Entergy

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PNP 2015-005

February 27, 2015

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852

SUBJECT: Palisades Nuclear Plant 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)

Palisades Nuclear Plant
Docket No. 50-255
License No. DPR-20

REFERENCES:

1. NRC Order Number EA-12-051, *Order To Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation*, dated March 12, 2012 (ADAMS Accession No. ML12054A682)
2. NRC Interim Staff Guidance JLD-ISG-2012-03, *Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation*, Revision 0, dated August 29, 2012 (ADAMS Accession No. ML12221A339)
3. 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 (ADAMS Accession No. ML12240A307)
4. Entergy Nuclear Operations, Inc. letter to NRC, PNP 2012-092, *Initial 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)*, dated October 25, 2012 (ADAMS Accession No. ML12300A067)
5. Entergy Nuclear Operations, Inc. letter to NRC, PNP 2013-009, *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 28, 2013 (ADAMS Accession No. ML13060A360)
6. Entergy Nuclear Operations, Inc. letter to NRC, PNP 2013-065, *Palisades Nuclear Plant First 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)*, dated August 28, 2013 (ADAMS Accession No. ML13241A235)

7. NRC Interim Staff Evaluation, Palisades-Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC No. MF0769), dated November 26, 2013 (ADAMS Accession No. ML13312A423)
8. Entergy Nuclear Operations, Inc. letter to NRC, PNP 2014-010, *Palisades Nuclear Plant Second 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)*, dated February 28, 2014 (ADAMS Accession No. ML14059A078)
9. Entergy Nuclear Operations, Inc. letter to NRC, PNP 2014-084, *Palisades Nuclear Plant Third 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)*, dated August 28, 2014 (ADAMS Accession No. ML14240A278)

Dear Sir or Madam:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued an order (Reference 1) to Entergy Nuclear Operations, Inc. (ENO). This order was immediately effective and directed ENO to install reliable spent fuel pool level instrumentation at the Palisades Nuclear Plant (PNP).

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an overall integrated plan pursuant to Section IV, Condition C. Reference 1 requires submission of a status report at six-month intervals following submittal of the overall integrated plan. Reference 3 provides direction regarding the content of the status reports. Reference 2 endorses industry guidance document NEI 12-02, Revision 1 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the PNP initial status report regarding mitigation strategies. Reference 5 provided the PNP overall integrated plan. Reference 6 provided the first six-month status report. Reference 7 contains a request for additional information regarding the overall integrated plan for implementation of Order EA-12-051. Reference 8 provided the second six-month status report and Reference 9 provided the third six-month status report.

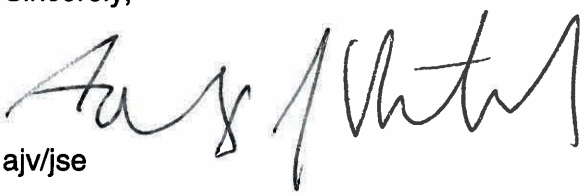
The purpose of this letter is to provide the fourth six-month status report pursuant to Section IV, Condition C.2, of Reference 1, that delineates progress made in implementing the requirements of Reference 1. The attached report provides an update of milestone accomplishments since the last status report,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

This letter also provides information in response to the request for additional information in Reference 7.

This letter contains no new commitments and no revised commitments.

I declare under penalty of perjury that the foregoing is true and correct; executed on February 27, 2015.

Sincerely,



ajv/jse

Attachment: Palisades Nuclear Plant 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)

cc: Office Director, NRR, USNRC
Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

Attachment

Palisades Nuclear Plant 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)

1 Introduction

Entergy Nuclear Operations, Inc. (ENO) developed for Palisades Nuclear Plant (PNP) 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 in Section 8. 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.

- Third Six-Month Status Report – August 2014
- Fourth Six-Month Status Report – Complete with submission of this document in February 2015.
- Response to NRC Interim Staff Evaluation (ISE) Request for Additional Information (received November 26, 2013) – Complete with submission of this document in February 2015.

