EA-12-051

aps

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102-06728-DCM/MAM/CJS
July 11, 2013

U.S. Nuclear Regulatory Commission
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References: 1. NRC Order Number EA-12-051, *Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Level Instrumentation,* dated March 12, 2012

2. APS Letter 102-06669, *APS Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Level Instrumentation (Order Number EA-12-051)*, dated February 28, 2013

3. NRC letter, *Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Request for Additional Information Regarding Overall Integrated Plan in Response to Order EA-12-051, "Reliable Spent Fuel Pool Instrumentation,"* dated June 10, 2013

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3**
Docket Nos. STN 50-528, 50-529, and 50-530
Response to Request for Additional Information for the PVNGS Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Level Instrumentation (Order Number EA-12-051)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued an order (Reference 1) to Arizona Public Service Company (APS). Reference 1 was immediately effective and directs that APS must have a reliable means of remotely monitoring wide-range spent fuel pool levels to support effective prioritization of event mitigation and recovery actions in the event of a

A001
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beyond-design-basis external event. APS submitted the PVNGS overall integrated plan (OIP) for reliable spent fuel pool level instrumentation to the NRC in Reference 2.

By email dated June 3, 2013, the NRC provided draft requests for additional information (RAIs) to APS regarding the OIP associated with EA-12-051. The NRC requested responses to the RAIs within 30 days of receipt of the email. Reference 3 provided the formal RAIs. By email dated June 26, 2013, the NRC authorized an extension until July 12, 2013, for the RAI responses.

The Enclosure to this letter provides the information requested by the RAI. No commitments are being made to the NRC by this letter.

Should you need further information regarding this letter, please contact, Mark A. McGhee, Operations Support Manager, Regulatory Affairs, at (623) 393-4972.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on JULY 11, 2013
(Date)

Sincerely,

FOR D.C. MIMS

Enclosure – APS Response to Requests for Additional Information (RAIs) regarding the Overall Integrated Plan Associated with EA-12-051

DCM/MAM/CJS/hsc

cc:	E. J. Leeds	NRC Director Office of Nuclear Reactor Regulation
	A. T. Howell III	NRC Region IV Regional Administrator
	J. K. Rankin	NRC NRR Project Manager
	J. P. Reynoso	NRC Senior Resident Inspector for PVNGS
	L. M. Regner	NRR/JLD/PMB, NRC
	D. H. Jaffe	NRR/JLD, NRC

ENCLOSURE

APS RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION (RAIs) REGARDING THE OVERALL INTEGRATED PLAN ASSOCIATED WITH EA-12-051

Introduction

By letter number 102-06669, dated February 28, 2013 [Agencywide Documents Access and Management System (ADAMS) accession number ML13070A077], Arizona Public Service Company (APS) submitted an Overall Integrated Plan (OIP) in response to the March 12, 2012, U.S. Nuclear Regulatory Commission (NRC) Order modifying licenses with regard to requirements for Reliable Spent Fuel Pool (SFP) Level Instrumentation (Order EA-12-051; ADAMS accession number ML12054A679) for Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3.

The NRC staff reviewed the APS OIP and determined that additional information was needed to complete its technical review, as documented in letter dated June 10, 2013 (ADAMS accession number ML13157A065). The NRC request for additional information (RAI), which is prefaced by relevant guidance, is stated first, followed by the APS response.

NRC Request 1

2.0 <u>LEVELS OF REQUIRED MONITORING</u>

The OIP states, in part, that

1. **Level adequate to support operation of the normal fuel pool cooling system** - Indicated level on either the primary or backup instrument channel of 23 feet 4.5 inches above the top of the fuel storage racks, corrected for the accuracy of the SFP level instrument channel, which is to be determined. This level provides adequate margin to maintain fuel pool cooling system operation.

2. **Level adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck** - 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 based on Reference 2 and Reference 3. The 10 feet criterion is conservative with regard to dose, in that the Palo Verde UFSAR (Reference 5) sections 9.1.3.3.1.3 and 9.1.4.3.4 indicate that dose would remain at or below 2.5 millirem/hr at the surface of the water. This monitoring level ensures there is adequate water level to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck.

