INDIANA MICHIGAN POWER®
A unit of American Electric Power

Indiana Michigan Power
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
IndianaMichiganPower.com

December 16, 2014

AEP-NRC-2014-90
10 CFR 50.4

Docket Nos.: 50-315
50-316

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

Donald C. Cook Nuclear Plant Units 1 and 2
Compliance with March 12, 2012, U. S. Nuclear Regulatory Commission (NRC) Order
Regarding Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)

Reference:

1. Letter from E. J. Leeds and M. R. Johnson, U. S. Nuclear Regulatory Commission (NRC), to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012, Agencywide Documents Access Management System (ADAMS) Accession No. ML12054A682.

2. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to the NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2 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 27, 2013, AEP-NRC-2013-14, ADAMS Accession No. ML13071A323.

3. Letter from T. J. Wengert, NRC, to L. J. Weber, I&M, "Donald C. Cook Nuclear Plant, Units 1 and 2 - 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 Nos. MF0761 and MF0762)," dated November 13, 2013, ADAMS Accession No. ML13310B499.

4. Letter from J. P. Gebbie, I&M, to the NRC, "Donald C. Cook Nuclear Plant Units 1 and 2, 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 27, 2014, ADAMS Accession No. ML14063A041.

In response to events at the Fukushima Dai-ichi nuclear power plant, the U. S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051 (Reference 1) to all power reactor licensees, including Indiana Michigan Power Company (I&M), the licensee for the Donald C. Cook Nuclear Plant (CNP) Units 1 and 2. The order directed licensees to implement reliable means of remotely monitoring wide-range Spent Fuel Pool levels to support effective prioritization of event mitigation and recovery actions in the event of a beyond-design-basis external event. The order also directed licensees to report when full compliance with the requirements stated in the order was achieved. This letter reports compliance with the requirements of the order for CNP Units 1 and 2.

The order also required that licensees submit an Overall Integrated Plan (OIP) describing how compliance with the specific requirements of the order would be achieved. The OIP for CNP Units 1 and 2 was submitted by Reference 2. Reference 3 transmitted NRC Requests for Additional Information (RAI) regarding the CNP OIP. By Reference 4, I&M provided responses to some of the RAIs. Responses to the remainder of the RAIs were provided to the NRC via the CNP Fukushima e-portal.

This letter transmits the RAI responses which were previously provided to the NRC staff via the e-portal, and provides an amended response to one RAI that had been previously addressed by Reference 4. This letter also transmits an updated version of the design "bridging document" which had previously been provided to the NRC staff via the e-portal. The bridging document evaluates vendor information as applied to CNP site-specific considerations.

Enclosure 1 to this letter provides an affirmation regarding the information contained herein. Enclosure 2 provides a description of CNP Unit 1 and Unit 2 compliance with Order EA-12-051. Enclosure 3 provides RAI responses as discussed above. Enclosure 4 provides the CNP Spent Fuel Pool Instrument Bridging document.

This letter contains no new or revised regulatory commitments. Should you have any questions, please contact Mr. Michael K. Scarpello, Regulatory Affairs Manager, at (269) 466-2649.

Sincerely,

Joel P. Gebbie
Site Vice President

JRW/amp

Enclosures:

1. Affirmation
2. Donald C. Cook Nuclear Plant Unit 1 Compliance with NRC Order EA-12-051
3. Responses to Requests for Additional Information
4. Donald C. Cook Nuclear Plant Spent Fuel Pool Instrument Bridging Document.

c: M. L. Chawla, NRC Washington, DC
J. T. King, MPSC, w/o enclosures
E. J. Leeds, NRR, NRC
MDEQ – RMD/RPS
NRC Resident Inspector
C. D. Pederson, NRC Region III
A. J. Williamson, AEP Ft. Wayne, w/o enclosures

Enclosure 1 to AEP-NRC-2014-90

## AFFIRMATION

I, Joel P. Gebbie, being duly sworn, state that I am Site Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this document with the U. S. Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Joel P. Gebbie
Site Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 16th DAY OF December, 2014

Megan D. Wendel
Notary Public

My Commission Expires 01/21/2018

**Enclosure 2 to AEP-NRC-2014-90**

**Donald C. Cook Nuclear Plant Unit 1 Compliance with NRC Order EA-12-051**

References for this enclosure are identified in Section 5.

## 1. Introduction

In response to events at the Fukushima Dai-ichi nuclear power plant, the U. S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051 (Reference 1) to all power reactor licensees, including Indiana Michigan Power Company (I&M), the licensee for the Donald C. Cook Nuclear Plant (CNP) Units 1 and 2. The order directed licensees to implement reliable means of remotely monitoring wide-range Spent Fuel Pool (SFP) levels to support effective prioritization of event mitigation and recovery actions in the event of a beyond-design-basis external event. To comply with the order, I&M installed two independent full scale level monitors for the CNP SFP.

As also required by Order EA-12-051, I&M developed an Overall Integrated Plan (OIP) (Reference 2) describing how compliance with the order would be achieved. The order required that licensees complete full implementation of the requirements stated in the order no later than the second refueling outage after submittal of the OIP. CNP Unit 1 and Unit 2 share a common SFP; therefore, compliance with EA-12-051 was required prior to restart of the first CNP unit to undergo two refueling outages following issuance of the OIP. That unit was CNP Unit 1.

