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

October 29, 2013

Mr. Randall K. Edington
Executive Vice President Nuclear/
Chief Nuclear Officer
Mail Station 7602
Arizona Public Service Company
P.O. Box 52034
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 - 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. MF0774, MF0775, AND MF0776)

Dear Mr. Edington:

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 operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

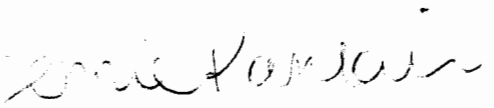
By letter dated February 28, 2013 (ADAMS Accession No. ML13070A077), Arizona Public Service Company (the licensee) provided the Overall Integrated Plan (OIP) for Palo Verde Nuclear Generating Station describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by fall 2014 for Unit 1, fall 2015 for Unit 2, and spring 2015 for Unit 3. By letter dated June 10, 2013 (ADAMS Accession No. ML13157A065), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 11, 2013 (ADAMS Accession No. ML13199A033), and August 28, 2013 (ADAMS Accession No. ML13246A008).

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 regarding this letter, please contact me at 301-415-1530 or via e-mail at jennivine.rankin@nrc.gov.

Sincerely,



Jennie K. Rankin, Project Manager
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Docket Nos. STN 50-528, STN 50-529,
and STN 50-530

Enclosure:
Interim Staff Evaluation and
Request for Additional Information

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

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-528, 50-529, AND 50-530

## 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. ML13070A077), Arizona Public Service Company (the licensee or APS) provided the OIP for Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by fall 2014 for Unit 1, fall 2015 for Unit 2, and spring 2015 for Unit 3. By letter dated June 10, 2013 (ADAMS Accession No. ML13157A065), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letter dated July 11, 2013 (ADAMS Accession No. ML13199A033), and August 28, 2013 (ADAMS Accession No. ML13246A008).

## 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 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

PVNGS, Units 1, 2, and 3 has three independent SFPs, each approximately 28-feet wide by 39-feet long 42-feet deep. The SFPs for the three units have similar configurations.

The licensee submitted its OIP on February 28, 2013. The OIP states that installation of the SFP level instrumentation at PVNGS will be completed by fall 2014 for Unit 1, fall 2015 for Unit 2, and spring 2015 for Unit 3, which is before startup from the second refueling outage for each unit.

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, for all three units, is the indicated level on either the primary or backup instrument channel of 23 feet (ft.) 4.5 inches (in.) above the top of the fuel storage racks, corrected for the accuracy of the SFP level instrument channel, which is to be determined.

In its letter dated July 11, 2013, the licensee stated, in part, that

> The plant pump line-up and elevation that corresponds to the most limiting submergence requirement to prevent air-entrainment (i.e. suction loss) in the cooling pumps suction line penetrating the pool at plant elevation 131'-0" (centerline-of-pipe) is:
>
> > 1 spent fuel pool cooling (PC) pump and 1 shutdown cooling (SDC) pump = Elevation 136'-5½"
>
> The net positive suction head (NPSH) requirements for the various cooling pump configurations are (UFSAR [Updated Final Safety Analysis Report] Section 9.1.3):
>
> > PC cooling pumps = 17' above pump suction centerline at elevation 103' 0"
> >
> > SDC cooling pump (during augmented pool cooling, full core off load) = 27'-1¾" above pump suction centerline at elevation 45'-7¼"
>
> The above required NPSH requirements have been adjusted accordingly to present the NEI 12-02 (Reference 1) described level above the centerline of the cooling pump suction.
>
> The level of "23 feet 4.5 inches above the top of the fuel storage racks" stated in the APS Overall Integrated Plan Response corresponds to an indicated instrument level of 137'- 6" (plant elevation). This level represents the higher of that required for suction loss or NPSH, as defined in NEI 12-02, with margin added.

The NRC staff notes that Level 1 at plant elevation 137 ft. 6 in. 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 all three units, 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 based on Reference 2 and Reference 3.

