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

May 20, 2014

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 – STAFF ASSESSMENT OF THE FLOODING WALKDOWN REPORT SUPPORTING IMPLEMENTATION OF NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NOS. MF0258, MF0259, AND MF0260)

Dear Mr. Edington:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information letter per Title 10 of the *Code of Federal Regulations*, Subpart 50.54(f) (50.54(f) letter). The 50.54(f) letter was issued to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions to be taken in response to lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami. The request addressed the methods and procedures for nuclear power plant licensees to conduct seismic and flooding hazard walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and to verify the adequacy of the monitoring and maintenance procedures.

By letter dated November 27, 2012, Arizona Public Service Company (APS, the licensee), submitted a Flooding Walkdown Report as requested in Enclosure 4 of the 50.54(f) letter for Palo Verde Nuclear Generating Station, Units 1, 2, and 3 (PVNGS). By letter dated January 31, 2014, APS provided a response to the NRC staff's request for additional information dated December 23, 2013, for the NRC staff to complete its assessments.

The NRC staff reviewed the information provided and, as documented in the enclosed staff assessment, determined sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

If you have any questions, please contact me at (301) 415-1530 or via e-mail at jennivine.rankin@nrc.gov.

Sincerely,

Jennivine K. Rankin, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Enclosure:
Staff Assessment of Flooding
Walkdown Report

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT

NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO

THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT

ARIZONA PUBLIC SERVICE COMPANY

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

DOCKET NOS. STN 50-538, STN 50-529, AND STN 50-530

1.0 INTRODUCTION

On March 12, 2012,[1] the U.S. Nuclear Regulatory Commission (NRC) issued a request for information per Title 10 of the *Code of Federal Regulations*, Subpart 50.54(f) (50.54(f) letter) to all power reactor licensees and holders of construction permits in active or deferred status. The request was part of the implementation of lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 4, "Recommendation 2.3: Flooding,"[2] to the 50.54(f) letter requested licensees to conduct flooding walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions using the corrective action program (CAP), verify the adequacy of monitoring and maintenance procedures, and report the results to the NRC.

Enclosure 4 of the 50.54(f) letter requested licensees to submit a final report which includes the following:

a. Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.

b. Describe protection and migration features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs [systems, structures, and components] important to safety.

c. Describe any warning systems to detect the presence of water in rooms important to safety.

d. Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information item 1.h.

e. Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures,)

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[1] Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340.
[2] ADAMS Accession No. ML12056A050.

using the documentation template discussed in Requested Information item 1.j, including actions taken in response to the peer review.

f. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using guidance in Regulatory Issues Summary 2005-20, Revision 1, Revision to the NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

g. Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects.

h. Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

In accordance with the 50.54(f) letter, Enclosure 4, Required Response Item 2, licensees were required to submit a response within 180 days of the NRC's endorsement of the flooding walkdown guidance. By letter dated May 21, 2012,[3] the Nuclear Energy Institute (NEI) staff submitted NEI 12-07, Revision 0-A, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" to the NRC staff to consider for endorsement. By letter dated May 31, 2012,[4] the NRC staff endorsed the walkdown guidance.

By letter dated November 27, 2012,[5] Arizona Public Service Company (APS, the licensee), provided a response to Enclosure 4 of the 50.54(f) letter Required Response Item 2, for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3 (PVNGS). The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013.[6] The licensee responded by letter dated January 31, 2014.[7]

The NRC staff evaluated the licensee's submittals to determine if the information provided in the walkdown report met the intent of the walkdown guidance and if the licensee responded appropriately to Enclosure 4 of the 50.54(f) letter.

2.0 REGULATORY EVALUATION

The SSCs important to safety in operating nuclear power plants are designed either in accordance with, or meet the intent of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," Criterion 2, "Design bases for protection against natural

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[3] ADAMS Package Accession No. ML121440522.
[4] ADAMS Accession No. ML12144A142.
[5] ADAMS Accession No. ML12334A416.
[6] ADAMS Accession No. ML13325A891.
[7] ADAMS Accession No. ML14038A076.

phenomena," and Appendix A to 10 CFR Part 100, "Reactor Site Criteria." Criterion 2 states that SSCs important to safety at nuclear power plants shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

For initial licensing, each licensee was required to develop and maintain design bases that, as defined by 10 CFR 50.2, identify the specific functions that an SSC of a facility must perform, and the specific values or ranges of values chosen for controlling parameters as reference bounds for the design.