3 Milestone Schedule Status

The following provides a line item update to the milestone schedule to support 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
Reliable SFPI Installed	Fall 2015 Refueling Outage	In Progress	N/A
Response to NRC Request for Additional Information (received July 18, 2013) (Reference 3)	August 19, 2013	Submitted August 19, 2013	N/A

Response to NRC ISE Request for Additional Information (received November 26, 2013)	March 31, 2015	Submitted February 27, 2015	N/A

†Target Completion Date is the last submitted date from either the overall integrated plan or previous six-month update.

4 Changes to Compliance Method

There are no additional changes to the compliance method.

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

ENO 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

ENO has received an Interim Staff Evaluation for PNP that includes 18 Requests for Additional Information (RAIs). Responses to the RAIs are due by March 31, 2015 and are discussed 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

7 Potential Interim Staff Evaluation Impacts

There are no potential impacts to the ISE identified at this time except for those identified in Section 6.

8 References

The following references support the updates to the overall integrated plan described in this attachment.

1. ENO letter to NRC, PNP 2013-009, *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 28, 2013 (ADAMS Accession No. ML13060A360)
2. NRC Order Number EA-12-051, *Order To Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation*, dated March 12, 2012 (ADAMS Accession No. ML12054A682)
3. NRC email to ENO, *Palisades Nuclear Plant – Requests for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation (TAC MF0769)*, dated July 18, 2013 (ADAMS Accession No. ML13200A328)
4. NRC letter to ENO, *Palisades – Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC NO. MF0769)*, dated November 26, 2013 (ADAMS Accession No. ML13312A423)
5. *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)

9 Responses to the Interim Staff Evaluation Requests for Additional Information

RAI #1

Given the potential for varied dose rates from other materials stored in the SFP, please describe how level 2 will be adjusted to other than the elevation provided in section 2 above.

ENO Response:

The response to this RAI was provided in the 3rd Six-Month Status Report (Reference 1).

RAI #2

Please provide the analyses verifying the seismic capability of the level probes, the mounting brackets, and the electronics units, and provide the results of the analysis of the combined maximum seismic and hydrodynamic forces on the cantilevered portion of the assembly exposed to the potential sloshing effects. Show that the SFP instrument design configuration will be maintained during and following the maximum seismic ground motion considered in the design of the SFP structure.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topics #8, 9, & 12 (Section 10 of this status report).

RAI #3

For each of the mounting attachments required to attach SFP Level equipment to plant structures, please describe the design inputs, and the methodology that will be used to qualify the structural integrity of the affected structures/equipment.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

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

RAI #4

Please address how other hardware stored in the SFP will not create adverse interaction with the fixed instrument location(s).

ENO Response:

The response to this RAI was provided in the 3rd Six-Month Status Report (Reference 1).

RAI #5

Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the sensor electronics will be exposed. Also, please provide documentation indicating the radiological dosage the electronics for this equipment are capable of withstanding. Please discuss the time period over which the analyzed total integrated dose is evaluated to be applied.

ENO Response:

The immediately following replaces what was provided in the 3rd Six-Month Status Report (Reference 1).

See bridging document Topic #3 (Section 10 of this status report).

RAI #6

Please provide information indicating the maximum expected ambient temperature in the room in which the sensor electronics will be located under BDB conditions with no ac power available to run Heating Ventilation and Air Conditioning (HVAC) systems, and whether the sensor electronics are capable of continuously performing required functions under this expected temperature condition.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topic #3 (Section 10 of this status report).

RAI #7

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

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topic #3 (Section 10 of this status report).

RAI #8

Please provide a description of the specific method or combination of methods that will be used to demonstrate the reliability of the permanently installed equipment under BDB shock and vibration conditions. Identify the specific commercial and/or military standards that will be used to establish the testing requirements, and the specific acceleration levels and frequencies that will be simulated.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) Reference 2).

