



**Bulletin 2012-01  
10 CFR 50.54(f)**

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102-06825-DCM/RKR  
January 31, 2014

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

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 -  
NRC Bulletin 2012-01, *Design Vulnerability in Electric  
Power System***

Pursuant to 10 CFR 50.54(f), Arizona Public Service Company (APS) letter number 102-06610, dated October 25, 2012 provided the response to NRC Bulletin 2012-01, *Design Vulnerability in Electric Power System* [Agencywide Document Access and Management System (ADAMS) Accession No. ML12305A361]. By letter dated December 20, 2013 (ADAMS Accession No. ML13351A314) the NRC staff requested additional information to verify completion of interim actions and compensatory measures, and to obtain the status of long-term corrective actions.

The industry established a template to guide development of plant responses to the NRC request for additional information regarding Bulletin 2012-01. APS used the established industry template as a guide in developing the response. The NRC letter requested that licensees submit a written response to the request for additional information by February 3, 2014. The enclosure to this letter provides the APS response to the NRC request for additional information regarding Bulletin 2012-01.

This response is submitted in accordance with 10 CFR 50.4. APS has reviewed the response and it does not contain any proprietary, sensitive, safeguards or classified information.

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NRR

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No commitments are being made to the NRC by this letter. Should you need further information regarding this response, 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 1/31/14  
(Date)

Sincerely,



Enclosure:

APS Response to Request for Additional Information - NRC Bulletin 2012-01,  
*Design Vulnerability in Electric Power System*

DCM/RKR/CJS/hsc

cc:	M. L. Dapas	NRC Region IV Regional Administrator
	J. K. Rankin	NRC NRR Project Manager (electronic & hard copy)
	A. E. George	NRC NRR Project Manager (electronic & hard copy)
	M. A. Brown	NRC Senior Resident Inspector for PVNGS

**ENCLOSURE**

**APS Response to Request for Additional  
Information - NRC Bulletin 2012-01, *Design  
Vulnerability in Electric Power System***

**Enclosure - APS Response to Request for Additional  
Information – NRC Bulletin 2012-01, *Design Vulnerability in  
Electric Power System***

**Background**

Pursuant to 10 CFR 50.54(f), Arizona Public Service Company (APS) letter number 102-06610, dated October 25, 2012, provided the response to NRC Bulletin 2012-01, *Design Vulnerability in Electric Power System* [Agencywide Document Access and Management System (ADAMS) Accession No. ML12305A361]. As part of the Bulletin response, APS described the design and operating alignments at the Palo Verde Nuclear Generating Station (PVNGS).

During normal plant operation, the Engineered Safety Features (ESF) buses are powered by offsite power sources (preferred source). The safety-related equipment is divided into two load groups per unit (ESF Bus A and ESF Bus B). Each Startup Transformer (SUT) supplies power to one ESF bus of two different units. Either one of the ESF buses is capable of providing power for safely shutting down the unit and/or supporting design basis accident mitigation. The ESF buses also supply power to certain selected non-Class loads important to plant operation, such as normal chilled water pumps and containment building reactor cavity normal cooling fans. These non-Class loads are tripped upon a Safety Injection Accident Signal (SIAS).

A postulated single-phase open circuit condition located on the high side of the SUT affects only one ESF bus of two different units. A single phase open circuit condition located on the low side of the SUT would only affect the associated ESF bus of one unit. The unaffected redundant train is capable of safely shutting down the unit and supporting design basis accident mitigation.

A potential outcome of implementing the industry open phase condition (OPC) initiative may be the installation of protection relay schemes that will automatically separate the preferred off-site power sources from the Class 1E bus in the event of a sensed OPC. The existing relay schemes being implemented at other sites are complex and the analysis techniques that support the relay settings have limited operating history. In addition, alternative OPC detection alternatives are being investigated that may impact design decisions, particularly for the PVNGS Class 1E buses which are normally lightly loaded. As the PVNGS electrical design and operational features make this site less vulnerable to an OPC, when compared to other configurations that exist in the industry, APS plans to assess the safety benefit of modifications with the potential safety consequences of an inadvertent separation of the preferred off-site sources. Should emerging OPC detection alternatives be determined to be viable that would be more conducive to plant reliability and nuclear safety than present industry initiatives involving installation of complex protective relay schemes, additional time to finalize and demonstrate the alternative schemes may delay modification decisions into 2015.

