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W3F1-2016-0001

January 18, 2016

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Rockville, MD 20852

SUBJECT: Completion of Required Action by NRC Order EA-12-051, Commission Order Modifying License With Regard To Reliable Spent Fuel Pool Instrumentation
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

Reference: 1. NRC Order Number EA-12-051, "Order to Modify Licenses with Regard to Reliable Spent Fuel Pool (SFP) Instrumentation," dated March 12, 2012 (ADAMS Accession No. ML12054A682)

Dear Sir or Madam:

On March 12, 2012, the NRC issued NRC Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, (Reference 1) to Entergy Operations, Inc. (Entergy). The Order was effective immediately and directed Waterford Steam Electric Station, Unit 3 (Waterford 3), to install reliable spent fuel pool instrumentation as outlined in Attachment 2 of the Order. This letter, along with its attachments, provides the notification required by Section IV.C.3 of the Order that full compliance with the requirements described in Attachment 2 of the Order has been achieved for Waterford 3. Attachment 1 contains statements of compliance. Attachment 2 presents responses to Request for Additional Information (RAIs). Attachment 3 is the vendor to licensee design bridging document. Note that Attachment 4 contains the list of references for Attachments 1, 2 and 3.

This letter contains no new NRC commitments. Should you have any questions concerning the content of this letter, please contact John Jarrell, Regulatory Assurance Manager, at (504) 739-6685.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 18, 2016.

Sincerely,

MRC/AJH

Attachments: 1. Compliance with Order EA-12-051
2. Responses to NRC Requests for Information (RAIs) and Open Audit Items
3. Design Bridge Document
4. References

cc: Attn: Director, Office of Nuclear Reactor Regulation
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Attachment 1

W3F1-2016-0001

Waterford Steam Electric Station, Unit 3,

Compliance with Order EA-12-051

**Waterford Steam Electric Station, Unit 3,
Compliance with Order EA-12-051,**

1 Background

On March 12, 2012, the NRC issued NRC Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, (Reference 1) to Entergy Operations, Inc. (Entergy). The Order was effective immediately and directed Waterford Steam Electric Station, Unit 3 (Waterford 3), to install reliable spent fuel pool instrumentation as outlined in Attachment 2 of the Order. The Order required compliance prior to plant startup from the second refueling outage following submittal of the Overall Integrated Plan (OIP) or by December 31, 2016, whichever comes first. The compliance date for Waterford 3 was November 23, 2015. The NRC staff requested that the compliance report be submitted within 60 days of the compliance date. The information provided herein documents full compliance for Waterford 3, in response to the Order.

2 Compliance

Waterford 3 has installed two independent full scale level monitors on the Spent Fuel Pool (SFP) in response to Reference 1.

Entergy submitted the Waterford 3 Overall Integrated Plan (OIP) by letter dated February 28, 2013 (Reference 40). By letter dated November 25, 2013 (Reference 41), the NRC provided the interim staff evaluation and requested additional information necessary for completion of the review. The information requested by the NRC is included in Attachment 2.

Compliance with NRC Order EA-12-051 was achieved using the guidance in Nuclear Energy Institute (NEI) document NEI 12-02 (Reference 2) which has been endorsed by the NRC (Reference 3)

3 References

References are presented in Attachment 4 to letter W3F1-2016-0001.

Attachment 2

W3F1-2016-0001

Waterford Steam Electric Station, Unit 3,

Responses to NRC Requests for Information (RAIs) and Open Audit Items

Responses to NRC Requests for Information (RAIs)

RAI #1

Please provide information regarding 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 SPF.

Waterford 3 Response

As allowed by NEI 12-02 Rev. 1 Section 2.3.2 (Reference 2), Entergy is selecting the Level 2 point to be 10 feet (+/- 1 foot) above the highest point of any fuel rack seated in the SFP. Because of the 10 ft. Level 2 selection, specific dose analysis from irradiated material stored in the SFP was not performed or required. Procedures for controlling non-SNM items in the SFP are intended to protect the SNM stored in the pool and do not control storage based on irradiated levels.

Permanently stored irradiated material in the spent fuel pool is only stored in the spent fuel pool racks, although fleet procedures EN-RE-220 and EN-RP-123 (References 42 and 43) apply to irradiated equipment or materials stored in the SFP.

RAI #2

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.

Waterford 3 Response

MOHR has prepared a series of generic seismic qualification reports for the SFP level instrument which bounds WF3's seismic criteria. The qualification reports envelop all components of the new SFP level instrumentation required to be operational during a BDBEE and post-event. Therefore, the SFP instrumentation and electronic units are acceptable for use at the site. The analyses are contained in proprietary MOHR Test and Measurement LLC Reports:

1. NAI-1725-004, "Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool" (Reference 16)
2. 1-0410-6, "MOHR EFP-IL SFPI System Seismic Test Report" (Reference 8)
3. 1-0410-9, "MOHR SFP-1 Level Probe Assembly Seismic Analysis Report"(Reference 11)

Mounting bracket design and seismic Class 1 mounting analysis are included in modification package EC-48147 (Reference 32). Calculation ECC14-003 (Reference 26) shows that the SFPI Probe Mounting Bracket is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0).

