



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 29, 2013

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, 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. MF0944 AND MF0945)

Dear Sir or Madam:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A679), to all power reactor licensees and holders of construction permits in active or deferred status. This order requires the licensee to have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool (SFP) operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A015), Entergy Operations Inc. (Entergy, the licensee), provided the Overall Integrated Plan (OIP) for Arkansas Nuclear One (ANO), Units 1 and 2, on compliance with Attachment 2 of Order EA-12-051. The OIP stated that installation of the SFP level instrumentation for the single SFP associated with ANO Unit 1 is scheduled for completion prior to startup from the fall 2014 refueling outage, and for ANO Unit 2 prior to startup from the fall 2015 refueling outage. This is the end of the second refueling outage for each unit following submittal of the OIP. In its letter dated July 25, 2013 (ADAMS Accession No. ML13207A269), the licensee indicated that the completion date for Unit 1 has changed due to the spring 2013 stator drop event recovery and outage extension, and the ANO Unit 1 Refueling Outage has slipped to early 2015. The NRC staff has reviewed the licensee's schedule for implementation of SFP level instrumentation provided in its OIP. If the licensee completes implementation in accordance with this schedule, it would appear to achieve compliance with Order EA-12-051 within two refueling cycles after submittal of the OIP and before December 31, 2016.

By letter dated June 26, 2013 (ADAMS Accession No. ML13156A313), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental

information by letters dated June 25, 2013, and August 28, 2013 (ADAMS Accession No. ML13241A415).

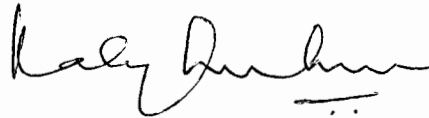
The NRC staff has reviewed these submittals with the understanding that the licensee will update its OIP as implementation of the Order progresses. With this in mind, the staff has included an interim staff evaluation with this letter to provide feedback on the OIP. The staff's findings in the interim staff evaluation are considered preliminary and will be revised as the OIP is updated. As such, none of the staff's conclusions are to be considered final. A final NRC staff evaluation will be issued after the licensee has provided the information requested

The interim staff evaluation also includes RAIs, response to which the NRC staff needs to complete its review. The licensee should provide the information requested in the 6-month status updates, as the information becomes available. However, the staff requests that all information be provided by September 30, 2014, to ensure that any issues are resolved prior to the date by which the licensee must complete full implementation of Order EA-12-051. The licensee should adjust its schedule for providing information to ensure that all this information is provided by the requested date.

A final NRC staff evaluation will be issued after the licensee has provided the information requested.

If you have any questions, please contact me at 301-415-1480 or via e-mail at kaly.kalyanam@nrc.gov.

Sincerely,



N. Kaly Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-313 and 50-368

Enclosure:
Interim Staff Evaluation and RAI

cc w/encl: Distribution via Listserv

INTERIM STAFF EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE OVERALL INTEGRATED PLAN IN RESPONSE TO

ORDER EA-12-051, RELIABLE SPENT FUEL POOL INSTRUMENTATION

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR STATION ONE, UNITS 1 AND 2

DOCKET NOS. 50-313 AND 50-368

1.0 INTRODUCTION

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A679), to all power reactor licensees and holders of construction permits in active or deferred status. This order requires, in part, that all operating reactor sites have a 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 (BDB) external event. The order required all holders of operating licenses issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," to submit to the NRC an Overall Integrated Plan (OIP) by February 28, 2013.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A015), Entergy Operations, Inc. (Entergy, the licensee), provided the OIP for Arkansas Nuclear One (ANO), Units 1 and 2, describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by fall 2014, for Unit 1, and fall 2015, for Unit 2. By letter dated June 26, 2013 (ADAMS Accession No. ML13156A313), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 25, 2013 (ADAMS Accession No. ML13207A269), and August 28, 2013 (ADAMS Accession No. ML13241A415).

2.0 REGULATORY EVALUATION

Order EA-12-051 requires all holders of operating licenses issued under 10 CFR Part 50, notwithstanding the provisions of any Commission regulation or license to the contrary, to comply with the requirements described in Attachment 2 to this Order except to the extent that a more stringent requirement is set forth in the license. Licensees shall promptly start implementation of the requirements in Attachment 2 to the order and shall complete full implementation no later than two refueling cycles after submittal of the OIP or December 31, 2016, whichever comes first.

Enclosure

Order EA-12-051 required the licensee, by February 28, 2013, to submit to the Commission an OIP, including a description of how compliance with the requirements described in Attachment 2 of the Order will be achieved.

Attachment 2 of Order EA-12-051 requires the license to have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

Attachment 2 of Order EA-12-051, states that the SFP level instrumentation shall include the following design features:

- 1.1 Instruments: The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.
- 1.2 Arrangement: The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.
- 1.3 Mounting: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.
- 1.4 Qualification: The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g., a process similar to that applied to the site fire protection program).
- 1.5 Independence: The primary instrument channel shall be independent of the backup instrument channel.

- 1.6 Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant [alternating current (ac)] and [direct current (dc)] power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.
- 1.7 Accuracy: The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.
- 1.8 Testing: The instrument channel design shall provide for routine testing and calibration.
- 1.9 Display: Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.

Attachment 2 of Order EA-12-051, states that the SFP instrumentation shall be maintained available and reliable through appropriate development and implementation of the following programs:

- 2.1 Training: Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.
- 2.2 Procedures: Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.
- 2.3 Testing and Calibration: Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

On August 29, 2012, the NRC issued an Interim Staff Guidance document (the ISG), JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12221A339), to describe methods acceptable to the NRC staff for complying with Order EA-12-051. The ISG endorses, with exceptions and clarifications, the methods described in the Nuclear Energy Institute (NEI) guidance document 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,'" dated August 2012 (ADAMS Accession No. ML12240A307). Specifically, the ISG states:

The NRC staff considers that the methodologies and guidance in conformance with the guidelines provided in NEI 12-02, Revision 1, subject to the clarifications and exceptions in Attachment 1 to this ISG, are an acceptable means of meeting the requirements of Order EA-12-051.

3.0 TECHNICAL EVALUATION

3.1 Background and Schedule

ANO, Units 1 and 2, has two independent SFPs. The pools for both units are essentially identical and are not interconnected in any way.

