



102-07027-JJC/TNW/CJS  
April 10, 2015

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

**10 CFR 50.54(f)**

**JOHN J. CADOGAN, JR**  
Vice President  
Engineering

**Palo Verde**  
**Nuclear Generating Station**  
P.O. Box 52034  
Phoenix, AZ 85072  
Mail Station 7602  
Tel 623 393 5553

- References
1. NRC Letter, *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, dated March 12, 2012
  2. Letter number 102-07010, dated March 10, 2015, Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3, Docket Nos. STN 50-528, 50-529, and 50-530, *Seismic Hazard and Screening Report*

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)  
Units 1, 2, and 3  
Docket Nos. STN 50-528, 50-529, and 50-530  
Supplemental Information Regarding the PVNGS Seismic  
Design and Licensing Basis**

In accordance with the NRC request for information in Reference 1, Arizona Public Service Company (APS) provided the *Seismic Hazard and Screening Report for Palo Verde Nuclear Generating Station Units 1, 2, and 3*, in Reference 2.

As described in Reference 2, the seismic spectral response curve used for the design of PVNGS structures, systems and components bounds the re-evaluated seismic hazard ground motion response spectrum (GMRS). The enclosure to this letter provides supplemental information regarding the PVNGS seismic design and licensing basis to support the conclusion that neither a seismic risk evaluation nor interim actions are necessary for the Near Term Task Force (NTTF) Recommendation 2.1 seismic review.

No commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact Thomas Weber, Department Leader, Regulatory Affairs, at (623) 393-5764.

AD10  
NRR

Page 2

Julius Rosenberg

cc: M. L. Dapas NRC Region IV Regional Administrator  
M. M. Watford NRC NRR Project Manager for PVNGS  
C. A. Peabody NRC Senior Resident Inspector PVNGS  
N. J. DiFrancesco NRC JLD Project Manager

**ENCLOSURE**

**Supplemental Information Regarding the Palo Verde  
Nuclear Generating Station (PVNGS) Seismic Design  
and Licensing Basis**

**Enclosure**

**Supplemental Information Regarding the PVNGS  
Seismic Design and Licensing Basis**

**Introduction**

In accordance with the NRC *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident* (Reference 1), Arizona Public Service Company (APS) provided the *Seismic Hazard and Screening Report for Palo Verde Nuclear Generating Station Units 1, 2, and 3* (Reference 2).

As described in Reference 2, the spectral response curve used for the design of Palo Verde Nuclear Generating Plant (PVNGS) structures, systems and components (SSCs) bounds the re-evaluated seismic hazard ground motion response spectrum (GMRS). This enclosure provides supplemental information regarding the PVNGS seismic design and licensing basis to support the conclusions of Reference 2.

**Seismic Hazard Screening for PVNGS Units 1, 2, and 3**

As described in Section 3, *Plant Design Basis*, Section 4, *Screening Evaluation*, and Section 5, *Interim Actions*, of Reference 2, the PVNGS Updated Final Safety Analysis Report (UFSAR) reflects two seismic response spectra. UFSAR section 2.5 describes the 10 CFR Part 100, Appendix A, site characterization safe shutdown earthquake (SSE) as having a peak ground acceleration (PGA) value of 0.20g (UFSAR Figure 2.5-94). UFSAR section 3.7 indicates that the seismic analysis of Seismic Category I structures, systems and components (SSCs) was performed utilizing a design spectral response curve anchored at a PGA value of 0.25g (UFSAR Figure 3.7-1). A PGA of 0.25g thus constitutes the applied design value for PVNGS Seismic Category I SSCs, which bounds the 0.20g site characterization (i.e., licensing basis) SSE.

As described later in this section, this approach of applying the 0.25g spectral response curve in the design of the PVNGS Seismic Category I SSCs was reviewed by the NRC staff during the original PVNGS licensing process, as documented in section 3.7 of the NRC PVNGS Safety Evaluation Report (SER) (Reference 3).

*Summary of 0.20g SSE and 0.10g OBE Values in PVNGS Current Licensing Basis*

Section 2.5.2.4, *Safe Shutdown Earthquake (SSE)*, of the NRC PVNGS SER (Reference 3) includes the following summary conclusion related to the derivation of the PVNGS 10 CFR Part 100, Appendix A, site characterization SSE:

*The staff and the staff consultant at Los Alamos National Laboratory agree that the proposed acceleration value of 0.20g, as the high frequency anchor to a RG 1.60 response spectrum, is adequately conservative as the SSE for the PVNGS site.*

Section 2.5.2.5, *Operating Basis Earthquake (OBE)*, of Reference 3, continues:

*The applicant has proposed 0.10g for the acceleration level corresponding to the OBE. The design vibratory ground acceleration for the OBE is taken to be one-half of the design vibratory ground acceleration for the SSE, consistent with Appendix A to 10 CFR 100. Considering the low seismicity near the PVNGS site, the staff concludes that the proposed acceleration value for the OBE is adequately conservative.*

**Enclosure**

**Supplemental Information Regarding the PVNGS  
Seismic Design and Licensing Basis**

Consistent with the OBE value being one-half of the 10 CFR Part 100, Appendix A, SSE value of 0.20g, the PVNGS seismic monitoring instrumentation OBE alarm is the site characterization OBE value of 0.10g. This alarm set-point supports a procedurally required plant shutdown, consistent with 10 CFR Part 100, Appendix A, section V(a)(2).

