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GNRO-2011/00073

August 29, 2011

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Request for Additional Information Regarding
Extended Power Uprate
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCES:
1. Email from A. Wang to F. Burford dated August 17, 2011, Grand Gulf Extended Power Uprate Health Physics and Human Performance Branch Request for Additional Information (ME4679) (NRC ADAMS Accession No. ML112300006)
2. License Amendment Request, Extended Power Uprate, dated September 8, 2010 (GNRO-2010/00056, NUC ADAMS Accession No. ML102660403)

Dear Sir or Madam:

The Nuclear Regulatory Commission (NRC) requested additional information (Reference 1) regarding certain aspects of the Grand Gulf Nuclear Station, Unit 1 (GGNS) Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 2). Attachment 1 provides responses to the additional information requested by the Health Physics and Human Performance Branch Request for Additional Information.

No change is needed to the no significant hazards consideration included in the initial LAR (Reference 2) as a result of the additional information provided. There are no new commitments included in this letter.

If you have any questions or require additional information, please contact Jerry Burford at 601-368-5755.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 29, 2011.

Sincerely,

MAK/FGB/dm

Attachments:
1. Response to Request for Additional Information, Health Physics and Human Performance Branch

cc: Mr. Elmo E. Collins, Jr.
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NRC Senior Resident Inspector
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Port Gibson, MS 39150

Attachment 1

GNRO-2011/00073

Grand Gulf Nuclear Station Extended Power Uprate

Response to Request for Additional Information

Health Physics and Human Performance Branch

Response to Request for Additional Information
Health Physics and Human Performance Branch

By letter dated September 8, 2010, Entergy Operations, Inc. (Entergy) submitted a license amendment request (LAR) for an Extended Power Uprate (EPU) for Grand Gulf Nuclear Station, Unit 1 (GGNS). By letter dated March 9, 2011, Entergy submitted responses to the initial request for additional information (RAI) from the Health Physics and Human Performance Branch (see NRC ADAMS Accession No. ML110730025). Subsequently, the Health Physics and Human Performance Branch has determined that the following additional information is needed for the U.S. Nuclear Regulatory Commission (NRC) staff to complete their review of the amendment. Entergy's response is provided below.

RAI # 1

Provide an analysis demonstrating that there will be continued access to vital areas within the plant (consistent with NUREG 0737 item II.B.2) under EPU accident conditions. This analysis should include the full mission dose to each vital area necessary during the course of the accident.

Response

Section 2.10.1.2.3 of EPU LAR Attachment 5 states that due to conservative assumptions in the current licensing basis (CLB) analyses, the estimated post-accident radiation levels specified for Current Licensed Thermal Power (CLTP) are bounding for EPU operations. Provided below is a summary of the assessment performed which resulted in the above conclusion and demonstrated continued accessibility to vital areas within the plant (consistent with NUREG 0737 item II.B.2) under EPU accident conditions.

Note that post-EPU habitability of vital areas that require continuous occupancy, i.e., the Control Room and Technical Support Center, are addressed separately in Section 2.9.2 and 2.9.3 of EPU LAR Attachment 5 and are not addressed in this response.

Summary of Current Licensing Basis (CLB)

GGNS UFSAR Table 12.6-2 lists the plant locations where personnel access is required post-accident. Post-LOCA radiation dose rate zone maps are provided in UFSAR Figures 12.6-1 through 12.6-6. Per the NRC License Amendment letter dated June 30, 2003 (Issuance of Amendment Re: Elimination of Requirements for Post Accident Sampling System (TAC NO. MB8061)), the post-accident sampling system is no longer required.

The design inputs and assumptions used to develop the CLB post-LOCA vital access mission doses are discussed in UFSAR Section 12.6.3. As stated in UFSAR Section 12.6.3.1, the vital access personnel mission doses are conservatively based on a core power level of 4025 MWt, which corresponds to 105% of the Original Licensed Thermal Power of 3833 MWt.