The licensee submitted its OIP on February 28, 2013. The OIP states that installation of the SFP level instrumentation for the single SFP associated with ANO Unit 1 is scheduled for completion prior to startup from the fall 2014 refueling outage, and prior to startup from the fall 2015 refueling outage, for Unit 2. This is the end of the second refueling outage for each unit following submittal of the OIP.

In its letter dated July 25, 2013, the licensee indicated that the completion date for Unit 1 has changed. The ANO Unit 1 Refueling Outage originally scheduled for fall 2014 has slipped to early 2015 due to the spring 2013 stator drop event recovery and outage extension.

The NRC staff has reviewed the licensee's schedule for implementation of SFP level instrumentation provided in its OIP. If the licensee completes implementation in accordance with this schedule, it would appear to achieve compliance with Order EA-12-051 within two refueling cycles after submittal of the OIP and before December 31, 2016.

3.2 Spent Fuel Pool Water Levels

Attachment 2 of Order EA-12-051 states, in part, that

All licensees identified in Attachment 1 to this Order shall have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system [Level 1], (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck [Level 2], and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred [Level 3].

NEI 12-02 states, in part, that

Level 1 represents the HIGHER of the following two points:

- The level at which reliable suction loss occurs due to uncovering of the coolant inlet pipe, weir or vacuum breaker (depending on the design), or
- The level at which the water height, assuming saturated conditions, above the centerline of the cooling pump suction provides the required net positive suction head specified by the pump manufacturer or engineering analysis.

In its OIP, the licensee stated, in part, that

Level 1 is the level adequate to support operation of the normal fuel pool cooling system. It is the higher of the following two points:

- (1) the level at which reliable suction loss occurs due to uncovering the coolant inlet pipe or any weirs or vacuum breakers associated with suction loss. This level, (1), is established for Unit 1 based on nominal coolant inlet pipe elevation [as it does not incorporate a vacuum (or siphon breaker)] and is established for Unit 2 based on nominal vacuum (or siphon) breaker elevation. The elevation associated with this level is 397 feet 5.21 inches for Unit 1 ... The elevation associated with this level is 401 feet 0 inches for Unit 2 ...
- (2) the level at which the normal fuel pool cooling pumps lose required NPSH [net positive suction head] assuming saturated conditions in the pool. It can be demonstrated that this elevation is below the elevation that defines Level 1 per (1) above. Unit 1 SFP Cooling pumps are at elevation 337'-0" with a required NPSH of 14 FT for suction temperatures up to 200°F ... Unit 2 SFP Cooling pumps are at elevation 336'-2.5" with a required NPSH of 20 FT for suction temperatures up to 200°F ...

The higher of the above points is (1). Therefore, LEVEL 1 is elevation 397 feet 5.21 inches for Unit 1 and LEVEL 1 is elevation 401 feet 0 inches for Unit 2.

The NRC staff notes that Level 1 at 397 feet (ft.) 5.21 inches (in.) for Unit 1 and at 401 ft. 0 in. for Unit 2 is adequate for normal SFP cooling system operation; it is also sufficient for NPSH and represents the higher of the two points described above.

NEI 12-02 states, in part, that

Level 2 represents the range of water level where any necessary operations in the vicinity of the spent fuel pool can be completed without significant dose consequences from direct gamma radiation from the stored spent fuel. Level 2 is based on either of the following:

- 10 feet (+/- 1 foot) above the highest point of any fuel rack seated in the spent fuel pools, or
- a designated level that provides adequate radiation shielding to maintain personnel radiological dose levels within acceptable limits while performing local operations in the vicinity of the pool. This level shall be based on either plant-specific or appropriate generic shielding calculations, considering the emergency conditions that may apply at the time and the scope of necessary local operations, including installation of portable SFP instrument channel components.

In its OIP, the licensee stated that Level 2, for both units, would be set at 10 ft. \pm 1 foot above the highest point of any fuel rack seated in each SFP. The licensee stated that the elevations associated with this level are 385 ft. 11.5675 in. \pm 1 foot, for Unit 1 and 388 ft. 3.3125 in. \pm 1 foot, for Unit 2.

In its letter dated July 25, 2013, the licensee provided two sketches showing the approximate location for the elevations identified as Levels 1, 2 and 3 and the top of the tallest fuel storage rack, one sketch for each unit. The NRC staff notes that Level 2 at an elevation of 385 ft. 11.5675 in. \pm 1 foot, for Unit 1 and 388 ft. 3.3125 in. \pm 1 foot, for Unit 2 is approximately 10 ft. above the top of the fuel rack.

The NRC notes that the licensee designated Level 2 using the first of the two options described in NEI 12-02 for Level 2.

In its OIP, the licensee stated that other hardware stored in the SFP will be evaluated to ensure that it does not adversely interact with the SFP instrument probes during a seismic event.

The NRC staff has concerns with the licensee's lack of information regarding the projected dose rate impact and the appropriate Level 2 value as a result of irradiated hardware stored in the SPF. The staff has identified this request as:

RAI #1

Please provide information regarding the projected dose rate impact of any irradiated hardware stored in the SPF on the Level 2 value. Please provide any changes in the elevation identified as Level 2, if applicable.

NEI 12-02 states, in part, that

Level 3 corresponds nominally (i.e., +/- 1 foot) to the highest point of any fuel rack seated in the spent fuel pool. Level 3 is defined in this manner to provide the maximum range of information to operators, decision makers and emergency response personnel.

The licensee stated in its OIP that Level 3 is the highest point (nominal) of any fuel rack seated in the SFP. For Unit 1, Level 3 would be set at 375 ft. 11.5675 in. \pm 1 foot and for Unit 2, at 378 ft. 3.3125 in. \pm 1 foot.

In its letter dated July 25, 2013, the licensee provided two sketches showing the approximate location for the elevations identified as Levels 1, 2, and 3 and the top of the fuel storage rack, one sketch for each unit. The NRC staff notes that Level 3 at an elevation of 375 ft. 11.5675 in. \pm 1 foot, for Unit 1 and at 378 ft. 3.3125 in. \pm 1 foot for Unit 2, is the highest point of any spent fuel storage rack seated in the SFP.

The licensee's proposed plan, with respect to identification of Levels 1 and 3, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.3 Design Features: Instruments

Attachment 2 of Order EA-12-051, states, in part, that

The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.