See bridging document Topic #14 (Section 10 of this status report).

RAI #9

For RAI #8 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.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topic #14 (Section 10 of this status report).

RAI #10

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

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topic #8 (Section 10 of this status report).

RAI #11

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.

ENO Response:

The response to this RAI was provided in the 3rd Six-Month Status Report (Reference 1).

RAI #12

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

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topic #18 (Section 10 of this status report).

RAI #13

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

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

See bridging document Topics #16, 17 & 18 (Section 10 of this status report).

RAI #14

Please provide a description of the methodology that will be used for determining the maximum allowed deviation from the instrument channel design accuracy to be employed under normal operating conditions as an acceptance criterion for a calibration procedure to alert operators and technicians of the need for adjustment to within normal design accuracy.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

In general relative to normal operating conditions, any applicable calibration procedure tolerances (or acceptance criterion) will be established based on the vendor manuals 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 Topics #20 (Section 10).

RAI #15

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.

ENO Response:

The immediately following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

The process will be captured in ENO procedures established based on manufacturer's recommendations and ENO process 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 beyond a configurable threshold prompts operator intervention. See bridging document Topic #20 (Section 10).

RAI #16

For the SFP level instrumentation backup display located in the radwaste control panel room, please describe the evaluation used to validate 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 backup display. Additionally, please 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 backup display or monitor the display periodically.

ENO Response:

The backup display will be mounted in the Radwaste Control Panel Room Cabinet C104 at the 590' elevation of the Aux. Building. This cabinet is located in Room 121, and can be accessed via Stairwell No. 16 and Door 75, or via Corridor 106A through Door 190. Both Stairwell 16 and Corridor 106A can be approached from the north, east, and west via Corridor 106. The back-up channel display can be considered promptly accessible, because it can be reached within the 30 minute deployment requirement that exists for portable instrumentation (Section 3.1 of NEI 12-02).

The impact to habitability would be primarily from elevated temperatures, as the C-40 panel room is considered a mild radiation environment. Habitability will be assured by heat stress countermeasures and rotation of personnel to the extent feasible. Personnel will not be continuously stationed at the backup 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.

The FLEX staffing plan has not been finalized at this time. The results of the staffing plan will be included in a future six month status report.

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

RAI #17

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.

ENO Response:

The following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

The calibration and test procedures developed by MOHR are provided in the technical manuals developed by MOHR. See bridging document Topics #10, 19, & 20 (Section 10 of this status report). 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 system software alerting the operator to abnormal deviation in selected system parameters such as battery voltage, 4-20 mA loop continuity, and Time Domain Reflectometry (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.

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

FLEX Support Guidelines will provide sufficient instructions for use of the SFPI during a beyond design basis external event.

RAI #18

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 your plans for ensuring that necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.

ENO Response:

The following was updated since the 3rd Six-Month Status Report (Reference 1) to include changes based on issuance of the NRC Audit Report for the SFPI vendor (MOHR) (Reference 2).

SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness will be established in accordance with ENO 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).

RAI Response References

1. Entergy Nuclear Operations, Inc. letter to NRC, PNP 2014-084, *Palisades Nuclear Plant Third 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),* dated August 28, 2014 (ADAMS Accession No. ML14240A278)