3. **Level where fuel remains covered** - 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. This monitoring level assures there is adequate water level above the stored fuel seated in the rack.

RAI-1

Please provide the following:

a) The specific functional reasons for identification of the elevations within the SFP as Levels 1, 2 and 3. For level 1, please specify how the identified location represents the HIGHER of the two points described in the NEI 12-02 guidance for this level.

b) A clearly labeled sketch depicting the elevation view of the proposed typical mounting arrangement for the portions of instrument channel consisting of permanent measurement channel equipment (e.g., fixed level sensors and/or stilling wells, and mounting brackets). Please indicate on this sketch the datum values representing level 1, level 2, and level 3 as well as the top of the fuel. Indicate on this sketch the portion of the level sensor measurement range that is sensitive to measurement of the fuel pool level, with respect to the level 1, level 2, and level 3 datum points.

APS Response

Request 1a

Level 1:

In accordance with Section 2.3.1 of NEI 12-02 (Reference 1), 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.

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 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.

Level 2:

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 ($\pm$ 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″.

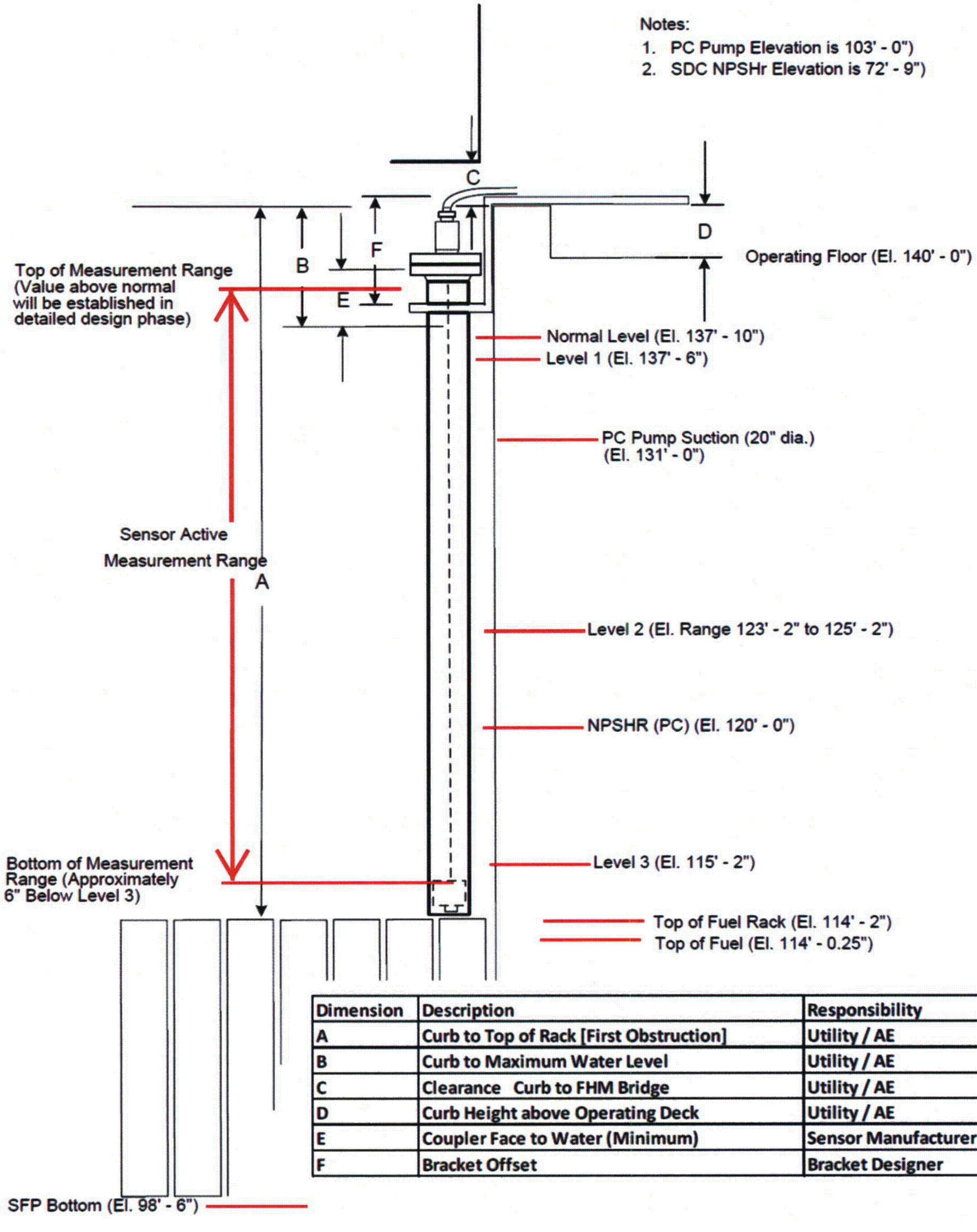
Level 3:

According to Section 2.3.3 of NEI 12-02 (Reference 1), Level 3 corresponds nominally (i.e., $\pm$ 1 foot) to the highest point of any fuel rack seated in the SFP. The plant elevation that corresponds to the highest point of the fuel rack is 114′-2″.

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″.

Request 1b

The sketch below (Figure 1) for the response to RAI-1b provides a visual representation of the required water levels described above.



Dimension	Description	Responsibility
A	Curb to Top of Rack [First Obstruction]	Utility / AE
B	Curb to Maximum Water Level	Utility / AE
C	Clearance Curb to FHM Bridge	Utility / AE
D	Curb Height above Operating Deck	Utility / AE
E	Coupler Face to Water (Minimum)	Sensor Manufacturer
F	Bracket Offset	Bracket Designer

Figure 1 – Visual Presentation of SFP Water Levels

NRC Request 2

3.0 INSTRUMENTATION DESIGN FEATURES

3.1 Arrangement

The OIP states, in part, that

> The primary system mounting bracket can be located in or near the plant northeast 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.
>
> 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.

RAI-2

Please provide the following:

a) A clearly labeled sketch or marked-up plant drawing of the plan view of the SFP area, depicting the SFP inside dimensions, the planned locations/ placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from the sensors toward the location of the readout/display device.

b) A plant-specific evaluation 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.

APS Response

Request 2a

Below are excerpts from plant drawings (Figures 2 and 3). Figure 3 depicts the conceptual locations of the two permanently mounted level probes (primary and backup) for the spent fuel pool instrumentation system (SFPIS) within the SFP area and the cable routing to locate the electronics to a non-harsh environment outside the SFP area. The final locations of the channel components and cabling will be determined during the design phase, anticipated to be completed in 4th quarter, 2013. Units 1, 2, and 3 have similar configurations and components will have similar arrangements, therefore, only one unit is depicted in the plant drawings.

Figure 2 provides the inside dimensions of the SFP (i.e., 28'-0" by 39'-0").

