Entergy

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GNRO-2015/00005

February 18, 2015

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

SUBJECT: Entergy's Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)
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. Entergy Letter to NRC, *Entergy's First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying License with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated August 28, 2013 (GNRO-2013/00061)

4. Entergy Letter to NRC, *Entergy's Second Six-Month Status Report 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 28, 2014 (GNRO-2014/00013)

5. Entergy Letter to NRC, *Entergy's Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying License with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated August 27, 2014 (GNRO-2014/00055)

Dear Sir or Madam:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued an order (Reference 1) to Entergy Operations, Inc. (Entergy). Reference 1 was immediately effective and directs Entergy to install reliable spent fuel pool level instrumentation.

Reference 1 requires submission of a status report at six-month intervals following submittal of the overall integrated plan (Reference 2). The purpose of this letter is to provide the fourth six-month status report pursuant to Section IV, Condition C.2, of Reference 1, that delineates progress made in implementing the requirements of Reference 1. The attached report provides an update of milestone accomplishments since the last status report, including any changes to the compliance method, schedule, or need for relief and the basis, if any.

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

I declare under penalty of perjury that the foregoing is true and correct; executed on February 18, 2015.

Sincerely,

KJM/tmc

Attachment: Grand Gulf Nuclear Station's Fourth Six Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation

cc: U. S. Nuclear Regulatory Commission
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Deputy Regional Administrator, Region IV
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U. S. Nuclear Regulatory Commission
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NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

**Attachment to GNRO-2015/00005**

**Grand Gulf Nuclear Station's Fourth Six Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation**

**Grand Gulf Nuclear Station's**
**Fourth Six Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation**

## 1 Introduction

Grand Gulf Nuclear Station (GGNS) developed an Overall Integrated Plan (Reference 1 in Section 8), documenting the requirements to install reliable spent fuel pool level instrumentation (SFPI), in response to Reference 2. This attachment provides an update of milestone accomplishments since the last status report, including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any.

## 2 Milestone Accomplishments

The following milestone(s) have been completed since July 31, 2014 and are current as of January 31, 2015.

- Respond to ISE Request for Additional Information (received November 25, 2013) – Complete with submission of this document planned for February 2015.

## 3 Milestone Schedule Status

The following provides an update to the schedule identified in Section 2 of the Overall Integrated Plan. It provides the activity status of each item, and whether the expected completion date has changed. The dates are planning dates subject to change as design and implementation details are developed.

| Milestone | Target Completion Date | Activity Status | Revised Target Completion Date |
|---|---|---|---|
| Install reliable SFPI | Spring 2016 Refueling Outage | Planned | N/A |
| Respond to NRC RAIs (received July 30, 2013) | August 29, 2013 | Submitted August 29, 2013 | N/A |
| Respond to ISE RAIs (received November 25, 2013) | September 30, 2015 | Submittal planned for February 27, 2015 | N/A |

## 4 Changes to Compliance Method

Section 3 of the OIP defines the water level for Level 1 as 204'-8" (Reference 1). Per NEI 12-02, Revision 1 (Reference 9), Level 1 is the higher of the following two points: 1) the level at which reliable suction loss occurs due to uncovering of the coolant inlet pipe, weir, or vacuum/siphon breaker (depending on the design); or 2) The level at which the normal fuel pool cooling pumps lose required NPSH assuming saturated conditions in the pool. At GGNS, the anti-siphon vent holes are located at elevation 204'-8". However, the FPCC system configuration consists of a drain tank and SFP skimmers and scuppers that maintain the water level at the normal pool level elevation. The required NPSH for the FPCC pumps would be lost if the SFP remains below the level of the skimmers and scuppers as the volume in the drain tank is pumped down until the FPCC pumps trip due to a low drain tank level. Normal pool level is elevation 207'-10".Therefore, based on the higher of the two levels, Level 1 at GGNS corresponds to 207'-10".

## 5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

GGNS expects to comply with the order implementation date and no relief/relaxation is required at this time.