NEI 12-02 states, in part, that

A spent fuel pool level instrument channel is considered reliable when the instrument channel satisfies the design elements listed in Section 3 [Instrumentation Design Features] of this guidance and the plant operator has fully implemented the programmatic features listed in Section 4 [Program Features].

In its OIP, the licensee stated, for both the Unit 1 and Unit 2 SFPs, that both the Primary and Backup Instrument Channels will utilize permanently-installed instruments, and that each instrument channel will be capable of monitoring SFP water level over a single continuous span from above Level 1 to within 1 foot of the top of the spent fuel racks (Level 3).

In its letter dated, July 25, 2013, the license stated, in part, that

The SFP level lower instrument span or probe bottom extends down to at least three inches below the upper limit of the range of Level 3 to account for channel

accuracy or instrument loop uncertainty. Therefore, the SFP level probe bottom/span extends down to at least elevation 376'-8.5675" for ANO-1 (see Figure 1) and 379'-0.3125" for ANO-2 (see Figure 2). The SFP level upper instrument span, at a minimum, includes normal water level high alarm.

The NRC staff notes that the range specified for the licensee's instrumentation will cover Levels 1, 2, and 3 as described in Section 3.2 above. The licensee's proposed plan, with respect to the number of channels and the range of the instrumentation for both of its SFPs, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.4 Design Features: Arrangement

Attachment 2 of Order EA-12-051, states, in part, that

The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and the fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.

NEI 12-02 states, in part, that

The intent of the arrangement requirement is to specify reasonable separation and missile protection requirements for permanently installed instrumentation used to meet this order. Although additional missile barriers are not required to be installed, separation and shielding can help minimize the probability that damage due to an explosion or extreme natural phenomena (e.g., falling or wind-driven missiles) will render fixed channels of SFP instrumentation unavailable. Installation of the SFP instrument channels shall be consistent with the plant-specific SFP design requirements and should not impair normal SFP function.

Channel separation should be maintained by locating the installed sensors in different places in the SFP area.

In its OIP, the licensee provided a sketch depicting the proposed locations of the instruments. For ANO Unit 1, the licensee intends to implement one fixed primary level instrument in the northeast corner of the SFP and the backup level instrument in the northwest corner of the SFP. For ANO Unit 2, the licensee intends to implement one fixed primary level instrument in the southeast corner of the SFP and the backup level instrument in the southwest corner of the SFP. The licensee stated that "separation of the channels/probes reduces the potential for falling debris or missiles affecting both channels of instrumentation."

The licensee's proposed plan, with respect to the location of the primary and back-up level instruments for both of its SFPs, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.5 Design Features: Mounting

Attachment 2 of Order EA-12-051 states, in part, that

Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.

NEI 12-02 states, in part, that

The mounting shall be designed to be consistent with the highest seismic or safety classification of the SFP. An evaluation of other hardware stored in the SFP shall be conducted to ensure it will not create adverse interaction with the fixed instrument location(s).

The basis for the seismic design for mountings in the SFP shall be the plant seismic design basis at the time of submittal of the Integrated Plan for implementing NRC Order EA-12-051.

In its OIP, the licensee stated, in part, that

Both the primary and backup system installation will incorporate seismic category 1 mounting to meet the NRC JLD-ISG-2012-03 and NEI 12-02 guidance requirements.

In its letter dated July 25, 2013, the licensee provided a sketch and stated that 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 licensee stated, in part, that

The bracket may be bolted and/or welded to the SFP deck and/or SFP liner/wall according to the requirements of the particular installation per Seismic Category I requirements. Installation maintains the level probe and electrical connection/cable below the elevation grade of the SFP area curbing that rises above the elevation grade of the SFP floor.

In its July 25, 2013, letter, the licensee also stated, in part, that

The loading on the probe mount and probe body includes both seismic and hydrodynamic loading using seismic response spectra that bounds the ANO units' design basis maximum seismic loads applicable to the installation location(s). The static weight load is also accounted for in the modeling described below but is insignificant in comparison to seismic and hydrodynamic loads. Analytic modeling is being performed by the instrument vendor using Institute of Electrical and Electronic Engineers (IEEE)-344:2004 methodology.

The simple unibody structure of the probe assembly make it a candidate for analytic modeling and the dimensions of the probe and complex hydrodynamic loading terms in any case preclude meaningful physical testing.

A detailed computational SFP hydrodynamic model has been developed for the instrument vendor by Numerical Applications, Inc., author of the GOTHIC computational fluid dynamics code. The computational model accounts for multi-dimensional fluid motion, pool sloshing, and loss of water from the pool.

Seismic loading response of the probe and mount is separately modeled using finite element modeling software. The GOTHIC-derived fluid motion profile in the pool at the installation site and resultant distributed hydrodynamic loading terms are added to the calculated seismic loading terms in the finite element model to provide a conservative estimate of the combined seismic and hydrodynamic loading terms for the probe and probe mount, specific to the chosen installation location for the probe.

The NRC staff notes that the proposed application of such seismic design criteria appears to be reasonable and addresses the staff-endorsed NEI 12-02 guidance stating that the channel is to be designed to be consistent with the highest seismic or safety classification of the SFP. The licensee's proposed plan, with respect to the seismic design of the mounting, appears to be consistent with NEI 12-02, as endorsed by the ISG. The staff plans to verify the results of the licensee's seismic testing and analysis report when it is completed based on the licensee's response to the following RAIs.

RAI #2

Please provide the analyses verifying that the SFP instrument design configuration will be maintained during and following the maximum seismic ground motion considered in the design of the SFP structure.

RAI #3

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

In its OIP, the licensee stated that other hardware stored in the SFP will be evaluated to ensure that it does not adversely interact with the SFP instrument probes during a seismic event.

The NRC staff has concerns with the licensee's lack of information regarding the interaction that other hardware stored in the SFP could have with the SFP level instrumentation during a seismic event. The staff has identified this request as:

RAI #4

Please provide the results of the evaluation performed to ensure that other hardware stored in the SFP cannot adversely interact with the SFP level instrumentation.

3.6 Design Features: Qualification

Attachment 2 of Order EA-12-051 states, in part, that

The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g. a process similar to that applied to the site fire protection program).