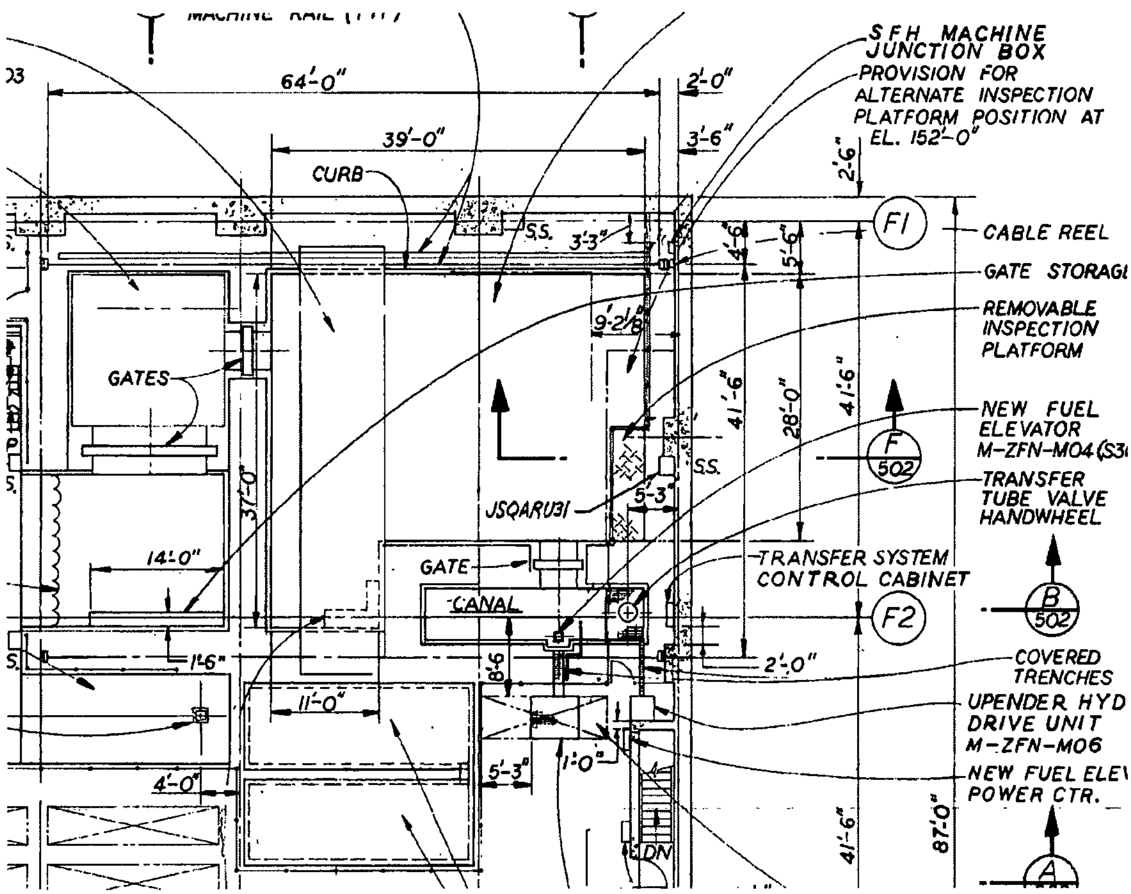


Figure 2 - Spent Fuel Pool Geometry and Dimensions

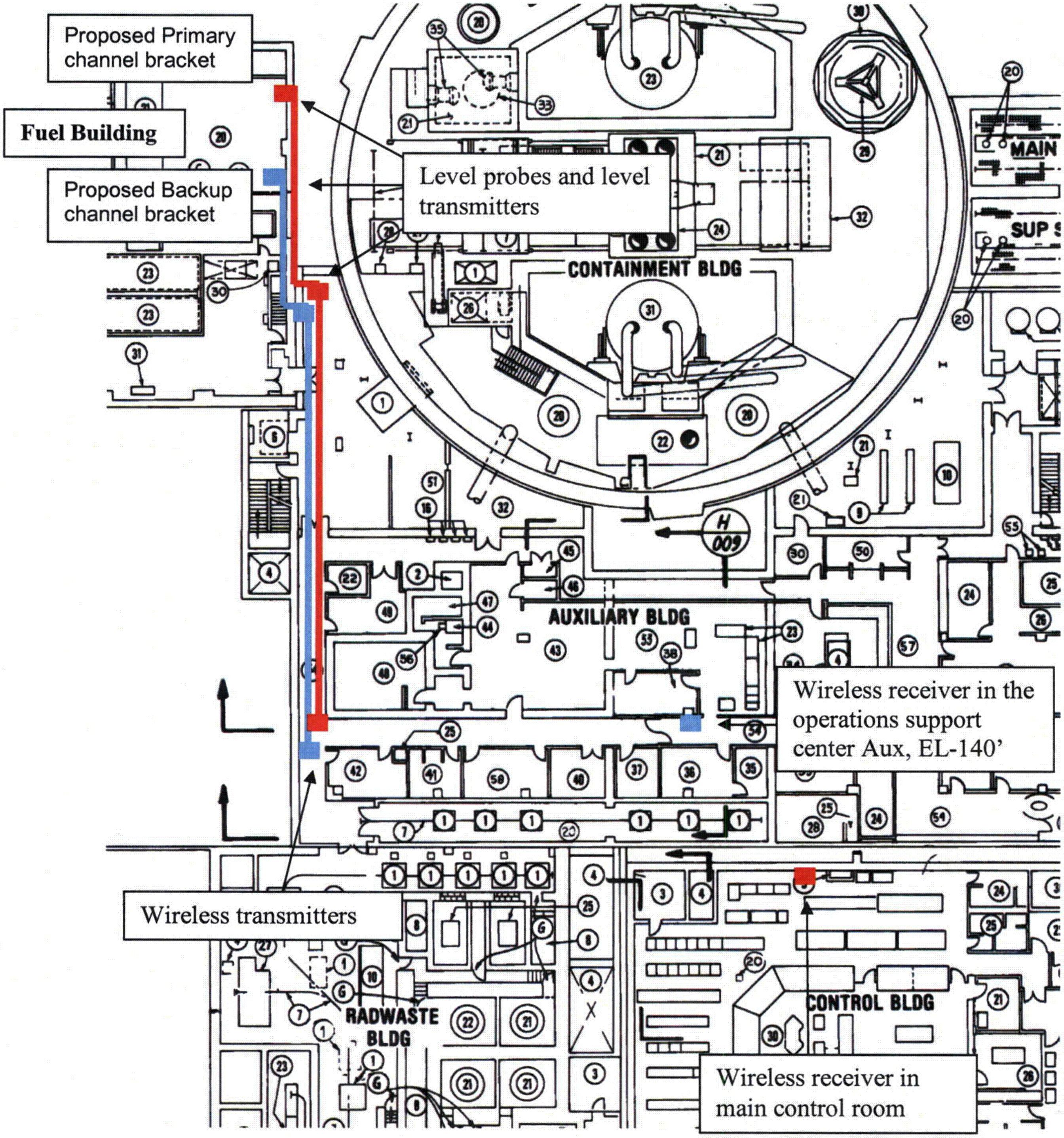


Figure 3 - Location SFPIS components within Fuel, Auxiliary and Control Buildings

Request 2b

The wireless technology for the primary and backup SFPIS level measurements uses the 900 MHz, 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 7 dbi.

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 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. Battery capacity for each of the SFP level measurement channels is sufficient to provide continuous operation for 72 hours, until off-site resources can be obtained.

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.

NRC Request 3

3.2 Mounting

The OIP states, 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.

RAI-3

Please provide the following:

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

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

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

APS Response

Request 3a

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.

Request 3b

The typical schematic below (Figure 4) details the pedestal that will attach to the pool deck. The bracket will be attached to the pool deck using installed anchors that will be designed according to the existing plant specification for design of concrete anchors. The pedestal will be adjusted to the height of the poolside curb to ensure the SFP bracket extends over the pool horizontally.

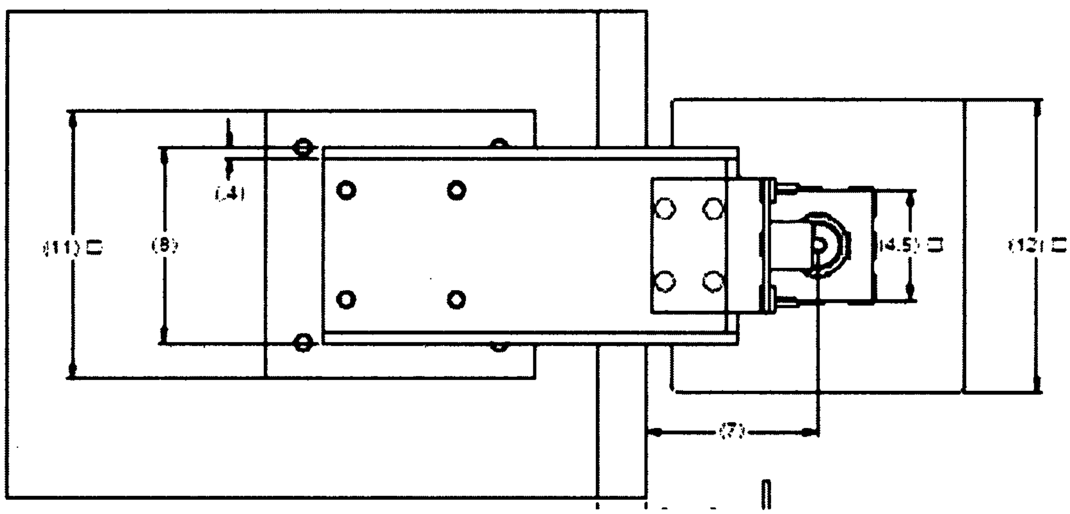


Figure 4 - Top View, Bracket Base Plate Design

The probe attaches to the bracket via a 1½ 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.

