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

November 25, 2013

Mr. Adam C. Heflin
Senior Vice President and
Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 – INTERIM STAFF EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION RE: OVERALL INTEGRATED PLAN IN RESPONSE TO ORDER EA-12-051, RELIABLE SPENT FUEL POOL INSTRUMENTATION (TAC NO. MF0773)

Dear Mr. Heflin:

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. ML130630581), Union Electric Company (dba Ameren Missouri, the licensee) provided the OIP for Callaway Plant, Unit 1, describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by the fourth quarter of 2014. By letter dated June 7, 2013 (ADAMS Accession No. ML13121A187), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 3, 2013 (ADAMS Accession No. ML13190A048), and August 29, 2013 (ADAMS Accession No. ML13242A240).

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 March 31, 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.

If you have any questions, please contact me at 301-415-2296 or via e-mail at fred.lyon@nrc.gov.

Sincerely,

CFLyon

Carl F. Lyon, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure
Interim Staff Evaluation and RAI

cc w/encl: Distribution via Listserv

INTERIM STAFF EVALUATION AND

REQUEST FOR ADDITIONAL INFORMATION

OVERALL INTEGRATED PLAN IN RESPONSE TO

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

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

## 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. ML130630581), Union Electric Company (dba Ameren Missouri, the licensee) provided the OIP for Callaway Plant, Unit 1 (Callaway), describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by the fourth quarter of 2014. By letter dated June 7, 2013 (ADAMS Accession No. ML13121A187), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 3, 2013 (ADAMS Accession No. ML13190A048), and August 29, 2013 (ADAMS Accession No. ML13242A240).

## 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 the 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.

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 licensees 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

Callaway is a Westinghouse four-loop pressurized-water reactor with a single SFP. The inside dimensions of the SFP are approximately 50 feet (ft.) 0 inches (in.) by 28 ft. 6 in.

The licensee submitted its OIP on February 28, 2013. The OIP states that the installation of the SFP level instrumentation is scheduled for completion by the fourth quarter of 2014, prior to startup from the second refueling outage after submittal of the OIP.

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 that Level 1 is the indicated level on either the primary or backup instrument channel of 24 ft. 10.75 in. above the top of the fuel storage, based on the normal SFP level as shown in Callaway Final Safety Analysis Report (FSAR).

In its letter dated July 3, 2013, the licensee stated, in part, that

> Callaway designated Level 1 to be EL. 2046 feet (24 feet, 10.75 inches above the top of the fuel racks). This corresponds to the normal water level. This level is adequate to support operation of the normal fuel pool cooling system, as required by Order EA-12-051. It is a higher level than either of the pump-limiting conditions specified in NEI 12-02, and as such, is conservatively safe. The normal water level is also above the level at which the cooling pumps trip on low level. Pump trip will occur before either of the pump-limiting levels defined in NEI 12-02 are reached.
>
> In selecting normal water level as Level 1, the need to define a specific operational action to be taken in response to reaching Level 1 is precluded.

The NRC staff notes the SFP elevation for Level 1 is set at a plant elevation of 2,046 ft. 10.75 in. This level corresponds to the normal water level of the SFP. However, as stated in NEI 12-02, Level 1 is to be established at the higher of two SFP elevations. Based on the information provided by the licensee, it appears that the elevation necessary to provide the required Net Positive Suction Head (NPSH) specified by the pump manufacturer or engineering analysis is not available at this time. The staff has identified this request as:

**RAI No. 1**

**Please provide the results of the calculation used to determine the water elevation that is sufficient for the pump's required NPSH so the NRC staff may confirm that Level 1 has been adequately identified.**

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 is the indicated level on either the primary or backup instrument channel of greater than 10 ft. (+/- 1 foot) above the top of the fuel storage racks.