In its letter dated July 11, 2013, the licensee stated, in part, that

> The SFP water level adequate to provide substantial radiation shielding for a person standing on the SFP operating deck is at plant elevation 124'-2". This elevation corresponds to a SFP water surface level which is 10 feet above the highest point of the SFP fuel rack and will ensure the dose rate at the surface of the pool does not exceed 2.5 mRem/hr [UFSAR section 9.1.4.3.4(E)].
>
> As stated in the APS Overall Integrated Plan Response, Level 2 corresponds to the indicated level on either the primary or backup instrument channel of greater than 10 feet (± 1 foot) above the top of the fuel storage racks. Thus, the NEI 12-02 described Level 2 range corresponds to plant elevation 123'-2" to 125'-2".

The NRC staff notes that 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, for all three units, is the indicated level on either the primary or backup instrument channel of greater than 1 foot above the top of the fuel storage

racks, corrected for the accuracy of the SFP level instrument channel, which is to be determined.

In its letter dated July 11, 2013, the licensee stated, in part, that

> As stated in the APS Overall Integrated Plan Response, indicated level on either the primary or backup instrument channel is greater than 1 foot above the top of the fuel storage racks. Thus, the Level 3 plant elevation where fuel remains covered and actions to implement make-up water addition should no longer be deferred is 115'-2".

In its letter dated July 11, 2013, the licensee provided Figure 1, "Visual Presentation of SFP Water Levels" identifying various pool elevations and SFP instrumentation levels. The NRC staff reviewed this sketch and notes that this elevation is above 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, 2, and 3, appears to be consistent with NEI 12-02, as endorsed by the ISG.

In its letter dated July 11, 2013, the licensee stated that PVNGS Units 1, 2, and 3 have similar configurations and components and will have similar arrangements. In addition, this letter included Figure 2, "Spent Fuel Pool Geometry and Dimensions", and Figure 3, "Location SFPIS components within Fuel, Auxiliary and Control Buildings".

The NRC staff notes that Figure 2 shows four gates to other pools connected to the SFP. The NRC staff has concerns with the lack of clarity in regards to the arrangement of the SPF floor and the function and connection of the spaces in the vicinity of SFPs. The NRC staff has identified this request as:

**RAI #1**

**Please provide the following:**

a) **A description of how the other structures in the vicinity of the SFPs (cask loading pit, transfer canals and gates) shown in Figure 2, "Spent Fuel Pool Geometry and Dimensions" are connected to the SFPs.**

b) **If additional structures, other than the SFPs in each unit, are used for fuel storage, describe in detail their usage, operation, and provide justifications for not installing separate level instrumentation in other structures used for fuel storage.**

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 that the SFP instrumentation will utilize fixed primary and backup guided waved radar sensors and that both instruments will provide continuous level indication over a minimum range of 22 ft. 4.5 in., from 12 in. above the top of the fuel storage racks (plant elevation 115 ft. 1.5 in.) to above the low level alarm elevation (plant elevation 137 ft. 6 in.)

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.

In its letter dated July 11, 2013, the licensee stated that wireless technology would be used for the primary and backup instrument channels.

Regarding wireless technology, NEI 12-02 states, in part, that

> Wireless and other advanced technologies may be used provided that an evaluation is performed to address their interaction with other plant systems, failure modes, and impact on plant cyber security controls. The use of such wireless technology must be evaluated for any possible adverse impact it may have on other plant equipment likely to be in use at the same time as the wireless SFP instrumentation is functioning. Licensees should also consider the ability of a wireless communication link to perform in the environment (e.g., high humidity, radiation) in which it may be called upon to function. Wireless technologies must meet the same requirements as wired technologies as specified in this guidance document. Wireless technologies that might be used in either the permanent or backup water level instrument channels are not Critical Digital Assets as defined in NEI 08-09, *Cyber Security Plan for Nuclear Power Reactors* (Reference 7); however, licensees should be cognizant of the logical connections that the wireless system may enable and adhere to the controls in their plant-specific cyber security plans with respect to its implementation.

In its letter dated July 11, 2013, the licensee explained that the wireless technology would use the 900 megahertz (MHz), Industry, Scientific and Medical (ISM) band, from 902 MHz to 928 MHz, and stated, in part, that

> Implementation of the wireless signal provides for up to 256-bit encryption. An individual, single-frequency transmission can be dropped without disruption or loss of the measurement signal. FHSS [frequency hopping spread-spectrum] technology facilitates system operation without interference with 900 MHz communication equipment or other plant systems. No other plant systems use the 900 MHz ISM band. 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 (transmitters) and in the main control room and Operations Support Center (OSC) (receivers), and will be capable of operating in the respective environments 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, Section 3.1.