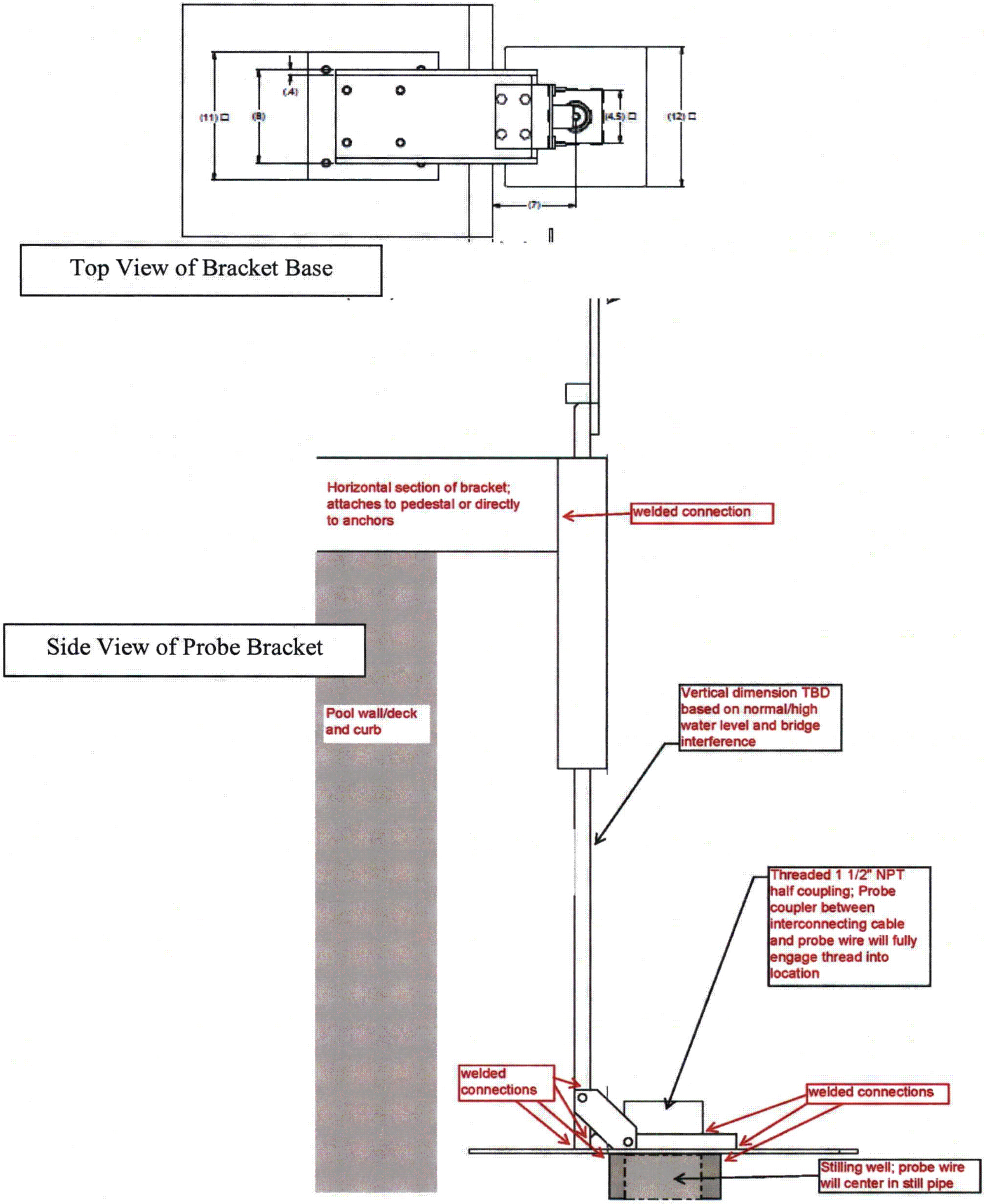


Figure 5 - SFPIS Mounting Details

Request 3c

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.

