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GNRO-2016/00036

July 29, 2016

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

SUBJECT: Entergy Response to Requests for Additional Information (RAIs) Regarding Final Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation  
Grand Gulf Nuclear Station, Unit 1  
Docket No. 50-416  
License No. NPF-29

- REFERENCES:
1. NRC Order Number EA-12-051, *Order to Modify Licenses with Regard to Reliable Spent Fuel Pool (SFP) Instrumentation*, dated March 12, 2012 (ML12054A682)
  2. Entergy Letter to NRC, *Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying License with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated February 26, 2013 (GNRO-2013/00016, ML13064A417)
  3. NRC Letter to Entergy, Grand Gulf Nuclear Station, Unit 1 – *Interim Staff Evaluation and Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation*, dated November 25, 2013 (Order Number EA-12-051) (TAC NO. MF0955)
  4. NRC Letter to Entergy, Grand Gulf Nuclear Station, Unit 1 – *Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0954 and MF0955)*, dated November 24, 2015 (ML15308A298)
  5. Entergy Letter to NRC, *Notification of Full Compliance with NRC Order EA-12-051 Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order EA-12-051)*, dated May 23, 2016 (GNRO-2016/00007, ML16145A497)

6. NRC Email to Entergy, Grand Gulf nuclear Station, Unit 1 – Request Additional Info on Grand Gulf SFPI RAIs on EA-12-051, dated June 21, 2016 (GNRI-2016/00065)

Dear Sir or Madam:

On March 12, 2012, the NRC issued Order EA-12-051, *Order Modifying Licenses with Regard to Reliable Spent Fuel Pool (SFP) Instrumentation* (Reference 1), to all power reactor licensees, which is applicable to Entergy Operations, Inc. (Entergy). The Order was effective immediately and directed the installation of reliable SFP instrumentation. Reference 2 provided the response to Section C.1., of the Order, which required that the Licensee submit an Overall Integrated Plan (OIP). Reference 5 provided updates to References 3, 4 and the notification, required by Section C.3 of the Order, that full compliance with the Order had been achieved. This letter provides a response to the Requests for Additional Information (RAIs) in Reference 6.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Mr. James J. Nadeau at (601) 437-2103.

I declare under penalty of perjury that the foregoing is true and correct; executed on July 29, 2016.

Sincerely,



VF/sas

Attachment: Entergy Response to Requests for Additional Information (RAIs) for NRC Order EA-12-051

cc: U.S. Nuclear Regulatory Commission  
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Attachment to GNRO-2016/00036

Entergy Response to Requests for Additional Information (RAIs) for NRC Order EA-12-051

**Entergy Response to Requests for Additional Information (RAIs) for NRC Order  
EA-12-051**

**RAI #3**

**Please provide the results of the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.**

**RAI #3 Response**

The vendor, MOHR, prepared a series of generic seismic qualification reports for the SFP level instrument which bound GGNS's seismic criteria. The qualification reports envelop all components of the new SFP level instrumentation required to be operational during a Beyond Design Basis External Event (BDDEE) 1 and post-event. Therefore, the SFP instrumentation and electronic units are acceptable for use at the site. The analyses are contained in MOHR Test and Measurement LLC Reports, which are included in GGNS-IC-14-00001, "MOHR EFP-IL SFPI System Test Reports, Qualification Reports, and NAI Calculation," Revision 0:

1. NAI-1725-004, "Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool"
2. 1-0410-6, "MOHR EFP-IL SFPI System Seismic Test Report"
3. 1-0410-9, "MOHR SFP-1 Level Probe Assembly Seismic Analysis Report"

The probe mounting bracket is designed Seismic Category 1 with all Interaction Ratios (IRs) less than one (1.0), as documented in CC-N1G41-14001. Conservative hydrodynamic forces (sloshing) within the pool caused by a seismic event are documented in NAI-1725-004 and those forces are used as input to the SFPI mounting bracket design to ensure the probe will remain in place and functional during and after a BDBEE.

The equipment supports for the displays, batteries, and isolation transformers meet or exceed the GGNS design basis seismic response spectra, as detailed in calculations 425A.4520 and 425A.4521.

Conduit routing throughout the Auxiliary and Control Buildings are seismically mounted using both new and existing supports. The majority of new supports are typical installations in accordance with the CSD series "Conduit Support General Notes", of which Note 1 states that "All supports and bracing are Seismic Category-I and shall be fabricated and installed as "Q" items." A small number of new supports are engineered for specific locations, while maintaining the seismic design criteria. Existing supports used for SFPI conduit routing contain Safety Related conduits and/or trays and were previously seismically qualified.