2. NRC letter, *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)

10 PNP Bridging Document Between Vendor Technical Information and Licensee Implementation Based on NRC Staff Requests for Additional Information (RAI) 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, & 3	References 4-13, 17-19, 28, 34, & 38			Evaluation of the vendor information is within the scope of EC 46466.
2	Test Strategy	Per Requirements in References 1, 2, & 3	References 4, 6-13, 17-19, 28, 34, & 38			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	50-121°F (References 1, 2, 14, & 16)	Reference 4		14-131°F	The display/processors will be located in the Control Room and C-40 Panel Room. Calculation EA-EC46465-03 (Reference 16) determines that the maximum temperature in the Control Room will be 121°F. The operating temperature of the C-40 Panel Room is 50-110°F (Reference 36). The SFPI vendor, MOHR, has successfully tested its system electronics to a nominal temperature range 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 Rev. 0 (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 Rev. 0, "MOHR EFP-IL SFPI System Temperature and Humidity Report (Reference 4)." Humidity in the Control Room and C-40 Panel Room are normally regulated by the HVAC system at 50% (Reference 43). During an extended loss of AC power, the HVAC system is no longer available. Assuming the Control Room and C-40 Panel Room remain isolated from outside air, the temperature is expected to increase and the humidity is expected to decrease because the heat loads are dominated by the sensible heat of electrical equipment. Therefore, the maximum temperatures of 121°F for the Control Room (Reference 16) and 110°F for the C-40 Panel Room (Reference 36) at a humidity below 50% is bounded by the 55°C (131°F) and 50 percent RH test case presented in MOHR Report # 1-0410-1 (Reference 4). In the event outside air is introduced to the Control Room or C-40 Panel Room, due to open doors or HVAC system connections to other rooms, ASHRAE (Reference 41, Chapter 14 Appendix: Design Conditions for Selected Locations) defines the 0.4% dehumidification condition to be 81.4 °F db, 73.0 °F dew point, and ~75% RH for Kalamazoo, Michigan. Similarly, 85.1 °F db, 76.2 °F wb, and ~66% RH is defined for a 0.4% evaporation condition. These conditions are also 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%

						encompasses all expected conditions for the Control Room and C-40 Panel Room and the sensor electronics are capable of continuously performing their required function under the expected humidity conditions.
		No radiation effects			N/A	The location of Channel A is acceptable since the Palisades Control Room is considered a mild environment and no additional testing is required per NRC Audit Report for MOHR (Reference 40). Similar to the Control Room, the C-40 Panel Room (Channel B location) is considered a mild environment as it is not included in the Electrical Equipment Qualification (EEQ) program (Reference 42). This is acceptable for safety-related equipment that contains semiconductor devices and therefore is acceptable to use for SFPI, which is non-safety related equipment. Radiation levels in the Control Room and C-40 Panel 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	50-212°F (References 1, 2, & 14)	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 40) concludes that the SFP-1 probe is suitable for operation in the SFP environment. The SFP is expected to remain at or above the minimum ambient temperature (50°F) as called out in the UFSAR (Reference 14) Table 9-13. Maximum accident condition of the spent fuel pool is taken to be 212°F boiling borated water/steam at atmospheric pressure. Based on the vendor analysis results, the sensitive materials in the probe body will not be challenged under the required conditions of References 1, 2, & 14, and are acceptable.
		Submerged Component (References 1 & 2)	Reference 5		PEEK Insulators capable of long term submergence	

		7.33E+07 rad TID (References 1, 2, & 31)	Reference 5		10 Grad for PEEK Insulators	The NRC Audit Report for MOHR (Reference 40) concludes that the SFP-1 probe is suitable for operation in the SFP environment. Calculation EA-EC46466-04 (Reference 31) defines a worst case dose rate of approximately 7.33E+07 rad to the probe via the applicable requirements of References 1 & 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	50-212°F (References 1, 2, & 14)	Reference 5	Rad TID is the total 40 yr dose plus the 7 day worst case accident dose at the location	PEEK: 480°F EPDM: 194°F long-term, 500 days @ 232°F, 12 days @ 311°F Sylgard 170: 392°F long-term	The NRC Audit Report for MOHR (Reference 40) concludes that the SFP-1 probe is suitable for operation in the SFP environment. The SFP area is expected to remain at or above the minimum ambient temperature (50°F) as called out in the UFSAR (Reference 14) Table 9-13. 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, & 14, and are acceptable. 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 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 40).