In its letter dated July 3, 2013, the licensee provided a sketch depicting the elevations identified as Levels 1, 2, and 3 and the SFP level instrumentation measurement range. The NRC staff reviewed this sketch and notes the top of the fuel racks is shown at elevation 2,021 ft. and 1.25 in. and Level 2 10 ft. above this elevation at 2,031 ft. and 1.25 in. The staff also notes the licensee designated Level 2 using the first of the two options described in NEI 12-02 for Level 2.

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.

In its OIP, the licensee stated that Level 3 is the indicated level on either the primary or backup instrument channel of greater than 1 ft. above the top of the fuel storage racks plus the accuracy of the SFP level instrument channel.

In its letter dated July 3, 2013, the licensee stated, in part, that

> Callaway designated Level 3 to be the water level "greater than 1 foot above the top of the fuel storage racks plus the accuracy of the SFP level instrument channel, which is to be determined." This is consistent with the "nominal" "highest point of any fuel rack..." characterization of NEI 12-02. Designation of this level as Level 3 is conservative; its selection assures that the fuel will remain covered, and at that point there would be no functional or operational reason to defer action to implement the addition of make-up water to the pool.

In its letter dated July 3, 2013, the licensee provided a sketch depicting the elevations identified as Levels 1, 2, and 3 and the SFP level instrumentation measurement range. The NRC staff reviewed this sketch and notes that the top of the fuel racks is shown at elevation 2,021 ft. and 1.25 in. Further, in this sketch, Level 3 is identified at elevation 2,022 ft. and 1.25 in, which is 1 ft. above the highest point of any fuel rack seated in the SFP.

The licensee's proposed plan, with respect to identification of Levels 2 and 3, appears to be consistent with the guidance.

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 SFP 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 it will use fixed primary and backup guided wave radar (GWR) sensors. The instrument channels will provide continuous level indication over a range of 23 ft. 10.75 in., from 12 in. above the top of the fuel storage racks (plant elevation 2,022 ft. 1.25 in.) to the normal pool level elevation (plant elevation 2,046 ft.)

In its letter dated July 3, 2013, the licensee provided a sketch depicting the elevations identified as Levels 1, 2, and 3 and the SFP level instrumentation measurement range. The NRC staff reviewed this sketch and notes the instrument will be able to read down to 6 inches above the top of the fuel storage racks.

The NRC staff notes 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 the guidance.

In its letter dated July 3, 2013, the licensee stated, in part, that

> The wireless technology used for the primary and backup SFP level measurements uses the 900 MHz [megahertz], Industry, Scientific and Medical (ISM) band, from 902 MHz to 928 MHz. The wireless system incorporates frequency hopping spread-spectrum (FHSS) techniques, with the pre-determined hopping pattern controlled by hardware "keys" plugged into the wireless transmitter and receiver modules. The wireless transmitter is limited to 1 watt of power, and antenna gain is 7dbi [decibels-isotropic]. Implementation of the wireless signal provides for up to 256-bit, advanced encryption standard (AES) encryption. An individual, single-frequency transmission can be dropped without disruption or loss of the measurement signal. FHSS technology facilitates system operation without interference with 900 MHz communication equipment or other plant systems. The FHSS technology allows for multiple wireless channels to be operating at the same time without interference. The wireless components will be located in the Auxiliary Building, and will be capable of operating in the environment during a beyond-design-basis event resulting from loss of SFP cooling. The wireless implementation meets the same requirements established for wired implementation in NEI 12-02. Battery capacity for each of the SFP level measurement channels is sufficient to provide continuous operation for 72 hours.
>
> The SFP instrumentation system (SFPIS) is a stand-alone system with no connection into other parts of plant instrumentation and control [(I&C)] systems. Failure of a wireless component will affect only the signal for which it is used.

> The SFPIS does not provide a path for entry of malicious code into any part of the plant I&C systems, and has no impact on plant cyber security controls.