NRC Request 4

3.3 Qualification

The OIP states, in part, that

> Reliability of both instrument channels will 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:
>
> 1) conditions in the area of instrument channel component used for each instrument component,
> 2) effects of shock and vibration on instrument channel components used during and following any applicable event for installed components, and
> 3) seismic effects on instrument channel components used during and following a potential seismic event for installed components.
>
> The instrument channel reliability will be demonstrated using an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the effects of shock and vibration. Demonstration of shock and vibration adequacy will be consistent with the guidelines in Reference 2 and Reference 3.
>
> 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 [Institute of Electrical and Electronics Engineers (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).

RAI-4

Please provide the following:

a) A description of the specific method or combination of methods the licensee intends to apply to demonstrate the reliability of the permanently installed equipment under beyond-design-basis (BDB) ambient temperature, humidity, shock, vibration, and radiation conditions.

b) A description of the testing and/or analyses that will be conducted to provide assurance that the equipment will perform reliably under the worst-case credible design basis loading at the location where the equipment will be mounted. Please include a discussion of this seismic reliability demonstration as it applies to (a) the level sensor mounted in the SFP area, and (b) any control boxes, electronics, or read-out and re-transmitting devices that will be employed to convey the level information from the level sensor to the plant operators or emergency responders.

c) A description of the specific method or combination of methods that will be used to confirm the reliability of the permanently installed equipment such that, following a seismic event, the instrument will maintain its required accuracy.

APS Response

Request 4a

Demonstration of the reliability of the permanently installed SFPIS equipment under the beyond-design-basis conditions will be by design, analysis, operating experience and testing by the system vendor and the equipment manufacturer(s), as described below for each of the identified conditions.

<u>Temperature and Humidity</u>

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.

System Component	Basis for Demonstration
Sensor Probe	By design and analysis. Stainless steel cable probe is inherently tolerant of the effects of the specified temperature and humidity.
Sensor Bracket and Stilling Well	By design and analysis. Stainless steel bracket and stilling well are inherently tolerant of the effects of the specified temperature and humidity.
Sensor Coupler	By design and analysis. The coupler is primarily stainless steel, and is specifically designed by the manufacturer for high temperature and humidity applications.
Coaxial Cable	By design and testing. Selected by design for conditions; tested for performance at 212 °F, saturated steam.
Sensor Electronics	By design. Sensor electronics design temperature and humidity exceeds requirements for the sensor electronics mounting locations. This component will be located in the Auxiliary Building.
System Electronics and Wireless Transmitter	By design and testing. Component design temperature exceeds requirements for equipment mounting locations; tested for performance under conditions of temperature and humidity cycling. This component will be located in the Auxiliary Building.
Wireless Receiver and Display	By design and testing. Component design temperature exceeds requirements for equipment mounting locations; tested for performance under conditions of temperature and humidity cycling. This component will be located in the Control Building (primary channel) or the Auxiliary Building (backup channel).

Shock and Vibration

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.

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.

Radiation

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).

Request 4b

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 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.

Request 4c

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. 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.

NRC Request 5

3.4 Independence

The OIP states, 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.

RAI-5

Please provide the following:

a) A description of how the two channels of the proposed level measurement system meet this requirement so that the potential for a common-cause event to adversely affect both channels is precluded.

b) Further information on how each level measurement system, consisting of level sensor electronics, cabling, and readout devices will be designed and installed to address independence through the application and selection of independent power sources, the use of physical and spatial separation, independence of signals sent to the location(s) of the readout devices, and the independence of the displays.

APS Response

Request 5a

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.

Units 1, 2, and 3 have similar configurations and components will have similar arrangements.

Request 5b

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. Primary and backup systems will be completely independent of each other, having no shared components.