		0-100% RH Condensing (References 1 & 2)	Reference 5		0-100% RH for PEEK, EPDM and Sylgard 170	The NRC Audit Report for MOHR (Reference 40) concludes that the SFP-1 probe is suitable for operation in the SFP environment. 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 & 2 and are acceptable.
		2.78E+05 rad TID (Reference 31)	Reference 5		PEEK: 10 Grad EPDM: 2 Grad Sylgard 170:200 Mrad	The NRC Audit Report for MOHR (Reference 40) concludes that the SFP-1 probe is suitable for operation in the SFP environment. Calculation EA-EC46466-04 (Reference 31) defines a worst case dose rate of approximately 2.78E+05 rad. 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, & 31 and are acceptable.
6	Thermal & Radiation Aging-Organic Components in SFP area	See Topics #4 & 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 & 2	N/A			ENO Calculation Procedure EN-DC-126 was used to develop calculations EA-EC46466-03 (Reference 30) and EA-EC46466-04 (Reference 31) based on the 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 & 14)	References 8, 11, & 12		Seismic Class 1	Acceptable, MOHR has prepared a site specific seismic analysis which bounds PNP's seismic criteria. The qualification report envelops all

						components of the new SFP level instrumentation required to be operational during a BDBEE and post-event. This document is MOHR Report 1-0410-9.19 (Reference 12). Supplemental MOHR Reports 1-0410-6 (Reference 8) and 1-0410-9 (Reference 11) are also provided. Calculations EA-EC46466-01 (Reference 32) and EA-EC46466-02 (Reference 33) determine that all components, supports, and anchorages required are structurally adequate and seismically qualified as all Interaction Ratios are less than one (1.0). Reference Topic #9 for discussion of seismically induced sloshing effect .
9	Sloshing	Water induced motion from seismic event does not cause equipment structural failure	References 11, 12, 17, 18, & 19	See Topic #8		Acceptable, the MOHR seismic qualification reports (References 8, 11, & 12) in combination with NAI-1725-003 (Reference 17), NAI-1725-004 (Reference 19) and PNP site specific Report #NAI-1791-006 (Reference 18) adequately bound the hydrodynamic loads associated with sloshing for PNP. Calculation EA-EC46466-01 (Reference 32) accounts for sloshing effects to the probe and determines that all components, supports and anchorages required are structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0). The NAI documents (References 18 & 19) are used as input to the bracket design. Reference 32 is available on the e-portal for review.
10	Spent Fuel Pool Instrumentation System Functionality	System must allow for routine, in situ functionality	References 25, 26,& 27			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 ENO 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. Revision 0 of the manuals has been provided by the vendor (References 26 & 27) for use, although it is possible these could be amended in the future based on installation experience.
11	Boron Build-Up	Buildup cannot produce error greater than 1' including all other error source terms (References 1 & 2)	Reference 10		Boron buildup can produce a maximum error of 2.5 inches	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. Previous Topic #10 already discusses maintenance / preventative maintenance requirements being established in consideration of vendor recommendations (which includes and bounds those associated with boron build-up). Similarly, Topic #20 below discusses overall calibration or channel functional testing methodology expected to be based on vendor stated accuracy along with comparison of SFPI channels to actual pool level (which would also bound boron build-up effects specified in Reference 40). Visual inspection and/or wash down of the probe assembly could be initiated by accuracy requirements or routine inspection. The probe head assembly includes a connection mechanism for flushing water to remove boron build-up as may be necessary. Alternatively, the SFP water level can be raised until it covers