The NRC staff notes that the licensee provided information regarding the wireless technology to be used at the Callaway plant. However, the staff has concerns the licensee's description of "stand-alone" and of the wireless system incorporating FHSS techniques, with the pre-determined hopping pattern controlled by hardware "keys" plugged into the wireless transmitter and receiver modules. The staff has identified this request as:

**RAI No. 2**

**Please clarify whether this wireless communications system will be used as two separate point-to-point wireless communications systems (i.e., one system between the sending unit and receiver for the primary level channel and a second system between the sending unit and receiver for the back-up level channel), or whether there will be shared communications channels over which both the primary and the backup channels can communicate simultaneously. Also, please verify whether there are other wireless communication devices within the plant that will be allowed to share this wireless communications system.**

In addition, the NRC staff has concerns regarding interference that may occur due to interaction with other plant systems, for example, as a result of potential failure modes of one channel, or due to BDB conditions. The staff has identified this request as:

**RAI No. 3**

**Please provide a plant-specific evaluation of the interaction of the proposed wireless technology with other plant systems, in particular, interactions and any malfunctions that could result from potential failure modes of one channel, or due to BDB conditions.**

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 stated, in part, that

> The primary and backup instrument sensing components will be separated consistent with the guidelines of Reference 2 and Reference 3. Design of the mounting bracket will allow the fuel handling machine to pass over it without interference.
>
> A SFP walkdown identified preliminary locations for the primary and backup level sensing components. The preliminary locations of the primary and backup instrument sensing components are at the plant northeast and northwest corners of the SFP. The design for installation will include physical separation of the two sensors, separate extension cables from the electronics to the sensors, routing all cables in separate conduit / trays, separate UPS [uninterruptible power supply] power supplied from different ac sources, and seismically qualified mounting with physical separation of both the level sensing electronics and indications.
>
> The final location of the primary and backup system mounting brackets will be determined during the design phase with consideration of power availability and separation requirements to protect against missiles.
>
> The level sensing electronics for both primary and backup systems will be located in the auxiliary building, compliant with Reference 2 and Reference 3 for separation and accessibility.

In its letter dated July 3, 2013, the licensee provided a sketch indicating the proposed locations of the various components of the SFP level instrumentation. The NRC staff notes the probes would be mounted near the northeast and northwest corners of the SFP, for a separation of nearly (but less than) 28 ft. Because of the proposed location of the SFP level instrument probes, the staff has concerns that cables for the two channels from the probes and the level sensing/transmitting electronics appear to come close together, before leaving the SFP area and passing through a building wall into a non-missile area. The staff has identified this request as:

**RAI No. 4**

**Please provide additional information describing how the proposed arrangement and routing of the cables meet the Order requirement to arrange the SFP level instrument channels in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP.**

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 that the mounting of both the primary and backup system will be installed to maintain its integrity during and following a design basis seismic event and that all locations will be reviewed for two-over-one seismic interference.

In its letter dated July 3, 2013, the licensee stated, in part, that

> The mounting bracket for the sensing probe will be designed according to the plant design basis for the Safe Shutdown Earthquake (SSE) seismic hazard curve at the plant elevation of the refuel floor. Loads that will be considered in the evaluation of the bracket and its mounting are: 1) Static loads including the dead weight of the mounting bracket in addition to the weight of the level sensing instruments and cabling; 2) Dynamic loads including the seismic load due to excitation of the dead weight of the system in addition to the hydrodynamic effects (if credible, considering the geometry and the flexibility of the sensing probe and the water sloshing height) resulting from the excitation of the SFP water. A response spectra analysis will be performed for the seismic evaluation of the mounting bracket using Finite Element Analysis (FEA) software and using floor response spectrum at Elevation 2047' 6" in the Fuel Building (i.e. mounting floor elevation). Damping values will be according to the SSE and consistent with the design basis of the station. The material properties that will be used for the bracket and its mounting will take into consideration the environmental conditions in the SFP area following an SSE. Hydrodynamic effects on the mounting bracket will be evaluated using TID-7024 (Nuclear Reactors and Earthquakes, dated 1963). Plant acceptance criteria and applicable codes will be used for the design of the bracket and its anchorage.

