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GNRO-2010/00071

November 18, 2010

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

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

REFERENCES:
1. Grand Gulf Nuclear Station, Unit 1 – Supplemental Information Needed for Acceptance of License Amendment Request for Extended Power Uprate (TAC No. ME4679) (ML103010200)
2. License Amendment Request, Extended Power Uprate dated September 8, 2010 (GNRO-2010/00056)

Dear Sir or Madam:

By letter dated November 9, 2010 (Reference 1), the Nuclear Regulatory Commission (NRC) requested supplemental information 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 three of the supplemental information requests. Entergy plans to provide the response to the request related to the criticality safety analysis by December 1, 2010.

No change is needed to the no significant hazards consideration included in the initial LAR (Reference 2) as a result of the supplemental 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 November 18, 2010.

Sincerely,

MAK/FGB/dm

Attachments:
1. Supplemental Information

cc: Mr. Elmo E. Collins, Jr.
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Attachment 1

GNRO-2010/00071

Supplemental Information

Supplemental Information

1. Environmental Qualification evaluation of all Group II items should [be] completed including determination regarding remaining life and required modification to the components or replacement of them. In case of replacement, please identify the replacement components and discuss how the replacement components will satisfy the EQ rule under EPU conditions.

   Response

   The Group II Partially Qualified components listed in Attachment 5 Table 2.3-1 of the Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 1) are solenoid valves that have silicone oil as a lubricant. The solenoids, and thus the lubricant, are located in the drywell and would be exposed to the drywell atmosphere conditions following a loss of coolant accident (LOCA). These valves were included on the Table because of a reduced qualified life related to the lubricant. The qualified life of the oil in the post-EPU radiation environment is 5.9 years, as shown in Table 2.3-1. The maintenance activities associated with assuring the qualified life of these valves are included in the Grand Gulf Nuclear Station (GGNS) Environmental Qualification (EQ) program.

   The existing maintenance procedures for these solenoid valves include requirements to rework the solenoid, replace non-metallic components, and lubricate the solenoid on a 5-year interval. Because the required maintenance schedule is bounded by the qualified life for EPU operation, no changes to the maintenance procedure requirements are needed. The EPU impact is to be reflected in an update to the component qualification file to document the revised qualified life of the lubricant. Changes made to the EQ program are documented and administered per Entergy Administrative Procedure, "Environmental Qualification (NUREG-0588 / 10 CFR 50.49," 01-S-06-57, Revision 0. EQ program changes and file updates will be completed as required by 10 CFR 50.49 prior to EPU implementation.

2. Group III items need to be replaced prior to EPU implementation. Please identify the replacement components and discuss how the replacement components will satisfy the EQ rule under EPU conditions.

   Response

   Group III Non-Qualified components are listed in EPU LAR Attachment 5 Table 2.3-2 and consist of valve actuator subcomponents (motors and control components), electrical splices (Scotch tape), and commodity wire. Each of these is addressed in the following discussion. The replacement of these components with suitably qualified components is included in the planned modifications list provided in EPU LAR Attachment 8.

   The valve actuator subcomponents (motors and control components) identified in EPU LAR Attachment 5 Table 2.3-2 are to be replaced with subcomponents qualified for the EPU environment. The replacement motors utilize type RH insulation and the replacement control components, including torque switches and limit switches, are made with Melamine or Fibrite material. The environmental conditions (temperature, pressure, humidity, and radiation) to which these replacement actuator subcomponents are qualified bound the requirements for EPU operation. The actuators are located in Auxiliary Building rooms associated with the Residual Heat Removal (RHR) system. The replacement materials are qualified for use in post LOCA and high energy line break (HELB) environments. The qualification summary for the actuators with the replacement subcomponents is provided in Table 1.

The Scotch tape splices identified in EPU LAR Attachment 5 Table 2.3-2 are to be replaced with Raychem splices qualified for the EPU environment. These splices are located in the RHR rooms and are used at motor terminations for the jockey pumps and valve actuators. The environmental conditions to which the replacement splice materials are qualified bound the requirements for EPU operation. The qualification summary for the splice material is provided in Table 2.

The commodity wire identified in EPU LAR Attachment 5 Table 2.3-2 is to be replaced with Rockbestos radiation resistant SR Cable qualified for the EPU environment. The affected wire is located on Hydrogen Analyzer panels in the sensor cell 'hot box.' The wire is identified for replacement due to an increase in radiation for the EPU environment at the location identified. This location is continuously maintained at 300°F. The replacement wire to meet the radiation requirement was thermally aged and analyzed to establish a qualified life of the equivalent of 5.7 years at this temperature. All other environmental conditions to which the replacement wire is qualified bound the requirements for EPU operation. The qualification summary for the wire is provided in Table 3.