The NRC staff has requested that the compliance report be submitted within 60 days of commencing unit startup from the outage in which implementation of the strategies is required. I&M is hereby reporting that full compliance with the order was achieved prior to commencing the CNP Unit 1 startup, on October 23, 2014, from the second refueling outage following submittal of the OIP.

## 2. Request for Additional Information (RAI) Resolution

By Reference 3, the NRC issued an Interim Staff Evaluation (ISE) regarding the Reference 2 OIP, and included Requests for Additional Information (RAI). By Reference 4, I&M provided responses to some of the RAIs. Responses to the remainder of the RAIs were provided to the NRC via the CNP Fukushima e-portal. Enclosure 3 to this letter transmits the RAI responses which were previously provided via the e-portal. Enclosure 3 also provides an amended response to one RAI that had been addressed by Reference 4.

## 3. Milestone Schedule Status

The following table lists the milestones identified in the most recent OIP status update (Reference 5), and reflects the status of the milestones on the required Unit 1 compliance date, i.e. when the unit startup was commenced on October 23, 2014.

| Milestone Completion | |
|---|---|
| **Milestone** | **Activity Status** |
| Submit 60-Day Status Report | Complete |
| Submit OIP | Complete |
| **Unit 1 refueling outage (1st RFO) start** | Complete |
| **Submit 6 Month Updates:** | |
| Update 1 | Complete |
| Update 2 | Complete |
| Update 3 | Complete |
| Update 4 | Not Needed |
| **Modifications:** | |
| Commence Engineering Modification Design | Complete |
| Order Electronics | Complete |
| Complete Design | Complete |
| Receive Electronics | Complete |
| Commence Installation | Complete |
| Complete Functional Test | Complete |
| **Procedures:** | |
| Issue Maintenance Procedures | Complete |
| **Training:** | |
| Implement Training | Complete |
| Submit Completion Report | Complete with this submittal |

## 4. Order EA-12-051 Compliance Elements Summary

CNP compliance with Order EA-12-051 was achieved using the guidance in Nuclear Energy Institute (NEI) document NEI 12-02 (Reference 6) which has been endorsed by the NRC (Reference 7). The significant compliance elements were addressed as described below.

IDENTIFICATION OF LEVELS OF REQUIRED MONITORING – COMPLETE

I&M identified the three required levels for monitoring SFP level in compliance with Order EA-12-051. As discussed in Enclosure 3 to this letter, Level 2, which was stated in Reference 4 to be at elevation 630 feet – 10.5 inches, was changed to be elevation 632 feet - 3.5 inches to assure adequate shielding. The three levels were incorporated into the SFP instrument design.

INSTRUMENT DESIGNED FEATURES – COMPLETE

The instruments installed at CNP were designed to comply with the requirements specified in the order and described in NEI 12-02. The instruments were installed in accordance with the CNP configuration control process.

The instruments were arranged to provide reasonable protection against missiles in accordance with the NRC endorsed guidance. The instruments were mounted to retain design configuration during and following the maximum expected ground motion. The instruments will be reliable during expected environmental and radiological conditions when the SFP is at saturation for extended periods. The instruments are independent of each other and have separate and diverse power supplies. The instruments will maintain their designed accuracy following a power interruption and are designed to allow for routine testing and calibration.

The instrument displays are readily accessible during postulated events and allow for SFP level information to be promptly available to decision makers.

PROGRAM FEATURES – COMPLETE

Training was completed in accordance with the Systematic Approach to Training process. Maintenance procedures were developed and integrated with existing procedures. Procedures were verified in accordance with the site procedure control program. Site processes were established to ensure the instruments are maintained at their design accuracy.

Reference 4 described actions that would be taken for non-functioning channels of SFP instrumentation, including ensuring the availability of normal alarms and direct visual monitoring of SFP level. However, the required actions for non-functioning channels are now specified in the CNP Unit 1 and Unit 2 Technical Requirement Manuals, which implement the applicable NEI 12-02 requirements for compensatory actions if channels are unavailable (e.g., "use of alternate suitable equipment or supplemental personnel").

## 5. References

1. Letter from E. J. Leeds and M. R. Johnson, U. S. Nuclear Regulatory Commission (NRC), to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012, Agencywide Documents Access Management System (ADAMS) Accession No. ML12054A682.

2. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to the NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2 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 27, 2013, AEP-NRC-2013-14, ADAMS Accession No. ML13071A323.

3. Letter from T. J. Wengert, NRC, to L. J. Weber, I&M, "Donald C. Cook Nuclear Plant, Units 1 and 2 - 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 Nos. MF0761 and MF0762)," dated November 13, 2013, ADAMS Accession No. ML13310B499.

4. Letter from J. P. Gebbie, I&M, to the NRC, "Donald C. Cook Nuclear Plant Units 1 and 2, 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 27, 2014, ADAMS Accession No. ML14063A041.