Additionally, in its letter dated July 3, 2013, the licensee provided a schematic for the mounting bracket.

The NRC staff notes the licensee's proposed plan for mounting the instrument appears to be consistent with NEI 12-02, as endorsed by the ISG. However, the staff notes that while other sections of the licensee's letter dated July 3, 2013, mention the existence of a stilling well in the design, there is no mention of this component in the above analysis, where it would seem to be relevant in terms of weight and hydrodynamic effects. The staff has identified this request as:

**RAI No. 5**

**Please clarify if a stilling well is part of the instrument design and, if so, how its weight is accounted for and how it will be mounted and analyzed.**

In addition, the NRC staff plans to verify the final design and the results of the licensee's seismic testing and analysis report. The staff has identified these requests as:

**RAI No. 6**

**Please provide the results of the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.**

**RAI No. 7**

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

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, (3.6.3) 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.

The NRC staff has concerns with the licensee's lack of information on the quality assurance process that will be applied to this project. The staff has identified this request as:

**RAI No. 8**

**Please describe the quality assurance process to be used to meet the augmented quality requirements identified in the Order.**

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.

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

> The normal operational, event, and post-event conditions for temperature, humidity, and radiation, will be addressed for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies resulting from the NRC issued Order EA-12-049, "*Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*," dated March 12, 2012 (Reference 6). 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 (Section III, item 3) as described in Reference 1,
> - temperatures of 212°F and 100 percent relative humidity environment,
> - boiling water and/or steam environment,
> - a concentrated borated water environment...

Related to radiological conditions, in its letter dated July 3, 2013, the licensee stated, in part, that

> Components subject to significant radiation under beyond design basis conditions are those in the Fuel Building. These include the probe, stilling well and bracket, which have no soft parts, the coupler and interconnecting cable. The sensor probe and bracket are stainless steel and will not be affected by the anticipated radiation. The coupler and cable are selected by design for the beyond design basis radiation service. Supplemental radiation testing of the interconnecting cable to the total integrated dose will be completed to demonstrate operation for more than one week with SFP water at Level 3, and indefinitely at Level 2 or above (refer to RAI 1) .

The NRC staff has concerns with the lack of information regarding the expected radiological conditions in the vicinity where the transmitter electronics equipment will be located under normal and BDB conditions. The staff has identified this request as:

**RAI No. 9**

**Please provide an analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the transmitter electronics will be exposed. Provide documentation indicating the cumulative (total integrated) radiological dose the electronics for this equipment are capable of withstanding. Discuss the time period over which the analyzed total integrated dose was applied.**

While addressing post-event temperature and humidity conditions, the licensee stated in its letter dated July 3, 2013, in part, that

> SFPIS materials and components were selected and specified by design to meet or exceed the temperature and humidity in the Fuel Building and other buildings during the extended loss of ac power (ELAP) event for the locations of sensor and system electronics. The design of system components will be validated by analytical methods or testing or both as shown below.

In its letter dated July 3, 2013, the licensee provided information on the SFP instrumentation components and the basis for validating the design of these components. According to the licensee, the sensor probe, sensor bracket, and stilling well are inherently tolerant of the effects of the specified temperature and humidity and this will be demonstrated by design and analysis. The sensor coupler is specifically designed by the manufacturer for high temperature and humidity applications. The coaxial cable will be selected by design for conditions and tested for performance at 212°F, saturated steam. The sensor electronics design temperature exceeds the requirements for the mounting locations which will be in the Auxiliary Building (AB). The system electronics design temperature exceeds the requirements for the mounting locations which will be in the AB. The wireless receiver and display design temperature exceeds the requirements for its mounting location and will be tested for performance under conditions of temperature and humidity cycling. The wireless receiver and display will be located in the Control Room A/A Unit & Filtration Units Room "A".