The following are design inputs and criteria used in Calculation CC-N1G41-14001:

- All new structural steel member shapes and built up sections and their properties are derived from 13th edition of AISC Steel Construction Manual. Design of the structural steel members is per the 9<sup>th</sup> edition of AISC Steel Construction Manual and Structural Design Guide 27 of Stainless Steel, AISC.

- The bracket is qualified as a seismic structure. This evaluation designs the bracket with seismic considerations per Civil Design Criteria Manual to meet Seismic Class I requirements. Throughout this calculation, the SSE is considered for design loading.
- The dead weight of the probe is provided by vendor in Attachment "F" and is 45 lbs.
- Hydrodynamic and seismic loads on the probe are provided by the vendor (MOHR Test and Measurement LLC) in drawing 1-0430-18.1 due to N-S Seismic and hydrodynamic loading (SRSS value per IEEE-344-2004).
- Seismic accelerations of the mounting bracket structure are per C-196. Based on the GT STRUDL analysis, it is concluded that this mounting bracket is rigid (Frequency =127 HZ > 100 HZ), therefore the ZPA value of 1g is used.
- The load combination is D +L+ SSE+ Hydrodynamic/Sloshing.
- All Interaction Ratios (IR) are less than 1.00. Frequency and Displacements are listed in the body of the calculation in section 5.2.

#### **RAI #4**

**For each of the mounting attachments required to fasten SFP level equipment to plant structures, please describe the design inputs, and the methodology that was used to qualify the structural integrity of the affected structures/equipment.**

#### **RAI #4 Response**

GGNS-specific calculations CC-N1G41-14001, 425A.4520 and 425A.4521 formally document design input and methodology used to qualify the structural integrity of affected structures/equipment. Calculation CC-N1G41-14001 shows that the SFPI Probe Mounting Bracket is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0), such that the qualification of the SFP steel liner is not adversely impacted. Calculations 425A.4520 and 425A.4521 account for seismic accelerations and show that the additional brackets and other applicable supports, such as those connected to the floor in the Lower Cable Room, are seismically qualified.

The SFP, Auxiliary Building, and Control Building are Seismic Category 1 structures. All walls and floors that SFPI components are mounted to are existing reinforced concrete walls/floors. The SFPI installation does not impact any existing panels.

#### **RAI #6**

**Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the sensor electronics (including power boxes, signal processors, and display panels) will be exposed. Provide documentation indicating the maximum total integrated dose the sensor electronics can withstand and how it was determined. Discuss the time period over which the analyzed total integrated dose was applied.**

#### **RAI # 6 Response**

According to the Environmental Parameters for GGNS (E100.0), the radiation dose rates and total integrated dose are identical for the Control Room (0C503) and the Lower Cable Room

(0C402) with a dose rate of 0.0005 Rad/hr and a total integrated dose of 1.8E02 Rads. Therefore, this environment is acceptable and no additional testing is required per the NRC Audit Report for MOHR.

Radiation levels in the Lower Cable Room are not impacted by a reduction in Spent Fuel Pool water level.

With regard to the probes themselves, calculation XC-N1FLEX-14002 determines that all probe sub-components will be functional through the life of the plant as well as during a 7-day period with the SFP water at level 3. The calculated 7-day total integrated dose of 1.06E08 rad is below the limits specified by MOHR of 2E+09 rads (EPDM standoff) and 1E+10 rads (PEEK standoff) given in the MOHR SFP-1 Level Probe Assembly Materials Qualification Report.

#### **RAI #7**

**Please provide information indicating (a) the temperature ratings and whether the temperature ratings for the system electronics are continuous duty ratings; and (b) the maximum expected ambient temperature in the rooms in which the system electronics will be located under BDB conditions, which include no AC power available to run Heating, Ventilation, and Air Conditioning (HVAC) systems.**

#### **RAI #7 Response**

As discussed in GGNS SFPI EC50286, the primary and backup SFPI channel displays for GGNS are located in the Lower Cable Room. The Lower Cable Room is in the Control Building. The Control Building Cooling Subsystem is not operational following a BDBEE. M3.10.001 states that the Lower Cable Room can be maintained at 104°F without cooling due to the heat loads that are lost to surrounding rooms; therefore, following a BDBEE, the Lower Cable Room will remain below the maximum design temperature due to the overall reduction in heat load from powered equipment. There is sufficient cooling margin within the Lower Cable Room, due to the flow of heat to surrounding rooms, to dissipate the minimal heat addition of the SFPI equipment. The SFPI vendor, MOHR, has successfully tested its system electronics to a nominal temperature range of 14°F to 131°F. The sensor electronics are capable of continuously performing their required function under the expected temperature conditions. Results of the vendor testing are available in proprietary MOHR Report 1-0410-1, MOHR EFP-IL SFPI System Temperature and Humidity Report.