## 6 Open Items from Overall Integrated Plan and Interim Staff Evaluation

GGNS has received an Interim Staff Evaluation that includes 19 RAIs. Responses to the RAIs are due by September 30, 2015 and are provided in Section 9 of this six-month status report. The following table provides a status of any RAIs documented in the Interim Staff Evaluation.

| RAI # | Response Status |
|---|---|
| 1 | See Section 9 |
| 2 | See Section 9 |
| 3 | See Section 9 |
| 4 | See Section 9 |
| 5 | See Section 9 |
| 6 | See Section 9 |
| 7 | See Section 9 |
| 8 | See Section 9 |
| 9 | See Section 9 |
| 10 | See Section 9 |
| 11 | See Section 9 |
| 12 | See Section 9 |
| 13 | See Section 9 |
| 14 | See Section 9 |
| 15 | See Section 9 |
| 16 | See Section 9 |
| 17 | See Section 9 |
| 18 | See Section 9 |
| 19 | See Section 9 |

## 7 Potential Interim Evaluation Impacts

There are no potential impacts to the Interim Staff Evaluation identified at this time except for those identified in Section 4 and 6.

## 8 References

The following references support the updates to the Overall Integrated Plan described in this Attachment.

1. "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, ML13059A316).

2. NRC Order Number EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012 (ML12054A679).

3. "Grand Gulf Nuclear Station, Unit 1 – Interim Staff Evaluation and Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC NO. MF0955)," dated November 25, 2013 (ML13316B986).

4. "Summary of the November 26, 2013, Public Meeting to Discuss Industry Responses to Staff Interim Evaluations for Spent Fuel Pool Instrumentation," dated December 26, 2013 (ML13347B030).

5. "Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation (Order EA-12-051)," dated July 30, 2013 (GNRI-2013/00129).

6. Entergy Letter to NRC, Entergy's First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying License with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated August 28, 2013 (GNRO-2013/00061)

7. Entergy Letter to NRC, Entergy's Second Six-Month Status Report 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 28, 2013 (GNRO-2014/00013)

8. Entergy Letter to NRC, Entergy's Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying License with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated August 27, 2014 (GNRO-2014/00055)

9. NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," Revision 1, dated August 2012 (ML12240A307)

## 9 Responses to the Interim Staff Evaluation Requests for Additional Information

**RAI #1**

**Please provide information on specific procedures controlling irradiated hardware stored in the SFP. Include details of any analysis performed to determine the projected dose rate impact and the appropriate Level 2 elevation as a result of dose from irradiated material stored in the SFP.**

Response to this RAI was provided in the 3rd Six-Month Status Report.

**RAI #2**

**Please provide a clearly labeled sketch or marked-up plant drawing depicting the proposed routing of the cables that will extend from the SFP sensors toward the location of the read-out/display device in the computer and control panel room.**

Response to this RAI was provided in the 3rd Six-Month Status Report.

**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.**

See bridging document Topic #8, 9, 12, & 13 (Section 10).

**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.**

See bridging document Topic #8, 9, 12 & 13 (Section 10).

**RAI #5**

**Please provide further information describing how other material stored in the SFP will not create adverse interaction with the SFP level instruments.**

The SFP and Auxiliary Building are Seismic Category 1 Structures. As a part of the Engineering Change (EC) process for GGNS, interferences (i.e. Refueling Group equipment, tools, control blades, etc.) in the pool shall be removed or relocated to make room for the new instruments. Additionally, this EC marks a 3.5ft exclusion zone surrounding the probes to ensure no adverse

radiological, personnel, EMI/RFI (electromagnetic interference) or seismic II/I interactions with the probe instrument.

**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.**

See bridging document Topic #3 (Section 10).

**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.**

See bridging document Topic #3 (Section 10).

**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.**

See bridging document Topic #3 (Section 10).

**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.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

See bridging document Topic #14 (Section 10).

**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.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

See bridging document Topic #14 (Section 10).

**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.**

See bridging document Topics # 8, 9, 12, & 13 (Section 10).