Changes made to the EQ program are documented and administered per Entergy Administrative Procedure, "Environmental Qualification (NUREG-0588 / 10 CFR 50.49)," 01-S-06-57, Revision 0. EQ program changes and file updates will be completed as required by 10 CFR 50.49 prior to EPU implementation.

Table 1
Qualification Summary for Limitorque Actuators

MANUFACTURER: Limitorque
COMPONENT: Motor Operated Valve Actuators - Includes Motors with type RH insulation and Control components of Fibrite or Melamine material
LOCATION: Outside Primary Containment

ENVIRONMENT			DOCUMENT REFERENCE		QUALIFICATION METHOD
PARAMETER	SPECIFICATION (EPU)	QUALIFICATION	SPECIFICATION	QUALIFICATION	
Post-Accident Op-Time	100 Days	100+ Days	TDC-07	EQDP 02.1 EC-Q1111-87011, R1 EC-Q1111-87012, R0	Simultaneous Test with Analysis
Aging	40 years	40 years			Simultaneous Test with Analysis
Temperature (°F) (maximum)	217	340	GGNS-E100.0 GGNS-NE-10 - 00060	Limitorque Qualification Report Projects 600376A and 600456	Simultaneous Test
Pressure (psia)	18.0	119.7			Simultaneous Test
Relative Humidity (%)	100	100			Simultaneous Test
Radiation (rads)	4.98×10^{7}	2×10^{8}	GGNS-NE-10-00060		Sequential Test

Table 2
Qualification Summary for Raychem Electrical Splices

MANUFACTURER: Raychem
COMPONENT: Splices
LOCATION: Outside Primary Containment

ENVIRONMENT			DOCUMENT REFERENCE		QUALIFICATION METHOD
PARAMETER	**SPECIFICATION (EPU)**	**QUALIFICATION**	**SPECIFICATION**	**QUALIFICATION**	
Post-Accident Op-Time	100 Days	110+ Days	TDC-07	EQDP 19.1 Calculations 0200-047-108, R0 0200-047-107, R0	Sequential Test and Analysis
Aging	40 years	40 years			Sequential Test and Analysis
Temperature (°F) (maximum)	217	357	GGNS E100.0 GGNS-NE-10-00060	The Franklin Institute Report F-C4033-3 Wyle Laboratories Test Report 58722-2 Wyle Laboratories Test Report 58722-5	Sequential Test
Pressure (psia)	18.0	84.7			Sequential Test
Relative Humidity (%)	100	100			Sequential Test
Radiation (rads)	6.11×10^7	2.20×10^8	GEH-GGNS-AEP-412		Sequential Test

Table 3
Qualification Summary for Rockbestos Cable

MANUFACTURER: Rockbestos
COMPONENT: 1/C 14 AWG Control Cable
LOCATION: Outside Primary Containment (inside Hydrogen Analyzer Panel hot box)

ENVIRONMENT			DOCUMENT REFERENCE		QUALIFICATION METHOD
PARAMETER	**SPECIFICATION (EPU)**	**QUALIFICATION**	**SPECIFICATION**	**QUALIFICATION**	
Post-Accident Op-Time	100 Days	100+ Days	TDC-07 EC-Q1E61-88006, Rev.0	Rockbestos Qualification Report QR 8802 EQDP 13.1	Test and Analysis
Aging	40 Years (5.7 Years @ 300°F)	5.7 Years @ 300°F			Test and Analysis
Temperature (°F)	300 (Hot Box)	392	EC-Q1E61-88006, Rev.0 GGNS-NE-10-00060	Rockbestos Qualification Report QR-8802	Test
Pressure	0.25 to 0 iwg	146.8 psia	GGNS-E100.0 GGNS-NE-10-00060		Test
Relative Humidity (%)	50	100			Test
Radiation (rads)	$1.64x10^5$	$2.0x10^8$	GGNS-NE-10-00060		Test

3. Please provide supplemental information regarding analysis of the Spent Fuel Pool under increase decay heat loads and the analysis of the enhanced ultimate heat sink performance credited in the accident analyses.