During the site audit walkdown, the NRC staff noticed that some of the conduit supports were installed with the span of 14'. The staff inquired the acceptability of this span with respect of maintaining the seismic mounting requirements. In response, Entergy provided the supplemental response, which includes the following:

Per Drawing B288 Sheet 18B (Reference 44) the maximum allowable conduit span length for 1.5" diameter conduit is 14'-0" for horizontal and vertical spans. EC-48147 (ECN53374) reduces the

maximum allowable conduit span length for supports under the Q-Deck to a maximum of 8'-0". For all other areas, a conduit support span of 14'-0" is acceptable. As a result, the conduit supports meet the NEI 12-02 and B288 seismic conduit support structural requirements.

Bridging Document (Attachment 3) Cross-Reference:

1. Topics #8, 9, & 12

RAI #3
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.

Waterford 3 Response
WF3-specific calculations ECC14-003 and ECC14-002 (References 26 and 27) formally document design input and methodology used to qualify the structural integrity of affected structures/equipment and are available on the e-portal for review. Calculation ECC14-003 shows that the SFPI Probe Mounting Bracket is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0). Calculation ECC14-002 seismically qualifies all electrical mounting equipment.

The probes are mounted in the Fuel Handling Building and the rest of the instrumentation is mounted in the Reactor Auxiliary Building. Both buildings are Seismic Category 1 structures.

Bridging Document (Attachment 3) Cross-Reference:

1. Topics #8, 9, 12, & 13

RAI #4
Please provide further information to describe how other material stored in the SFP will not create adverse interaction with the fixed instrument location(s).

Waterford 3 Response
The SFP and Auxiliary Building are Seismic Category 1 Structures. The probes are seismically qualified and mounted in the northeast and southwest corners of the SFP, following the guidance provided in Section 3.2 of NEI 12-02 (Reference 2). EC 48147 (Reference 32) documents how the fixed probes will not be adversely impacted by fuel assemblies and other equipment currently in the SFP. As a part of the Engineering Change (EC) process for WF3, it was verified that material stored in the SFP will not create any adverse interaction with the fixed instrument locations in the northeast and southwest corners.

RAI #5
Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the transmitter electronics located within the Reactor Auxiliary Building will be exposed. Also, provide documentation indicating the maximum total integrated dose the electronics for this equipment is capable of withstanding. Discuss the time period over which the analyzed total integrated dose was applied.

Waterford 3 Response
According to G-M0012 and G-M0001 (References 38 and 39), the RAB (wing area) where the new signal processor/display is mounted has a normal 40-year dose of 8.8E+1 rad. According to WF3 UFSAR Table 3.11-1 (Reference 13), the Control Room also has a normal 40-year dose of 8.8E+1 rad. Furthermore, both the RAB (wing area) and Control Room are designated as mild environments in this table. Therefore this environment is acceptable and no radiation testing on the transmitter electronics was performed or required.

Bridging Document (Attachment 3) Cross-Reference:

1. Topic #3

RAI #6
Please provide information indicating (a) 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 (b) whether the sensor electronics are capable of continuously performing required functions under this expected temperature condition.

Waterford 3 Response
The SFPI panels will be located in the +21' RAB (wing area). This area has a design temperature of (a) 104°F during normal operation per G-M0001 and G-M0004 (References 39 and 45). During a BDBEE, this area will have no operating equipment besides the SFPI panels and will not be subject to the heat generated during a LOCA/MSLB. Additionally, the doors immediately adjacent to the SFPI panels will be opened during a BDBEE per FIG-001 Attachment 10 (Reference 46). Therefore, (b) it is reasonable to conclude that conditions in this area will not exceed 131°F (55°C) which the SFPI was qualified to in MOHR Report 1-0410-1(Reference 4) and the sensor electronics are capable of continuously performing their required function under the expected temperature conditions.

Bridging Document (Attachment 3) Cross-Reference:

1. Topic #3

RAI #7

Please provide information indicating (a) 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 (b) whether the sensor electronics are capable of continuously performing required functions under this expected humidity condition.

Waterford 3 Response

The highest mean monthly relative humidity is (a) 91%, which occurs at 6:00am in both July and August. The mean monthly temperature, which is conservatively high for 6:00am, is 79.8°F during these months. Therefore, if the SFPI display is exposed to these conditions, (b) it is still bounded by the 32°C (89.6°F) and 96% RH test case from MOHR Report 1-0410-1 (Reference 4), with margin and is, therefore, capable of continuously performing required functions under these expected humidity conditions. Note that BDB humidity conditions for outside air are not expected to differ from normal humidity variances in this area, nor is this required to be evaluated by NEI 12-02 (Reference 2).

Bridging Document (Attachment 3) Cross-Reference:

1. Topic #3

RAI #8

Please provide information describing the evaluation of the local electronics cabinet and display panel ratings against postulated plant conditions. Also provide results of the manufacturer's shock and vibration test methods, test results, and the forces and their frequency ranges and directions applied to the display panel associated with its successful tests. Provide a description of the specific method or combination of methods to be applied to demonstrate the reliability of the permanently installed local and electronics cabinet equipment under BDB shock and vibration conditions. Identify the specific commercial or military standards that will be used to define the parameters of the shock and vibration testing as well as the g-forces and frequency response spectra to be applied.