The NRC staff has concerns with the lack of information regarding whether the sensor electronics are capable of continuously performing required functions under this expected temperature and humidity condition. The staff has identified these requests as:

**RAI No. 10**

**Please provide information indicating a) the temperature ratings for all system electronics (including sensor electronics, system electronics, transmitter, receiver and display) and whether the ratings are continuous duty ratings; and, b) the maximum expected temperature in the room(s) in which the sensor electronics will be located under BDB conditions, with no ac power available to run Heating, Ventilation, and Air Conditioning (HVAC) systems.**

**RAI No. 11**

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

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 the instrument channel reliability will be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the effects of shock and vibration.

Passive components located within the SFP building

In its letter dated July 3, 2013, the licensee stated, in part, that

> All components located within the SFP are passive components, inherently resistant to shock and vibration loadings. These include the stainless steel sensor cable probe, sensor bracket, coupler and interconnecting cable.

Active components located outside the SFP building

In its letter dated July 3, 2013, the licensee stated, in part, that

> Active electronic components, located outside the SFP building, are permanently and rigidly attached to seismic racks or structural walls, and are not subject to significant shock and vibration loadings. However, assurance of reliability under conditions of shock and vibration is supported by manufacturer operating experience, which includes use of components in high vibration installations, such as compressed air systems and transportation industries.

The NRC staff notes that while the passive components may be inherently resistant to shock and vibration loadings, the actual resistance depends on the component material property,

structure, and the final installation. The staff has concerns with the licensee's lack of information on the tests, applied forces and their directions, frequency ranges, and the operability of the sensor after shock and vibration tests are completed. The staff has identified this request as:

**RAI No. 12**

**Please provide the following:**

**a) Information describing the evaluation of the sensor electronics design, the shock test method, test results, and forces applied to the sensor electronics applicable to successful tests demonstrating the testing provides an appropriate means to demonstrate reliability of the sensor electronics under the effects of severe shock.**

**b) Information describing the evaluation of the sensor electronics design, the vibration test method, test results, forces and their frequency ranges, and directions applied to the sensor applicable to successful tests demonstrating the testing provides an appropriate means to demonstrate reliability of the sensor electronics under the effects of high vibration.**

3.6.4 Seismic Reliability

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

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

> Demonstration of seismic adequacy will be achieved using one or more of the following methods:
>
> 1. demonstration of seismic motion consistent with that of existing design basis loads at the installed location;
>
> 2. 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 shall be inclusive of the effects of seismic motion imparted to the components proposed at the location of the proposed installation;
>
> 3. adequacy of seismic design and installation is demonstrated based on the guidance in Sections 7, 8, 9, and 10 of IEEE Standard 344-2004, *"IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations,"* (Reference 7) or a substantially similar industrial standard;

4. 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

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

Passive components located within the SFP building

In its letter dated July 3, 2013, the licensee stated, in part, that

> The probe, interconnecting cable, supporting bracket and stilling well are functionally passive components. Analysis will be used to demonstrate they will maintain their structural integrity and design configuration and to establish their reliability. The coupler and interconnecting cable are also passive components; however, they will be included in the seismic testing of the sensor electronics.

Active components located outside the SFP building

In its letter dated July 3, 2013, the licensee stated, in part, that

> All active system components, including sensor electronics, wireless transmitter, system electronics, batteries, display and enclosures will be seismically tested based on rigid mounting conditions. Testing is tri-axial, using random multi-frequency inputs, in accordance with IEEE 344-2004. Analyses and testing will conservatively envelope the conditions at equipment mounting locations resulting from the design basis maximum ground motion, plus margin.