#### **RAI #8**

**Please provide information indicating the maximum expected relative humidity in the room in which the sensor electronics will be located under BDB conditions, in which there is no ac power available to run HVAC systems, and whether the sensor electronics is capable of continuously performing required functions under this expected humidity condition.**

### **RAI #8 Response**

The SFPI vendor, MOHR, has successfully tested its system electronics to operate in a humidity range of 5% to 95% relative humidity. Results of the vendor testing are available in proprietary MOHR Report 1-0410-1, MOHR EFP-IL SFPI System Temperature and Humidity Report.

Humidity in the Lower Cable Room is regulated by the non-safety related Control Building Cooling Subsystem; normal operation between 10 and 60 percent RH (E100.0). During an extended loss of AC power, the non-safety related Control Building HVAC system is no longer available. Assuming the Control Building doors remain closed, the temperature increase in the Lower Cable Room is primarily due to sensible heat from electrical cables and equipment. Even if the upper limits of the humidity and temperature occur simultaneously, the maximum temperature condition of 104°F and 60 percent RH (E100.0) is bounded by the 47°C (116.6°F) and 71 percent RH test case presented in MOHR Report # 1-0410-1.

In the event that outside air is introduced to the Lower Cable Room due to open doors or HVAC system connections to other rooms, ASHRAE defines the 0.4 percent dehumidification condition to be 84°F dry-bulb with 77 percent RH for Jackson, Mississippi. Similarly, 90 °F DB, with ~66% RH is defined for a 0.4% evaporation condition, the maximum RH in Lower Cable Room is bounded by the outside conditions with the assumption that the Control Building doors are opened. The maximum humidity condition of 77 percent RH is bounded by the 32°C (89.6°F) and 96 percent RH test case presented in MOHR Report # 1-0410-1. Hence, the operational humidity range of 5–95 percent encompasses all expected conditions for the Lower Cable Room and the sensor electronics are capable of continuously performing their required function under the expected humidity conditions.

### **RAI #9**

**Please provide a description of the specific method or combination of methods to be applied to demonstrate the reliability of the permanently installed equipment under BDB shock and vibration conditions.**

### **RAI #9 Response**

The NRC Audit Report for MOHR concludes that the shock and vibration test results were satisfactory. The report also acknowledges that the testing performed in MOHR Report 1-0410-16 is sufficient to close the open item identified during the MOHR audit.

MOHR Report 1-0410-5 adequately addresses the requirements for general robustness of the enclosures. The probe and repairable head are essentially a coax cable system that is considered inherently resistant to shock and vibration. The probes and repairable head are evaluated to be adequately designed for resilience against shock and vibration (1-0410-16).

The new probe mounting components and fasteners are seismically qualified and designed as rigid components inherently resistant to vibration effects. The probes will be affixed to the bracket using a machine screw connection designed with proper thread engagement.



The indicator and battery enclosures will be mounted in the Lower Cable Room. The equipment is not affixed or adjacent to any rotating machinery that would cause vibration effects in the area of installation. The new instrument mounting components and fasteners are seismically qualified and designed as rigid components inherently resistant to vibration effects. Similarly, the effects of shock on the supporting fixtures for the instruments are not a credible threat; all existing equipment in the vicinity of the new SFPI equipment is qualified seismically such that there are no expected impacts from adjacent objects during the BDBEE or design basis earthquake requirements imposed by NEI 12-02. Even though shock and vibration is not credible for Lower Cable Room equipment, it is adequately addressed by vendor test reports.

#### **RAI #10**

**For RAI #9 above, please provide the results for the selected methods, tests, and analyses used to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.**

#### **RAI #10 Response**

Factory Acceptance Testing of the SFPI equipment after repairs documented in CR-HQN-2015-00345 is contained in Procedure 2014.01 Rev. 0.5. All tests passed satisfactorily and acceptance is signed by MOHR representatives.