5. Letter from, J. P Gebbie, I&M, to the NRC, "Donald C. Cook Nuclear Plant Units 1 and 2 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 27, 2014, AEP-NRC-2014-67, ADAMS Accession No. ML14241A236.

6. Nuclear Energy Institute 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 24, 2012, ADAMS Accession No. ML122400399.

7. JLD-ISG-2012-03, "Compliance with Order EA-12-051, 'Reliable Spent Fuel Pool Instrumentation' Interim Staff Guidance, Revision 0, dated August 29, 2012, ADAMS Accession No. ML12221A339.

**Enclosure 3 to AEP-NRC-2014-90**

**Responses to Requests for Additional Information**

The letter from T. J. Wengert, U. S. Nuclear Regulatory Commission (NRC), to L. J. Weber, Indiana Michigan Power Company (I&M), dated November 13, 2013, transmitted an NRC Interim Staff Evaluation (ISE) regarding I&M's Overall Integrated Plan (OIP) for Spent Fuel Pool (SFP) instrumentation required by NRC Order EA-12-051. The ISE included Requests for Additional Information (RAI) regarding the OIP. A letter from J. P. Gebbie, I&M, to the NRC, dated February 27, 2014, provided I&M's responses to some of the RAIs. Responses to the remainder of the RAIs were provided to the NRC via the Donald C. Cook Nuclear Plant (CNP) Fukushima e-portal. This enclosure transmits the RAI responses which were previously provided via the e-portal (responses to RAI #3(a), (b), and (c), RAI #8(a), RAI #11(a), and RAI #12). A portion of the response to RAI #12 has been changed to reflect reliance on operator training for knowledge of the three assigned SFP levels. This enclosure also provides a revised response to one RAI (RAI #1) that had been previously addressed by I&M's letter dated February 27, 2014. The response to RAI #1 has been changed to assure adequate shielding for personnel. All other responses are unchanged except for editorial changes and replacement of future tense statements with past tense statements as necessary to reflect the completed status of the associated actions.

**RAI #1**

*Please identify the final elevations identified as Levels 2 and 3 as well as the top of the fuel rack elevation.*

**Response:** (amended with change bars)

**Level 2:**

SFP Level of 26 feet (') -1 inch (") (Elevation (El.) 632' - 3 ½").

Basis:

a) MD-12-SFP-002-N states that the highest point to the top of any spent fuel rack is 14'-8" (El. 620'-10 ½") from the bottom of the SFP (El. 606'-2 ½"). An additional 10' gives 24'-8" (El. 630'-10 ½").

b) PMP-2080-EPP-101, "Emergency Classification," Attachment 3, R-3: "Alert - Loss of Water Level in any Area Holding Irradiated Fuel" designates "12 feet (of water) above the top of the spent fuel" as the level which "provides adequate radiation shielding for staff personnel from excessive radiation doses in the area of the SFP." Per MD-12-SFP-002-N, the top of the spent fuel assemblies are at 620'-3 ½". Adding 12' corresponds to a SFP level of 26'-1" (El. 632'-3 ½"). This level provides adequate shielding for personnel.

Item 'b' (SFP Level at El. 632'-3 ½") is chosen for Level 2 as it would provide a conservative level of shielding for activities in the immediate vicinity of the pool (e.g., addition of makeup water).

**Level 3:**

SFP Level of 14'-8" (El. 620'-10 ½")

Basis:

Nuclear Energy Institute (NEI) 12-02 defines Level 3 nominally as the highest point of any fuel rack seated in the SFP. MD-12-SFP-002-N states that the highest point to the top of any spent fuel rack is 14'-8" (El. 620'-10 ½").

**Fuel Rack Elevation:**

MD-12-SFP-002-N states that the highest point to the top of any spent fuel rack is 14'- 8" (El. 620'-10 ½").

**RAI #3(a)**

*Please provide the following:*

a) *The design criteria that will be used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads. Describe the methodology that will be used to estimate the total loading, inclusive of design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.*

**Response:**

The design criteria used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads uses a bounding seismic case. The bounding seismic case consists of a range of four seismic cases and is analyzed from the CNP response spectrum. The seismic case that induces maximum lateral velocities local to the probe, as well as maximum vertical velocities which may impact the probe mount is identified as the bounding single frequency case. Time History analysis, a type of multiple-frequency testing, provides a closer simulation of typical seismic motion without introducing a higher degree of conservatism.

The methodology used to estimate the total loading, inclusive of design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces, is contained in 1-0410-9, "MOHR SFP-1 Level Probe Assembly Seismic Analysis Report." This calculation was performed using a detailed 3D CAD fluid-structure interaction model of the probe using the ANSYS Mechanical APDL software package. Seismic excitation made use of the artificial earthquake time histories enveloping the 5.384 g reference (target) required response spectrum.