Response

Spent Fuel Pool Cooling and Cleanup System Heat Exchangers

The GGNS Fuel Pool Cooling and Cleanup (FPCC) System consists of two trains, each with a single pump and heat exchanger. During normal operation, the system is normally cooled by the Component Cooling Water (CCW) system and one or both trains may be in operation to maintain the pool temperature less than 140°F. Under loss of offsite power conditions, cooling is provided by the Standby Service Water (SSW) system to maintain the pool temperature less than the system design temperature of 150°F. This system is described in detail in GGNS Final Safety Analysis Report (FSAR) Section 9.1.3.

The impact of EPU on this system is an increase in the fuel pool decay heat load. As described in LAR Attachment 5 Section 2.5.3.1, the EPU heat loads were evaluated using the decay heat correlation in ANS/ANSI-5.1-1994, *Decay Heat Power in Light Water Reactors,* with two-sigma uncertainty. The current licensing basis evaluation of the normal heat load case considers full pool including a reload batch of 240 bundles, which are assumed to be discharged to the pool within 150 hours after shutdown. The EPU evaluation is based on a full fuel pool and considers a reload batch of 380 bundles as a result of EPU and the planned future transition to 24 month fuel cycles; the larger batch extends the discharge time to 173 hours. As a result, the peak pool heat load increases from 19.06 MBtu/hr at 150 hours of decay (pre-EPU) to 27.4 MBtu/hr at 173 hours after shutdown (post-EPU). Note that the 18.34 MBtu/hr reported in LAR Attachment 5 Section 2.5.3.3 is the heat load considering the current plant scenario (i.e., full pool with 240 recently discharged bundles) at 173 hours of decay, which corresponds to the time at which the peak heat load would be reached in the EPU discharge scenario. The assumed rate of discharge to the pool is consistent with that assumed in the current licensing basis.

Currently, there are two tube and shell heat exchangers, each with a heat removal capability of 11.6 MBtu/hr with spent fuel pool water temperature at 140°F and CCW at its maximum design temperature of 95°F. The modification to the FPCC system involves the replacement of the current heat exchangers with two plate and frame heat exchangers and any necessary support auxiliaries. Each of the new heat exchangers are designed with a heat removal capability of at least 15 MBtu/hr at the same conditions cited above. No changes to the FPCC, CCW, or SSW flow rates are planned. The design criteria as described in FSAR Section 9.1.3.3 for the spent fuel storage facility continue to be met with the installation of the plate and frame heat exchangers. No single active failure of the FPCC equipment or components will cause an inability to: 1) maintain irradiated fuel submerged in water; 2) re-establish normal fuel pool water level; or 3) remove decay heat from the pool.

Consistent with the current licensing basis for the abnormal heat load case, FPCC heat removal capability may be insufficient to maintain the spent fuel pool temperature below

150°F during the early stages of a complete core offload. In this case, the RHR System would be aligned to remove decay heat from the spent fuel pool.

Consistent with the current heat exchangers, the replacement heat exchangers are to be Nuclear Safety Related, Safety Class 3, and Seismic Category I. In addition, the spent fuel pool heat exchangers are to be designed in accordance with ASME III, Div. 1, Subsections ND and NF. The heat exchangers are to be installed per ASME XI.

UHS Cooling Tower Fill Replacement and Water Inventory Change

The Ultimate Heat Sink (UHS) consists of two four-cell mechanical draft cooling towers and two concrete makeup water basins of the Standby Service Water (SSW) System. One tower services one Residual Heat Removal (RHR) train and other safety-related loads on Division I with two fan cells, and the High Pressure Core Spray (HPCS) cooling loads (Division III) with the remaining two cells. The other tower services the second RHR train and safety-related cooling loads on Division II with two fan cells (two cells are not utilized.) The SSW cooling towers are the safety-related source of cooling water during accident and loss of offsite power (LOOP) conditions. The UHS for GGNS is designed to supply water to the heat loads at 90^{O}F maximum temperature. The UHS inventory is designed to maintain a reserve water supply for 30 days post-accident operation without replenishment. There is an interconnecting line between the basins below grade that allows water to siphon from one basin to the other. The total UHS usable inventory between the two basins is approximately 13.2×10^6 gallons. The system is described in detail in UFSAR Section 9.2.1.

Cooling Tower Fill Modification

During the recent refueling outage (spring 2010), the cooling tower cells for Division I and II were modified to increase the cooling tower heat removal capability. This modification involved replacement of the original ceramic block fill material with high-efficiency stainless steel fill material. No EPU impact was anticipated for the HPCS system and no modification was made for the cooling tower cells associated with the HPCS service water system.