Waterford 3 Response

Temperature: The requested information is provided in the response to RAI #6.
Humidity: The requested information is provided in the response to RAI #7.
Radiation: The requested information is provided in the response to RAI #5.
Seismic: The requested information is provided in the response to RAI #2.
Shock and Vibration: The analyses and documentation of applicable standards are contained in proprietary MOHR Test and Measurement LLC Reports:

1. 1-0410-5 “MOHR EFP-IL SFPI System Shock and Vibration Test Report” (Reference 7)
2. 1-0410-6 “MOHR EFP-IL SFPI System Seismic Test Report” (Reference 8)

The indicator and battery enclosures will be mounted in the +21' RAB (wing area). 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. There are no expected impacts from adjacent objects during the BDBEE or design basis earthquake requirements imposed by NEI 12-02 (Reference 2). The vendor testing provided adequately addresses the requirements for general robustness of the enclosures.

Bridging Document (Attachment 3) Cross-Reference:
Topics #8 & 14

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.

Waterford 3 Response

The results are included the following proprietary MOHR Test and Measurement LLC Reports:

1. 1-0410-1 “MOHR EFP-IL SFPI System Temperature and Humidity Test Report” (Reference 4)
2. 1-0410-4 “MOHR EFP-IL SFPI System EMC Test Report” (Reference 6)
3. 1-0410-5 “MOHR EFP-IL SFPI System Shock and Vibration Test Report” (Reference 7)
4. 1-0410-6 “MOHR EFP-IL SFPI System Seismic Test Report” (Reference 8)
5. 1-0410-7 “MOHR EFP-IL SFPI System Battery Life Report” (Reference 9)
6. 1-0410-8 “MOHR EFP-IL SFPI System Boric Acid Deposition Report” (Reference 10)
7. 1-0410-10 “MOHR EFP-IL SFPI System Power Interruption Report (Reference 12)

RAI #10

Please provide analysis of the vendor analysis and seismic testing results and show that SFP level instrument performance reliability, following exposure to simulated seismic conditions representative of the environment anticipated for the SFP structures at Waterford 3, has been adequately demonstrated. Include information describing the design inputs and methodology used in any analyses of the mounting of electronic equipment onto plant structures, as requested in RAI #2 above.

Waterford 3 Response

MOHR has prepared a series of generic seismic qualification reports for the SFP level instrument which bounds WF3’s seismic criteria. The qualification reports envelop all components of the new SFP level instrumentation required to be operational during a BDBEE and post-event.

Mounting bracket design and seismic Class 1 mounting analysis are included in modification package EC-48147 (Reference 32). Calculation ECC14-003 (Reference 26) 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).

The analyses are contained in proprietary MOHR Test and Measurement LLC Reports:

1. NAI-1725-004,“Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool” (Reference 16)
2. NAI-1725-003, “GOTHIC Verification and Sensitivity Studies for Predicting Hydrodynamic Response to Acceleration in Rectangular Shaped Pools” (Reference 15)
3. 1-0410-9, “MOHR SFP-1 Level Probe Assembly Seismic Analysis Report” (Reference 11)

Bridging Document (Attachment 3) Cross-Reference:

1. Topics #8, 9, 12, & 13

RAI #11

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

Waterford 3 Response

Channel 1 is powered by LP 312PA, and Channel 2 is powered by LP 313PB. LP 312PA is fed power from MCC 3A311S (part of the "A" bus), and LP 313PB is fed power from MCC 3B311-S (part of the "B" bus). This is consistent with Section 3.6 of NEI's guidance (Reference 2) which states: "The normal electrical power supply for each channel shall be provided by different sources such that the loss of one of the channels primary power supply will not result in a loss of power supply function to both channels of SFP level instrumentation." The loss of power supplied to the "A" bus will not result in a loss of power supplied to the "B" bus and vice versa. Drawings B-424 sheets 3079 and 3080 (References 47 and 48) show the wiring diagrams for the instrument channels, each with an independent power source.

During the onsite audit, the NRC staff inquired about the description of how the SFP instrument channels are powered during an ELAP event, prior to the depletion of the back-up batteries and the relevant procedure(s).

Entergy provided a supplemental response, stating that AC power is not credited for restoring power to the instrumentation in the event of an ELAP. Instead, external batteries will be used to supply power through the external connection ports along the bottom of the battery enclosure. This is captured in FIG-001, Attachment 9 (Reference 46).

RAI #12

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

Waterford 3 Response

Per MOHR Report 1-0410-7 (Reference 9), the instrument testing demonstrates the battery capacity is sufficient for seven days continuous operation using conservative instrument power requirements. The permanent installed battery capacity of seven days is planned consistent with NEI 12-02 (Reference 2) duration without reliance on or crediting of potentially more rapid FLEX program power restoration.

Bridging Document (Attachment 3) Cross-Reference:

1. Topic #18

RAI #13

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

Waterford 3 Response

The absolute accuracy specified in MOHR Report 1-0410-12 (Reference 22) is 3.0 inches, which complies with the limit of ±1 foot set by NEI 12-02 (Reference 2). The probe is designed to produce accurate level indication in boiling and frothing (multiphase) environments. MOHR Report 1-0410-10 (Reference 12) concludes that the accuracy is not affected by an interruption in power.

During the onsite audit, the NRC staff inquired the Site Acceptance Test (SAT) report to verify the system's as-built accuracy and accuracy performance values following a loss of power and subsequent restoration.

In response, Entergy stated that the SFPI modification was not completed and the SAT was not available for review, but committed to providing the SAT when it was available. The SAT reports (References 49 and 50) for the display and probes were uploaded onto the NRC ePortal on 8/6/2015.

