REQUEST FOR ADDITIONAL INFORMATION (RAI)

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT NO. 1 (GGNS)

LICENSE AMENDMENT REQUEST REGARDING EXTENDED POWER UPRATE (EPU)

DOCKET NO. 50-416

By letter dated September 8, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102660403), Entergy Operations, Inc. (the licensee) submitted a license amendment request (LAR) for Grand Gulf Nuclear Station, Unit 1 (GGNS). The proposed amendment requests an increase in the maximum steady-state power level at GGNS from 3898 megawatts thermal (MWt) to 4408 MWt. This represents a 15-percent increase over the original licensed thermal power (OLTP).

Based on the U.S. Nuclear Regulatory Commission (NRC) review of the LAR and the supplemental information provided by the licensee in letter dated November 23, 2010 (ML103330093), the NRC staff has determined that additional information requested below is needed to complete our review.

RAIs related to NEDC-33173P

1. The NRC staff has reviewed the PRIME T-M methodology and documented its approval in its safety evaluation (SE) dated January 22, 2010 (ML102600259). The GNF2 fuel system design evaluation for GGNS EPU application has been performed using the updated PRIME T-M methods. Footnote 3 to Appendix A of the PUSAR states that the GSTRM thermal-mechanical properties will be used in the downstream codes until the changes have been implemented and the NRC has performed an audit of that process and published their SE. This is consistent with the NRC staff approval of IMLTR Supplement 4 describing the plan to implement PRIME models and inputs into downstream safety analysis codes. However, the licensee should justify the continued use of GSTRM methods consistent with the "Interim Process Thermal Overpower Condition" specified in Appendix A to the NRC staff safety evaluation that approved the PRIME T-M methodology (ML102600259).

   Provide information demonstrating compliance with the "Interim Process Thermal Overpower Condition" specified in the NRC staff SE for PRIME T-M methods.

2. Footnote 4 to Appendix A of the PUSAR states, "As a consequence of the NRC staff review of the GE Part 21 report, a modified GNF2 T-M basis using GESTR-M was established by the GNF2 Compliance Report (Reference A-6)." Clarify whether this implies that GNF2 thermal-mechanical operating limit (TMOL) is based on GESTR-M.

   Also, confirm that the GE14 LHGR is based on the revised TMOL provided in Appendix C of the GE14 GESTAR II Compliance Report, NEDC-32868P Revision 3.

Fuel and Core Design

3. The average bundle power increases from the current licensed thermal power (CLTP) by 13.1% from 4.87 MW/bundle to 5.51 MW/bundle, which corresponds to the same percent increase of total core power from CLTP to EPU. It is assumed in the constant pressure EPU for BWRs that the additional core power is obtained by raising the average bundle power, and that the peak bundle power should remain the same. However, past EPU operations have shown that peak bundle power can increase by a limited amount. Please provide the current peak bundle power and compare it with the expected value of peak bundle power for EPU operation in GGNS.

4. As stated in the PUSAR, GGNS EPU analyses assumed an “equilibrium” core comprised of GNF2 fuel. Describe the GGNS core design for the first EPU cycle. If the EPU core design is comprised of any other fuel types (including other GE fuels), then justify how using a GNF2 equilibrium core provides bounding results for EPU.

5. Pellet clad interaction (PCI) and stress corrosion cracking (SCC) phenomena can cause clad perforation resulting in leaking fuel bundles and resultant increased reactor coolant activity. Therefore, the staff requests the licensee to provide the following additional information regarding PCI/SCC for GGNS at EPU conditions:

    a) Describe whether GNF2 fuel design has barrier cladding which have built-in PCI resistance.

    b) Describe any differences in operating procedures associated with PCI/SCC at EPU conditions versus pre-EPU operations.

    c) From the standpoint of PCI/SCC, discuss which of the Anticipated Operational Occurrences (AOOs), if not mitigated, would most affect operational limitations associated with PCI/SCC.

    d) For the AOOs in part c), discuss the differences between the type of required operator action, if any, and the time to take mitigating actions between pre-EPU and EPU operations.

    e) If the EPU core will include fuel designs with non-barrier cladding which have less built-in PCI resistance, then demonstrate by plant-specific analyses that the peak clad stresses at EPU conditions will be comparable to those calculated for the current operating conditions.

    f) Describe operator training on PCI/SCC operating guidelines.