The NRC staff notes 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. 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 No. 13**

**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 Callaway, has been adequately demonstrated. Include information describing the design inputs and methodology used in any analyses of the mounting of electronic equipment onto plant structures, as requested in RAI No. 7 above.**

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 backup instrument system will be redundant to and independent of the primary instrument system.
>
> Independence of the two systems includes: location, mounting, power sources, power and signal wiring, and indications, to prevent any failure of one system from affecting the other system.

In its letter dated July 3, 2013, the licensee stated, in part, that

> Each channel will be installed using completely independent cabling structures, including routing of the interconnecting cable within the SFP area in separate hard-pipe conduits. Power sources will be routed to the electronics enclosures from electrically separated sources ensuring the loss of one train or bus will not disable both channels. The system displays will be installed in separate qualified NEMA 4X or better enclosures, with the primary display in the Control Room A/C Unit & Filtration Units Rm "A" and the back-up in the Control Room A/C Unit & Filtration Units Rm "B". Primary and backup systems will be completely independent of each other, having no shared components.

The licensee's information related to independence appears to be consistent with NEI 12-02, as endorsed by the ISG. 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 No. 14**

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

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

> An ac source will be selected for each system's 24-Vdc [Volts dc] UPS [Uninterruptible Power Supply] with power cables routed separately through existing or new tray / conduit and penetrations.

> Both channels will be powered by independent batteries following a loss-of-ac power. The minimum battery life will be 72 hours. The 72 hour battery life is a sufficient amount of time for an alternate source of power to be provided by the plant-specific procedures to address Reference 6. Each channel will include an externally accessible bulkhead connector and transfer switch for connection of an alternate power source.

In its letter dated July 3, 2013, the licensee stated, in part, that

> Battery sizing is in accordance with standard IEEE 485-2010. Design criteria applied are: Continuous system operation for 72 hours following loss of ac power. Calculation of system power consumption is based on the specified values listed in component manufacturer specifications. A 10% capacity margin is added to battery sizing calculations, following guidelines of IEEE 485-2010, Section 6.2.2. The time to restore AC power to the primary and backup channels will be within 72 hours, and will be established in the FLEX Support Guidelines.

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. 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. In addition, the staff plans to review the AC power sources of the design in more detail. The staff has identified this request as:

**RAI No. 15**

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

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

> Instrument channels will be designed such that they will maintain their specified accuracy without recalibration following a power interruption or change in power source.

In its letter dated July 3, 2013, the licensee stated, in part, that

> The instrument channel accuracy will be established during the design verification phase. An estimate of the expected instrument channel accuracy under normal and beyond-design-basis conditions will be provided in the 6-month update due in February, 2014.
>
> The calibration procedure, and the methodology and basis for establishing both the criteria indicating the need for recalibration, and the acceptance criterion to be used with the procedure, will be established during the design verification phase. The methodology for defining these criteria will be provided in the 6-month update due in February, 2014.

The NRC staff notes the information on the accuracy of the SFP level instrumentation is not currently available for review. In its letter dated July 3, 2013, the licensee indicated that the information will be provided to the staff during in the 6-month update due in February 2014. The staff has identified this request as:

**RAI No. 16**

**Please provide the following:**

a) **An estimate of the expected instrument channel accuracy performance (e.g., in percent of span) under both a) normal SFP level conditions (approximately Level 1 or higher) and b) at the BDB conditions (i.e., radiation, temperature, humidity, post-seismic and post-shock conditions) that would be present if the SFP level were at the Level 2 and Level 3 datum points.**

b) **A description of the methodology used for determining the maximum allowed deviation from the instrument channel design accuracy under normal operating conditions, which would be used as an acceptance criterion for a calibration procedure to alert operators and technicians that the channel requires adjustment to within normal design accuracy.**

*(This information was previously requested in RAI-9 of the NRC letter dated June 7, 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 the instrument channel design will provide for routine testing and calibration consistent with Reference 2 and Reference 3.