In addition, in its letter dated July 11, 2013, the licensee stated, in part, that

> The SFPIS is a stand-alone system with no connection into other parts of the plant instrumentation and control systems and it is not a Critical Digital Asset as defined in NEI 08-09, *Cyber Security Plan for Nuclear Power Reactors*. 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 instrumentation and control 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 in PVNGS. However, the NRC staff has concerns with the lack of information describing the performance evaluation of the wireless technology to be used for the SFP level instrumentation. The NRC staff has identified this request as:

**RAI #2**

**Please provide your plant-specific performance evaluation result and a brief summary of the proposed wireless technology that will be used in the primary and backup measurement systems to address the criteria summarized in Section 3.1 of NEI 12-02.**

*(This information was previously requested as RAI-2 (b) in NRC letter dated June 10, 2013. As a result of the information provided by the licensee, the RAI has been revised).*

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 arrangement will be similar for each of the three SFPs. The following description of the orientation of the primary and backup mounting brackets is for the Palo Verde Unit 1 SFP.
>
> The primary system mounting bracket can be located in or near the plant north-east corner of the pool, attached on the east deck.
>
> The backup system mounting bracket can be located along the plant east side of the spent fuel pool consistent with the guidelines in Reference 2 and 3.
>
> The detailed location of the primary and backup system mounting brackets, for each of the three SFPs, will be determined during the design phase with consideration of power availability and separation requirements to protect against potential missiles. This is an Open Item described in Section XIX of this document.
>
> The level sensing electronics for both primary and backup systems will be located in the respective auxiliary building, compliant with Reference 2 and Reference 3 for separation and accessibility.

In its letter dated July 11, 2013, the licensee provided a sketch depicting the conceptual locations of the two permanently mounted sensor probes and cable routings for the two redundant channels. This sketch depicts the two routings to be run side by side from probes to wireless transmitters located in the Auxiliary Building (AB), and from there the transmitting signals are sent to the operations support center at the AB, and to the main control room (MCR) at the Control Building.

In its letter dated August 28, 2013, the licensee identified the status of its open item with regards to arrangement of the primary and backup channel instrument as "Started". In this letter, the licensee stated that probe locations have not been finalized and that detailed engineering and design work is ongoing with expected completion in the 4th quarter of 2013.

The NRC staff notes that the final locations for the probes have not been finalized and that detailed engineering work is still ongoing. The NRC staff has concerns regarding the lack of information about the routing of these two channels in accordance with the guidance on channel separation as described in NEI 12-02. The NRC staff has identified this request as:

**RAI #3**

**Please provide the following:**

a) **The final locations/placement of the primary and back-up SFP level sensor.**

b) **Additional information describing how the proposed arrangement of the sensor probe assembly and routing of the cabling between the sensor probe assembly and the electronics in the Auxiliary Building meets 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, in part, 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. The locations will be reviewed for two-over-one seismic interference.

In its letter dated July 11, 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 appropriate plant elevation. 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, pipe guard 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 resulting from the excitation of the spent fuel pool water.

A response spectra analysis will be performed for the seismic evaluation of the mounting bracket using a Finite Element Analysis (FEA) software and using floor response spectrum at the operating deck elevation (140') in the Fuel Building (i.e., mounting floor elevation). Damping values will be according to 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 spent fuel pool area following an event. The design of the bracket and its mounting will maintain a design margin of 10% or more from the plant design basis criteria. 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.

The probe attaches to the bracket via a $1^1/_2$ inch threaded connection. The schematic below (Figure 5) details the vertical portion of the bracket where the probe will thread into the bracket. All non-movable connections of parts will be welded during manufacturing. Units 1, 2, and 3 have similar configurations and components will have similar arrangements. Dimensions are nominal and may be adjusted for seismic qualification and final delivery.

The attachment of the seismically qualified bracket to the pool deck will be through permanently installed anchors that will be designed according to the plant existing specification for design of concrete anchors. With the permanently installed anchors, the bracket pedestal will be secured to the poolside deck with

> adequate washers and bolts and the pedestal will attach to the bracket with adequate washers and bolts.