#### **RAI #11**

**Please provide analysis of the vendor analysis and seismic testing results to show that instrument performance reliability, following exposure to simulated seismic conditions representative of the environment anticipated for the SFP structures at GGNS, has been adequately demonstrated.**

#### **RAI # 11 Response**

Please see **RAI # 3** for seismic qualifications.

In the post audit version of the SE Tracker for **RAI # 11**, a request was made to "Please make available for staff audit the following: Site acceptance test report showing the as-found accuracy," which is inconsistent with RAI # 11. Nevertheless, Site Acceptance Testing of the installed SFPI equipment is contained in document 1-0530-1 and all tests passed satisfactorily. Please see SE Tracker **SRAI-14-D**.

#### **RAI #12**

**Please provide the NRC staff with the final configuration of the power supply source for each channel so the staff may conclude the two channels are independent from a power supply assignment perspective.**

### **RAI #12 Response**

Each instrumentation channel is independently powered by a different electrical bus and source of power than the other channel. Power for the new instrumentation is supplied from 120 VAC panels 1P199 and 1L143. 120 VAC power for Channel-A is supplied from power panel 1P199 (through new breaker #18), which is supplied from transformer 1X199 powered from 480 VAC

BOP MCC 13B12. 120 VAC power for Channel-B is supplied from lighting panel 1L143 (through breaker #5), which is supplied from lighting transformer 1X143 powered from 480 VAC BOP MCC 14B21.

Drawings E-1750 and E-1751 show the single line diagrams for the two channels.

Since AC power is assumed to be lost during a BDBEE, the system includes an internal battery to support system operation for 7 days. Additionally, 05-S-01-FSG-011 contains the instructions for connecting an external DC source via provided cable to provide power beyond the 7-day battery life.

### **RAI #14**

**Please provide analysis verifying the proposed instrument performance is consistent with these estimated accuracy normal and BDB values. Demonstrate that the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power.**

### **RAI #14 Response**

The absolute accuracy specified in MOHR Report 1-0410-12 is 3.0 inches, which complies with the limit of  $\pm 1$  foot set by NEI 12-02. The probe is designed to produce accurate level indication in boiling and frothing (multiphase) environments. MOHR Report 1-0410-10 concludes that the accuracy is not affected by an interruption in power.

### **RAI #18**

**Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection that will be developed for use of the SFP instrumentation. The licensee is requested to include a brief description of the specific technical objectives to be achieved within each procedure.**

**RAI #18 Response**

The following items address normal and abnormal operation of the SFPI:

<b>Task Name</b>	<b>Objective</b>	<b>Frequency of Occurrence</b>
Channel Calibration Check (Operator Rounds)	To validate that the MOHR instruments (both channels) are displaying the correct spent fuel pool level within the accuracy of the instruments and that the date stamp on the display is indicating correctly.	1D 02-S-01-032
Channel Check / Panel Functional Check	To check each channel against each other for comparison and to perform functional assessments of each panel.	1Y WO 416253 WO 416254
Signal Processor Clock Battery Replacement	To prevent failure of the onboard clock battery and adverse impact to the signal processor operating system.	10Y WO 416255 WO 416256
05-S-01-FSG-11	New procedure that provides actions to restore SFP level using an alternate makeup source for a BDBEE resulting in an ELAP. This procedure includes remote SFPI display locations and a procedure for how and when to connect an external DC source to the power the SFP level indicator.	N/A
Technical Requirements Manual (TRM)	Provides compensatory actions for SFPI out of service. (See response to RAI #21)	N/A

**RAI #19**

**Please provide further information describing the maintenance and testing program the licensee will establish and implement to ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Include a description of plans to ensure necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.**

**RAI #19 Response**

The following is a list of Preventative Maintenance (PM) tasks documenting the Entergy Fleet PM Strategy for the MOHR instrumentation system:

<b>Task Name</b>	<b>Objective</b>	<b>Frequency of Occurrence</b>
Channel Calibration Check (Operator Rounds)	To validate that the MOHR instruments (both channels) are displaying the correct spent fuel pool level within the accuracy of the instruments and that the date stamp on the display is indicating correctly.	1D  02-S-01-032
Channel Check / Panel Functional Check	To check each channel against each other for comparison and to perform functional assessments of each panel.	1Y  WO 416253 WO 416254
Signal Processor Clock Battery Replacement	To prevent failure of the onboard clock battery and adverse impact to the signal processor operating system.	10Y  WO 416255 WO 416256