NEI 12-02 states, in part, that

The instrument channel reliability shall be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters, as described in the paragraphs below:

- conditions in the area of instrument channel component use for all instrument components,
- effects of shock and vibration on instrument channel components used during any applicable event for only installed components, and
- seismic effects on instrument channel components used during and following a potential seismic event for only installed components...

The NRC staff assessment of the instrument qualification is discussed in the following subsections below: (3.6.1) Augmented Quality Process, (3.6.2) Post Event Conditions, (3.6.1) Shock and Vibration, and (3.6.4) Seismic Reliability.

3.6.1 Augmented Quality Process

Appendix A-1 of the guidance in NEI 12-02 describes a quality assurance process for non-safety systems and equipment that is not already covered by existing quality assurance requirements. Within the ISG, the NRC staff found the use of this quality assurance process to be an acceptable means of meeting the augmented quality requirements of Order EA-12-051.

In its OIP, the licensee stated that, in part, that

Augmented quality requirements will be applied to all components in the instrumentation channels for:

- design control
- procurement document control
- instructions, procedures, and drawings
- control of purchased material, equipment, and services
- inspection, testing, and test control
- inspections, test, and operating status
- nonconforming items
- corrective actions
- records
- audits

The licensee's proposed augmented quality assurance process appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.6.2 Post Event Conditions

NEI 12-02 states, in part, that

The temperature, humidity and radiation levels consistent with conditions in the vicinity of the [SFP] and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049 should be considered. Examples of post-event (beyond-design-basis) conditions to be considered are:

- radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with the SFP water level 3 as described in this order,
- temperatures of 212 degrees F and 100% relative humidity environment,
- boiling water and/or steam environment
- a concentrated borated water environment, and...

In its OIP, the licensee stated, consistent with NEI 12-02, in part, that

Components in the area of the SFP will be designed for the temperature, humidity, and radiation levels expected during normal, event, and post-event conditions for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies resulting from Order EA-1 2-049, *Order Modifying Licenses With Regard to Requirements for Mitigation Strategies for*

Beyond-Design-Basis External Events. Examples of post event conditions that will be considered are:

- Radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with SFP water level within 1 foot of the top of the SFP racks (Level 3),
- Temperature of 212 degrees F and 100% relative humidity environment,
- Boiling water and steam environment
- Concentrated borated water environment, and...

Related to radiological conditions, in its OIP the licensee stated, in part, that

Equipment located in the SFP will be qualified to withstand a total accumulated dose of expected lifetime at normal conditions plus accident dose received at post event conditions with SFP water level within 1 foot of the top of the fuel rack seated in the spent fuel pool (Level 3).

The metal probe and cable in the spent fuel pool area are robust components that are not adversely affected by expected radiation, temperature, or humidity. The areas selected for display/processor installation are considered mild environments, such that personnel access is not prohibited by radiation, temperature or humidity, and are readily accessible by operators during or after a BDBE event.

In its letter dated July 25, 2013, the licensee stated, in part, that

Signal processor: The electric field perturbation (EFP) signal processor is installed in a mild environment with radiation levels similar to background radiation, with the acknowledgement that the radiation limit for the EFP is similar to other commercial-grade complementary–metal–oxide–semiconductor (CMOS)-based electronics. Radiation testing is not planned. It should be noted that the instrument performs self-diagnostics before measurements are obtained and the electronics are easily accessible for periodic replacement.

Probe assembly: Materials properties qualification is used.

While addressing post-event temperature conditions, in its letter dated July 25, 2013, the licensee stated, in part, that

Signal processor: Designed for mild environment installation. Physical testing in an environmental chamber to demonstrate normal operation at the operating temperatures specified for the instrument.

Probe assembly: Qualification by materials properties and use history of substantially similar probe designs in steam generator applications at significantly higher temperatures and pressures and saturated steam environments.

The NRC staff has concerns with the licensee's lack of information regarding the ambient temperature in the vicinity where the signal processor (electronics) will be located under normal and worst case postulated conditions. The staff has identified this request as:

RAI #5

Please provide information indicating what will be the maximum expected ambient temperature in the room in which the signal processor (electronics) will be located under BDB conditions in which there is no ac power available to run Heating, Ventilation, and Air Conditioning (HVAC) systems.

In its letter dated July 25, 2013, the licensee stated, in part, that

Signal processor: Designed for mild environment installation. Physical testing in an environmental chamber to demonstrate normal operation at the operating humidity specified for the instrument.

Probe assembly: Qualification by materials properties and use history as noted above.

The NRC staff has concerns with the lack of information regarding the signal processor (electronics) capability of continuously performing its required functions under the expected humidity condition. The staff has identified this request as:

RAI #6

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

3.6.3 Shock and Vibration

NEI 12-02 states, in part, that

Applicable components of the instrument channels are rated by the manufacturer (or otherwise tested) for shock and vibration at levels commensurate with those of postulated design basis event conditions in the area of instrument channel component use using one or more of the following methods:

- instrument channel components use known operating principles, are supplied by manufacturers with commercial quality programs (such as ISO9001) with shock and vibration requirements included in the purchase

specification and/or instrument design, and commercial design and testing for operation in environments where significant shock and vibration loadings are common, such as for portable hand-held devices or transportation applications;

- substantial history of operational reliability in environments with significant shock and vibration loading, such as transportation applications, or
- use of component inherently resistant to shock and vibration loadings or are seismically reliable such as cables.

In its OIP, the licensee stated that components of the instrument channels will be qualified for shock and vibration using the methods identified in NEI 12-02.

In its letter dated July 25, 2013, the licensee stated, in part, that

Shock:

Signal processor: Physical testing to commercial and/or military standards using shake-table and drop testing.

Probe assembly: Finite element analysis in conjunction with seismic modeling described above.

The NRC staff has concerns regarding the lack of information describing the tests, applied forces, and the operability condition of the sensor after the tests were completed. The staff has identified this request as:

RAI #7

Please provide information describing the evaluation of the comparative sensor design, the shock test method, test results, and forces applied to the sensor applicable to its successful tests demonstrating that the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of severe shock.

In its letter dated July 25, 2013, the licensee stated, in part, that

Vibration:

Signal processor: Physical testing to applicable commercial and/or military standards using shake-table and drop testing.