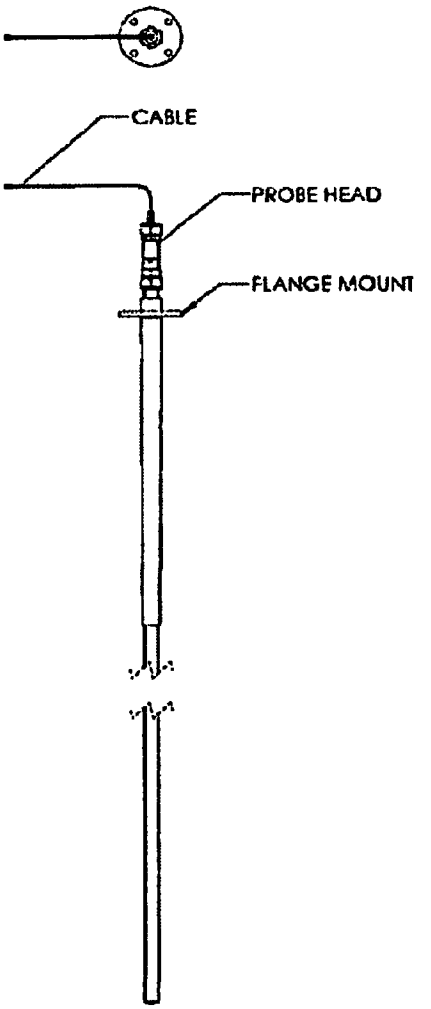
The following reports document this modeling:

1. Report Number NAI-1791-001, "Seismic Induced Hydraulic Response in the D. C. Cook Spent Fuel Pool."

2. Report Number 1-0410-9, "MOHR SFP-1 Level Probe Assembly Seismic Analysis Report."

**RAI #3(b)**

*b) A description of the manner in which the level sensor (and stilling well, if appropriate) will be attached to the refueling floor and/or other support structures for each planned point of attachment of the probe assembly. Indicate in a schematic the portions of the level sensor that will serve as points of attachment for mechanical/mounting or electrical connections.*




**Response:**

The proximal portion of the level probe is designed to be attached near its upper end to a Seismic Category I mounting bracket configured to suit the requirements of a particular SFP. The bracket is bolted and/or welded to the SFP wall per Seismic Category I requirements.

The following CNP documents are used for installation of Seismic Category I components:

- Procedure 12-MHP-5021-001-227, "Hilti Kwik Bolt II and 3 Installation."

- Specification ES-CIVIL-0439-QCN, "Field Installation of Hilti Kwik Bolt 3 Concrete Expansion Anchors."

- Procedure 12-MHP-5021-EMP-005, "Electrical Support Installation."

- Procedure 12-MHP-5021-001-203, "Fabrication and Installation of Safety Related/Safety Interface Pipe Supports and their Components."

- Design Standard SDS-88, "Recommended Expansion Type Anchors."

- Procedure 12-MHP-5021-001-009, "Torque Selection."

- Procedure 12-MHP-5021-001-200, "Concrete Drilling."

**RAI #3(c)**

c) *A description of the manner by which the mechanical connections will attach the level instrument to permanent SFP structures so as to support the level sensor assembly.*

**Response:**

The proximal portion of the level probe is designed to be attached near its upper end to a Seismic Category I mounting bracket configured to suit the requirements of a particular SFP. The bracket is bolted and/or welded to the SFP wall per Seismic Category I requirements.

The following CNP documents are used for installation of Seismic Category I components:

- Procedure 12-MHP-5021-001-227, "Hilti Kwik Bolt II and 3 Installation."
- Specification ES-CIVIL-0439-QCN, "Field Installation of Hilti Kwik Bolt 3 Concrete Expansion Anchors."
- Procedure 12-MHP-5021-EMP-005, "Electrical Support Installation."
- Procedure 12-MHP-5021-001-203, "Fabrication and Installation of Safety Related/Safety Interface Pipe Supports and their Components."
- Design Standard SDS-88, "Recommended Expansion Type Anchors."
- Procedure 12-MHP-5021-001-009, "Torque Selection."
- Procedure 12-MHP-5021-001-200, "Concrete Drilling."

**RAI #8(a)**

*Please provide the following:*

a) *A description of how the two channels of the proposed level measurement system meet this requirement [for separation] so that the potential for a common cause event to adversely affect both channels is minimized to the extent practicable.*

**Response:**

Electrical Power Supply Separation:

The CNP SFP uses two level sensing probes that are located at opposite ends of the pool. One probe is powered by Unit 1 (U1) (Critical Control Room Power Panel 1-CCRP-3) and provides indication in the U1 Control Room (CR) and the other probe is powered by Unit 2 (U2) (2-CCRP-3) and provides indication in the U2 CR. Each instrument has a dedicated battery backup. The U1 and U2 CRs are physically separated by a common wall. Physical separation as well as the electrical separation provided by being supplied by separate units meets the requirements for separation so that the potential for a common cause event to adversely affect both channels is minimized to the extent practicable.

