertainty analysis of that accounts for any additional uncertainty or bias associated with adding fluence values together from these two methods. Also provide benchmarking information to show that the results of the vessel fluence analyses remain valid when combined.

   (e) Provide information to establish that the difference between the two flux values calculated using the different methods is valid. For example, compare the two methods in calculational benchmarks: provide an estimate of the pre-extended power uprate (EPU) fluence using GEH calculational methods and provide an estimate of the post-EPU fluence using MPM calculational methods.

2) Provide a description, including a technical basis, for each of the different calculational methods that are used to determine the fluence values of the reactor vessel internals. For each of the reactor vessel internal components, describe the fluence calculational method used for the component. In addition, explain why the use of different calculational methods is adequate to determine the fluence values of the reactor vessel internals.

3) Justify the acceptability of using different methods to calculate related phenomena (e.g., neutron fluence) that all stem from the same source (e.g., the GGNS reactor core), for different surfaces (i.e., nozzles, beltline welds, vessel surface, and upper internals), as opposed to choosing one method to apply to all the surfaces.

4) Provide additional information to clarify why the modeling variation between the MPM and GEH methods results in conservative bounding-case flux values for the core shroud weld locations (H1, V1, V2, V3, and V4) using the MPM method. As part of the response, clarify whether the analysis with the MPM method approximates the region above the reactor core as water, without explicitly modeling the stainless steel top guide. In addition, clarify whether the analysis with the GEH method uses this approximation as well.

5) As an alternative to Items 1-3 above, please provide:

   a) Fluence values that have been determined from Beginning Of Life to End of Life Extended in accordance with a single method.
      i) If the method is NRC-approved insofar as it applies to vessel fluence calculations, provide the reference to the staff-accepted methodology.
      ii) If the method is not NRC-approved, provide the plant-specific calculations and documentation, and include sufficient information, to enable the NRC staff to determine whether the calculation adheres to NRC Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," or other justification as required to establish that the fluence calculation is acceptable.
      iii) Refer to Regulatory Position 3, "Reporting," for the specific documentation required to establish adherence to NRC RG 1.190.
   b) Finally, confirm whether, and describe how, the remaining neutron fluence-related time-limited aging analyses are affected by this new fluence calculation.

Letter to K. Mulligan from J. Daily, dated August 28, 2013

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