Bridging Document (Attachment 3) Cross-Reference:

1. Topics #16, 17 & 18

RAI #14

Please provide a description of the methodology to 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.

Waterford 3 Response

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 is based on the vendor manuals and captured in plant procedures and/or programs.

Bridging Document (Attachment 3) Cross-Reference:

1. Topics #10 & 20

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.

Waterford 3 Response

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 beyond a configurable threshold prompts operator intervention.

The probe itself is a perforated tubular coaxial waveguide with defined geometry and is not calibrated. Channel design provides capability for calibration or validation against known/actual SFP level.

The WF3 SFP instrument channels have a reasonably high certified design accuracy of equal to or better than +/- three inches (excluding boric acid deposition effects that cause a conservative decrease in indicated level).

During the onsite audit, the NRC staff inquired about the Waterford SFP level instrument calibration procedure(s) providing instructions for functional testing, in-situ testing, and channel check (cross-channel comparison). In response, Entergy stated that the calibration procedure is not available for review and the following were generated:

- CR-WF3-2015-4478, CA #4 was initiated to develop the SFPI Calibration Procedure in accordance with vendor Technical Manual requirements. Work Order WO #428789 Tasks 01 and 02 were created to perform instrument calibration per vendor technical manual, TD-M924.0025 Section 7.1 and 7.2. (Reference 59)

- CR-WF3-2015-4478 CA #5 was initiated to develop SFPI Operator Rounds procedure wording (including checking each channel separately to actual pool level, channel check, battery indication) and to document frequency of Operator Rounds. Surveillance procedure OP-903-001 (Reference 51) was approved which provides for a 7 day Channel Check of the SFPI level instruments.

Bridging Document (Attachment 3) Cross-Reference:

1. Topic #20

RAI #16

For any SFP level instrumentation displays located outside the main control 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) it will take for personnel to access the 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. Identify whether personnel are to be continuously stationed at the display or will monitor the display periodically.

Waterford 3 Response

The processor/display for each channel will be located on the Reactor Auxiliary Building (RAB) +21.00 elevation in the (wing area). The wing area can be approached from the Main Control Room (+46.00 elevation of RAB) by descending one of two stairwells adjacent to the Main Control Room. Once on the +21.00 elevation of the Reactor Auxiliary Building, the wing area is accessed from the south through door D-21. For non-flood events, the displays in the wing area can also be accessed from the Reactor Auxiliary Building by going outside (crossing a Radiologically Controlled Boundary), through the west-side entrance, and through the north entrance of the RAB +21 wing area. The permanently mounted primary and back-up channel displays can be considered promptly accessible, because station operators can obtain SFP level data trends and report those to decision makers within 30 minutes of request per the WF3 SFPI OIP (Reference 40). This is in alignment with Section 3.1 of NEI 12-02 (Reference 2) regarding portable instrumentation.

To confirm this, a simulated walkdown was performed for one of the routes from the Main Control Room (RAB +46') to the SFPI Displays (RAB wing area +21'). A time of less than 5 minutes was timed during the simulated walkdown. There were no apparent obstructions or lighting issues identified during the walkdown, and there is adequate time margin allowing for any obstructions that may be in the path. Additionally, Operators carry flashlights in case of lighting issues.

The impact to habitability would be primarily from elevated temperatures, as the EL. +21' of the RAB (wing area) 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, this area is utilized as part of the overall FLEX BDBEE strategy per the FLEX OIP (Reference 52) and habitability for that strategy bounds the activity of reading the instruments. Refer to RAI #5 for radiological conditions and RAI #6 for temperature conditions at the display location.

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. Include a brief description of the specific technical objectives to be achieved within each procedure.

Waterford 3 Response
The calibration and test procedures developed by MOHR are provided in the MOHR technical manuals. 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 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 and are provided in the technical manual. These allow a technician trained in EFP-IL system maintenance to ensure that system functionality is maintained.

CR-WF3-2015-4478, CA #4 was initiated to develop the SFPI Calibration Procedure in accordance with vendor Technical Manual requirements. Work Order WO #428789 Tasks 01 and 02 were issued to perform instrument calibration per vendor technical manual, TD-M924.0025 Section 7.1 and 7.2 (Reference 59).

Operations procedure OP-002-006, “Fuel Pool Cooling and Purification” (Reference 53) provides sufficient instructions for operation and use of the system and was developed in accordance with the vendor manuals provided by MOHR.

Operations procedure OP-903-001 “Technical Specification Surveillance Logs” (Reference 51) was approved which provides for a 7 day Channel Check of the SFPI level instruments.

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

- FIG-001, “Extended Loss of AC Power” (Reference 46) - Provides actions using FLEX equipment which are focused on maintaining or restoring key plant safety functions for a Beyond Design Basis External Event (BDBEE) resulting in an Extended Loss of AC Power (ELAP). This procedure includes a procedure for how and when to connect an external DC source to power the SFP level indicator.

- FSG-011, “Alternate SFP Makeup and Cooling” (Reference 54 - New procedure which provides actions to restore Spent Fuel Pool (SFP) level using an alternate makeup source for a Beyond Design Basis External Event (BDBEE) resulting in an Extended Loss of AC Power (ELAP).

Procedure NE-001-005, “Preparation, Control and Documentation of Fuel Movement” (Reference 55) was revised to document the four fuel cells below each probe will not be accessible unless the probe is removed.