The design bases for the SSCs reflect appropriate consideration of the most severe natural phenomena that have been historically reported for the site and surrounding area. The design bases also reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The current licensing basis (CLB), as defined in 10 CFR 54.3(a), is the set of NRC requirements applicable to a specific plant, including the licensee's docketed commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis, including all modifications and additions to such commitments over the life of the facility operating license.

3.0 TECHNICAL EVALUATION

3.1 Design Basis Flooding Hazard for the Palo Verde Nuclear Generating Station Site

The licensing basis flood event at the PVNGS site is a probable maximum precipitation (PMP) event (15.53 inches in 6 hours) as described in the Updated Final Safety Analysis Report. The calculated maximum water surface elevations due to local PMP storm runoff are 955.5 feet (ft), 952.5 ft, and 949.5 ft, respectively, for Units 1, 2, and 3. These maximum flood elevations are 2.0 ft below the floor elevations at the respective units.

The PVNGS site is located on a plain within the Sonoran high desert at an average elevation of about 951 ft above mean sea level (msl). The three PVNGS power reactors are at elevations respectively of 957.5 ft, 954.5 ft, and 951.5 ft msl. The licensee notes that the PVNGS site is not considered to be susceptible to flooding by rivers, intermittent tributaries (washes), dam failures, ice flooding, or channel migration. The site is also not adjacent to any coastal area and, therefore, not vulnerable to flooding by tsunami, tidal surge, or seiche. As a consequence, these flooding scenarios were not considered as part of the original licensing basis or in the earlier Individual Plant Examination of External Events for the site. As such, the PVNGS site can be considered a "dry site."

Groundwater intrusion is not considered to be a design issue at the site as no groundwater was encountered during the original construction at the PVNGS site. Some (limited) perched water may occur at depths 30 to 60 ft below the site. A regional groundwater system is also present but its depth is about 200 ft below the ground surface.

Based on the NRC staff's review, the NRC staff concludes that the licensee has described the design basis flood hazard levels as indicated in Requested Information item 2.a of the 50.54(f) letter, consistent with Appendix D, "Walkdown Report," of the walkdown guidance.

3.2 Flood Protection and Mitigation

3.2.1 Flood Protection and Mitigation Description

The CLB for flood protection at the PVNGS site is a PMP event. The site is located on gently dipping plain in which the surface drainage afforded by the natural topography at the site has been complimented by a man-made drainage system that includes ditches and culverts. The licensee reports that the onsite drainage system is designed to minimize water pondage in the yard adjacent to plant facilities. For example, surface runoff from the power block area is collected by drainage ditches and discharged into the realigned East Wash in a lower portion of the site. At some locations within the site, the licensee reports that compacted fill has been introduced adjacent to structures to raise the elevations in those areas above projected flood levels. The addition of fill has also been used to modify site grades locally to improve the efficiency of the site drainage system. Surface drainage is also enhanced by the geology of the site. The PVNGS site is underlain by high-permeability soils which permit the rapid infiltration of surface water. The nature of the site drainage therefore is such that the topography in combination with the geology would divert surface water away from PVNGS structures. Therefore, the CLB states that no surface ponding of water will affect safety-related structures or systems.

3.2.2 Incorporated and Exterior Barriers

In general, any flood protection measures intended to protect safety-related systems and equipment are passive features. They were incorporated into the original PVNGS site design or added subsequently, and are now credited in the CLB. The licensee notes in the flooding walkdown report dated November 27, 2012, that these features include interior and exterior walls of structures, floors, doors, penetrations, roofs, and sump pumps. Also cited is the existing topography (both natural and modified) of the site as well as catchment basins, drainage basins, and drainage ditches.

The licensee reported that no safety-related systems or equipment are affected by flooding.

Lastly, the licensee did not identify any exterior flood prevention barriers permanently in-place requiring operator manual actions.

3.2.3 Temporary Barriers and Other Manual Actions

The site has no temporary barriers that require manual operator actions in the event of a flood threat.

3.2.4 Reasonable Simulation and Results

The purpose of performing reasonable simulations is to verify that the required flood protection procedures or activities can be executed as specified /as written. The licensee noted that flood

protection features at the PVNGS site do not include any temporary or active features that would require the implementation of a procedure for the performance of those manual/operator actions necessary for the flood protection feature in question to perform its intended flood protection function. Therefore, the licensee reported that no procedure, walk-through, or "Reasonable Simulation," was conducted at the PVNGS site.

3.2.5 Conclusion

Based on its review, the NRC staff concludes that the licensee has described protection and mitigation features as indicated in Requested Information item 2.b of the 50.54(f) letter consistent with Appendix D, "Walkdown Report," of the walkdown guidance.