**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.**

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.

**RAI #13**

**Please provide the results of the calculation depicting battery backup duty cycle requirements, demonstrating that battery capacity is sufficient to maintain the level indication function until offsite resource availability is reasonably assured.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

See bridging document Topic #18 (Section 10).

**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.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

See bridging document Topics #16, 17 and 18 (Section 10).

**RAI #15**

**Please provide a description of the methodology that will be used for determining the maximum allowed deviation from the instrument channel design accuracy under normal operating conditions. The NRC staff understands this allowed deviation will serve as an acceptance criterion for a calibration procedure to alert operators and technicians that the channel requires adjustment to within normal design accuracy.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

In general relative to normal operating conditions, any applicable calibration procedure tolerances (or acceptance criterion) will be established based on the vendor manual's stated/recommended reference accuracy (or design accuracy). The methodology used will be based on the vendor manuals and captured in plant procedures and/or programs. See bridging document Topic #20 (Section 10).

**RAI #16**

**Please provide a description of the in-situ calibration process at the SFP location that will result in the channel calibration being maintained at its design accuracy.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

The process will be captured in Entergy procedures established based on manufacturer's recommendations and Entergy processes and procedures. The instrument automatically monitors the integrity of its level measurement system using in-situ capability. Deviation of measured test parameters from manufactured or as-installed configuration values beyond a configurable threshold-tolerable limit prompts operator intervention. See bridging document Topic #20. (Section 10).

**RAI #17**

**Please describe the evaluation used to validate that the display location can be accessed without unreasonable delay following a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as well as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display periodically.**

The displays will be located in the Lower Cable Room which is in the Control Building, one floor below the Control Room. This room is accessible from the Control Room via two stairwells in a Category One Structure (one each on the east and west walls) and therefore can be accessed without unreasonable delay following a BDB event. Therefore, an evaluation of the time it takes to access the display is not required.

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

The stairways to the display location and the Lower Cable Room are mild radiation environments. Habitability will be assured by heat stress countermeasures and rotation of personnel. Personnel are not typically continuously stationed at the display, it will be monitored periodically. The site FLEX Support Guidelines will provide guidance for personnel to evaluate the room temperature and take actions as necessary. In addition, site procedures already use passive cooling technologies for response personnel.

If necessary, portable radios will be used to communicate with decision makers.

**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.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

The calibration and test procedures are provided in the technical manuals developed by MOHR. See bridging document Topics #10, 19, and 20. The objectives are to measure system performance, determine if there is a deviation from normal tolerances, and return the system to normal tolerances.

Diagnostic procedures developed by MOHR are provided as automated and semi-automated routines in the system software alerting the operator to abnormal deviation in selected system parameters such as battery voltage, loop continuity, and TDR waveform of the transmission cable. The technical objective of the diagnostic procedures is to identify system conditions that

require operator attention to ensure continued reliable liquid level measurement. Manual diagnostic procedures are also provided in the event that further workup is determined to be necessary.

Maintenance procedures developed by MOHR are provided in the technical manual. These allow a technician trained in EFP-IL system maintenance to ensure that system functionality is maintained.

An operation procedure will provide sufficient instructions for operation and use of the system.

Entergy procedures will be developed in accordance with the vendor manuals provided by MOHR and Entergy procedures and processes.

FLEX Support Guidelines will provide sufficient instructions for use of the SFPI following a Beyond Design Basis external event.

**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.**

The following response was updated from the 3rd Six-Month Status Report to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR).

SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness will be established in accordance with Entergy's processes and procedures and in consideration of vendor recommendations to ensure that appropriate regular testing, channel checks, functional tests, periodic calibration, and maintenance are performed (and available for inspection and audit). See bridging document Topics #10 and 20 (Section 10).