Technical Requirements Manual (TRM) Amendment 133 (Reference 56) provides Action statements for out of service channels and surveillance requirements.

Bridging Document (Attachment 3) Cross-Reference:
1. Topics # 10, 19, & 20

RAI #18
Please provide the following:

a) **Further information describing the maintenance and testing program to be established and implemented 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.**
b) **A description of the compensatory actions that will be taken in the event that one or both channels are non-functioning, as described in the guidance in NEI 12-02 Section 4.3.**

Waterford 3 Response

a. SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness have been 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 is performed.

During the onsite audit, the NRC staff inquired about the Waterford SFP level instrument calibration procedure(s) providing instructions for functional testing, in-situ testing, and channel check (cross-channel comparison). In response, Entergy stated that the calibration procedure is not available for review and the following were generated:

1) CR-WF3-2015-4478, CA #4 was initiated to develop the SFPI Calibration Procedure in accordance with vendor Technical Manual requirements. Work Order WO #428789 Tasks 01 and 02 were created to perform instrument calibration per vendor technical manual, TD-M924.0025 Section 7.1 and 7.2 (Reference 59)

2) CR-WF3-2015-4478 CA #5 was initiated to develop SFPI Operator Rounds procedure wording (including checking each channel separately to actual pool level, channel check, battery indication) and to document frequency of Operator Rounds. Surveillance procedure OP-903-001 (Reference 51) was approved which provides for a 7 day Channel Check of the SFPI level instruments.

b Both primary and backup SFPI channels incorporate permanent installation (with no reliance on portable, post-event installation) of relatively simple and robust augmented quality equipment. Permanent installation coupled with stocking of adequate spare parts reasonably diminishes the likelihood that a single channel (and greatly diminishes the likelihood that both channels) is (are) out-of-service for an extended period of time. Control of compensatory actions for out of service SFPI channel(s) is controlled by inclusion in the Plant's Technical Requirements Manual (TRM) 3.13.1 (Reference 56).

Open Audit Items

Below are responses for the Open Audit items associated with NRC Order EA 12-051 as contained in Attachment 3 to the NRC Audit Report (Reference 57).

SE.7 Operating Experience – Recent MOHR SFPI Equipment Failures

Describe any actions/measures Waterford plans to implement to address this operating experience. Provide vendor information on the replacement parts' qualifications. Make responses and vendor reports available on e-portal for NRC review.

Waterford Response
The vendor, MOHR, has determined the source of the failures is a miniature surface mount common-mode choke component used on the Video and Digicomp printed circuit boards (PCB's) within the EFP-IL Signal Processor. Per MOHR's recommendation, the two boards have both already been replaced. The new boards have equivalent substitute components that are less susceptible to transient electrical events. The substitute components have equivalent size, mass, and solder attachment technique as the original component such that there is no impact to the system mechanical characteristics. The components demonstrate equivalent electrical performance such that EMC characteristics are not significantly changed.

MOHR has provided a copy of their Root Cause Analysis Report, Revision 1 dated 6/1/2015.
In the event one or both channels become non-functioning at any point in the future, compensatory actions are covered under the plant's TRM. See Audit Item SFPI.18 for more detail on the TRM insert.

The vendor's parts qualification report has been uploaded to the ePortal. (Reference 58)

SE.26 SFPI Cable Conduits Located Side-by-Side for a Portion of the Routing Inside the FHB

Provide completed design that includes protection to this portion of the conduit routing as described to the NRC staff during the on-site audit.

Waterford Response
EC 48147 ECN 58881 (Reference 32) includes the missile shield design for protecting these conduits, which was installed under Work Order 376626. Details of the design have been uploaded to the ePortal.

Attachment 3

W3F1-2016-0001

Waterford Steam Electric Station, Unit 3,

Design Bridge Document

#	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 4-12, 15-16 28, 34, & 35			Evaluation of the vendor information is within the scope of engineering change package EC-48147 (Reference 32).
2	Test Strategy	Per Requirements in References 1 2, & 3	References 4, 6-12, 15-16, 25, 28 & 35			The equipment testing performed for the SFPI has been found to be acceptable based on the current design requirements.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
3	Environmental Qualification for electronics enclosure with Display	50-131°F (References 1, 2, & 13)	Reference 4		14-131°F	The SFPI Panels will be located in the +21' RAB (wing area). This area has a design temperature of 104°F during normal operation (Reference 32). During a BDBEE, this area will have no operating equipment besides the SFPI panels and will not be subject to the heat generated during a LOCA/MSLB. Additionally, the doors immediately adjacent to the SFPI panels will be opened during a BDBEE. Therefore, it is reasonable to conclude that conditions in this area will not exceed 131°F (55°C) which the SFPI was qualified to in MOHR Report 1-0410-1 (Reference 4) and the sensor electronics are capable of continuously performing its required function under the expected temperature conditions. The area will not require prolonged operator occupancy for SFPI. Also, operators will be required to pass through the area for other FLEX functions. There is reasonable assurance that the temperature in the area will remain at a safe level. The minimum temperature of the RAB is 50°F from Table 9.4-1 of Reference 13.
		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