						and dissolves the boric acid deposit (Reference 27).
12	Pool-side Bracket Seismic Analysis (References 1 & 2)	Seismic Class I (References 1, 2, & 15)	References 11 & 12	See Topic #8	Seismic Class I	Calculation EA-EC46466-01 (Reference 32) determines that all components, supports, and anchorages required are structurally adequate. Reference 32 is available on the e-portal for review.
13	Additional Brackets (Sensor Electronics and Electronics Enclosure)	Seismic Class I (Reference 1, 2, 3 & 14)	Reference 8	See Topic #8	Seismic Class I	Calculation EA-EC46466-02 (Reference 33) determines that all components, supports, and anchorages required are structurally adequate. Reference 33 is available on the e-portal for review.
14	Shock & Vibration	(Reference 1, 2, 3) MIL-STD-167-1 (Reference 23) for vibration and MIL-STD-901D (Reference 24) for shock	References 7, 11, 12, & 38		IEC 60068-2-27 (2008-02) (Reference 20) IEC 60068-2-6 (2007-12) (Reference 21)	The NRC Audit Report for MOHR (Reference 40) concludes that the shock and vibration test results were satisfactory. The report also acknowledges that the testing performed in MOHR Report 1-0410-16 (Reference 38) is sufficient to close the open item identified during the MOHR audit. Acceptable, the vendor testing provided 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 38). 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. The indicator and battery enclosures will be mounted in the control room and C-40 Panel 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 is not a credible threat; all equipment in the control room and C-40 Panel Room 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 Control Room and C-40 Panel Room equipment, it is adequately addressed by vendor test reports.
15	Requirements Traceability Matrix	Software Traceability Matrix Required for Software Evaluation of equipment	Reference 29			The instrument software Verification and Validation was performed by MOHR per Revision 2 of MOHR Report 1-0410-11 (Reference 29).
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 25 & 28		3.0 in max, not including boric acid deposition or boiling effects	Appendix A of Reference 25 states that the absolute accuracy is 76.2 mm or 3.0 in, not including boric acid deposition effects. This error complies with the limit of ±1 foot set by NEI 12-02 (Reference 2). See Topic #11 for boric acid deposition effects. Additionally, the probe is designed to produce

						accurate level indication in boiling and frothing (multiphase) environments according to MOHR Report 1-0410-15 (Reference 28).
18	Power consumption	120 VAC, 60 Hz (References 14 & 37)	References 9, 13, & 37		85-264 VAC 47-63 HZ 11.48 W (average) 18.83 W (Maximum)	The NRC Audit Report for MOHR (Reference 40) concludes that no deficits were identified with respect to function reliability, accuracy, or calibration as a result of power interruption. Acceptable, the power requirements for the instrument are met by the power supply that will provide normal AC power to the units MOHR Report 1-0410-10 (Reference 13) concludes that the accuracy is not affected by an interruption in power.
		7 day battery life required	Reference 9		7 day battery life @ 15 samples per hour rate	The NRC Audit Report for MOHR (Reference 40) concludes that battery life capability is satisfactory. Acceptable, the instrument testing demonstrates the battery capacity is sufficient for the maximum duration required by References 1 & 2.
19	Technical Manual	N/A	References 26 & 27			Revision 0 of the manuals have been submitted by the vendor for use, although it is possible these could be amended in the future based on installation experience.
20	Calibration	Must allow for in-situ calibration	References 25, 26, & 27	System is calibrated using CT-100 device and processing of scan files by vendor. Dry scan from original installation		Revision 0 of the manuals have been submitted by the vendor for use, although it is possible these could be amended in the future based on installation experience. Previous Topic #10 already discusses maintenance / preventative maintenance requirements being established in consideration of vendor recommendations. Overall calibration or channel functional testing methodology is expected to be based on vendor stated accuracy and to incorporate a comparison of

				must be maintained		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 of References 1 & 2	Reference 39		SFPI system will meet requirements of References 1 & 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 & 2.
22	Emissions Testing	EPRI TR-102323, Rev. 3 (Reference 22)	Reference 6		EPRI TR-102323, Rev. 3 (Reference 22)	Acceptable, MOHR reports 1-0410-4 (Reference 6) and 1-0410-4-S1 (Reference 34) demonstrate the new SFPI satisfies the EMI/RFI compliance guidelines of Revision 3 of EPRI TR-102323 (Reference 22) in accordance with ENO Engineering Standard EN-IC-S-004-MULTI (Reference 35). As demonstrated in the MOHR System EMC Test Report and Supplemental Information (References 6 & 34), the SFPI system passed the High Frequency Radiated and Conducted Emissions testing. 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.

