EA-12-051

DWIGHT C. MIMS
Senior Vice President, Nuclear
Regulatory & Oversight

Palo Verde
Nuclear Generating Station
P.O. Box 52034
Phoenix, AZ 85072
Mail Station 7605
Tel 623 393 5403

102-06669-DCM/RKR
February 28, 2013

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

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. NRC Interim Staff Guidance JLD-ISG-2012-03, *Compliance with Order EA-12-051, Reliable Spent Fuel Pool Level Instrumentation*, Revision 0, dated August 29, 2012
3. 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
4. APS Letter 102-06613, *Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Level Instrumentation (Order Number EA-12-051)*, dated October 29, 2012

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, and 3
Docket Nos. STN 50-528, 50-529, and 50-530
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)

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 PVNGS 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 beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 requires submission of an overall integrated plan by February 28, 2013. The NRC Interim Staff Guidance (ISG) (Reference 2) was issued August 29,

A001
NRR

2012, which endorsed industry guidance document NEI 12-02, Revision 1 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 3 provides direction regarding the content of this overall integrated plan. Reference 4 provided the initial status report for PVNGS, as required by Reference 1.

The purpose of this letter is to provide the overall integrated plan pursuant to Section IV, Condition C.1, of Reference 1. This letter confirms APS has received Reference 2 and has an overall integrated plan developed in accordance with the guidance, that will enhance the ability to cope with conditions resulting from beyond-design-basis events.

The information in the enclosure provides the Palo Verde Units 1, 2, and 3 Overall Integrated Plan pursuant to Reference 3. The enclosed Overall Integrated Plan is based on conceptual design information. Final design details and associated procedure guidance, as well as any revisions to the information contained in the Enclosure, will be provided in the 6-month updates required by Reference 1.

No commitments are being made to the NRC by this letter.

Should you have any questions concerning the content of this letter, please contact Robert K. Roehler, Licensing Section Leader, at (623) 393-5241.

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

Executed on 3/28/13
(Date)

Sincerely,

D. C. Mauro

Enclosure - Palo Verde Units 1, 2, and 3 Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation

DCM/RKR/CJS/hsc

cc:

E. J. Leeds,	NRC Director, Office of Nuclear Reactor Regulation
E. E. Collins Jr.	NRC Region IV Regional Administrator
L. K. Gibson	NRC NRR Project Manager
J. K. Rankin	NRC NRR Project Manager
M. A. Brown	NRC Senior Resident Inspector for PVNGS
L. M. Regner	NRR/JLD/PMB, NRC
D. H. Jaffe	NRR/JLD, NRC

ENCLOSURE

PALO VERDE UNITS 1, 2, AND 3 OVERALL INTEGRATED PLAN FOR RELIABLE SPENT FUEL POOL INSTRUMENTATION

Palo Verde Units 1, 2, and 3 Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation

I. Introduction

The Nuclear Regulatory Commission (NRC) issued Order EA-12-051, *Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation*, (Reference 1) dated March 12, 2012. The Order modified licenses to require 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. The Order also requires submission of an overall integrated plan that provides a description of how the requirements of the Order will be achieved.

Nuclear Energy Institute (NEI) 12-02, *Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,'* (Reference 2) provides an approach for complying with order EA-12-051. NRC Interim Staff Guidance (ISG) JLD-ISG-2012-03, *Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation*, (Reference 3) considers that the methodologies and guidance in conformance with the guidelines provided in Reference 2, subject to the clarifications and exceptions specific to Reference 2, Section 3.4, *Qualification*, are an acceptable means of meeting the requirements of Reference 1.

This overall integrated plan applies to Palo Verde Nuclear Generating Station Units 1, 2, and 3 (hereafter referred to as Palo Verde) and provides the approach for complying with Reference 1 using the methods described in Reference 3. Consistent with the requirements of Reference 1 and the guidance in Reference 2, six-month reports will delineate progress made, any proposed changes in compliance methods, updates to the schedule, and if needed, requests for relief and basis.

II. Schedule

Installation of reliable spent fuel pool (SFP) level instrumentation will be completed prior to startup from the second refueling outage per Unit, after submittal of this plan, or December 31, 2016, whichever occurs first, consistent with *Palo Verde Units 1, 2, and 3 Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation* (Reference 4).

The following milestone schedule is provided. The dates are planning dates and are subject to change as design and implementation details are developed. Any

changes to the following milestones will be reflected in the subsequent six-month status reports.

The current milestones are:

	Unit 1	Unit 2	Unit 3
• Commence Engineering and Design	1Q2013	1Q2013	1Q2013
• Complete Design	4Q2013	4Q2013	4Q2013
• Receipt of SFP Instruments	2Q2014	2Q2015	4Q2014
• Complete SFP Instruments Procedures & Training	3Q2014	3Q2015	1Q2015
• SFP Instruments Operational	4Q2014*	4Q2015*	2Q2015*

*Consistent with Reference 4, implementation for Unit 1 is prior to startup from 1R18 (Fall 2014), Unit 2 is prior to startup from 2R19 (Fall 2015) and Unit 3 is prior to startup from 3R18 (Spring 2015).