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
						SFPI System Temperature and Humidity Report (Reference 4). Humidity on the +21' RAB (Zone JJ, wing area, Reference 38 is normally regulated by the RAB HVAC system. Drawing G-M0001, Revision 4 (Reference 39) states during normal operation, the relative humidity in the RAB air conditioned or ventilated areas will be 20% to 90%, with an average of 60%. Since humidity decreases when dry bulb temperature increases given a constant mass of water per mass of air (humidity ratio), high relative humidity conditions will not occur at the upper end of the temperature range, which is 50°F – 104°F. Therefore, the normal operating conditions are bounded by the MOHR test cases of 47°C (116.6°F), 71% RH and 32°C (89.6°F), 96%RH. These were endorsed by the NRC Audit Report for MOHR (Reference 37). During a BDBEE, the RAB HVAC system is no longer available and the doors adjacent to the SFPI panels will be opened to allow outside air into the +21' RAB Wing Area. Cases of both high humidity and high temperature are considered. In the case of high humidity, the highest mean monthly relative humidity is 91%, which occurs at

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
						6:00am in both July and August (Reference 13, Table 2.3-34). The mean monthly temperature, which is conservative for 6:00am, is 79.8°F during these months (Reference 13, Table 2.3-33). Therefore, if the SFPI display is exposed to these conditions, it is still bounded by the 32°C (89.6°F) and 96% RH test case from Reference 1, with margin. In the case of high temperature, the highest mean monthly temperature is 87.8°F, which occurs in July (Reference 13, Table 2.3-33). This corresponds to a mean mid-day RH between 66%-73% at 12:00pm and 6:00pm, respectively (Reference 13, Table 2.3-34). The record maximum temperature at nearby Moisant International Airport is 100°F (Reference 13, Table 2.3-31). Therefore, if the SFPI display is exposed to these conditions, it is still bounded by the 47°C (116.6°F), 71% RH and 32°C (89.6°F), 96%RH test cases from Reference 1, with margin. Therefore, the operational humidity range of 5% to 95% encompasses all expected conditions for the SFPI display location and the sensor electronics are capable of continuously performing their

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
						required function under the expected humidity conditions.
		Mild Radiation Environment			N/A	According to G-M0012 (Reference 38) and G-M0001 (Reference 39) the RAB (wing area) where the new signal processor/display is mounted, has a normal 40-year dose of 8.8E+1 rad. According to Table 3.11-1 in the WF3 UFSAR (Reference 13), the Control Room also has a 40-year normal dose of 8.8E+1 rad. Both the RAB (wing area) and control room are also designated as mild environments in this table. Therefore this environment is acceptable and no additional testing is required per NRC Audit Report for MOHR (Reference 37). During a BDBEE, radiation levels in the +21' RAB (wing area) are not impacted by a reduction in Spent Fuel Pool water level.
4	Environmental Testing for Level Sensor components in	50-212°F (References 1, 2 & 13)	Reference 5	RAD TID is the total 40 yr dose plus the 7 day	480°F long-term for PEEK Insulators	The NRC Audit Report for MOHR (Reference 37) concludes that the SFP-1 probe is suitable for operation in the SFP environment.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
	SFP area-Submerged Portion of Probe Body	Submerged Component (References 1 & 2)	Reference 5	worst case accident dose at the lowest spacer location on the Probe body	PEEK Insulators capable of long term submergence	The SFP is expected to remain at or above the minimum ambient temperature (50°F) as called out in the UFSAR (Reference 13) Table 9.4-1. 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 & 13, and are acceptable.
		(References 1, 2 & 30)	Reference 5		10 Grad for PEEK Insulators	The NRC Audit Report for MOHR (Reference 37) concludes that the SFP-1 probe is suitable for operation in the SFP environment. Calculation ECS14-008 (Reference 30) defines a worst case dose of approximately 2.89E7 rad to the probe via the applicable requirements of References 1 and 2. As such, the PEEK spacers are suitable for the application.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
5	Environmental Testing for Level Sensor Electronics Housing-Probe Head located Above the SFP	50-212°F (References 1, 2 & 13)	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 day @ 311°F Sylgard 170: 392°F long-term	The NRC Audit Report for MOHR (Reference 37) 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 of the Auxiliary Building (50°F) as called out in the UFSAR (Reference 13) Table 9.4-1. 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 & 13, 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 37).