NRC Request 6

3.5 Power Supplies

The OIP states, in part, that

> An [alternating current (ac)] source will be selected for each system's 24-Vdc [Volts direct current] 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. The alternate power source is provided as part of the NEI 12-06 FLEX equipment (Reference 8[1]) and is not provided solely for the SFP instrumentation. Each channel will include an externally accessible bulkhead connector and transfer switch for connection of an alternate power source.

RAI-6

If the level measurement channels are to be powered through a battery system (either directly or through an Uninterruptible Power Supply (UPS)), please provide the design criteria that will be applied to size the batteries in a manner that ensures, with margin, that the channel will be available to run reliably and continuously following the onset of the BDB event for the minimum duration needed, consistent with the mitigation strategies for beyond-design-basis external events (Order EA-12-049).

[1] Nuclear Energy Institute, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," NEI 12-06 [Rev.0], August 2012 (ADAMS Accession No. ML12242A378).

APS Response

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; 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.

NRC Request 7

3.6 Accuracy

The OIP states, 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.
>
> The accuracy will be within the resolution requirements of Reference 2, Figure 1.
>
> The instrument accuracy will be sufficient to allow personnel using plant procedures to determine when the water level reaches levels 1, 2, and 3 (Section III, Items 1, 2, and 3) without conflicting or ambiguous indication.

RAI-7

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.

APS Response

Request 7a

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.

Request 7b

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.

NRC Request 8

3.7 Testing

The OIP states, in part, that

> Instrument channel design will provide for routine testing and calibration consistent with Reference 2 and Reference 3.

RAI-8

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. Please describe how calibration tests will be performed, and the frequency at which they will be conducted. Also, provide a discussion as to how these surveillances will be incorporated into the plant surveillance program.

d) A description of what preventative 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.

APS Response

Request 8a

Details of the capabilities and provisions of the level instrumentation for periodic calibration and testing will be established during the design verification phase. A description of these features and the way they will support in-situ testing will be provided in the second six-month update in February 2014.

Request 8b

A description of how the instrument channel design provides for routine in-situ testing and calibration (including channel checks) will be provided in the second six-month update in February 2014.

Request 8c

Details of functional checks and instrument channel calibrations will be determined during the design verification 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 second six-month update in February 2014. An explanation of how these surveillances (maintenance testing) will be incorporated into the plant surveillance program will be included.

Request 8d

The preventative maintenance tasks required to be performed during normal operation, and the planned surveillance intervals will be determined during the design verification phase. A description of these tasks and intervals will be provided in the second six-month update in February 2014.

NRC Request 9

3.8 Display

The OIP states, 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. The display will provide continuous indication of the SFP water level and will be consistent with the guidelines of References 2 and 3.

RAI-9

Please provide the following:

a) The specific location for the backup instrument channel display.

b) If the backup display location is other than the main control room, then provide justification for prompt accessibility to displays including primary and alternate route evaluation, habitability at display location(s), continual resource availability for personnel responsible to promptly read displays, and provisions for communications with decision makers for the various SFP drain down scenarios and external events.

c) The reasons justifying why the locations selected enable the information from these instruments to be considered "promptly accessible" to various drain-down scenarios and external events.

APS Response

Request 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.'

NRC Request 10

4.0 <u>PROGRAM FEATURES</u>

4.1 Procedures

The OIP 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.
>
> FLEX Support Guidelines will address a strategy to ensure the SFP water makeup is initiated at an appropriate time consistent with implementation of NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide* (Reference 8).

RAI-10

Please provide a description of the standards, guidelines and/or criteria that will be utilized to develop procedures for inspection, maintenance, repair, operation, abnormal response, and administrative controls associated with the SFP level instrumentation, as well as storage and installation of portable instruments.

APS Response

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*. 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.

NRC Request 11

4.2 Testing and Calibration

The OIP states, 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, Section 4.3.

RAI-11

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. Please 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 how the guidance in NEI 12-02 Section 4.3 regarding compensatory actions for one or both non-functioning channels will be addressed.

c) A description of what compensatory actions are planned in the event that one of the instrument channels cannot be restored to functional status within 90 days.

APS Response

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.

References:

1. NEI 12-02, *Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,'* Revision 1, dated August 24, 2012.
2. APS letter number 102-06670, *APS Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 28, 2013