Instrument Channel Component And Cable Separation:

When the coaxial cables are located in the same general area or room, they are routed separately, at minimum, to the extent suggested by NEI 12-02, which is a distance comparable to the shortest side of the SFP. According to drawing 12-3800-10, "Unit 1 & 2 Auxiliary Building Spent Fuel Pit & Fuels Transfer Canal Stainless Steel Liner – Plans Sections & Details SH 1 of 4," the shortest side of the CNP SFP is 39'-3". The northeast (NE) and northwest corners of the SFP are located on the long side of the pool which is 58'-6" long per 12-3800-10. The 1 channel coaxial cable runs directly from the U1 fuel transfer gate valve room, located north of the SFP, down to cable tray at approximately El. 627'. The U2 channel conduit travels south from the NE corner of the SFP along the east wall of the SFP, above the crane bay, until it reaches the south wall of the fuel pool area. The NE corner of the SFP is approximately 75' (nearly twice the required separation distance) from the south wall of the fuel pool area, based on drawing 12-3330-16, "Auxiliary Building Floor Plan El. 650' 0" East Portion." This conduit runs east along the south wall of the fuel pool area, maintaining this separation, until it enters the U2 gate valve room. Similar to the U1 conduit, the U2 channel then penetrates down to approximately El. 627' where it enters separate U2 cable tray to reach the CR.

The coaxial cables enter separate U1 and U2 cable trays on opposite sides of the auxiliary building. The cable tray routing follows the requirements of CNP Specification ES-CABLE-0221-QCN "Design and Installation Criteria for Cable, Trough, and Conduit." Per the subject specification purpose statement, "The implementation of these criteria will enable the cable to meet the Institute of Electrical and Electronics Engineers 279 [*379*] – 'Single Failure Criterion,' such that no single failure or event affecting one train of cable can prevent the operation of the required safety functions of RP and ESS."

Drawings 2-1444, 2-1440, 2-1437, and 2-1446 depict the cable trays used by the U2 channel coaxial cable to reach the CR. Drawings 1-1444, 1-1437T, 1-1440 and 1-1446T, depict the cable trays used by the U1 channel coaxial cable to reach the CR. The trays maintain a separation of greater than 80', and are separated by multiple concrete walls, as evidenced by plant General Arrangement drawings 12-5169 and 12-5168.

**RAI #11(a)**

*Please provide the following:*

*a) A description of the capability and provisions the proposed level sensing equipment will have to enable periodic testing and calibration, including how this capability enables the equipment to be tested in-situ.*

**Response:**

Periodic Diagnostics and Testing

1. Electronic diagnostics alert the operator to deviation of system electronic modules and backup batteries from manufactured tolerances. Equipment diagnostic routines can be configured to run in an automated fashion or, alternatively, can be performed on-demand.

2. Testing mode allows the operator to change the indicated level to an arbitrary value to test predefined alert or alarm settings.

Periodic Calibration

1. Continuous automated calibration is performed against internal references to correct for electronic drift and thermal effects in the level measurement electronics and transmission cable without interruption of the level measurement function.

2. Periodic (e.g., two year) calibration verification of system electronic equipment using standard portable electronic test and measurement equipment is recommended to maintain traceability to National Metrology Institute/National Institute of Standards and Technology standards. This is performed without moving system electronics.

3. The probe is a passive waveguide and calibration as such is not performed. Periodic visual and time-domain reflectometry inspections (performed by system electronics) are adequate to demonstrate maintenance of waveguide electromagnetic properties.

**RAI #12**

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

**Response:**

| Procedure | Objective to be achieved |
|---|---|
| Calibration and Test | To verify that the system is within the specified accuracy is functioning as designed, and is appropriately indicating SFP water level. |
| Maintenance | To establish and define scheduled and preventive maintenance requirements and activities necessary to minimize the possibility of system interruption, including, if required, inspections to verify that system components are in place, complete, and in the correct configuration, and that the sensor probe is free of significant deposits of crystallized boric acid. |
| Repair | To specify troubleshooting steps and component repair and replacement activities in the event of system malfunction. |
| Operation | To provide sufficient instructions for operators to recognize a loss of spent fuel pool cooling resulting from a loss of level and respond appropriately, including use of alternate makeup methods. In performing the specified actions, operators may use the knowledge level gained from training on the SFP instrumentation including the levels defined in NEI 12-02. |

Enclosure 4 to AEP-NRC-2014-90

Bridging Document Between Vendor Technical Information and
Donald C. Cook Nuclear Plant Site Specific Considerations

Referenced documents are identified on Pages 4 and 5.