Control Rod Drive (CRD) Scram Time

6. It was stated in Section 2.8.4.1.1 of the PUSAR, “To address the expected increase in scram times, GGNS is implementing Option B scram times to maintain operating margin.” Please provide the following additional information:

    a) Clarify the usage “Option B” scram times and their effects on transient and accident analysis.

b) Explain how they maintain operating margin as well as ensure safe operation.

c) Discuss the scram times assumed to perform AOO analyses for EPU, as presented in the PUSAR, and justify that it was conservative.

Reactor Core Isolation Cooling (RCIC)

7. In Section 2.8.4.3.2 of the PUSAR it was stated, "GGNS plant procedures caution operators that damage may occur if the SP temperature exceeds 140°F with the RCIC suction aligned to the SP." As the SP temperature is expected to increase for EPU, discuss how this requirement is satisfied for EPU operation.

Transient and Accident Analyses

8. Please provide the following additional information regarding the Loss of One Feedwater Pump analysis performed in support of EPU operation at GGNS:

   a) Provide plant-specific result for Loss of One Feedwater Pump event showing water level vs. time. (Similar to Fig. 2.8-21 of PUSAR.)

   b) It was stated in Section 2.8.5.2.3.2 of PUSAR that the Loss of One Feedwater Pump event only addresses operational considerations to avoid reactor scram on low reactor water level (Level 3). This requirement is intended to avoid unnecessary reactor shutdowns. Clarify whether Level 3 scram was avoided for this event at EPU condition; and if not, explain how this requirement was addressed.

9. In Section 2.8.4.2 of the PUSAR, it was stated, "….based on both plant initial core analyses and subsequent power uprate evaluations, the MSIVF is more limiting than the TT event with respect to reactor overpressure. The EPU evaluations show a 40 to 50 psi difference between these two events." If an analysis was performed for the Turbine Trip with Bypass Failure and Scram on High Flux (TTNBPF), as it is required in Table E-1 of ELTR-1, please provide a plot comparing the pressure transients for the Main Steam Isolation Valve Closure with Scram on High Flux (MSIVF) and the TTNBPF events. If a TTNBPF analysis was not performed for EPU, then justify why not.

10. In Table 2.8-5 of the PUSAR, the most limiting fuel thermal margin event was listed as the Generator Load Rejection with Steam Bypass Failure (LRNBP) event having delta-CPR equal to 0.23. What are the delta-CPR values for the MSIVF event and for the Turbine Trip with Bypass Failure and Scram on High Flux (TTNBPF) event? If the delta-CPR value is higher than 0.23 for either of these events, then discuss why the event was not considered as the limiting fuel thermal margin event?

11. Please provide the following additional information regarding the LOCA analysis performed in support of EPU operation at GGNS:

   a) Discuss the reasons, supported by analytical results, at what flow rate, i.e., minimum flow, rated flow, or increased core flow (shown as state-points C, D or E in the Power-Flow (P/F) map for EPU in Fig. 1-1 of the PUSAR) the most conservative PCT occurs. Confirm that the GGNS licensing Basis PCT for EPU and CLTP were calculated at the most conservative state-point in the P/F map, and identify those state-points for EPU and CLTP. If the state-points are different for pre-EPU and EPU condition, explain why.

b) Discuss the limiting single-failures for EPU and CLTP for Large-Break (LB) and Small-Break (SB) LOCA analyses. If the limiting single-failure changed from pre-EPU to EPU, then explain why.

c) What are the limiting break sizes for the worst SB-LOCA for EPU and CLTP conditions?

d) Provide the vendor (GEH) prepared report on the ECCS-LOCA analyses for GGNS at EPU power using SAFER/GESTER methodology.

12. It is stated in Section 2.8.5.7.1 of the PUSAR that the limiting ATWS event with respect to RPV overpressure for GGNS is ATWS-MSIVC event and that the ATWS-PRFO event produces the highest peak upper plenum pressure at SLCS initiation (1205 psia). Please provide the following additional information:

a) What core flow was assumed for these analyses? The staff believes that in order to maximize the pressure, the Increased Core Flow (ICF) condition of 105% core flow should have been assumed. Confirm that it was; otherwise explain.

b) Compare the highest peak upper plenum pressure at SLCS initiation for CLTP and EPU conditions, and justify that sufficient margin remain available in the setpoint for the SLCS pump discharge relief valve at EPU condition.