Probe assembly: The probe assembly and bracket together form a simple static unibody structure with intrinsic vibration resistance that is additionally subject to substantial damping due to the surrounding water medium. This is planned to be modeled using finite element modeling in conjunction with seismic modeling described above.

The NRC staff has concerns with the lack of information describing the tests, applied forces and their directions and frequency ranges, or the operability condition of the sensor after the tests were completed. The staff has identified this request as:

RAI #8

Please provide information describing the evaluation of the comparative sensor design, the vibration test method, test results, and the forces and their frequency ranges and directions applied to the sensor applicable to its successful tests, demonstrating that the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of high vibration.

3.6.4 Seismic Reliability

The ISG recommends the use of Sections 7, 8, 9, and 10 of IEEE 344-2004 for seismic qualification of the SFP level instrumentation.

In its OIP, the licensee stated, in part, that

For seismic effects on instrument channel components used after a potential seismic event for only installed components (with the exception of replaceable batteries and chargers), the following measures will be used to verify that the design and installation is adequate:

- Components will be rated by the manufacturer (or otherwise tested) for seismic effects at levels commensurate with those of postulated design basis event conditions in the area of instrument channel component use using one or more of the following methods:
 - demonstration of seismic motion will be consistent with that of existing design basis loads at the installed location;
 - substantial history of operational reliability in environments with significant vibration, such as for portable hand-held devices or transportation applications. Such a vibration design envelope will be inclusive of the effects of seismic motion imparted to the components proposed at the location of the proposed installation;
 - demonstration of seismic reliability using methods that predict equipment performance (e.g., analysis, testing, combination thereof, or use of experience data) where demonstration should be based on the guidance in Sections 7, 8, 9, and 10 of Reference 5 or a substantially similar industrial standard;
 - demonstration that proposed devices are substantially similar in design to models that have been previously tested for seismic effects in excess of the plant design basis at the location where

the instrument is to be installed (g-levels and frequency ranges);
or

- seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

In its letter dated July 25, 2013, the licensee stated, in part, that

Signal processor (electronics): Triaxial shake-table testing is planned to be performed by the vendor to envelope seismic category 1 safe shutdown earthquake (SSE) conditions or ANO design basis maximum seismic loads (relative to the location where the equipment is mounted) using IEEE-344:2004 methodology.

Probe assembly (level sensor): Seismic and hydrodynamic finite element analyses are performed by the vendor using relevant IEEE-344:2004 methodology (using enveloping seismic category 1 SSE conditions or ANO design basis maximum seismic loads relative to the location where the equipment is mounted)...

The NRC staff has concerns with the lack of information regarding the results of such testing and analyses to enable the staff to evaluate the seismic reliability of the SFP level instrumentation. The staff has identified this request as:

RAI #9

Please provide the results of the seismic testing performed per IEEE 344-2004 to provide assurance that the equipment will perform reliably under the worst-case credible design basis loading at the location where the equipment will be located.

Additionally, in its letter dated July 25, 2013, the licensee stated, in part, that

With respect to the probe assembly, combined seismic and hydrodynamic analysis is planned to be used to demonstrate that the probe waveguide's geometric dimensions do not change significantly as a result of the seismic conditions. In the absence of alteration to the geometric configuration of the probe waveguide there is no mechanism for seismic excitation of the probe assembly to alter system accuracy.

The accuracy of system electronics is demonstrated following seismic excitation as part of the seismic testing protocol.

The NRC staff notes that the licensee will demonstrate the reliability of the seismic design and installation in accordance with NEI 12-02, as endorsed by the ISG. The licensee's planned approach with respect to the seismic reliability of the instrumentation appears to be consistent NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the results of the licensee's seismic test when it is completed. The staff has identified this request as:

RAI #10

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

3.6.5 Qualification Evaluation Summary

Upon acceptable resolution of the RAIs in Section 3.6, the NRC staff will be able to make a conclusion regarding the instrument qualification.

3.7 Design Features: Independence

Attachment 2 of Order EA-12-051 states, in part, that

The primary instrument channel shall be independent of the backup instrument channel.

NEI 12-02 states, in part, that

Independence of permanently installed instrumentation, and primary and backup channels, is obtained by physical and power separation commensurate with the hazard and electrical isolation needs. If plant AC or DC power sources are used then the power sources shall be from different buses and preferably different divisions/channels depending on available sources of power.

In its OIP, the licensee stated, in part, that

The primary instrument channel will be independent of the backup instrument channel. Independence is obtained by physical separation of components between channels and the use of normal power supplied from separate 480V buses. Independence of power sources is described in Section 11. The two (2) permanently mounted instruments in the pool are physically separated as described in Sections 6 and 7.

In its letter dated July 25, 2013, the licensee stated, in part, that

SFP level measurement system channel independence reasonably precludes (or minimizes to the extent practicable) the potential for a common cause event to adversely affect both channels as described in the OIP Section 10 (referencing Sections 6, 7, and 11 and OIP Attachments 1, 2, and 3) summarized as follows.

Independence requirements are achieved by incorporation of two permanently installed, physically independent, and physically separated channels (with channel separation in accordance with existing plant design basis requirements) which incorporate independent plant power sources [not only originating from different buses (NEI 12-02 required) but also from different power divisions (NEI 12-02 preferred)] as well as channel-specific stand-alone replaceable battery power (NEI 12-02 acceptable in and of itself) and which also incorporate channel interconnecting cabling routed in seismically mounted raceway. Each level measurement channel is physically separate and physically independent from level sensor through the display/read-out device. Each channel includes a level sensor in the SFP, display in the main control room, stand-alone replaceable batteries as backup to normal power sources, and interconnecting cabling between the level sensor and display. In the vicinity of the SFP [or the area potentially subject to a BDB external event (BDBEE)], level sensors and cabling maintain spatial separation to minimize the potential for falling debris or missiles to impact both channels with level sensors located near opposite corners of the SFP (further taking advantage of inherent debris and missile protection near SFP corners and generally below the SFP floor/wall elevation) and with cable routing both maintaining this relative separation and incorporating seismically mounted protective metal raceway until exiting the SFP area. Once exiting the SFP area, cables are routed in seismically qualified plant structures within seismically mounted raceway. In the main control room, display/read-out/signal-processing enclosures and their associated backup battery enclosures are seismically mounted.