| # | Topic | Parameter Summary | Vendor Reference Document # | Additional Comment | Test or Analysis Results | Licensee Evaluation |
|---|---|---|---|---|---|---|
| 1 | Design Specification | Spent Fuel Pool (SFP) instrument requirements derived from References 1, 2 & 3 | References 4 through 14, 18, 19, and 33 | | N/A | Evaluation of the vendor information completed under engineering change packages EC-0000052892 and EC-0000053083 completed per procedures PMP-5040-MOD-007 and PMP-5040-ECC-001, respectively. |
| 2 | Test Strategy | Per requirements in References 1, 2, & 3 | Reference 4, 6, 7, 8, 9 | | N/A | The equipment testing performed for the SFP instrument has been found to be acceptable based on the current design requirements. |
| 3 | Environmental qualification for electronics enclosure with Display | 60 – 104 degrees Fahrenheit (°F) (Reference 1, 2, & 29) | Reference 4 | | 14-131°F | Vendor testing analysis bounds licensee parameters defined in the references provided in the parameter summary column. DIT-B-00197-21 (Reference 29) states that the minimum and maximum Control Room (CR) temperatures under accident conditions are 60°F and 104°F respectively. |
| | | 3% – 80% relative Humidity (RH) non condensing (Reference 29) | Reference 4 | | 5% - 95% RH | Vendor test / analysis bound licensee parameters; DIT-B-00197-21 (Reference 29) states that the humidity range is between 3% and 80% during accident conditions |
| | | No radiation effects | | | N/A | Vendor test / analysis bounds licensee parameters; the Control Rooms are considered mild environments with no expected radiation. |
| 4 | Environmental Testing for Level Sensor components in SFP area – Submerged Portion of Probe Body | 60 – 212°F (Reference1, 2, 16) | Reference 5 | The Total Integrated Dose (TID) is the total 40 year dose plus the seven day worst case accident dose at the lowest spacer location on the probe body | 480°F long-term for poly-ether-ether-ketone (PEEK) insulators | The SFP is expected to remain at or above the minimum ambient temperature of the Auxiliary building (60°F) as called out in Updated Final Safety Analysis Report (UFSAR) (Reference16) Section 9.9.2. An accident condition assumes that the SFP is in a boiling condition, thus the boiling temperature of water at atmospheric pressure (212°F) is indicated. The limiting critical components of the probes are the PEEK spacers. Based on this evaluation the spacers are acceptable for the application. |
| | | Submerged component (Reference 1, 2) | Reference 5 | | PEEK insulators capable of long term submergence | |
| | | $6.5 \times 10^8$ rads TID (Reference 1, 2, &15) | Reference 5 | | $1 \times 10^{10}$ rads for PEEK insulators | Calculation RD-13-03 (Reference 15) defines a worst case dose rate of approximately $6.5 \times 10^8$ rads to the probe via the applicable requirements of References 1 and 2. As such, the PEEK spacers are expected to be suitable for the application. |
| 5 | Environmental Testing for Level Sensor Electronics Housing – Probe Head located Above the SFP | 60-212°F (Reference 1, 2, 16) | Reference 5 | Rad TID is the total 40 year dose plus the seven day worst case accident dose at the location of the probe head | PEEK: 480°F long-term, 12 day @ 311°F | The SFP area is expected to remain at or above the minimum ambient temperature of the Auxiliary building (60°F) as called out in UFSAR (Reference 16) Section 9.9.2. Maximum accident condition temperature and humidity directly above the SFP will likely be in 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 expected conditions of Reference1, 2, and 16 and are acceptable. |
| | | 0% – 100% RH Condensing (Reference1&2) | Reference 5 | | 0% - 100% RH for PEEK | 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 expected conditions of Reference 1 and 2, and are acceptable. |
| | | $7.814 \times 10^6$ rads TID (Reference15) | Reference 5 | | PEEK: $1 \times 10^{10}$ rads | RD-13-03 (Reference 15) defines a worst case dose rate of approximately $7.814 \times 10^6$ rads. Based on the vendor analysis results, the sensitive materials in the probe head will not be challenged under the expected conditions of Reference1, 2, and 15, and are acceptable. |
| 6 | Thermal & Radiation Aging – organic components in SFP area | See Items 4 & 5 above | Reference 5 | | See above Items 4 and 5 | Vendor test / analysis bound licensee parameters, see discussion above in Items 4 and 5. |

| # | Topic | Parameter Summary | Vendor Reference Document # | Additional Comment | Test or Analysis Results | Licensee Evaluation |
|---|---|---|---|---|---|---|
| 7 | Basis for Dose Requirement | Reference 1 & 2 | N/A | | Reference 15 | Calculation RD-13-03 Rev. 0 (Reference 15) is based on the requirements of Nuclear Energy Institute (NEI) 12-02 (Reference 2) and EA-12-051 (Reference1). The calculation determines the dose rates for various locations and SFP water levels for both a seven day accident scenario and 40 year TID. |
| 8 | Seismic Qualification | Seismic Class I (References 1, 2, & 16) | References 8, 11, & 12 | | Seismic Class I | Calculation SD-140320-001 (Reference 37) determines the loading produced by a seismic event. Calculation SD-140130-001 (Reference 36) qualifies the probe support bracket and anchorage. The bracket is designed to Seismic Class I requirements and is a Non-Safety related structure anchored to the concrete SFP wall with Nuclear Safety Related expansion anchors.<br><br>The MOHR-EFP level indicator and battery enclosure were seismically tested by the vendor. The results are documented in MOHR test report 1-0410-6 (Reference 8) which is compared against the installed configuration of instruments (battery enclosure and indicators) and documented in calculation SD-140320-002 (Reference 38). The installed location of the enclosures is within panels in both CRs. The battery enclosures are mounted to concrete walls in the CR. The support of the battery enclosures is documented in.SD-140320-003 (Reference 39) and SD-140320-002. |
| 9 | Sloshing | Water induced motion from seismic event does not cause equipment structural failure | References 11,12, 17, 18, & 19 | See Item # 8 | | "Calculation SD-140320-001 (Ref. 37) documents the loading produced by a seismic event on the bracket, which includes the sloshing effects as documented in References 12 and 19." |
| 10 | SFP Instrumentation System Functionality Test Procedure | System must allow for routine, in situ functionality testing (Reference 2) | Reference 30, 31 and 32 | | | The system features on board electrical diagnostics. Full channel functional testing utilized comparison of actual pool level to that which is indicated, as well as additional tests using references. The level indication is calibrated in-situ. |
| 11 | Boron Build-Up | Buildup cannot produce error greater than 1foot including all other error source terms (References 1 & 2) | Reference 10 | | Boron buildup can produce a maximum error of 2.5 inches (") | The system possesses an absolute maximum accuracy of 3.0", not including boric acid deposition effects. The maximum error due to boric acid buildup is 2.5". This creates an absolute maximum error for the system of ±5.5", below the 12" required by NEI 12-02 (Reference 2). |
| 12 | Pool-side Bracket Seismic Analysis (References 1, 2, & 16, Sec 2.9.2) | Seismic Class I (References 1, 2, & 16, Sec. 2.9.2) | References 11 & 12 | See Item #8 | Seismic Class I | See Item #8 |
| 13 | Additional Brackets (Sensor Electronics and Electronics Enclosure) | Seismic Class I (References 1, 2, & 16) | Reference 8 | See Item #8 | Seismic Class I | See Item #8 |