13. In Table 2.8-9 of PUSAR, the results for ATWS analysis were presented. Please provide the following additional information:

a) Confirm that the peak SP temperature of 165 F for EPU was obtained for the ATWS-PRFO event, and compare this result with the GGNS design limit for peak SP temperature for ATWS.

b) The higher core power and decay heat for EPU should have resulted in higher SP temperature for EPU. Explain why the peak SP temperature remains same (165 F) for both CLTP and EPU.

14. In Table 2.8-8 of PUSAR, the key inputs for ATWS analysis were provided. Please provide the following additional information:

a) With higher core power, increased steam flow and higher vessel peak pressure for EPU, explain why five (5) SRVs can be out-of-service (OOS) during EPU, vs. only one (1) SRV can be OOS during CLTP in order to meet the safety limits.

b) Which decay heat model was used for EPU ATWS analysis; and are all the inputs for ATWS analysis consistent with ELTR1 guidelines for ATWS input parameters? If not, justify.

<u>Bypass Voiding</u>

15. Characterize the expected amount of bypass voiding under CPPU conditions. Provide the expected bypass void level at points A, C, and D of Figure 1.1 of NEDC-33477P, Rev 0, using a methodology equivalent to that used by ISCOR for both hot and average channel.

Effect of bypass voids on instrumentation during normal operation

16. Reliability of the local power range monitor (LPRM) instrumentation and accurate prediction of in-bundle pin powers typically requires operation with bypass voids lower than 5% at nominal conditions (e.g. point D of Fig 1.1 of NEDC-33477P, Rev 0). If the expected bypass void conditions at CPPU are greater than 5%, evaluate the impact on (1) reliability of LPRM instrumentation, (2) accuracy of LPRM instrumentation, and (3) in-bundle pin powers.

Effect of bypass voids on instrumentation to detect and suppress (D&S) unstable oscillations

17. The presence of bypass voids affects the LPRM calibration. Evaluate the expected calibration error on OPRM and APRM cells induced by the expected level of bypass voids. Document the impact of this error on the D&S Option III scram setpoint.

D&S Setpoint calculations

18. Table 2.8-2 only shows Option III Setpoint Demonstration. Please provide an example setpoint calculation for Cycle 19 including an uncertainty term reflecting the possible LPRM miss-calibration under bypass void conditions.

DIVOM slope for Cycle 19 under CPPU conditions

19. The DIVOM slope does not include in Table 2.8-2 under CPPU conditions. Please provide DIVOM slope for Cycle 19.

Interface between GE Methods and existing Solution EI-A hardware

20. Provide a short summary of the stability-related hardware currently installed in GGNS (Solution EI-A, III, and or DSS-CD)). Provide a plan for transition between methods. Are there any issues related to the interface between the existing hardware and GE methods?

ATWS EPGs

21. What version of emergency operating guidelines is currently implemented in GGNS? Provide a short description of the process used to ensure that the EPG variables (e.g. HSBW, HCTL) are adequate under CPPU conditions.

ATWS/Stability

22. Provide a short description of how the Stability Mitigation Actions (e.g. immediate water level reduction and early boron injection) are implemented in GGNS. Does operation at CPPU conditions require modification of any operator instructions?

Plant-Specific OPRM System

23. GGNS will operate under Option III solution. Please provide a clarification for the following areas:
    a. Describe the process that was followed by GGNS to implement Option III L/T Stability Solution and to verify that Option III is still applicable under CPPU operation.
    b. Describe the expected effects of CPPU operation on Option III.

c. Describe any alternative method to provide detection and suppression of any mode of instability if licensed OPRM scram becomes unavailable.

e. Provide a summary of the GGNS Technical Specifications affected by the Option III implementation and future CPPU operation.

f. Provide approved methodologies used to calculate the OPRM setpoint by the current operation and future GGNS CPPU operation.

Hot Channel and Core-Wide Decay Ratio

24. Provide a table of hot channel and core-wide decay ratios at the most limiting state point for the last cycles and the proposed CPPU condition. The purpose is to evaluate the impact of CPPU on relative stability of the plant, and the applicability of Option III to GGNS under these new conditions.

Suppression Pool Cooling

25. Describe any effects or impacts, if any, of EPU on suppression pool cooling during isolation ATWS events and/or EOPs.

ECCS NPSH Requirements

26. Provide the GGNS ECCS net positive suction head (NPSH) requirements. Are these affected by the CPPU upgrade?

GGNS Simulator Update

27. Please provide a short description of the simulator neutronic core model. Also, provide the schedule to show when the GGNS simulator is upgraded for EPU conditions.

Approved Methodologies

28. Provide a list of approved methodologies used to support the calculation for Section 2.8.3 and 2.8.5.7 of the proposed CPPU LAR.