III. Identification of Spent Fuel Pool Water Levels

Key spent fuel pool water levels:

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.

IV. Instruments

The design of the instruments will be consistent with the guidelines of Reference 2 and Reference 3 as discussed below.

Primary and Backup Instrument Channels:

The Palo Verde SFP Instrumentation System (SFPIS) will utilize fixed primary and backup guided wave radar (GWR) sensors. The GWR technology meets the guidance of References 2 and 3 by providing the capability to reliably monitor the spent fuel pool water level under adverse environmental conditions.

GWR technology uses the principle of time domain reflectometry to detect the SFP water level. A microwave signal is sent down the cable probe sensor, and when it reaches the water, it is reflected back to the sensor electronics. This is due to the difference between the dielectric constants of air and water. Using the total signal travel time, the sensor electronics embedded firmware computes the level of the water in the SFP. The probe, which is located in the SFP, is separated from the sensor electronics, and connected by an interconnecting cable that is routed into the Auxiliary Building which is not a harsh environment. By placing the sensor electronics outside of the SFP area it is not subject to the harsh environment resulting from the boiling or loss of water in the pool during a postulated loss of inventory event that creates high humidity, steam and/or radiation.

The primary and backup instrument channels will provide continuous level indication over a minimum range of 22 feet 4.5 inches, from 12 inches above the top of the fuel storage racks (plant elevation 115 feet 1.5 inches) to above the low level alarm elevation (plant elevation 137 feet 6 inches) as described in UFSAR Section 9.1.3.3.1.1.1 of Reference 5.

Instrument channel independence is described in Section X, *Independence,* of this document.

V. Reliability

Reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of Reference 3 and Reference 2, Section 3.4, *Qualification* and Section 4.3, *Testing and Calibration*.

VI. Instrument Channel Design Criteria

Instrument channel design criteria will meet the guidelines of Reference 2 and Reference 3.

The primary and backup measurement systems will consist of a flexible stainless-steel sensor cable probe, suspended in the SFP from a bracket attached to the operating deck or to a raised curb at the side of the pool. The cable probe will extend from slightly above the normal pool level elevation to less than 1 foot above the top of the fuel storage racks. The sensor electronics will be mounted in the Auxiliary Building, to prevent instrument exposure to radiation and high temperatures which could result from a postulated loss of water inventory in the pool. There are also two wall mounted panels, providing sensor and display interfaces and wireless transmission and reception capabilities.

The 4-20 milliamp (mA) signal from the sensor electronics module will be connected to a wall-mounted, seismically qualified, power supply and transmitter panel. The panel contains a 24-volt (V) direct current (dc) (Vdc) uninterruptible power supply (UPS), a wireless transmitter for the sensor signal, and batteries for continued system operation during a loss of alternating current (ac) power for a minimum of 72 hours, in which time an alternate external source of power can be supplied. A bulkhead connector and transfer switch is externally accessible for the connection of an alternate power source. The alternate power source is provided as part of the NEI 12-06 FLEX equipment (Reference 8) and is not provided solely for the SFP instrumentation. The transmitter panel will be located with or near the sensor electronics housing, outside of the spent fuel pool area in the Auxiliary Building. The interface between the sensor electronics and the wall-mounted transmitter panel is a twisted, shielded pair cable. The transmitter panel will send a signal to the wireless receiver panel.

The wall-mounted seismically qualified wireless receiver panel contains a 24-Vdc UPS, door-mounted digital display of SFP level, and batteries for continued system operation during a loss of ac power for a minimum of 72 hours until an alternate external source of power can be supplied. A bulkhead connector and transfer switch is externally accessible for the connection of an alternate power source. The alternate power source is provided as part of the NEI 12-06 FLEX equipment (Reference 8) and is not provided solely for the SFP instrumentation. The wall mounted receiver panel for the backup measurement system is located in an accessible location with the primary measurement system displayed in the control room.

VII. Arrangement

The primary and backup instrument sensing components will be separated consistent with the guidelines of Reference 2 and Reference 3. Design of the mounting bracket will allow the fuel handling machine to pass over it without interference.

A SFP walkdown for all three SFPs identified preliminary locations for the primary and backup level sensing components as described below. The design for installation will include physical separation of the two sensors, separate extension cables from the electronics to the sensors, routing cables in separate conduit / trays, separate UPS power supplied from different ac sources, and seismically qualified mounting with physical separation of both the level sensing electronics and indications. 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.

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.

VIII. Mounting

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.

IX. Qualification

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 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,
(6) impact of FLEX mitigating strategies.

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 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).

X. Independence

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.

XI. Power Supplies

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. 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) 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.

XII. Accuracy

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.

XIII. Testing

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

XIV. Display

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.

XV. Instrument Channel Program Criteria

Instrument channel program criteria will be consistent with the guidelines of References 2 and 3.

A. Training

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.

B. Procedures

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).

C. Testing and Calibration

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.

XVI. Need for Relief and Basis

Arizona Public Service is not requesting relief from the requirements of Reference 1 or the guidance in References 2 and 3 at this time.