In its letter dated July 3, 2013, the licensee stated, in part, that

> Details of the capabilities and provisions of the level instrumentation for periodic calibration and testing will be established during the design phase. A description of these features and the way they will support in-situ testing will be provided in the 6-month update due in February, 2014.
>
> A description of how the defined testing and calibration will enable the conduct of regular channel checks of each independent channel against the other, and against any other permanently-installed SFP level instrumentation will be provided in the 6-month update due in February, 2014.
>
> Details of functional checks and instrument channel calibrations will be determined during the design phase. A description of how functional checks and calibration tests will be performed, and the frequency at which they will be conducted, will be provided in the 6-month update due in February, 2014. An explanation of how these surveillances will be incorporated into the plant surveillance program will be included.
>
> The preventative maintenance tasks required to be performed during normal operation, and the planned surveillance intervals will be determined during the design phase. A description of these tasks and intervals will be provided in the 6-month update due in February, 2014.

The NRC staff notes the information on the design of the SFP level instrumentation to provide for routine testing and calibration is not currently available for review. In its letter dated July 3, 2013, the licensee indicated that the information will be provided to the staff during in the 6-month update due in February 2014. The staff has identified this request as:

**RAI No. 17**

**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.**

**b) A description of the way such testing and calibration will enable the conduct of regular channel checks of each independent channel against the other, and against any other permanently-installed SFP level instrumentation.**

**c) A description of the functional checks to be performed, and the frequency at which they will be conducted. Describe how calibration tests will be performed, and the frequency at which they will be conducted. Discuss how these surveillances will be incorporated into the plant surveillance program.**

**d) A description of the preventive maintenance tasks required to be performed during normal operation, and the planned maximum surveillance interval that is necessary to ensure that the channels are fully conditioned to accurately and reliably perform their functions when needed.**

*(This information was previously requested in RAI-10 of the NRC letter dated June 7, 2013.)*

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 system indicator will be located in the vicinity of the control room. The backup system indicator will be located in an accessible location.

In its letter dated July 3, 2013, the licensee stated, in part, that

> The primary display will be located in the Control Room A/C Unit & Filtration Units Room "A", Room 1512 EL-2047'-6", on the approximate centerline of the Plant West wall. The backup display will be located in the Control Room A/C Unit & Filtration Units Room "B", Room 1501 EL-2047'-6", on the approximate centerline of the Plant West wall.
>
> The displays are on the wall separating the Control Room from the Auxiliary Building, to the Plant East. The displays can be promptly viewed by Control Room staff due an access from the Control Room to the Control Room A/C Unit & Filtration Units Room "A". An alternate path can be utilized through the Communication Corridor, into the Auxiliary Building and into either the Control Room A/C Unit & Filtration Units Room "A" or "B". During and after an event, the area of the displays will be accessible by Operations personnel from the Control Room. The Control Room A/C Unit & Filtration Units Rooms "A" and "B" are located in the Control Room envelope. The Control Room envelope is isolated and pressurized during an accident involving the release of radioactive gases in the surrounding zones. Due to the close proximity between the Control Room and the display locations, use of wireless handheld radios or other equipment for communications will not be necessary.
>
> During all drain-down scenarios and external events the Control Room will be manned. With the displays just outside the Control Room they are considered "promptly accessible."

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 selected locations are within the Control Room's "envelope" and are directly accessible from the Control Room. 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 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 letter dated July 3, 2013, the licensee stated, in part, that

> Procedures for inspection, maintenance, repair, operation, and abnormal response associated with the SFP level instrumentation will be developed consistent with Appendix A-1 of [NEI 12-02]. Site procedures will be prepared, reviewed and approved in accordance with Callaway Plant administrative controls, using the vendor technical manual and other documentation. The vendor technical manual and documentation will include principles of operation, inspection and maintenance recommendations, drawings and technical documentation, individual component manufacturer manuals and documentation and recommended spare parts. Additional procedures for abnormal response will be developed in conjunction with FLEX implementation.