## 10 GGNS Bridging Document Between Vendor Technical Information and Licensee Use Based on NRC Staff Requests for Additional Information (RAIs) and NRC Vendor Audit

| # | Topic | Parameter Summary | Vendor Reference Document # | Additional Comment | Test or Analysis Results | Licensee Evaluation |
|---|---|---|---|---|---|---|
| 1 | Design Specification | SFPI Requirements derived from References 1, 2, and 3. | References 4 - 13, 23, and 27- 29 | | | Evaluation of the vendor information is within the scope of engineering change package EC-50286. |
| 2 | Test Strategy | Per Requirements in References 1, 2, and 3. | References 4, 6- 13, 23, and 27- 29 | | | The equipment testing performed for the SFPI has been found to be acceptable based on the current design requirements. |
| 3 | Environmental Qualification for electronics enclosure with Display | 65-104°F (References 1, 2, & 37) | Reference 4 | | 14-131°F | As discussed in GGNS SFPI EC50286, the primary and backup SFPI channel displays for GGNS are located in the Lower Cable Room (Reference 38). The Lower Cable Room is in the Control Building. The Control Building Cooling Subsystem is not operational following a BDBEE. M3.10.001 (Reference 37) 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 (Reference 37); therefore, following a BDBEE, the Lower Cable Room will remain below the maximum design temperature due to 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 |

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| | | | | | | of 14°F to 131°F. The sensor electronics is capable of continuously performing its required function under the expected temperature conditions. Results of the vendor testing are available in proprietary MOHR Report 1-0410-1 (Reference 4), MOHR EFP-IL SFPI System Temperature and Humidity Report. |
| | | 5-95% RH | Reference 4 | | 5-95% RH | 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 (Reference 4).<br><br>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 (Reference 35). 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 (Reference 35) is bounded by the 47°C (116.6°F) and 71 percent RH test case presented in MOHR Report # 1-0410-1 (Reference 4).<br><br>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 (Reference 36). Similarly, 90 °F DB, with |

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| | | | | | | ~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 (Reference 4). 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. |
| | | No Radiation Effects | | | N/A | According to the Environmental Parameters for GGNS (E100.0, Reference 35), the radiation dose rates and total integrated dose are identical for the Control Room (0C503) and the Lower Cable Room (0C402). Therefore this environment is acceptable and no additional testing is required per NRC Audit Report for MOHR (Reference 30).<br><br>Radiation levels in the Lower Cable Room are not impacted by a reduction in Spent Fuel Pool water level. |
| 4 | Environmental Testing for Level Sensor components in SFP area-Submerged Portion of Probe Body | 65-212°F (References 1, 2, and 18) | Reference 5 | RAD TID is the total 40 yr dose plus the 7 day worst case accident dose at the lowest spacer location on the Probe body | 480°F long-term for PEEK Insulators | The NRC Audit Report for MOHR (Reference 30) concludes that the SFP-1 probe is suitable for operation in the SFP environment.<br><br>The SFP is expected to remain at or above the minimum ambient temperature (65°F) as called out in the UFSAR (Reference 18) Section 9.4.2.1.2. Maximum accident condition of the spent fuel pool is taken to be 212°F boiling water/steam at atmospheric pressure. Based on the vendor analysis results, the sensitive materials in the probe body will |
| | | Submerged Component (References 1 and 2) | Reference 5 | | PEEK Insulators capable of long term submergence | |