3.3 Warning Systems

There are no credited external flooding warning systems installed at the PVNGS site.

Based on its review, the NRC staff concludes that the licensee has provided information to describe any warning systems as indicated in Requested Information item 2.c of the 50.54(f) letter consistent with Appendix D, "Walkdown Report," of the walkdown guidance.

3.4 Effectiveness of Flood Protection Features

The licensing basis flood event at the PVNGS site is a PMP event. All flood protection features at the PVNGS site intended to protect safety-related equipment have passive design features. These features include reliance on the existing topography or grading of the existing ground surface in combination with a gravity-driven drainage system. Field observations by the licensee during the course of the walkdowns included the identification of modifications to the topography within the site footprint. The licensee reported that these topographic alterations/modifications were judged to not adversely affect the run-off assumed in the CLB.

Based on its review, the NRC staff concludes that the licensee has discussed the effectiveness of flood protection features as indicated in Requested Information item 2.d of the 50.54(f) letter consistent with Appendix D, "Walkdown Report," of the walkdown guidance.

3.5 Walkdown Methodology

By letter dated June 8, 2012,[8] the licensee responded to the 50.54(f) letter stating that it intended to utilize the NRC endorsed walkdown guidelines contained in NEI 12-07. The licensee's walkdown submittal dated November 27, 2012, indicated that the licensee implemented the walkdowns consistent with the intent of the guidance provided in NEI 12-07. The licensee did not identify any exceptions from NEI 12-07.

Based on its review, the NRC staff concludes that the licensee has presented information related to the implementation of the walkdown process as indicated in Requested Information item 2.e of the 50.54(f) letter, consistent with Appendix D, "Walkdown Report," of the walkdown guidance.

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[8] ADAMS Accession No. ML12171A201.

3.6 Walkdown Results

3.6.1 Walkdown Scope

The licensee performed walkdowns of flood protection features. The walkdown scope was developed by the licensee to confirm that flood protection features credited in the CLB were acceptable and capable of performing their credited flood protection functions.

The licensee used acceptance criteria in accordance with NEI 12-07.

3.6.2 Licensee Evaluation of Flood Protection Effectiveness, Key Findings, and Identified Deficiencies

The licensee performed an evaluation of the overall effectiveness of PVNGS site's flood protection features. By virtue of its walkdown inspections, the licensee verified that permanent safety-related SSCs at the PVNGS site were acceptable, not degraded, and capable of performing their intended design function as credited in the CLB. No PVNGS site operator actions are credited for external flood protection.

NEI 12-07 specifies that licensees identify observations that were not yet dispositioned at the time the walkdown report was submitted, and that were placed in the CAP. NEI 12-07 defines a deficiency as follows: "a deficiency exists when a flood protection feature is unable to perform its intended function when subject to a design basis flooding hazard." The licensee identified potential deficiencies because of the flood walkdowns and entered them into the CAP.

The licensee noted that it was determined that the potential deficiencies identified could meet their design function, or there was no impact to operability of Technical Specification equipment. Items entered into the CAP included 1) site topography and onsite drainage and 2) roof drainage. In the walkdown report dated November 27, 2012, the licensee explained that various new permanent and (long-term) temporary structures had been introduced into the PVNGS footprint without having conducted a revised surface drainage calculation for the site. Additionally, a spoils pile from construction of the 45-acre reservoir was found and relocated. In addition, several issues were observed regarding the condition of the drainage ditches related to debris, erosion, and settlement. Secondly, the licensee stated that the seismic Category I buildings were found to not be equipped with both roof drains and scuppers as described in the CLB. On May 15, 2012,[9] NRC issued a green no-cited violation (NCV) for this non-conforming condition. The licensee also identified several other various issues related to roof drainage.

In each case described above, the licensee determined the SSCs continue to be functional or operable, and is taking corrective action through the CAP.

3.6.3 Flood Protection and Mitigation Enhancements

There are no recently-implemented or planned enhancements to the PVNGS site identified by the licensee that were intended to improve or increase flood protection and/or mitigation.

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[9] ADAMS Accession No. ML12136A479.

3.6.4 Planned or Newly Installed Features

The licensee determined that a revised surface drainage analysis was necessary following the flooding walkdowns. The licensee reported that the PVNGS site has several construction projects underway involving new facilities and structures, and the site topography has undergone significant changes in light of this construction. The licensee noted that it intended to perform an aerial flyover of the site to re-map the modified topography and use that information to support the Near-Term Task Force Recommendation 2.1 flooding hazards reevaluation, as specified in the 50.54(f) letter to better understand the cumulative impact of the modified topography on flood risk. Further, a modification is planned to address water intrusion into the smoke removal system.