The NRC staff has concerns with the licensee's lack of information regarding the procedures to be established and maintained for testing, calibration, and use of the primary and backup spent fuel pool instrument channels. The staff previously requested this information in RAI-10 of the NRC letter dated June 7, 2013. However, based on feedback from licensees, the staff revised this RAI as follows:

**RAI No. 18**

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

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

> Processes will 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. Testing and calibration of the instrumentation will be consistent with vendor recommendations and any other documented basis.

In its letter dated July 3, 2013, the licensee stated, in part, that

> Maintenance and testing of the SFP level instrumentation system will be performed in accordance with the Callaway Plant preventive maintenance program procedure based on vendor recommendations. The design change program at Callaway Plant contains provisions for identifying such maintenance and testing requirements as part of the design process. Specific information regarding the maintenance and testing will be provided in the February, 2014 6-month status update after final design details and vendor information is obtained.
>
> Callaway will implement measures to minimize the possibility of either the primary or backup channel being out of service for any extended period. Sufficient spare components and materials will be maintained to enable timely repair or replacement of defective components. Callaway will follow the NEI 12-02 guidance with regard to the time periods when one or more channels may be out of service.
>
> If a channel is non-functional, a corrective action document will be initiated and actions taken to correct the deficiency within 90 days as described in NEI 12-02. The technology selected for level instrumentation is easily replaceable as components are passive and modular. Sufficient spares will be available on-site and the vendor can supply parts in a timely manner.

The NRC staff notes the information on processes for testing and calibration of the SFP level instrumentation is not currently available for review. In its letter dated July 3, 2013, the licensee indicated the information will be provided to the staff during in the 6-month update due in February 2014. The staff has identified this request as:

**RAI No. 19**

**Please provide the following:**

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

b) **A description of the compensatory actions to be taken in the event that one or both channels are non-functioning, as described in the guidance in NEI 12-02 section 4.3**

c) **A description of the planned compensatory actions to be taken when one of the instrument channels cannot be restored to functional status within 90 days.**

*(This information was previously requested in RAI-13 of the NRC letter dated June 7, 2013.)*

**RAI No. 20**

**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.**

3.15 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 channels is to be assured through conformance with the guidance in NEI 12-02 and the NRC staff's ISG, and that such reliability will be demonstrated through testing, analysis, qualification, and operating experience.

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 be provided by March 31, 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.

If you have any questions, please contact me at 301-415-2296 or via e-mail at fred.lyon@nrc.gov.

Sincerely,

***/RA/***

Carl F. Lyon, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure
Interim Staff Evaluation RAI

cc w/encl: Distribution via Listserv

DISTRIBUTION:
PUBLIC
LPL4-1 Reading
RidsAcrsAcnw_MailCTR Resource
RidsNroDe Resource
RidsNrrDeEicb Resource
RidsNrrDorlLpl4-1 Resource
RidsNrrDssSbpb Resource
RidsNrrLAJBurkhardt Resource
RidsNrrPMCallaway Resource
RidsRgn4MailCenter Resource
CRoque-Cruz, NRR/DSS/SBPB
DHalverson, NRO/DE/ICEEB
DRahn, NRR
GCasto, NRR
MMitchell, NRR
CHunt, NRR
BPurnell, NRR

**ADAM Accession No. ML13323A111** *via memo dated October 29, 2013

| OFFICE | NRR/DORL/LPL4-1/PM | NRR/DORL/LPL4-1/LA | NRR/DSS/SBPB/BC* |
|---|---|---|---|
| NAME | FLyon | JBurkhardt | GCasto |
| DATE | 11/22/13 | 11/20/13 | 10/29/13 |
| OFFICE | NRR/DE/EICB/BC* | NRR/DORL/LPL4-1/BC | NRR/DORL/LPL4-1/PM |
| NAME | JThorp | MMarkley | FLyon |
| DATE | 10/29/13 | 11/25/13 | 11/25/13 |

**OFFICIAL RECORD COPY**