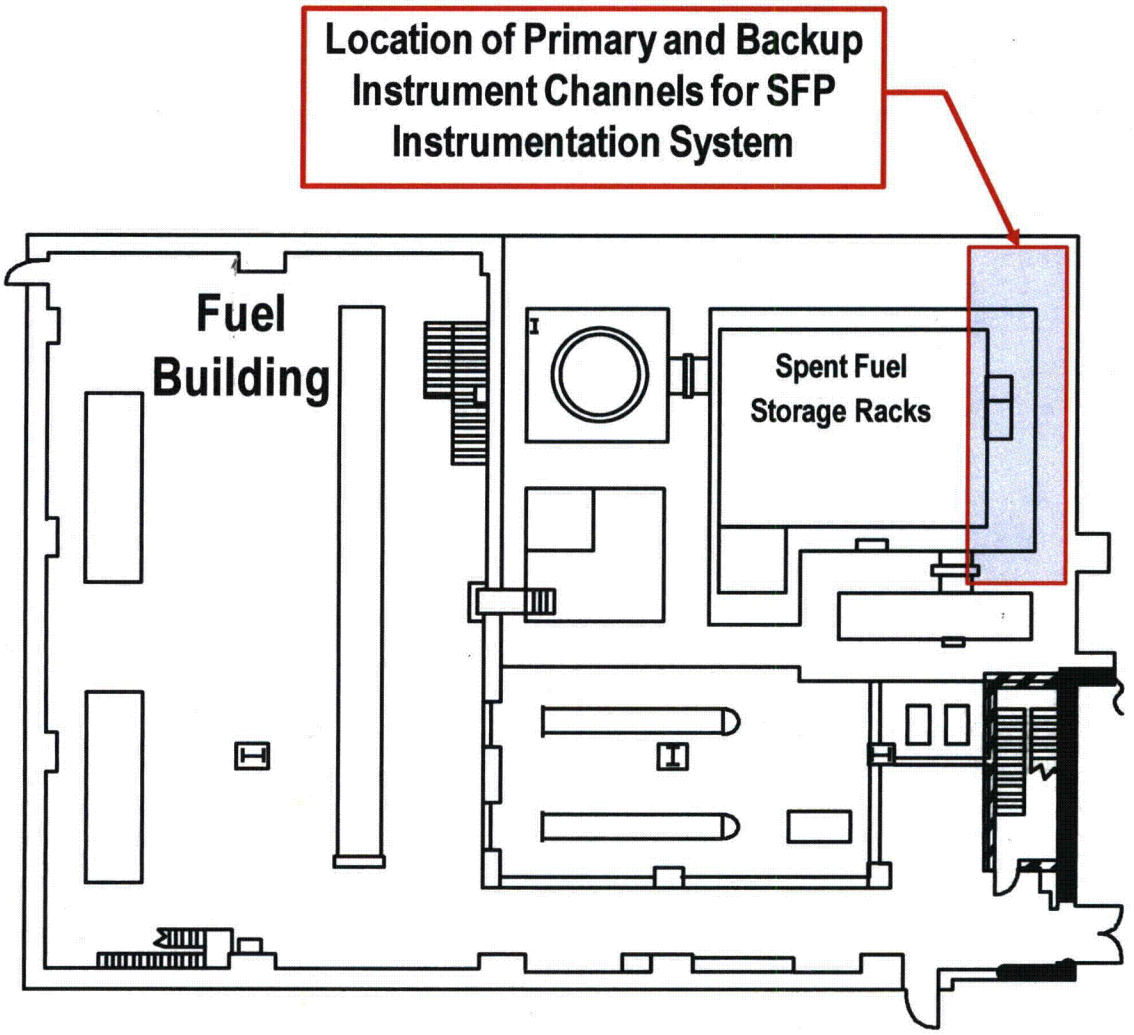
Consistent with the requirements of Reference 1 and the guidance in Reference 2, the six-month reports will delineate progress made, any proposed changes in the

compliance methods, updates to the schedule, and if needed, requests for relief and their bases.

XVII. References

1) EA-12-051, *Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,* March 12, 2012.
2) 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, August 24, 2012.
3) NRC JLD-ISG-2012-03, *Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,* Revision 0, August 29, 2012.
4) Arizona Public Service Letter 102-06613-DCM/MAM/TLC, *Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, 3, Docket Nos. STN 50-528, 50-529, and 50-530, Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051),* October 29, 2012.
5) Palo Verde Nuclear Generating Station Units 1, 2, and 3, *Updated Final Safety Analysis Report*, Revision 16, June 2011.
6) EA-12-049, *Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis-External Events,* March 12, 2012.
7) IEEE Standard 344-2004, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations,* June 8, 2005.
8) NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,* Revision 0, August 2012.

XVIII. Sketch



Sketch 1
Preliminary Probe Location for Palo Verde Unit 1
Note: The preliminary probe locations are similar for Palo Verde Units 2 and 3

XIX. Open Items

As the design process progresses, the various issues described in this document will be finalized.

The following open item has been identified. An update on the closure of this item will be provided in each six-month status report, until completed.

1. Section VII, *Arrangement*, finalize primary and backup system probe locations for each of the three SFPs.