The thermal performance capability of the SSW cooling towers with stainless steel fill installed was analyzed using Cooling Tower Institute (CTI) tower analysis methodology as described in GGNS UFSAR Section 9.2.1.3. A heat load increase of 15% above original design conditions was conservatively assumed in the fill-design evaluation to bound the impact of EPU.

As demonstrated in the table below, the new fill provided enhanced air circulation and improved tower performance. The original and EPU design parameters for the two cells in each tower serving the Division I and II SSW cooling trains are:

Parameters	Original Design	EPU Design
Cell water flow (gpm)	5922	5922
Fan air flow (acfm)	678,000	736,093
DBT (Dry Bulb Temperature, °F)	100	100
WBT (Wet Bulb Temperature, °F)	79	79
L/G (Liquid/Gas Ratio)	1.0989	1.0529
KaV/L – (Tower fill performance characteristic)	1.5545	1.85587
HWT (Hot Water Temperature, °F)	130.6	135.6
CWT (Cold Water Temperature, °F)	90	88.9
Heat Duty per SSW cell (MBTU/hr)	120.25	138.3
Fill DP (iwg)	0.4875	0.2507

The heat loads served by the SSW System, which include the containment suppression pool, spent fuel pool, diesel generators, SSW pumps, and various other auxiliary cooling systems, were evaluated for EPU. The main increases occurred for the containment suppression pool and the spent fuel pool. The peak heat load increase due to EPU has been analyzed to be less than 6% above original design conditions.

UHS Inventory Modification

The increased heat load due to EPU and the higher air flow rate through the fill result in higher rates of evaporation. Based on the water inventory analysis, the siphon line between the basins is being extended vertically downward to increase the amount of water available for cooling.

The UHS capability to dissipate heat from the SSW system was evaluated to determine if the cooling towers and associated components are adequate to provide required cooling at EPU conditions. The EPU evaluation was performed in the same manner as described in UFSAR Section 9.2.1.3. The system operation analysis is based on the following assumptions:

a. Loss of Coolant Accident
b. Total loss of offsite power
c. The worst single active failure, which is the loss of one of the two standby diesel generators removing one of the standby service water loops from operation
d. No makeup water available to the SSW cooling tower basins for 30 days
e. The worst 30-day site meteorology

These assumptions result in the greatest heat rejection rate for the UHS during the most severe meteorology for cooling tower performance. The meteorological conditions were updated to include the years 1996 - 2008; the original analysis considered the years 1948 - 1975. An average wet bulb temperature over a 30-day period in 1998 that was higher than the previous high that had occurred in 1970 was identified. The 1970 30-day average wet bulb temperature was 76.6°F with peak daily average of 79°F; for the period 7/4/98 to 8/2/98, the 30-day average wet bulb temperature was 78.5°F with peak daily average of 81°F.

As a conservative approach to the heat rejection analysis, the entire energy of the SSW pumps was assumed to be a sensible heat input to the SSW system.

The cooling tower was modeled in the UHS with the CTI Merkel Method. Various analyses were made using different conservative assumptions, evaluating the (30 day) water inventory, maximum heat load (1 day) calculations, and different failures. For consideration of water inventory, no active failure was considered in order to maximize water consumption (i.e., evaporation, drift, and system losses) with operation of both cooling towers.

The result for EPU operation demonstrated that the calculated UHS CWT (SSW supply temperature to the plant) would be 88.9°F, which is less than the 90°F maximum temperature in the current licensing basis. Based on the water inventory analysis, the siphon line between the basins is being extended vertically downward to increase the amount of water available for cooling. Water consumption during SSW operation in a 30-day post-LOCA scenario would be approximately 10.4×10^6 gallons for the pre-EPU design. Considering the increased heat loads due to EPU and improved tower air flow rates following the tower fill modification, the water consumption for the 30-day post-accident scenario under EPU conditions is approximately 11.2×10^6 gallons. The modification to extend the siphon in the basin makes available an additional 1.4×10^6 gallons, thus assuring the inventory and SSW-cooling function for 30 days. In the basin with the least inventory remaining at the end of the 30-day period, the analysis demonstrates there remains at least 5-feet of depth above minimum required for pump suction (approximately 730,000 gallons of useable inventory).

<u>References</u>

1. License Amendment Request, Extended Power Uprate dated September 8, 2010 (GNRO-2010/00056)