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 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 NRC 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 request. The NRC staff has identified these requests as:

**RAI #4**

**Please provide the analyses verifying that the seismic testing of the sensor probe assembly and the electronics units, and the licensee's analysis of the combined maximum seismic and hydrodynamic forces on the sensor probe assembly exposed to the potential sloshing effects, show that the SFP instrument design configuration will be maintained during and following the maximum seismic ground motion considered in the design of the SFP structure.**

**RAI #5**

**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.**

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, (3.6.2) 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 letter dated, July 11, 2013, the licensee stated, in part, that

> The PVNGS administrative procedure for equipment quality classifications will be revised to reflect the quality augmented designation for SFPIS required by the order (EA-12-051). Appropriate quality assurance measures will be selected consistent with Appendix A-1 of NEI 12-02 (Reference 1), similar to those described in Regulatory Guide 1.155, *Station Blackout*.

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

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:
>
> (1) 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,
>
> (2) temperatures of 212°F and 100 percent relative humidity environment,
>
> (3) seismic motion consistent with that of design basis loading at the installation location,
>
> (4) boiling water and/or steam environment,
>
> (5) a concentrated borated water environment,

Related to radiological conditions, in its letter dated July 11, 2013, the licensee stated, in part, that

> Components subject to significant radiation under beyond-design-basis conditions are those in the spent fuel pool building. These include the sensor probe, stilling well and bracket (which have no soft parts), and 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 total integrated dose will be completed to demonstrate operation for more than one week with spent fuel pool water at level 3, and indefinitely at level 2 or higher (refer to response 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 NRC staff has identified this request as:

**RAI #6**

**Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the equipment located within the control building or AB will be exposed. Also, please provide documentation indicating the radiological dosage amount that the electronics for this equipment is capable of withstanding. Please 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 11, 2013, in part, that

> SFPIS materials and components were selected and specified by design to meet or exceed the temperature and humidity in the SFP building and other buildings during an extended loss of alternating current 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 11, 2013, the licensee provided information regarding 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 and humidity exceeds the requirements for the mounting locations which will be in the AB. The system electronics and wireless transmitter 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 controls building (primary channel) or the AB.

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

**RAI #7**

**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) what will be the maximum expected temperature and relative humidity conditions in the room(s) in which the sensor electronics will be located under BDB conditions in which there will be no ac power available to run Heating Ventilation and Air Conditioning (HVAC) systems.**

*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 demonstration of shock and vibration adequacy will be consistent with the guidelines in Reference 2 [NEI 12-02], and Reference 3 [JLD-ISG-2012-03].

Passive components located within the SFP building

In its letter dated July 11, 2013, the licensee stated, in part, that

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

Active components located outside the SFP building

In its letter dated, July 11, 2013, the licensee stated, in part, that

> Active electronic components, located outside the spent fuel pool building, are permanently and rigidly attached to seismic racks or structural walls, and are not subject to significant shock and vibration loadings from sloshing. 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 inherently be resistant to shock and vibration loadings, the actual resistance depends on the component material property, structure, and the final installation. The NRC staff has concerns with the licensee's lack of information regarding the tests, applied forces and their directions, frequency ranges, and the operability of the sensor after shock and vibration tests are completed. The NRC staff has identified this request as:

**RAI #8**

**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 its successful tests demonstrating that 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, the forces and their frequency ranges and directions applied to the sensor applicable to its successful tests, demonstrating that 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 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 [Institute of Electrical and Electronics Engineers] 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).

Passive components located within the SFP building

In its letter dated July 11, 2013, the licensee stated, in part, that

> The sensor 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.
>
> All components except for the stainless steel sensor cable probe and the stainless steel bracket will be seismically tested in a rigidly-mounted condition equivalent to their as-installed condition. The sensor probe and bracket are passive components for which maintenance of structural or physical integrity is the only requirement.

Active components located outside the SFP building

In its letter dated July 11, 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 active components of the spent fuel pool instrumentation system will be functionally tested before and after seismic simulation. Water level inputs to the system will be simulated by grounding the sensor probe at selected, repeatable positions. Comparison of system output will be made both to pre-test results and to the measured position of the sensor probe input.