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| | | | | | | not be challenged under the required conditions of References 1, 2, and 18, and are acceptable. |
| | | 3.67E+08 rad TID (References 1, 2, & 32) | Reference 5 | | 10 Grad for PEEK Insulators | The NRC Audit Report for MOHR (Reference 30) concludes that the SFP-1 probe is suitable for operation in the SFP environment.<br><br>Calculation XC-N1FLEX-14002 (Reference 32) defines a worst case dose of approximately 3.67E+08 rad to the probe via the applicable requirements of References 1 and 2. As such, the PEEK spacers are suitable for the application. |
| 5 | Environmental Testing for Level Sensor Electronics Housing-Probe Head located Above the SFP | 65-212°F (References 1, 2, and 18) | Reference 5 | Rad TID is the total 40 yr dose plus the 7 day worst case accident dose at the location | PEEK: 480°F long term<br>_____<br>EPDM: 194°F long-term, 500 days @ 232°F, 12 days @ 311°F<br>Sylgard 170: 392°F long-term | The NRC Audit Report for MOHR (Reference 30) concludes that the SFP-1 probe is suitable for operation in the SFP environment.<br><br>The SFP area is expected to remain at or above the minimum ambient temperature (65°F) as called out in the UFSAR (Reference 18). Maximum accident condition temperature and humidity directly above the spent fuel pool is taken to be a condensing steam environment which conservatively will be no greater than 212°F, the temperature of boiling water at atmospheric pressure. Based on the vendor analysis results the sensitive materials in the probe head will not be challenged under the required conditions of References 1, 2, and 18, and are acceptable. There are no electronics in the probe head located above the SFP. See Topic #3 for discussion of electronics enclosure with display.<br><br>For coaxial transmission cable beyond the Probe Head, MOHR uses Class 1E Nuclear Safety Related RSCC Wire & Cable RSS-6-110A/LE which meets the requirements of Institute of Electrical and |

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| | | | | | | Electronic Engineers (IEEE) 383-1974, "IEEE Standard for Type Test of Class 1 E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations" and is acceptable (Reference 30). |
| | | 0-100% RH Condensing (References 1 and 2) | Reference 5 | | 0-100% RH for PEEK, EPDM and Sylgard 170 | The NRC Audit Report for MOHR (Reference 30) concludes that the SFP-1 probe is suitable for operation in the SFP environment.<br><br>100% non-condensing RH is a conservative humidity range for normal operating conditions. Based on the vendor analysis results, the sensitive materials in the probe head will not be challenged under the required conditions of References 1 and 2, and are acceptable. |
| | | 3.46E+07 rad TID (References 1, 2, & 32) | Reference 5 | | PEEK: 10 Grad<br>EPDM: 2 Grad<br>Sylgard 170: 200 Mrad | The NRC Audit Report for MOHR (Reference 30) concludes that the SFP-1 probe is suitable for operation in the SFP environment.<br><br>Calculation XC-N1FLEX-14002 (Reference 32) defines a worst case dose of approximately 3.46E+07 rad to the area above the SFP. Based on the vendor analysis results, the sensitive materials in the probe head will not be challenged under the required conditions of References 1, 2, and 32 and are acceptable. |
| 6 | Thermal & Radiation Aging-organic components in SFP area | See Topics #4 and 5 above | Reference 5 | | See above Topics #4 and 5 | Acceptable, vendor test/analysis bound licensee parameters, see discussion above in Topics #4 and 5. |
| 7 | Basis for Dose Requirement | References 1 and 2 | N/A | | | Entergy Calculation Procedure EN-DC-126 (Reference 19) was used to develop calculations XC-N1FLEX-14001 (Reference 31) and XC-N1FLEX-14002 (Reference 32) based on the |

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| | | | | | | requirements of NEI 12-02 (Reference 2) and EA-12-051 (Reference 1). The calculations determine conservative source terms and dose rates at key instrument locations, for both a 7 day accident scenario and 40 year TID. |
| 8 | Seismic Qualification | Seismic Class I (References 1, 2, 3 and 18) | References 8 and 11 | | Seismic Class 1 | Acceptable, MOHR has 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 following a BDBEE and post-event. These documents are MOHR Reports 1-0410-6 (Reference 8) and 1-0410-9 (Reference 11).<br><br>Calculation CC-N1G41-14001 (Reference 33) accounts for seismic loads and shows that the SFPI Probe Mounting Bracket is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0).<br><br>Reference Topic #9 for discussion of seismically induced sloshing affect which is included. |
| 9 | Sloshing | Water induced motion from seismic event does not cause equipment structural failure | References 8, 11, 27, and 28 | See Topic #8 | | Acceptable, the MOHR generic seismic qualification reports (References 8 and 11) in combination with NAI Reports NAI-1725-003 and NAI-1725-004 (References 27 and 28) adequately bound the hydrodynamic loads associated with sloshing for GGNS.<br><br>Calculation CC-N1G41-14001 (Reference 33) accounts for sloshing and shows that the SFPI Probe Mounting Bracket is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0). Reference 33 is available on the e-portal for review. |