The NRC staff notes that with the licensee's proposed arrangement for independence, the loss of one backup power supply will not affect the operation of the independent channel under BDB event conditions. The implementation of such design provisions appears to be consistent with NEI 12-02, as endorsed by the ISG, and the electrical functional performance of each level measurement channel would be considered independent of the other channel. However, the NRC staff plans to verify the final electrical power supply design information when it is provided. The NRC staff has identified this request as:

RAI #11

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

3.8 Design Features: Power Supplies

Attachment 2 of Order EA-12-051, states in part, that

Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and

replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

NEI 12-02 states, in part, that

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.

All channels of SFP level instrumentation shall provide the capability of connecting the channel to a source of power (e.g., portable generators or replaceable batteries) independent of the normal plant AC and DC power systems. For fixed channels this alternate capability shall include the ability to isolate the installed channel from its normal power supply or supplies. The portable power sources for the portable and installed channels shall be stored at separate locations, consistent with the reasonable protection requirements associated with NEI 12-06 (Order EA-12-049). The portable generator or replaceable batteries should be accessible and have sufficient capacity to support reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049.

If adequate power supply for either an installed or portable level instrument credits intermittent operation, then the provisions shall be made for quickly and reliably taking the channel out of service and restoring it to service. For example, a switch on the power supply to the channel is adequate provided the power can be periodically interrupted without significantly affecting the accuracy and reliability of the instrument reading. Continuous indication of SFP level is acceptable only if the power for such indication is demonstrably adequate for the time duration specified in section 3.1[.]

In its OIP, the licensee stated, in part, that

Each instrument channel is normally powered from 120VAC 60 Hz plant power to support continuous monitoring of SFP level. The primary channel receives power from a different 480V bus than the backup channel. Therefore, loss of any one 480V bus does not result in loss of normal 120VAC power for both instrument channels.

- On loss of normal 120VAC power, each channel's UPS automatically transfers to a dedicated backup battery. If normal power is restored, the channel will automatically transfers back to the normal AC power.
- The backup batteries are maintained in a charged state by commercial-grade uninterruptible power supplies. The batteries are sized to be capable of supporting intermittent monitoring for a minimum of 3 days of operation. This provides adequate time to allow the batteries to be

replaced, or until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049 Revision 0.

- An external connection permits powering the system from any portable DC source.
- Instrument accuracy and performance are not affected by restoration of power or restarting the processor.

The NRC staff requested the licensee to provide the sample rate under intermittent monitoring conditions and explain if the sample rate is determined by the instrument, or by plant procedures. In its letter dated July 25, 2013, the licensee stated, in part, that

Sample rate when the instrument is under battery power is determined by the instrument and/or plant procedures according to operator preference. Sample rate can be set so that the battery life extends to the desired duration of use following loss of normal power. The instrument is equipped in its standard configuration with batteries sufficient to support automated intermittent and on-demand sampling at an estimated average sample rate of at least one sample per three-to-five minutes for at least seven days, or proportionately more rapid sampling over shorter time periods. The instrument configuration is planned to be established for an automated sample rate when under battery power consistent with seven days continuous operation.

The NRC staff requested the licensee to provide the design criteria that will be applied to size the battery. In its letter dated July 25, 2013, the licensee stated, in part, that

The sample rate estimates have been developed by the vendor using conservative instrument power requirements and measured battery capacity with draw-downs during and following exposure of the batteries to their maximum operating temperature for up to seven days. The instrument configuration is planned to be established for an automated sample rate when under battery power consistent with seven days continuous operation. Permanent installed battery capacity for seven days continuous operation is planned consistent with NEI 12-02 duration without reliance on or crediting of potentially more rapid FLEX Program power restoration. Batteries are readily replaceable via spare stock without the need for recalibration to maintain accuracy of the instrument. These measures ensure adequate power capacity and margin.

The NRC staff notes that the proposed criteria for sizing of the battery backup appears to be consistent with NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the results of the licensee's calculation for required duty cycle given the final design load of the instrument channel for its installed configuration. The staff has identified this request as:

RAI #12

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

3.9 Design Features: Accuracy

Attachment 2 of Order EA-12-051 states, in part, that

The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.

NEI 12-02 states, in part, that

Accuracy should consider operations while under SFP conditions, e.g., saturated water, steam environment, or concentrated borated water. Additionally, instrument accuracy should be sufficient to allow trained personnel to determine when the actual level exceeds the specified lower level of each indicating range (levels 1, 2 and 3) without conflicting or ambiguous indication.

In its OIP, the licensee stated, in part, that

Accuracy will be consistent with the guidelines of NRC JLD-ISG-2012-03 Revision 0 and NEI 12-02 Revision 1. Accuracy and indication features are as follows:

- Accuracy: The absolute system accuracy is equal or better than ± 3 inches. This accuracy is applicable for normal conditions and the temperature, humidity, chemistry, and radiation levels expected for BDBE event conditions.
- Trending: The display trends and retains data when powered from either normal or backup power.
- Restoration after Loss of Power: The system automatically swaps to available power (backup battery power or external DC source) when normal power is lost. Neither the source of power nor system restoration impact accuracy. Previously collected data is retained.
- Diagnostics: The system performs and displays the results of real-time information related to the integrity of the cable, probe, and instrument channel.

In its letter dated July 25, 2013, the licensee stated, in part, that

The SFP level instrument channel accuracy across the entire measured span (including Levels 1, 2, 3) under all applicable conditions [i.e., normal as well as BDBEE (radiation, temperature, humidity, post-seismic, and post-shock)] is planned to be specified to be \leq three inches. Minimum level sensor range or measured level span is depicted on Figure 1 for ANO-1 (24'-3.4325") and Figure 2 for ANO-2 (22'-7.6875"). As such, minimum instrument channel accuracy in terms of percent measured level span is approximately 1.03% span for ANO-1 and 1.10% span for ANO-2. This is a conservative bounding instrument channel accuracy with the vendor estimating expected instrument channel accuracy to be considerably better (i.e., vendor expected accuracy is approximately one-third of the above bounding accuracy).