The site characterization 10 CFR Part 100, Appendix A, SSE of 0.20g and OBE of 0.10g are part of the PVNGS current licensing basis. Seismic Category I SSCs, however, were not designed using these SSE and OBE values. Instead, the bounding seismic spectral response curve values of 0.25g and 0.13g were applied in the plant design to establish capacity margin for the SSE and OBE, respectively.

*Use of 0.25g and 0.13g Spectral Response Curves in PVNGS Current Licensing Basis*

The original PVNGS FSAR described the seismic design in section 3.7, in part, as follows:

*Structures, systems, equipment, and components related to plant safety feature systems are required to have the ability to withstand potential earthquakes. Structures, systems and components are placed in the applicable seismic category, depending on their function.*

*A two-level system is used for the seismic classification of structures, systems, and components:*

- *Seismic Category I structures, systems, and components*
- *Non-Category I structures, systems, and components ...*

*The safe shutdown earthquake (SSE) and the operating basis earthquake (OBE) are 0.20g and 0.10g, respectively. Refer to section 2.5 for a discussion of the selection of these conservative values. For additional conservatism, a seismic analysis for Seismic Category I structures was performed utilizing a 0.25g SSE and a 0.13g OBE.*

Section 3.7.1.1, *Design Response Spectra*, of the original FSAR and the current UFSAR indicate that figures 3.7-1 and 3.7-3 provide the horizontal components of the spectral response curves used to establish capacity margin to the site characterization SSE and OBE. The spectral response curves reflect a Regulatory Guide 1.60 shape and are anchored at a value of 0.25g to bound the SSE and a value of 0.13g to bound the OBE. In this context, the UFSAR figures 3.7-1 and 3.7-3 are labeled as design spectra for SSE and OBE, respectively. The detailed description of the seismic design in the remaining body of UFSAR section 3.7 indicates how this design approach was applied to the various Category I SSCs.

The original NRC SER for PVNGS (Reference 3) documented the acceptability of this conservative design approach in section 3.7, in part, as follows:

*The input seismic design response spectra based on the maximum horizontal ground motion of 0.13g for OBE and 0.25g for SSE and applied in the design of BOP seismic Category I structures, systems, and components comply with the recommendations of RG 1.60, "Design Response Spectra for Nuclear*

**Enclosure**

**Supplemental Information Regarding the PVNGS  
Seismic Design and Licensing Basis**

*Plants." The specific percentage of critical damping values used in the seismic analysis of Category I structures, systems and components within the balance-of-plant (BOP) scope are in conformance with RG 1.61, "Damping Values for Seismic Analysis of Nuclear Power Plants."*

*The synthetic time history used for the seismic design of BOP Category I plant structures, systems and components is adjusted in amplitude and frequency content to obtain response spectra that envelope the response spectra specified for the site.*

*Conformance with the recommendations in RG 1.60 and RG 1.61 provides reasonable assurance that the seismic inputs to BOP Category I structures, systems, and components are adequately defined to assure a conservative basis for the design of such structures, systems and components to withstand the consequent seismic loadings. ...*

*The staff concludes that the PVNGS response spectra are enveloped by the response spectra developed for the NSSS components, and, therefore, the CESSAR interface requirements are satisfied.*

**Screening Summary**

The use of the 0.25g seismic spectral response curve to design PVNGS Seismic Category I SSCs (as compared to the site characterization SSE of 0.20g) is part of the current licensing basis. APS, therefore, compared the 0.25g seismic spectral response curve design capacity to the re-evaluated hazard when performing the screening requested in Near-Term Task Force (NTTF) Recommendation 2.1, as documented in Reference 2.

Figure 50, of Reference 2 and Figure 1 of this enclosure show that the design spectral response curve (i.e., 0.25g) exceeds the re-evaluated seismic hazard GMRS response curve. PVNGS Seismic Category I SSCs, therefore, have demonstrated seismic capacities above the re-evaluated GMRS. This is the basis upon which APS concluded in Reference 2 that neither a seismic risk evaluation nor interim actions are necessary for the NTTF Recommendation 2.1 seismic review.