3.6.5 Deficiencies Noted and Actions Taken or Planned to Address

The licensee reported that in connection with the walkdown: rip rap was missing and a corrective action was undertaken to restore the missing material; the spoils pile noted during the walkdowns (described in Section 3.6.2, above) was removed; modifications to roof scuppers were identified (an issue being tracked in the CAP); maintenance and inspection activities associated with the roof scuppers are implemented and tracked through the CAP.

3.6.6 Staff Analysis of Walkdowns

The NRC staff reviewed the licensee's walkdown report dated November 27, 2012. As part of the walkdown effort, the licensee evaluated the capability of flood protection features by conducting a set of visual inspections. The walkdown scope was developed by the licensee to confirm that flood protection features credited in the CLB were acceptable and capable of performing their credited flood protection functions.

As part of the walkdown effort, the licensee identified a few issues associated with features intended to protect seismic Category I structures from the effects of PMP, a probable maximum flood, and groundwater intrusion. In each case, the licensee determined that the SSCs continue to be functional or operable, and is taking corrective action through the CAP.

Based on the NRC staff's review, the NRC staff concludes that the licensee has provided results of the walkdown and described any planned or newly installed flood protection systems or flood mitigation measures as indicated in Requested Information items 2.f and 2.h of the 50.54(f) letter consistent with Appendix D, "Walkdown Report," of the walkdown guidance. Based on the information provided in the licensee's submittals, the NRC staff concludes that the licensee's implementation of the walkdown process meets the intent of the walkdown guidance.

3.6.7 Available Physical Margin

NRC staff issued a request for additional information (RAI) to the licensee regarding the APM dated December 23, 2013.[10] The licensee responded by letter dated January 31, 2014.[11] The

[10] ADAMS Accession No. ML13325A891.
[11] ADAMS Accession No. ML14038A076.

licensee has reviewed its APM determination process, and entered any unknown APMs into the CAP. The NRC staff reviewed the response, and concluded that the licensee met the intent of the APM determination per NEI 12-07.

Based on its review, the NRC staff concludes that the licensee has documented the information requested for any cliff-edge effects, as indicated in Requested Information item 2.g of the 50.54(f) letter consistent with Appendix D, "Walkdown Report," of the walkdown guidance. Further, the staff reviewed the response, and concludes that the licensee met the intent of the APM determination per NEI 12-07.

3.7 NRC Oversight

3.7.1 Independent Verification by Resident Inspectors

On June 27, 2012, the NRC issued Temporary Instruction (TI) 2515/187, "Inspection of Near-Term Task Force Recommendation 2.3 Flooding Walkdowns."[12] In accordance with the TI, NRC inspectors independently verified that the PVNGS licensee implemented the flooding walkdowns consistent with the intent of the walkdown guidance. Additionally, the inspectors independently performed walkdowns of a sample of flood protection features. The inspection report dated February 7, 2013,[13] documents the results of this inspection. No findings of significance were identified.

4.0 SSCS NOT WALKED DOWN

The licensee identified inaccessible features but no restricted access features.

4.1 Restricted Access

The licensee reported that there were no features or areas of the PVNGS physical plant for which there was restricted access, as defined by NEI 12-07.

4.2 Inaccessible Features

The licensee reported that the only feature of the PVNGS physical plant that was not inspected because of inaccessibility were waterstops embedded in the walls installed at concrete joints located within the Auxiliary Building walls. The locations of the waterstops are about 30 ft or more below grade and provide an adequate margin above the maximum predicted groundwater levels. In addition, the licensee has a structural monitoring program that provides for periodic inspection of the walls and structures. Based on the information the licensee provided, the NRC staff concludes that there is reasonable assurance that the inaccessible access feature is available and will perform its credited function.

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[12] ADAMS Accession No. ML12129A108.
[13] ADAMS Accession No. ML13038A565.

5.0 CONCLUSION

The NRC staff concludes that the licensee's implementation of flooding walkdown methodology meets the intent of the walkdown guidance. The NRC staff concludes that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current flooding licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. Furthermore, the licensee's walkdown results, which were verified by the staff's inspection, identified no immediate safety concerns. The NRC staff reviewed the information provided and determined that sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

If you have any questions, please contact me at (301) 415-1530 or via e-mail at jennivine.rankin@nrc.gov.

Sincerely,

/RA/

Jennivine K. Rankin, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Enclosure:
Staff Assessment of Flooding
Walkdown Report

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ADAMS Accession No.: ML14120A072 * concurrence by e-mail

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