A review of the source term analyses supporting the vital area access mission doses presented in UFSAR Table 12.6-2 indicated that the pre-uprate source terms were highly conservative, not only relative to the assumed core power, but also in the development of the source terms. Briefly, the pre-uprate source terms were generated using a subset of the total list of isotopes identified in the core inventory. An activity adjustment factor of 1.266 was

applied to all isotopes in the selected subset in order to conserve the total T= 0 hr core activity. This adjustment factor was based on the ratio of total activity in the initial list of core isotopes at T=0 hr to the total activity of the isotopes selected for the subset. Application of this adjustment factor was very conservative since at T= 0 hr post-accident, the total core activity includes isotopes with short half-lives (less than 30 minutes). It was determined that after decay of the short half-life isotopes, the adjustment factor would essentially become 1.0, however, the factor of 1.266 was conservatively retained for all time intervals. Thus, for time periods greater than 30 minutes, the CLB source terms used in the post-accident mission doses were effectively based on a core power level of 133% of OLTP.

Per License Amendment No. 145, GGNS has been approved for the use of Alternative Source Terms (AST) as outlined in 10 CFR 50.67, Standard Review Plan 15.0.1, Revision 0, and Regulatory Guide 1.183, Revision 0, for post-accident dose assessments associated with the site boundary and on-site locations that require continuous occupancy such as the Control Room and the Technical Support Center (TSC).

However, the CLB post-LOCA vital area access mission doses (with the exception of the control room and TSC), continue to be based on TID-14844 Source Terms as documented in UFSAR Section 12.6.3. This approach is acceptable based on the AST benchmarking study reported in SECY-98-154, which concluded that results of analyses based on TID-14844 would be more limiting earlier on in the event, after which time the AST results would be more limiting. Areas designated as vital for purposes of accident mitigation usually require access within the first week when the original TID-14844 source terms are more limiting. Thus, with the implementation of AST, the conclusions of UFSAR Section 12.6.3 were retained and considered conservative for the CLTP of 3898 MWt.

EPU Assessment

The EPU core power level is 4408 MWt. Radiological safety analyses supporting the EPU have been performed at a reactor power level of 4496 MWt (i.e., the core power level of 4408 MWt with a 2 percent margin for power uncertainty) and a 24-month fuel cycle.

The EPU assessment takes into account the following:

- The EPU equilibrium core inventory which was developed based on 4496 MWt and at the expected fuel enrichment and burnup. The radiation source terms in equipment/structures containing post-accident fluids and the corresponding environmental radiation levels will change accordingly.

- The GGNS EPU does not impact the post-LOCA vital area mission requirements defined in UFSAR Section 12.6.3, including the task description, access route and required time for access. In addition, there are no EPU-related modifications that impact the operation and layout/arrangement of plant radioactive systems that are considered when estimating mission doses. Thus, the impact of the EPU on the post-LOCA gamma environmental conditions in the areas that require access can be assessed based on a comparison of the source terms (containment atmosphere, suppression pool water, etc) developed based on the core inventory used for the CLB vital area access dose assessment versus the source terms developed based on the EPU core inventory. Since the relative abundance of each isotope and the average energy of each isotope are the key parameters that affect direct exposure, a source term scaling factor that

addresses the change in these parameters is sufficient to assess the radiological impact of the EPU on the pre-EPU mission dose estimates.

Thus, source term scaling techniques are used to demonstrate continued compliance with the operator exposure dose limits of 5 rem whole body provided in NUREG-0737, II.B.2, following EPU. Specifically, a comparison is made of the gamma source terms based on the original core inventory utilized to develop the post-LOCA dose rates to the gamma source terms based on the EPU core inventory.

Theoretically, following the EPU, the post-LOCA environmental gamma dose rates and the operator dose per identified mission should increase by approximately 11.7-percent (4496 MWt/4025 MWt). However, because the EPU analyzed core reflects operation with a 24-month fuel cycle and more advanced fuel burnup modeling/libraries than used in the original analyses, the calculated EPU scaling factor values will deviate from the core power ratio. Additionally, the existing conservatism in the CLB methodology which included an increased factor of 1.266 on the pre-EPU core inventory will lower the EPU source term scaling factor. Note that the radiation source dilution volumes used in the CLB analysis are not significantly impacted by EPU, thus there is no volume adjustment component to the EPU source term scaling factor.