The NRC staff notes that the estimated instrument channel design accuracies and methodology appear to be sufficient to maintain the instrument channels to within their designed accuracies before significant drift can occur. The NRC staff plans to verify that the licensee's proposed instrument performance is consistent with these estimated accuracy values. Further, the NRC staff plans to verify that the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power. The staff has identified these requests as:

RAI #13

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

RAI #14

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

(This information was previously requested as RAI-6b in NRC letter dated June 26, 2013)

3.10 Design Features: Testing

Attachment 2 of Order EA-12-051 states, in part, that

The instrument channel design shall provide for routine testing and calibration.

NEI 12-02 states, in part, that

Static or non-active installed (fixed) sensors can be used and should be designed such that testing and/or calibration can be performed in-situ. For microprocessor based channels the instrument channel design shall be capable of testing while mounted in the pool.

In its OIP, the licensee stated, in part, that

Testing and calibration will be consistent with the guidelines of NRC JLD-ISG-2012-03 Revision 0 and NEI 12-02 Revision 1 and vendor recommendations.

The display/processor performs automatic in-situ calibration and automatically monitors for cable, connector, and probe faults using time domain reflectometry (TDR) technology. Channel degradation due to age or corrosion is not expected but associated testing, calibration, and monitoring provides reasonable opportunity for identification thereof.

In its letter dated July 25, 2013, the licensee stated, in part, that

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.

Periodic calibration checks of the signal processor electronics to extrinsic National Institute of Standards and Technology (NIST)-traceable standards can be achieved through the use of standard measurement and test equipment.

The probe itself is a perforated tubular coaxial waveguide with defined geometry and is not calibrated. It is planned to be periodically inspected electromagnetically using time-domain reflectometry at the probe hardline cable connector to demonstrate that the probe assembly meets manufactured specification and visually to demonstrate that there has been no mechanical deformation or fouling.

The NRC staff requested the licensee to provide a description of how such testing and calibration will enable the conduct of routine channel checks of each independent channel against the other, and against any other permanently installed SFP level instrumentation. In its letter dated July 25, 2013, the licensee stated, in part, that

Each instrument electronically logs a record of measurement values over time in non-volatile memory that is compared to demonstrate constancy, including any changes in pool level, such as that associated with the normal evaporative loss/refilling cycle. The channel level measurements can be directly compared to each other (i.e., regular cross-channel comparisons). Any existing permanently installed SFP level instrumentation or other direct measurements of SFP level

may be used for diagnostic purposes if cross-channel comparisons are anomalous.

The NRC staff notes that the results of the comparison between the SFP level instrument channels can be compared with the acceptance criteria described in Section 3.9 above to determine if recalibration or troubleshooting is needed. However, the NRC staff has concerns with the licensee's lack of information regarding the feasibility of the licensee's process for in-situ calibration to ensure that the design accuracy will be maintained. The staff has identified this request as:

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.

3.11 Design Features: Display

Attachment 2 of Order EA-12-051 states, in part, that

Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.

NEI 12-02 states, in part, that

The intent of this guidance is to ensure that information on SFP level is reasonably available to the plant staff and decision makers. Ideally there will be an indication from at least one channel of instrumentation in the control room. While it is generally recognized (as demonstrated by the events at Fukushima Daiichi) that SFP level will not change rapidly during a loss of spent fuel pool cooling scenario more rapid SFP drain down cannot be entirely discounted. Therefore, the fact that plant personnel are able to determine the SFP level will satisfy this requirement, provided the personnel are available and trained in the use of the SFP level instrumentation (see Section 4.1) and that they can accomplish the task when required without unreasonable delay.

SFP level indication from the installed channel shall be displayed in the control room, at the alternate shutdown panel, or another appropriate and accessible location (reference NEI 12-06). An appropriate and accessible location shall have the following characteristics:

- occupied or promptly accessible to the appropriate plant staff giving appropriate consideration to various drain down scenarios,
- outside of the area surrounding the SFP floor, e.g., an appropriate distance from the radiological sources resulting from an event impacting the SFP,

- inside a structure providing protection against adverse weather, and
- outside of any very high radiation areas or LOCKED HIGH RAD AREA during normal operation.
- If multiple display locations beyond the required "appropriate and accessible location" are desired, then the instrument channel shall be designed with the capability to drive the multiple display locations without impacting the primary "appropriate and accessible" display.

In its OIP, the licensee stated, in part, that

The primary and backup instrument displays will be located in the Main Control Room (MCR)...

The NRC staff notes that the NEI guidance for "Display" specifically mentions the control room as an acceptable location for SFP instrumentation displays as it is occupied or promptly accessible, outside the area surrounding the SFP, inside a structure providing protection against adverse weather and outside of any very high radiation areas or LOCKED HIGH RAD AREA during normal operation. The licensee's proposed location for the primary and backup SFP instrumentation displays appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.12 Programmatic Controls: Training

Attachment 2 of Order EA-12-051 states, in part, that

Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.

NEI 12-02 states, in part, that

The personnel performing functions associated with these SFP level instrumentation channels shall be trained to perform the job specific functions necessary for their assigned tasks (maintenance, calibration, surveillance, etc.). SFP instrumentation should be installed via the normal modification processes. In some cases, utilities may choose to utilize portable instrumentation as a portion of their SFP instrumentation response. In either case utilities should use the Systematic Approach to Training (SAT) to identify the population to be trained. The SAT process should also determine both the initial and continuing elements of the required training.

In its OIP, the licensee stated, in part, that

The Systematic Approach to Training (SAT) will be used to identify the population to be trained and to determine both the initial and continuing elements of the required training. Training will be completed prior to placing the instrumentation in service.

The licensee's proposed plan, with respect to the training personnel in the use and the provision of alternate power to the primary and backup instrument channels, including the approach to identifying the population to be trained, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.13 Programmatic Controls: Procedures

Attachment 2 of Order EA-12-051 states, in part, that

Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

NEI 12-02 states, in part, that

Procedures will be developed using guidelines and vendor instructions to address the maintenance, operation and abnormal response issues associated with the new SFP instrumentation.

In its OIP, the licensee stated, in part, that

Procedures for maintenance and testing will be developed using regulatory guidelines and vendor instructions.

In its letter dated July 25, 2013, the licensee stated, in part, that

Vendor recommended inspection, maintenance, and repair procedures for the EFP liquid level measurement system have been developed through the vendor's 30-year experience developing and manufacturing liquid level measurement and cable testing instrumentation. These are for the most part specific to the system's proprietary electronics, subject to relevant industry standards for electronics fabrication and inspection and vendor's quality management system.