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 NRC staff plans to verify the results of the licensee's seismic test when it is completed. The NRC staff has identified this request as:

**RAI #9**

**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 Palo Verde, has been adequately demonstrated. Include information describing the design inputs and methodology used in any analyses of the mountings of electronic equipment onto plant structures, as requested in RAI #5 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 noted that the backup instrument system would be redundant to and independent of the primary instrument system. Independence would consider: 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 11, 2013, the licensee states, in part, that

> Within the SFP area, the brackets will be mounted as close to the Northeast (primary sensor) and Southeast (back-up sensor) corners of the pool as permanent plant structures allow. Placing the brackets and probes in the corners allows for natural protection from a single event or missile from disabling both channels. The cabling within the SFP area will be routed in separate hard-pipe

> conduit. All conduit routing and location of system components will be selected such that there will not be a 2 over 1 hazard.
>
> 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 envelope and the back-up in the Auxiliary Building and backup systems will be completely independent of each other, having no shared components.

The NRC staff notes that with this arrangement, 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 #10**

**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.**

The physical separation of the instruments was previously discussed in Section 3.4, "Arrangement." As stated in Section 3.4, the licensee appears to have routed the cables for each of the independent SFP level sensors in close proximity to one another, thus jeopardizing the independence between primary and backup instrument channels that could have been gained from the application of physical separation (Reference RAI # 3).

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 UPS, 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.
>
> Each channel will include an externally accessible bulkhead connector and transfer switch for connection of an alternate power source.

In its letter dated July 11, 2013, the licensee stated, in part, that

> Battery sizing is in accordance with standard IEEE 485-2010. Design criteria applied are:
>
> 1- Continuous system operation for 72 hours following loss of ac power.
>
> 2- 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 72-hour operating design basis is conservative, in that it exceeds the expected time of 34 hours for restoration of FLEX, Phase 2, AC power (Reference 2 [NEI 12-02]; Attachment 1A, Table Item 14).
>
> In addition, APS is aware of the generic industry battery life concern. When the nuclear industry addresses this concern generically through the Nuclear Energy Institute (NEI) and the applicable industry Groups (e.g., BNL), APS will consider any new recommendations and provide supplementary information in a subsequent six-month update. NEI will be coordinating with the NRC on the schedule for resolution.

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 NRC 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 NRC staff has identified this request as:

**RAI #11**

**Please provide the following:**

**a) A description of the electrical ac power sources and capabilities for the primary and backup channels.**

**b) 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

> 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 11, 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 second six-month update 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 second six-month update in February 2014.

The NRC staff notes that further information regarding SFP level instrumentation accuracy are not available for review and that the licensee will provide further information to the NRC staff in the second six-month update in February 2014. The NRC staff has identified this request as:

**RAI #12**

**Please provide the following:**

a) **An estimate of the expected instrument channel accuracy performance 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 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-7 in NRC letter dated June 10, 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 that instrument channel design will provide for routine testing and calibration consistent with Reference 2 [NEI 12-02], and Reference 3 [JLD-ISG-2012-03].

In addition, in its letter dated July 11, 2013, the licensee stated that all information regarding the RAI for testing in NRC letter dated June 11, 2013, will be provided in the second six-month update in February 2014.

The NRC staff notes that further information with regards to the design of the SFP level instrumentation to provide for routine testing and calibration are not available for review and that the licensee will provide further information to the NRC staff in the second six-month update in February 2014. The NRC staff has identified this request as:

**RAI #13**

**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 how 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 how functional checks will 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. Provide a discussion as to how these surveillances will be incorporated into the plant surveillance program.**

d) **A description of what preventive maintenance tasks are 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 as RAI-8 in NRC letter dated June 11, 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 control room. The backup system indicator will be located in an accessible location. The locations will allow for reading of the indicators following an event.