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| 10 | Spent Fuel Pool Instrumentation System Functionality | System must allow for routine, in situ functionality | References 14, 15, and 16 | | | The system features on board electrical diagnostics. SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness will be established in accordance with Entergy's processes and procedures and in consideration of vendor recommendations to ensure that appropriate regular testing, channel checks, functional tests, periodic calibration, and maintenance are performed (and available for inspection and audit). The instrument automatically monitors the integrity of its level measurement system using in-situ capability. |
| 11 | Boron Build-Up | Buildup cannot produce error greater than 1' including all other error source terms (References 1 and 2) | Reference 10 | | Boron buildup can produce a maximum error of 2.5 inches | Acceptable, MOHR Report 1-0410-8 (Reference 10) concludes that the presence of borated water and/or boric acid deposits will not significantly impair the ability of the MOHR EFP-IL SFPI system to accurately measure water level in the SFP environment. Regardless of these findings, GGNS is a BWR and does not use borated water in their SFP. |
| 12 | Pool-side Bracket Seismic Analysis (References 1, 2, and 18) | Seismic Class I (References 1, 2, and 18) | Reference 11 | See Topic #8 | Seismic Class I | Calculation CC-N1G41-14001 (Reference 33) shows that the SFPI Probe Mounting Bracket is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0). Reference 33 is available on the e-portal for review. |
| 13 | Additional Brackets (Sensor Electronics and Electronics Enclosure) | Seismic Class I (References 1, 2, 3 and 18) | Reference 8 | See Topic #8 | Seismic Class I | Calculations 425A.4520 and 425A.4521 (References 39 and 40) account for seismic accelerations and show that the additional brackets and other applicable supports are seismically qualified. References 39 and 40 are available on the e-portal for review. |
| 14 | Shock & Vibration | (References 1, 2 and 3) | References 7, 11, and 29 | | IEC 60068-2-27 (2008-02) (Reference | Acceptable, the NRC Audit Report for MOHR (Reference 30) concludes that the shock and vibration test results were satisfactory. The report |

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| | | MIL-STD-167-1 (Reference 20) for vibration and MIL-S-901D (Reference 21) for shock | | | 25) IEC 60068-2-6 (2007-12) (Reference 26) | also acknowledges that the testing performed in MOHR Report 1-0410-16 (Reference 29) is sufficient to close the open item identified during the MOHR audit.<br><br>MOHR Report 1-0410-5 (Reference 7) 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 (Reference 29).<br><br>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 and lock washers.<br><br>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- |

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| | | | | | | 02 (Reference 2). Even though shock and vibration is not credible for Lower Cable Room equipment, it is adequately addressed by vendor test reports. |
| 15 | Requirements Traceability Matrix | Software Traceability Matrix Required for Software Evaluation of Equipment | Reference 13 | | | The instrument software Verification and Validation was performed by MOHR per Revision 2 of MOHR Report 1-0410-11 (Reference 13). |
| 16 | Factory Acceptance Test | Must demonstrate functionality of full EFP-IL and SFP-1 | MOHR FAT Procedure | | | Acceptable channel factory acceptance tests have been completed successfully. |
| 17 | Channel Accuracy | +/- 1 foot (Reference 2) | References 14 and 17 | | 3.0 in max, not including boric acid deposition or boiling effects | Appendix A of Reference 14 states that the maximum SFPI absolute accuracy is 76.2 mm or 3.0 in, not including boric acid deposition effects. Note GGNS is a BWR and does not use borated water in their SFP. This error complies with the limit of ±1 foot set by NEI 12-02 (Reference 2).<br><br>Additionally, the probe is designed to produce accurate level indication in boiling and frothing (multiphase) environments (Reference 17). |
| 18 | Power Consumption | 120 VAC, 60 Hz (Reference 18) | References 9 and 12 | | 85-264 VAC 47-63 HZ 11.48 W (average) 18.83 W (maximum) | Acceptable, the NRC Audit Report for MOHR (Reference 30) concludes that no deficits were identified with respect to function reliability, accuracy, or calibration as a result of power interruption.<br><br>The power requirements for the instrument are met by the power supply that will provide normal AC power to the units.<br><br>MOHR Report 1-0410-10 (Reference 12) concludes |