| # | Topic | Parameter Summary | Vendor Reference Document # | Additional Comment | Test or Analysis Results | Licensee Evaluation |
|---|---|---|---|---|---|---|
| 14 | Shock & Vibration | MIL-STD-167-1 (Reference 24) for vibration and MIL-STD-901D (Reference 25) for shock | References 7, 11, & 12 | | IEC 60068-2-27 (2008-02) (Reference 20)<br><br>IEC 60068-6-8 (2007-12) (Reference 21) | The vendor testing adequately addresses the requirements for general robustness of the enclosures. The probes were evaluated to be adequately designed for resilience against shock and vibration expected in the area of use, given that there are no missile impact requirements imposed by References 1 & 2.<br><br>Per NEI 12-02 (Reference2) Section 3.4 "Shock and Vibration" the requirements for shock and vibration testing or analyses do not apply to the mounting of components in the SFP; However, the new probe mounting components and fasteners are seismically qualified and designed as rigid components inherently resistant to vibration effects. The probes are affixed to the bracket using a machine screw connection designed with proper thread engagement and lock washers.<br><br>The indicator and battery enclosures are mounted in the CR. The equipment is not affixed or adjacent to any rotating machinery that would cause vibration effects in the area of installation. The new instrument mounting components and fasteners are seismically qualified and designed as rigid components inherently resistant to vibration effects. Similarly, the effects of shock on the supporting fixtures for the CR instruments is not a credible threat; all equipment in the CR area is qualified seismically such that there are no expected impacts from adjacent objects during the design basis earthquake requirements imposed by NEI 12-02. |
| 15 | Requirements Traceability Matrix | Software Traceability Matrix Required for Software Evaluation of equipment | Reference 33 | | | The instrument software Verification and Validation has been completed |
| 16 | Factory Acceptance Test | Must demonstrate functionality of full EFP-IL and SFP-1 | MOHR Factory Acceptance Test Procedure | | | Acceptable, channel factory acceptance tests have been completed successfully |
| 17 | Channel Accuracy | ± 1 foot (Reference 2) | Reference 30 | | 3.0" maximum, not including boric acid deposition or boiling effects | The system possesses an absolute maximum accuracy of 3.0", not including boric acid deposition effects. The maximum error due to boric acid buildup is 2.5". This creates an absolute maximum error for the system of ±5.5", below the 12" required by NEI 12-02 (Reference 2). |
| 18 | Power Consumption | 120volts (v) alternating current (AC), 60 Hertz (Reference16) | References 9 & 13 | | 85-264v AC, 47-63 Hertz | The power requirements for the instrument are met by the Critical CR Power panels that will provide normal AC power to the units. |
| | | Seven day battery life required | Reference 9 | | Seven day battery life at 15 samples per hour rate | Acceptable, the instrument testing demonstrates the battery capacity is sufficient for the maximum duration required by References 1 & 2. |
| 19 | Technical Manual | N/A | Reference 31 and 32 | Reference 31 "Signal Processor Technical Manual"<br>Reference 32 "Level Probe Assembly Technical Manual | | The manuals have been provided by the vendor. |
| 20 | Calibration | Must allow for in-situ calibration | Reference 30, 31, and 32 | Reference 30 "Signal Processor Operator Manual"<br>Reference 31 "Signal Processor Technical Manual"<br>Reference 32 "Level Probe Assembly Technical Manual" | | The manuals have been provided by the vendor. The level indication is calibrated in-situ. |
| 21 | Failure Modes and Effects Analysis (FMEA) | System provides reliable indication of fuel pool level, consistent with the requirements of References 1 & 2 | Reference 14 | | SFP Instrument system will meet requirements of Reference 1 & 2 | The FMEA provides 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 Reference 1 & 2. |