In its letter dated July 11, 2013, the licensee stated, in part, that

> Requests 9a
>
> The backup display will be mounted in the vicinity of the Operations Support Center (OSC), on the EL-140' in the Auxiliary Building (see response to RAI-2, Figure 3). Units 1, 2, and 3 have similar configurations and components will have similar arrangements.
>
> Request 9b
>
> The OSC is in the seismically qualified Auxiliary Building, on EL-140', the same level as the main control room. The OSC and vicinity are designated as a low radiation zone during post accident conditions and is accessible from the main control room though a connecting corridor. The backup display will be in direct line-of-sight of the wireless transmitter, therefore minimal interferences with the signal would be observed.
>
> Request 9c
>
> During all drain-down scenarios and external events, the main control rooms will be manned (Reference 2) and the backup display location is at the same elevation as the main control room and accessible through a connecting corridor. The back-up display is located in a habitable location and is accessible during an event. Both displays inside and outside the main control room 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 proposed location for the primary SFP level instrumentation display appears to be consistent with NEI 12-02, as endorsed by the ISG. However, the NRC staff notes that the licensee indicated that the backup display will be mounted in the vicinity of the Operations Support Center (OSC), on the EL-140' in the Auxiliary Building. The NRC staff is concern with the lack of information with regards to the location for the backup SFP instrumentation display. The NRC staff has identified this request as:

**RAI #14**

**For the SFP level instrumentation back up display please describe the evaluation used to validate that the display location can be accessed without unreasonable delay following**

**a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as well as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, please include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display periodically.**

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 to train personnel in the use and the provision of alternate power to the primary and backup instrument channels, including the approach to identify 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 11, 2013, the licensee stated, in part, that

> Site procedures for inspection, maintenance, repair, operation, abnormal response and administrative controls for the SFPIS will be developed in accordance with PVNGS procedure controls, using the vendor technical manual and other documentation, which 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 and included in FLEX support guidelines (FSGs) with FLEX implementation.

The NRC staff notes that the licensee's plan to develop procedures appears to be consistent with NEI 12-02, as endorsed by the ISG and that information regarding inspection, maintenance, repair, operation, abnormal response and administrative controls is not currently available for review. The NRC staff previously requested this information as RAI-10 in NRC letter dated June 10, 2013. However, based on feedback from licensees, the NRC staff revised this RAI as follows:

**RAI #15**

**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

> 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 other documented bases, consistent with Reference 2 [NEI 12-02], Section 4.3.

In its letter dated July 11, 2013, the licensee stated, in part, that

> Request 11a
>
> As described in the APS response to RAI-10, appropriate quality assurance measures will be applied to the SFPIS, consistent with NEI 12-02, Section 4.3 and Appendix A-1, which includes procedures, test control, corrective actions and audit functions. APS will establish and implement procedures for control and scheduling of SFPIS maintenance and testing. The new procedure(s) will include requirements for the necessary tests to be performed, frequency of testing, and acceptance criteria.
>
> Request 11b
>
> APS 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. APS will follow the NEI 12-02, Section 4.3, guidance with regard to the time periods when one or more channels may be out of service.
>
> Request 11c
>
> 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.
>
> As the spent fuel pool level instrumentation required by the order (EA-12-051) is to be coordinated with FLEX actions, equipment unavailability actions will be

> similar to NEI 12-06, Section 11.5, Item 2. Specifically, if the equipment becomes unavailable such that the site capability (e.g., 2 channels) is not maintained, APS will initiate actions within 24 hours to restore the site capability and implement compensatory measures (e.g., use of alternate suitable equipment or designated personnel) within 72 hours.

The NRC staff notes that the licensee proposed approach regarding compensatory actions with respect to testing and calibration appears to be consistent with NEI 12-02, as endorsed by the ISG. The NRC staff has concerns regarding the 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 NRC staff has identified this request as:

**RAI #16**

**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 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.**

**b) 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, in part, that

> Reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of Reference 3 [JLD-ISG-2012-03], and Reference 2 [NEI 12-02], Section 3.4, *Qualification* and Section 4.3, *Testing and Calibration.*

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 NRC staff will issue a final staff evaluation with its conclusion after the licensee has provided the requested information.

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 regarding this letter, please contact me at 301-415-1530 or via e-mail at jennivine.rankin@nrc.gov.

Sincerely,

***/ra/***

Jennie K. Rankin, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,
and STN 50-530

Enclosure:
Interim Staff Evaluation and
Request for Additional Information

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