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
		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 37) 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 **Error! Reference source not found.** & 2 and are acceptable.
		(Reference 30)	Reference 5		PEEK: 10 Grad EPDM: 2 Grad Sylgard 170: 200 Mrad	The NRC Audit Report for MOHR (Reference 37) concludes that the SFP-1 probe is suitable for operation in the SFP environment. Calculation ECS14-008 (Reference 30) defines a worst case dose of approximately 2.14E5 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 & 13 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.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
7	Basis for Dose Requirement	References 1 & 2	N/A			Entergy Calculation Procedure EN-DC-126 (Reference 14) was used to develop calculations ECS14-007 and ECS14-008 (References 29 and 30) based on the requirements of NEI 12-02 (Reference 2) and EA-12-051 (Reference 1). The calculation determines the dose rates for various locations and SFP water levels for both a 7 day accident scenario and 40 year TID.
8	Seismic Qualification	Seismic Class I (References 1, 2, 3 & 13)	References 8 & 11		Seismic Class 1	Acceptable, MOHR has prepared a series of generic seismic qualification reports for the SFP level instrument which bounds WF3's seismic criteria. The qualification reports envelop all components of the new SFP level instrumentation required to be operational during a BDBEE and post-event. These documents are MOHR Reports 1-0410-6 (Reference 8) and 1-0410-9 (Reference 11). Calculations ECC14-002 (Reference 27) and ECC14-003 (Reference 26) account for seismic loads and shows that the SFPI Probe Mounting Bracket and all other electrical mounting equipment is structurally adequate and seismically qualified as all Interaction Ratios (IR) are less than one (1.0). Reference Topic #9 for discussion of seismically induced sloshing affect which is included.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
9	Sloshing	Water induced motion from seismic event does not cause equipment structural failure	References 11, 15 & 16	See Topic #8		Acceptable, the MOHR generic seismic qualification reports (References 8 & 11) in combination with NAI Report # NAI-1725-003 (Reference 15) and NAI Report # NAI-1725-004 (Reference 16) adequately bound the hydrodynamic loads associated with sloshing for WF3. Calculation ECC14-003 (Reference 26) 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). The CGS NAI document (Reference 16) is used as input to the bracket design. Reference 26 is available on the e-portal for review.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
10	Spent Fuel Pool Instrumentation System Functionality	System must allow for routine, in situ functionality	References 22, 23 & 24			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 is performed (and available for inspection and audit). The instrument automatically monitors the integrity of its level measurement system using in-situ capability. Revision 1 of the manuals have been provided by the vendor (References 22, 23 & 24) for use, although it is possible these could be amended by the vendor in the future based on installation experience.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
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	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. 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 37). 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 24).

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
12	Pool-side Bracket Seismic Analysis (References 1, 2 & 13)	Seismic Class I (References 1, 2 & 13)	Reference 11	See Topic #8	Seismic Class I	Calculation ECC14-003 (Reference 26) 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 26 is available on the e-portal for review.
13	Additional Brackets (Sensor Electronics and electronics Enclosure	Seismic Class I (References 1, 2, 3 & 13)	Reference 4	See Topic #8	Seismic Class I	Calculation ECC14-002 (Reference 27) seismically qualifies all electrical mounting equipment. Reference 27 is available on the e-portal for review.
14	Shock & Vibration	(References 1, 2 & 3) MIL-STD-167-1 (Reference 20) for vibration and MIL-STD-901D (Reference 21) for shock	References 7, 11 & 35		IEC 60068-2-27 (2008-02) (Reference 17) IEC 60068-2-6 (2007-12) (Reference 18)	The NRC Audit Report for MOHR (Reference 37) 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 35) 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 inherently resistant to shock and vibration based on design. The probes and repairable head are evaluated to be adequately designed for resilience against shock and vibration (Reference 35). The new probe mounting components and

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
						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 +21' RAB (wing area). 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. There are no expected impacts from adjacent objects during the BDBEE or design basis earthquake requirements imposed by NEI 12-02.
15	Requirements Traceability Matrix	Software Traceability Matrix Required for Software Evaluation of Equipment	Reference 25			The instrument software Verification and Validation was performed by MOHR per Revision 2 of MOHR Report 1-0410-11 (Reference 25).

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
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 22 & 34.		3.0 in max, not including boric acid deposition or boiling effects	Appendix A of Reference 22 states that the absolute accuracy is 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 item # 11 for boric acid deposition effects. Additionally, the probe is designed to produce accurate level indication in boiling and frothing (multiphase) environments (Reference 34)
18	Power consumption	120 VAC, 60 Hz, (References 13, 32 & 33)	References 9, 12 & 33		85-264 VAC 47-63 Hz 11.48 W (average) 18.83 W (maximum)	The NRC Audit Report for MOHR (Reference 37) 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 12) concludes that the accuracy is not affected by an interruption in power.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
		7 day battery life required	Reference 9		7 day battery life @ 15 sample per hour rate	The NRC Audit Report for MOHR (Reference 37) 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 23 & 24			Revision 1 of the manuals have been provided by the vendor (References 23 & 24) for use, although it is possible these could be amended by the vendor in the future based on installation experience.
20	Calibration	Must allow for in-situ calibration	References 22, 23 & 24	System is calibrated using CT-100 device and processing of scan files by vendor. Dry scan from original installation must be maintained		Revision 1 of the manuals have been provided by the vendor (References 22, 23 & 24) for use, although it is possible these could be amended by the vendor 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 SFPI channels to actual pool level as well as a SFPI cross channel comparison.

#	Topic	Parameter Summary	Vendor Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
21	Failure Modes and Effects Analysis (FMEA)	System provides reliable indication of fuel pool level, consistent with the requirements of References 1 & 2	Reference 36		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 19)	References 6 & 28		EPRI TR-102323, Rev. 3 (Reference 19)	Acceptable, MOHR reports 1-0410-4 (Reference 6) and 1-0410-4-S1 (Reference 28) demonstrate the new SFPI satisfies the EMI/RFI compliance guidelines of Revision 3 of EPRI TR-102323 (Reference 19) in accordance with Entergy Engineering Standard EN-IC-S-004-MULTI (Reference 31). FLEX Support Guidelines (FSG) governing the use of the SFPI will include a cautionary statement to preclude radio usage within close proximity to the displays.

Attachment 4

W3F1-2016-0001

Waterford Steam Electric Station, Unit 3,

References

References

The following references support the information described in this letter.

1. NRC Order Number EA-12-051, “Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,” dated March 12, 2012 (ADAMS Accession No. ML12054A682).