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, Revision 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, Revision 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. 1-0410-9.19, "MOHR SFP-1 Site-Specific Seismic Analysis Report: Palisades Nuclear Power Station (PLP)"
13. 1-0410-10, "MOHR EFP-IL SFPI System Power Interruption Report
14. FSAR, Rev. 31, "Palisades Final Safety Analysis Report"
15. EN-DC-126, Rev. 5, "Engineering Calculation Process"
16. EA-EC46465-03, Rev. 0, "Control Room Heatup for Extended Loss of AC Power"
17. NAI-1725-003, Rev. 0, "GOTHIC Verification and Sensitivity Studies for Predicting Hydrodynamic Response to Acceleration in Rectangular Shaped Pools"
18. NAI-1791-006, Rev. 0, "PLP GOTHIC Hydrodynamic Analysis"
19. NAI-1725-004, Rev. 3, "Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool"
20. IEC 60068-2-27 (2008-02), "Environmental Testing-Part 2-27: Tests-Test Ea and Guidance: Shock"
21. IEC 60068-2-6 (2007-12), "Environmental Testing-Part 2-6: Tests-Test Fc: Vibration (sinusoidal)"
22. EPRI TR-102323, Rev. 3, "Guidelines for Electromagnetic Interference of Power Plant Equipment"
23. MIL-STD-167-1, "Mechanical Vibrations of Shipboard Equipment (Type 1-Environmentally and Type II-Internally Excited)"
24. MIL-S-901D, "Shock Tests H.I.(High Impact) Shipboard Machinery, Equipment, and Systems, Requirements for"

25. 1-0410-12, "EFP-IL Signal Processor Operator's Manual "
26. 1-0410-13, "EFP-IL Signal Processor Technical Manual"
27. 1-0410-14, "SFP-1 Level Probe Assembly Technical Manual"
28. 1-0410-15, "MOHR EFP-IL SFPI System Uncertainty Analysis"
29. 1-0410-11, "MOHR EFP-IL SFPI System Software Verification and Validation"
30. EA-EC46466-03, Rev.0, "Beyond Design Basis Spent Fuel Pool Instrumentation Source Term Calculation"
31. EA-EC46466-04, Rev. 0, "Beyond Design Basis Spent Fuel Pool Instrumentation Dose Calculation"
32. EA-EC46466-01, Rev. 0, "Design of SFPI Probe Mounting Bracket"
33. EA-EC46466-02, Rev. 0, "Qualification of SFP Instrumentation Mounting Details"
34. 1-0410-4-S1, "MOHR EFP-IL SFPI Supplemental EMC Information"
35. EN-EC-S-004-MULTI, Rev. 1, "EMI/RFI Design Considerations"
36. DBD-1.07, Rev. 5, "Entergy Nuclear Northeast Palisades Design Basis Document for Auxiliary Building HVAC Systems"
37. MOHR drawing 1-0430-20, "EFP-IL System Electrical Diagram"
38. 1-0410-16, "MOHR SFP-1 Level Probe Assembly Shock and Vibration Test Report"
39. EVAL-194-4812-01, "MOHR EFP-IL Liquid Level Measurement System Failure Modes and Effects Analysis (FMEA)"
40. "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)
41. 2009 ASHRAE Handbook Fundamentals, I-P Edition
42. DBD-7.01, Rev. 10, "Entergy Nuclear Northeast Palisades Design Basis Document for Electrical Equipment Qualification Program"
43. DBD-1.06, Rev. 8, "Entergy Nuclear Northeast Palisades Design Basis Document for Control Room HVAC System"