Where relevant, standards for naval shipboard liquid level indicating equipment have been used to develop procedures for operation, abnormal response, and administrative controls.

The specific procedures to be used to capture the required activities described in this RAI response have not yet been developed but are planned to be developed in accordance with the vendor recommendations and Entergy processes and procedures.

The NRC staff has concerns with the licensee's lack of information regarding the development of the procedures for maintenance, operation and abnormal response issues associated with the new SFP instrumentation. The NRC staff had identified this request as:

RAI #16

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.

3.14 Programmatic Controls: Testing and Calibration

Attachment 2 of Order EA-12-051 states, in part, that

Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

NEI 12-02 states, in part, that

Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup SFP level instrument channels to maintain the instrument channels at the design accuracy. The testing and calibration of the instrumentation shall be consistent with vendor recommendations or other documented basis.

In its OIP, the licensee stated, in part, that

Station procedures and preventive maintenance tasks will be developed as necessary (e.g. to perform required surveillance testing, calibration, backup battery maintenance, functional checks, and visual inspections of the probes).

In its letter dated July 25, 2013, the licensee stated, in part, that

SFPI [spent fuel pool instrumentation] channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness are planned to 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). Subject maintenance and testing program requirements are planned to be developed during the SFPI modification design process.

Further, in its letter dated July 25, 2013, the licensee stated, in part, that

Operator performance tests (functional checks) are automated and/or semi-automated (requiring limited operator interaction) and are performed through the instrument menu software and initiated by the operator. There are a number of other internal system tests that are performed by system software on an essentially continuous basis without user intervention but can also be performed on an on-demand basis with diagnostic output to the display for the operator to review. Other tests such as menu button tests, level alarm, and alarm relay tests are only initiated manually by the operator. Operator performance checks are described in detail in the Vendor Operator's Manual, and the applicable information is planned to be contained in plant operating procedures.

Operator performance tests are planned to be performed periodically as recommended by the equipment vendor, for instance quarterly but no less often than the calibration interval of two years.

Channel functional tests per operations procedures with limits established in consideration of vendor equipment specifications are planned to be performed at appropriate frequencies established equivalent to or more frequently than existing SFPI.

Manual calibration and operator performance checks are planned to be performed in a periodic scheduled fashion with additional maintenance on an as-needed basis when flagged by the system's automated diagnostic testing features.

Channel calibration tests per maintenance procedures with limits established in consideration of vendor equipment specifications are planned to be performed at frequencies established in consideration of vendor recommendations.

Regarding calibration checks, in its letter dated July 25, 2013, the licensee stated, in part, that

Periodic (e.g., quarterly or monthly) review of the system level history and log files and routine attention to any warning message on the system display is recommended by the vendor. Formal calibration checks are recommended by the vendor on a two-year interval to demonstrate calibration to external NIST-traceable standards. Formal calibration check surveillance interval and timing would be established consistent with applicable guidance [i.e., NEI 12-02 Section 4.3; on a refueling outage interval basis and within 60 days of a planned refueling outage considering normal testing scheduling allowances (e.g., 25%)]. Items such as system batteries are planned to be assessed under the Preventive Maintenance (PM) Program for establishment of replacement frequency. Surveillance/PM timing/performance are planned to be controlled via tasks in the PM Program.

The licensee's proposed plan to established and maintained processes for scheduling and implementing necessary testing and calibration appear to be consistent with NEI 12-02, as

endorsed by the ISG. However, the NRC staff plans to verify the final implementation of the licensee's maintenance, testing and calibration program. The staff has identified this request as:

RAI #17

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

Regarding compensatory actions, in its letter dated July 25, 2013, the licensee stated, in part, that

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.

In its letter dated July 25, 2013, the licensee also described planned compensatory actions for unlikely extended out-of-service events.

The licensee's proposed design, with respect to compensatory actions, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.15 Instrument Reliability

NEI 12-02 states, in part, that

A spent fuel pool level instrument channel is considered reliable when the instrument channel satisfies the design elements listed in Section 3 [Instrument Design Features] of this guidance and the plant operator has fully implemented the programmatic features listed in Section 4 [Program Features].

In its OIP, the licensee stated that the reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of NRC JLD-ISG-2012-03 Revision 0 and NEI 12-02 Revision 1.

Upon acceptable resolution of the RAIs noted above, the NRC staff will be able to make a conclusion regarding the reliability of the SFP instrumentation.

4.0 CONCLUSION

The NRC staff is unable to complete its evaluation regarding the acceptability of the licensee's plans for implementing the requirements of Order EA 12 051 due to the need for additional information as described above. The staff will issue an evaluation with its conclusion after the licensee has provided the requested information.

information by letters dated June 25, 2013, and August 28, 2013 (ADAMS Accession No. ML13241A415).

The NRC staff has reviewed these submittals with the understanding that the licensee will update its OIP as implementation of the Order progresses. With this in mind, the staff has included an interim staff evaluation with this letter to provide feedback on the OIP. The staff's findings in the interim staff evaluation are considered preliminary and will be revised as the OIP is updated. As such, none of the staff's conclusions are to be considered final. A final NRC staff evaluation will be issued after the licensee has provided the information requested

The interim staff evaluation also includes RAIs, response to which the NRC staff needs to complete its review. The licensee should provide the information requested in the 6-month status updates, as the information becomes available. However, the staff requests that all information be provided by September 30, 2014, to ensure that any issues are resolved prior to the date by which the licensee must complete full implementation of Order EA-12-051. The licensee should adjust its schedule for providing information to ensure that all this information is provided by the requested date.

A final NRC staff evaluation will be issued after the licensee has provided the information requested.

If you have any questions, please contact me at 301-415-1480 or via e-mail at kaly.kalyanam@nrc.gov.

Sincerely,

/ra/

N. Kaly Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-313 and 50-368

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Interim Staff Evaluation and RAI

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OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	NRR/DSS/SBPB/BC*
NAME	NKalyanam	JBurkhardt	GCasto
DATE	10/24/13	10/24/13	10/2/13
OFFICE	NRR/DE/EICB/BC*	NRR/DORL/LPL4/BC	NRR/DORL/LPL4/PM
NAME	JThorp	MMarkley	NKalyanam
DATE	10/2/13	10/29/13	10/29/13