**Comparison of Various PVNGS Site Response Spectra**

Figure 50 of Reference 2 compared two curves, the design spectral response curve (i.e., 0.25g, 5% damping) used for the design of PVNGS Seismic Category I SSCs and the re-evaluated seismic hazard GMRS response curve.

Figure 1 of this enclosure provides these two curves along with three additional curves for comparison purposes. The additional curves are:

- 10 CFR Part 100, Appendix A, site characterization SSE (i.e., 0.20g, 5% damping)
- Individual Plant Examination of External Events (IPEEE) median percentile (50%) Review Level Earthquake (RLE) of 0.30g
- IPEEE 84<sup>th</sup> percentile RLE of 0.30g

**Enclosure**

**Supplemental Information Regarding the PVNGS  
Seismic Design and Licensing Basis**

The 10 CFR Part 100, Appendix A, site characterization SSE (i.e., 0.20g) curve bounds the re-evaluated seismic hazard for most frequencies. A small magnitude exceedance of the 0.20g curve exists in the high frequency range above approximately 27 hertz; but, this exceedance is enveloped by the 0.25g and IPEEE curves.

The PVNGS Seismic Category I SSCs have demonstrated capacity margin (0.25g curve) to the re-evaluated hazard, including the high frequency range. No interim actions are, therefore, considered necessary to address the small magnitude high frequency re-evaluated seismic hazard exceedance of the 10 CFR Part 100, Appendix A, site characterization SSE (i.e., 0.20g) response spectra for PVNGS.

The low frequency range is relevant to structures and spent fuel pool integrity. An insert is provided in Figure 1 of this enclosure to visually magnify the area in the low frequency range that appears close to the site characterization (0.20g) response spectra curve. This shows there is no exceedance of the 0.20g SSE curve by the GMRS curve in the low frequency range.

Performance of an Expedited Seismic Evaluation Process (ESEP), as described in EPRI Technical Report 1025287 (Reference 4), would not provide additional safety benefit. From a seismic safety perspective, the original plant design spectral response curve (i.e., 0.25g), used in the design of PVNGS Seismic Category I SSCs, demonstrates that the plant can safely shut down with plant seismic capacity above the re-evaluated GMRS, across the entire frequency range.

Additionally, the use of the 0.30g RLE anchor value, characterized by a NUREG/CR-0098 spectrum, was approved by an NRC letter dated September 27, 1993 (Reference 5). The IPEEE, which used the EPRI seismic margin assessment approach, was performed for PVNGS in 1995 (Reference 6). It evaluated the ability of the plant to mitigate any accident that could reasonably be postulated to occur as a result of a major earthquake in the area surrounding the plant site. The IPEEE concluded that the Seismic Category I equipment within the scope of the review, including relays and equipment required for containment performance, were qualified to a higher level of seismic demand than required by the IPEEE.

### **Conclusion**

The PVNGS design spectral response curve (i.e., 0.25g) bounds the re-evaluated seismic hazard GMRS response curve. PVNGS Seismic Category I SSCs, therefore, have demonstrated seismic capacities above the re-evaluated GMRS. This is the basis upon which APS concluded in Reference 2 that neither a seismic risk evaluation (including high frequency confirmation and spent fuel pool evaluation) nor interim actions are necessary for the Near Term Task Force (NTTF) Recommendation 2.1 seismic review.

APS considers that there would be no safety benefit from ESEP since PVNGS has demonstrated seismic capacities above the re-evaluated GMRS.

**Enclosure**

**Supplemental Information Regarding the PVNGS  
Seismic Design and Licensing Basis**

**References**

1. NRC Letter, *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, dated March 12, 2012
2. APS Letter number 102-07010, dated March 10, 2015, Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3, Docket Nos. STN 50-528, 50-529, and 50-530, *Seismic Hazard and Screening Report*
3. NUREG-0857, *Safety Evaluation Report - Related to the Operation of Palo Verde Nuclear Generating Station: Units 1, 2, and 3*, Docket Nos. STN 50-528, STN 50-529, and STN 50-530, Arizona Public Service Company, et al., November 1981
4. EPRI Technical Report 1025287, *Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details (SPID) for Resolution of Fukushima Near-Term Task Force Recommendation 2.1*, dated February 2013
5. NRC Letter, *Review of Response to Generic Letter No. 88-20, Supplement No. 4 - Individual Plant Examinations for External Events for the Palo Verde Nuclear Generating Station*, dated September 27, 1993
6. APS Letter number 102-03407, *Individual Plant Examination for External Events (IPEEE) for Severe Accident Vulnerabilities (Generic Letter 88-20, Supplement 4*, dated June 30, 1995



**Enclosure**  
**Supplemental Information Regarding the PVNGS**  
**Seismic Design and Licensing Basis**

**Figure 1**  
**PVNGS Horizontal GMRS Comparison, 5% damping**