The EPU assessment is essentially a two-step process. The first step develops a bounding EPU dose rate scaling factor versus time, and the second multiplies the CLB personnel dose rates at target areas, identified in the licensing basis, by the bounding EPU scaling factor.

Development of the EPU scaling factor takes into consideration that uprate gamma dose rate scaling factors will vary with source, time, and shielding. Thus, to cover all types of analysis models/assessments, a bounding approach is utilized that takes into account the potential for presence of multiple radiation sources that are shielded or unshielded, and missions that are undertaken at different time periods post-LOCA.

Development of the scaling factor starts with a compilation of the CLB and the EPU post-accident sources gamma energy release rates (Mev/sec) per energy group versus time. The dose rate factors are then estimated by ratioing the CLB and EPU source term gamma energy release rates weighted by the flux-to-dose rate conversion factors, as a function of time. To address the fact that most radiation sources are contained in piping, the energy release rate values discussed above assess the shielding effect of various pipe wall thicknesses associated with sample lines and small/large bore piping. This ensures that the results are not impacted by lower energy photons, which are substantially attenuated by any piping sources or self-attenuation (e.g., charcoal filter media or water).

To address shielded radiation sources, the dose rate scaling factors versus time developed above are weighted by concrete reduction factors for each energy group. The concrete reduction factors for 1ft, 2ft, and 3ft of concrete are used to provide a basis for comparison of the post-LOCA spectrum hardness with respect to time, for lightly shielded and heavily shielded cases.

Table 1 provides a summary of the maximum EPU dose rate scaling factor at a given time for each source category. The earliest vital area access time is after 30 minutes post-accident. Since the EPU post-LOCA vital area access scaling factors from one-half hour to 30 days post-accident are approximately 1 (one), a factor of one is used. The EPU doses are obtained by

multiplying the pre-uprate doses by the EPU scaling factor. Thus, the EPU post-LOCA vital area access mission doses remain the same as those applicable to the CLTP (and recorded in UFSAR Table 12.6-2) and are presented in Table 2. In all cases, the EPU post-LOCA vital area access mission doses are less than the NUREG-0737 II.B.2 dose limit of 5 rem.

Post-LOCA Radiation Zone Maps

UFSAR Figures 12.6-1 through 12.6-6 present post-accident radiation zone maps that address the contributions of post-LOCA airborne sources through the containment wall as well as contribution through penetrations, and contained sources outside containment. Based on the assessment documented above, these zone maps will not be impacted by the EPU.

Table 1 - Summary of EPU Scaling Factors for Vital Area Access

Time Post -LOCA	EPU Scaling Factors		
	Press. RCS	Recirc Liquid	Airborne Releases
0.5 hr	0.97	0.94	0.97
1 hr	0.97	0.93	0.98
2 hrs	0.98	0.93	0.99
8 hrs	1.00	0.99	0.99
24 hrs	1.00	1.00	0.97
168 hrs	0.95	0.95	0.98
720 hrs	0.98	0.98	1.01

Table 2 - Locations Requiring Accessibility Following an Accident

Location	Pre-uprate Integrated Personnel Dose (Rem) [1]	EPU Integrated Personnel Dose (Rem) [2]
Remote Shutdown Panel	4	4
Diesel Generator Buildings	0.12	0.12
Post-Accident Sampling Station [3]	-----	-----
SGTS Sampling Station	0.44	0.44
Laboratories	4.38	4.38
ADS Air Supply Makeup Connection	3.46	3.46
ADS Booster Compressor Area	1.13	1.13

(1) See UFSAR Table 12.6-2
(2) EPU Integrated Dose = Pre-uprate Integrated Dose x Scaling Factor (= 1)
(3) As indicated in the NRC letter dated June 30, 2003 and the accompanying safety evaluation, the PASS is no longer required.