| # | Topic | Parameter Summary | Vendor Reference Document # | Additional Comment | Test or Analysis Results | Licensee Evaluation |
|---|---|---|---|---|---|---|
| 22 | Emissions Testing | Electric Power Research Institute (EPRI) TR-102323, Revision 2 (Reference 22) | Reference 6, Reference 35 | | EPRI TR-102323, Revision 3 (Reference 23) | The third revision of EPRI TR-102323 adequately satisfies the emissions testing methodology laid out in Revision 2. It addresses the applicable testing for Non Safety equipment. (Reference 6)<br><br>Electro Static Discharge (IEC 61000-4-2:2008), Electrical Fast Transient (IEC 61000-4-4:2004) and Surge (IEC 61000-4-5:2005) immunity, which are optional tests for Non safety equipment per Rev 3 of EPRI TR-102323, are addressed by similitude with the MOHR CT-100. The MOHR CT100 electronic hardware has been incorporated as the level measurement system in the EFP-IL SFP instrument system without modification, and the MOHR EFP-IL includes a metal enclosure compared to the plastic enclosure of the CT-100 which provides superior shielding properties.<br><br>The CT-100 TDR demonstrates no anomalies from 80-1000 MegaHertz and from 1400-2700 MegaHertz at test levels $\geq$ 3 Volts/meter. Radiated Immunity testing was performed in accordance with IEC 61000-4-3:2008. This provides reasonable assurance that radiofrequency interference from radio handsets or other commonly encountered commercial or industrial sources of interference will not impact system performance (Reference 35). |

References:

1) Agencywide Documents Access Management System (ADAMS) Accession No. ML12056A044, NRC Order EA-12-051, "ORDER MODIFYING LICENSES WITH REGARD TO RELIABLE SPENT FUEL POOL INSTRUMENTATION," Nuclear Regulatory Commission, March 12, 2012.
2) ADAMS Accession No. 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) ADAMS Accession No. 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) 1-0410-9.1 "MOHR SFP-1 Site-Specific Seismic Analysis Report: Donald C. Cook Nuclear Plant (DC COOK)"
13) 1-0410-10 "MOHR EFP-IL SFPI System Power Interruption Report"
14) EVAL-194-4812-01 "MOHR EFP-IL Liquid Level Measurement System Failure Modes and Effects Analysis (FMEA)"
15) RD-13-03 Rev. 0 "Radiation Dose to Spent Fuel Pool Level Instrumentation in Accordance with NEI 12-02"
16) UFSAR, Rev 25 "DC Cook Updated Final Safety Analysis Report"
17) NAI-1725-003 Rev 0 "GOTHIC Verification and Sensitivity Studies for Predicting Hydrodynamic Response to Acceleration in Rectangular Shaped Pools"
18) NAI-1725-004, Rev 3 "Seismic Induced Hydraulic Response in the CGS Spent Fuel Pool"
19) NAI-1791-001, Rev 1 "Seismic Induced Hydraulic Response in the D.C. Cook 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 "Guidelines for Electromagnetic Interference of Power Plant Equipment" Rev. 2"
23) EPRI TR-102323 "Guidelines for Electromagnetic Interference of Power Plant Equipment" Rev. 3"
24) MIL-STD-167-1 "Mechanical Vibrations of Shipboard Equipment (Type 1- Environmentally and Type II – Internally Excited)
25) MIL-S-901D "Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements for"

26) 12-EHP-5040-DES-003 Rev. 21 “Calculations and Reports”
27) DCC-NS-103-QCN Rev. 1 “Seismic Qualification of Electrical and Mechanical Equipment”
28) 12-EHP-5125-SQC-001 Rev. 6 “Seismic Technical Evaluation and Qualification of Components”
29) DIT-B-00197-21 “Area Temperature and Relative Humidity for Selected Plant Areas Outside Containment”
30) 1-0410-12 “EFP-IL Signal Processor Operator Manual”
31) 1-0410-13 “EFP-IL Signal Processor Technical Manual”
32) 1-0410-14 “SFP-1 Level Probe Assembly Technical Manual”
33) 1-0410-11 “MOHR EFP-IL SFPI System Software Verification and Validation”
34) EG-IC-004 Rev 4 “Instrument Set Point Uncertainty”
35) 1-0410-4-S1 “MOHR EFP-IL SFPI Supplemental EMC Information”
36) SD-140130-001 Rev. 0 "Qualification of Bracket and Anchorage for Spent Fuel Pool Level Probes for NRC Order EA- 12-05 1"
37) SD-140320-001 Rev. 0 "Support Bracket Loading Values for SFP Level Probe at DC Cook"
38) SD-140320-002 Rev 0 "Seismic Qualification of Spent Fuel Pool Level Instrument Enclosures for NRC Order EA- 12-05 1"
39) SD-140320-003 Rev 0 "Seismic Anchorage Qualification for Spent Fuel Pool Level Instrument Enclosures for NRC Order EA- 12-051I"