2. 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 (ADAMS Accession No. ML12240A307)

3. NRC Interim Staff Guidance, JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, August 29, 2012 (ADAMS Accession No. ML12054A682)

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. UFSAR, Rev. 308, “Waterford Updated Final Safety Analysis Report”

14. EN-DC-126, Rev. 5, “Engineering Calculation Process”

15. NAI-1725-003, Rev. 0, “GOTHIC Verification and Sensitivity Studies for Predicting Hydrodynamic Response to Acceleration in Rectangular Shaped Pools”

16. NAI-1725-004, Rev. 3, “Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool”

17. IEC 60068-2-27 (2008-02) “Environmental Testing-Part 2-27: Tests-Test Ea and Guidance: Shock”

18. IEC 60068-2-6 (2007-12) “Environmental Testing-Part 2-6: Tests-Test Fc: Vibration (sinusoidal)”

References

19. EPRI TR-102323, Rev. 3, “Guidelines for Electromagnetic Interference of Power Plant Equipment”

20. MIL-STD-167-1 “Mechanical Vibrations of Shipboard Equipment (Type 1-Environmentally and Type II-Internally Excited)”

21. MIL-STD-901D “Shock Tests H.I.(High Impact) shipboard Machinery, Equipment, and Systems, Requirements for”

22. 1-0410-12 “EFP-IL Signal Processor Operator’s Manual”

23. 1-0410-13 “EFP-IL Signal Processor Technical Manual”

24. 1-0410-14 “SFP-1 Level Probe Assembly Technical Manual”

25. 1-0410-11 “MOHR EFP-IL SFPI System Software Verification and Validation”

26. ECC14-003, Rev. 0, “SFPI Probe Mounting Bracket Design”

27. ECC14-002, Rev. 0, “SFPI Electrical Equipment Support Qualification”

28. 1-0410-4-S1 “MOHR EFP-IL SFPI Supplemental EMC Information”

29. ECS14-007, Rev. 0, “Spent Fuel Pool Instrumentation Source Term Calculation”

30. ECS14-008, Rev. 0, “Spent Fuel Pool Instrumentation Shielding Calculation”

31. EN-IC-S-004-MULTI, Rev. 1, “EMI/RFI Design Considerations”

32. EC-48147 Rev. 0, “Waterford 3 Spent Fuel Pool Level Instrumentation Upgrade”

33. MOHR drawing 1-0430-20, “EFP-IL System Electrical Diagram”

34. 1-0410-15, “MOHR-EFP-IL SFPI System Uncertainty Analysis”

35. 1-0410-16, “MOHR SFP-1 Level Probe Assembly Shock and Vibration Test Report”

36. EVAL-194-4812-01 “MOHR EFP-IL Liquid Level Measurement System Failure Modes and Effects Analysis (FMEA)”

37. 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)

38. G-M0012, Rev. 003, “Environmental Zone Map Radiation Reactor BLDG. Plan EL. +21.00”

References

39. G-M0001, Rev. 004, “Radiation and Temperature Charts Table II and III, Figures B1A, B1B, & B1C Figure B-1”

40. Waterford Steam Electric Station, Unit 3 letter to NRC, “Overall Integrated Plan 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, 2013 (ADAMS Accession No. ML13063A263).

41. NRC Letter “Waterford Steam Electric Station, Unit 3 – 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. MF0946),” dated November 25, 2013 (ADAMS Accession No. ML13312A787).

42. Entergy Nuclear Management Manual, EN-RE-220, “PWR Control of Miscellaneous Material in the Spent Fuel Pool”

43. Entergy Nuclear Management Manual, EN-RP-123, “Radiological Controls for Highly Radioactive Objects”

44. B288 Sheet 18B, “Cable and Conduit List Installation Details Conduit Seismic Support Chart”

45. G-M0004, Rev. 002, “Environmental Zone Map T.P.H.C.S. Reactor BLDG. Plan EL. +21 Figure B-4”

46. FLEX Implementing Guide, FIG-001, “Extended Loss of AC Power”

47. B424 Sheet 3079, “Control Wiring Diagram Spent Fuel Pool Instrument Channel # 1”

48. B424 Sheet 3080, “Control Wiring Diagram Spent Fuel Pool Instrument Channel # 2”

49. 1-0530-2, MOHR SFPI Installation Checklist for Control Room

50. 1-0530-3, MOHR SFPI Installation Checklist for SFP Room

51. Waterford 3 Operations Surveillance Procedure OP-903-001, “Technical Specification Surveillance Logs”

52. Waterford Steam Electric Station, Unit 3 letter to NRC, “Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049),” dated February 28, 2013 (ADAMS Accession No. ML13063A266).

53. Waterford 3 Operations Procedure OP-002-006, “Fuel Pool Cooling and Purification”

54. FLEX Support Guideline, FSG-011, “Alternate SFP Makeup and Cooling”

55. Waterford 3 Technical Procedure NE-001-005, “Preparation, Control and Documentation of Fuel Movement”

56. Waterford 3 Technical Requirements Manual (TRM)

References

57. NRC Letter "Waterford Steam Electric Station, Unit 3 – Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool instrumentation Related to Orders EA-12-049 and EA-12-051(TAC No. MF0977 and MF0946)," dated October 8, 2015 (ADAMS Accession No. ML15272A398)

58. 1-1010-2, "Qualification Report: EFP-IL MOD 1 Modification Package"

59. MOHR Technical Manual, TD-M924.0025, "EFP-IL Signal Processor Technical Manual"