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| | | | | | | that the accuracy is not affected by an interruption in power. |
| | | 7 day battery life required | Reference 9 | | 7 day battery life @ up to 15 samples per hour rate (Suspend mode); up to 30 samples per hour rate (Minimum power mode) | Acceptable, the NRC Audit Report for MOHR (Reference 30) concludes that battery life capability is satisfactory.<br><br>The instrument testing demonstrates the battery capacity is sufficient for the maximum duration required by References 1 and 2. |
| 19 | Technical Manual | N/A | References 15 and 16 | | | Acceptable, the technical manuals have been provided by the vendor, MOHR in References 15 and 16. |
| 20 | Calibration | Must allow for in-situ calibration | References 14, 15, and 16 | System is calibrated using CT-100 device and processing of scan files by vendor. Dry scan from original installation must be maintained | | Acceptable, the manuals have been provided by the vendor, MOHR in References 14, 15, and 16. Previous Topic #10 already discusses maintenance / preventative maintenance requirements being established in consideration of vendor recommendations.<br><br>Overall calibration or channel functional testing methodology is completed based on vendor stated accuracy and to incorporate a comparison of SFPI channels to actual pool level as well as a SFPI cross channel comparison. |
| 21 | Failure Modes and Effects Analysis (FMEA) | System provides reliable indication of fuel pool level, consistent with the requirements | Reference 34 | | SFPI system will meet requirements of References 1 and 2 when installed as required | Acceptable, the FMEA provided adequately addresses failure modes and effects for the full instrument channel with credit taken for the use of two redundant channels provided the installation meets all requirements stipulated in References 1 and 2. |

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| | | of References 1 and 2 | | | | |
| 22 | Emissions Testing | EPRI TR-102323, Rev. 3 (Reference 22) | References 6 and 23 | | EPRI TR-102323, Rev 3 (Reference 22) | Acceptable, MOHR reports 1-0410-4 (Reference 6) and 1-0410-4-S1 (Reference 23) demonstrate the new SFPI satisfies the EMI/RFI compliance guidelines of Revision 3 of EPRI TR-102323 (Reference 22) in accordance with Entergy Engineering Standard EN-IC-S-004-MULTI (Reference 24). As demonstrated in the MOHR System EMC Test Report and Supplemental Information (References 6 and 23), the SFPI system passed the High Frequency Radiated and Conducted Emissions testing.<br><br>FLEX Support Guidelines (FSG) governing the use of the SFPI are expected to include a cautionary statement to preclude radio usage within close proximity to the displays. |

Spent Fuel Pool Instrumentation Order (EA-12-051)
Bridging Document Between Vendor Technical Information and Licensee Use
Based on NRC Staff Requests for Additional Information (RAIs) and NRC Vendor Audit

Bridging Document References:

1. ML12054A682, NRC Order EA-12-051, "ORDER MODIFYING LICENSES WITH REGARD TO RELIABLE SPENT FUEL POOL INSTRUMENTATION", Nuclear Regulatory Commission, March 12, 2012
2. ML12240A307, NEI 12-02 Rev. 1, "Industry Guidance for compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation'" August, 2012.
3. ML12221A339, Rev. 0, JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation", August 29, 2012, Nuclear Regulatory Commission Japan Lessons-Learned Project Directorate.
4. 1-0410-1 "MOHR EFP-IL SFPI System Temperature and Humidity Test Report"
5. 1-0410-2 "MOHR SFP-1 Level Probe Assembly Materials Qualification Report"
6. 1-0410-4 "MOHR EFP-IL SFPI System EMC Test Report"
7. 1-0410-5 "MOHR EFP-IL SFPI System Shock and Vibration Test Report"
8. 1-0410-6 "MOHR EFP-IL SFPI System Seismic Test Report"
9. 1-0410-7 "MOHR EFP-IL SFPI System Battery Life Report"
10. 1-0410-8 "MOHR EFP-IL SFPI System Boric Acid Deposition Report"
11. 1-0410-9 "MOHR SFP-1 Level Probe Assembly Seismic Analysis Report"
12. 1-0410-10 "MOHR EFP-IL SFPI System Power Interruption Report"
13. 1-0410-11 "MOHR EFP-IL SFPI System Software Verification and Validation"
14. 1-0410-12 "MOHR EFP-IL Signal Processor Operator's Manual"
15. 1-0410-13 "MOHR EFP-IL Signal Processor Technical Manual"
16. 1-0410-14 "MOHR SFP-1 Level Probe Assembly Technical Manual"
17. 1-0410-15 "MOHR EFP-IL SFPI System Uncertainty Analysis"
18. UFSAR , Rev 10, "Grand Gulf Nuclear Station Updated Final Safety Analysis Report
19. EN-DC-126, Rev. 5, "Engineering Calculation Process"
20. MIL-STD-167-1 "Mechanical Vibrations of Shipboard Equipment (Type 1- Environmentally and Type II – Internally Excited)"
21. MIL-S-901D "Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements for"
22. EPRI TR-102323, Rev. 3, "Guidelines for Electromagnetic Interference of Power Plant Equipment"
23. 1-0410-4-S1 "MOHR EFP-IL SFPI Supplemental EMC Information"
24. EN-IC-S-004-MULTI, Rev. 001, "EMI/RFI Design Considerations"
25. IEC 60068-2-27 (2008-02) "Environmental Testing-Part 2-27: Tests-Test Ea and Guidance: Shock"
26. IEC 60068-2-6 (2007-12) "Environmental Testing-Part 2-6: Tests-Test Fc: Vibration (sinusoidal)"

27. NAI-1725-003, Rev. 0, "GOTHIC Verification and Sensitivity Studies for Predicting Hydrodynamic Response to Acceleration in Rectangular Shaped Pools"
28. NAI-1725-004, Rev 3 "Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool"
29. 1-0410-16, "MOHR SFP-1 Level Probe Assembly Shock and Vibration Test Report"
30. Donald C. Cook Nuclear Plant, Units 1 and 2 - Report for the Onsite Audit of MOHR Regarding Implementation of Reliable Spent Fuel Pool Instrumentation Related to Order EA-12-051 (TAC NOS. MF0761 and MF0762) dated August 27, 2014 (ADAMS Accession No ML14216A362)
31. XC-N1FLEX-14001, Rev. 000, "Spent Fuel Pool Instrumentation Source Term Calculation"
32. XC-N1FLEX-14002, Rev. 000, "Spent Fuel Pool Instrumentation Shielding Calculation"
33. CC-N1G41-14001, Rev. 000, "Spent Fuel Pool Probe Mounting Bracket Qualification"
34. EVAL-194-4812-01, "MOHR EFP-IL Liquid Level Measurement System Failure Modes and Effects Analysis (FMEA)"
35. E100.0, Rev. 007, "Technical Specification for Environmental Safety Related Parameter"
36. ASHRAE Fundamentals, 2001 IP Ed.
37. M3.10.001, Rev. 300, "Control Building HVAC"
38. EC50286, "GGNS Spent Fuel Pool Level Instrumentation Upgrade"
39. 425A.4520, Rev. 000, "Spent Fuel Pool Display Panel, Battery Enclosure, and Transformer Mounting Qualification for Channel A"
40. 425A.4521, Rev. 000, "Spent Fuel Pool Display Panel, Battery Enclosure, and Transformer Mounting Qualification for Channel B"