Fuel Storage (Sections 2.8.6)

29. Section 6.5.1 of NEDC-33621P discusses the use of a blocking device to prevent storage of fuel in certain cells. The section appears to conclude that misloading a bundle into a blocked location in Region II is not a credible event. Provide a quantitative analysis that evaluates the probability of occurrence of a fuel misloading event at GGNS, in order to support the licensee's position that the event is not credible. Note that the NRC staff requested similar information in a recent application that attempted to use a similar approach to justify that a misloading event was not a credible event (ML091550832).

30. Boraflex is known to degrade in a high radiation environment leading to panel cracking, panel gap formation, and boron carbide dissolution. Demonstrate that a stable structural configuration of the poison panels exists under the design basis seismic events to ensure that the stored fuel assemblies remain subcritical. This could be accomplished by either (1) demonstrating through seismic and mechanical analysis that the Boraflex panels will not be affected (i.e. the poison panels will not split, shift, and/or dissolve to the extent to which the k-effective of the storage rack may become unacceptable) by the design basis loads or

(2) demonstrating that the storage rack will continue to meet the k-effective requirements even if the poison panels split, shift, and/or dissolve to the maximum credible extent.

31. Section 3.6 of NEDC-33621P, “Assumptions and Conservatisms,” states that the Boron-10 content for Region I panels is assumed to be 70% of the 95/95 minimum assayed areal density. Clarify the meaning of “70% of the 95/95 minimum assayed areal density.” Is the value based on the minimum certified areal density of the GGNS Boraflex panels? Is it based on the minimum as-fabricated value of the panels?

32. Attachment 1 to GNRO-2010/00073 states that 32 panels were measured in Region I and Region II locations. How many Region I panels were measured? How many panels total are in Region 1? How can we ascertain that the bounding panels in the Region I population have been represented in the measured sample?

33. Attachment 1 of GNRO-2010/00073 states that the Region I panels that were tested had accumulated doses up to 1.77E10 rads. What is the highest accumulated dose for a Region I panel in the GGNS spent fuel pool?

34. Attachment 1 of GNRO-2010/00073 states that BADGER and RACKLIFE difference is bounded by a 95/95 uncertainty of 0.0022 gram/square centimeter. Explain how BADGER and RACKLIFE comparisons were made. Also, what is the basis for the 0.0022 gram/square centimeter uncertainty?

35. According to your predictions, when will the most degraded panel in Region I exceed the assumptions in the criticality analysis? RACKLIFE is not intended for precise prediction of local degradation. How does just monitoring for areal density capture the other possible degradation modes such as gapping and scalloping?

36. Table 1 of Attachment 1 to GNRO – 2010/00073 provides the results of the BADGER test in terms of “Panel Loss (%).” Define “Panel Loss (%).” Describe how the “Panel Loss (%)” provides a measure that includes the effects of the different degradation modes (e.g., uniform thinning, shrinkage, localized dissolution, etc.). With respect to each BADGER campaign provide the following information:

    a) What was the actual areal density of the reference panel used during the BADGER campaign?

    b) How did GGNS verify the actual areal density of the reference panel?

    c) Provide the distribution of the as-built areal densities of the Boraflex panels installed in the GGNS SFP.

    d) Explain how the as-built areal densities are distributed in the SFP.

37. Supply the BADGER campaign report to all the NRC staff to confirm the basis for the Boraflex assumed in the criticality analysis.

38. What is the BADGER measurement uncertainty associated with measuring shrinkage-induced gaps? Does BADGER miss detecting certain gaps? How are these considerations addressed in the criticality model?

39. Provide a sample MCNP model that graphically shows the axial modeling of the Boraflex degradation.

40. Table 17 of NEDC-33621P provides the lattice information at zero void condition. Show that other void conditions have been considered and are bounded by the selected lattice.

41. 10 CFR 50.36(c)(4) states:

> Design features to be included are those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered in categories described in paragraphs (c)(1), (2), and (3) of this section.

In a separate applicant request, the NRC staff has taken a position that U-235 enrichment and in-core k-infinity limits should be specified in the Technical Specifications. The licensee is requested to specify these limits in the GGNS Technical Specifications in accordance with 10CFR 50.36.

In addition, the proposed Region I and Region II storage configuration requirements are normally required in the Technical Specification. The licensee is requested to specify these requirements in the GGNS Technical Specifications in accordance with 10CFR 50.36.