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**NRC Request of Additional Information**

By letter dated December 20, 2013 (ADAMS Accession No. ML13351A314), the NRC requested the following additional information to complete its review of responses to Bulletin 2012-01, *Design Vulnerability in Electric Power System*:

1. *Provide a summary of all interim corrective actions that have been taken since the January 30, 2012, event at Byron Station, Unit 2, to ensure that plant operators can promptly diagnose and respond to open phase conditions on the offsite power circuits for Class-1E vital buses until permanent corrective actions are completed.*
2. *Provide a status and schedule for completion of plant design changes and modifications to resolve issues with an open phase of electric power.*

**Response 1 - Summary of All Interim Corrective Actions**

APS has reviewed industry lessons learned from the events at Byron Station and implemented various interim actions for PVNGS. Based on the PVNGS offsite power configuration and electrical design details, the following actions were taken to ensure plant operators can promptly diagnose and respond to an OPC on the offsite power circuits that supply the Class 1E vital buses until permanent corrective actions are completed:

• **Interim Corrective Actions**

- Daily walk-downs of the switchyard are performed to identify OPC vulnerabilities. Specifically, steps were added to visually verify the integrity of high voltage connections supplying the SUTs in procedure 40DP-9OPA9, *Outside Area Operator Logs*.
- Alarm response procedures were revised to clarify that negative sequence relays may be activated by an unbalance between voltages when no under-voltage condition exists and to check for unbalance by verifying voltages locally. The specific alarm response procedures revised were:
  - Procedure 40AL-9RK1A, *Panel B01A Alarm Responses*
  - Procedure 40AL-9RK1B, *Panel B01B Alarm Responses*
  - Procedure 40AL-9RK1C, *Panel B01C Alarm Responses*
- The severe weather abnormal operating procedure was revised to verify the integrity of the SUT connections following a severe weather event (40AO-9ZZ21, *Acts of Nature*). In addition, the same procedure was revised to now require that APS maintenance

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personnel be notified to perform thermography and/or corona scans of overhead lines feeding the SUTs, at the next available opportunity subsequent to the severe weather event, to identify signs of fatigue or cracking that could lead to an OPC.

- Thermography inspections of the SUTs are performed when they are returned to service following maintenance.
- Training for the Byron Event was provided to both licensed and non-licensed operators to familiarize the operating staff members with the event and its potential consequences.

**Response 2 - Status and Schedule for Completion of Plant Design Changes**

• **Status**

- Holders of operating licenses and combined licenses for nuclear power reactors are investigating options being researched by several vendors (PSC2000, EPRI, Schweitzer, etc.) to detect OPC faults. There is currently no generic, off-the-shelf technology that has been proven to detect all the required open phase fault conditions for all plant and transformer designs.
- Holders of operating licenses and combined licenses for nuclear power reactors are engaged in the development of NEI 13-12, *Open Phase Condition Industry Guidance Document*, as well as development of enhancements to software tools being used to analyze OPC faults.
- With the goal of ensuring accurate detection without compromising nuclear safety or increasing plant risk, new OPC detection technology will be thoroughly evaluated, tested, and fully analyzed before installation.
- Vulnerability studies of the OPC faults have been started for PVNGS.

• **Schedule**

- APS has agreed to the generic schedule, provided in the industry OPC initiative document, for PVNGS. Specifically:
  - By December 31, 2014, demonstrate compliance with the industry OPC initiative criteria through analysis or identify appropriate actions required to demonstrate compliance.

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- By December 31, 2016, implement design changes, if necessary, to comply with the industry OPC initiative criteria. The 'active' actuation features, if installed, may remain in a monitoring mode to demonstrate reliability.
- By December 31, 2017, if a monitoring period was deemed necessary, complete any design adjustments and enable 'active' actuation features needed to demonstrate compliance with the industry OPC initiative criteria. Any relevant UFSAR updates are also to be completed by this date. If the Technical Specifications are impacted, any license amendment request should be submitted by this date. Should a TSTF Traveler be developed, the license amendment request should be submitted within six months of issuance of an NRC approved Traveler.
- APS expects to meet the milestones of the generic schedule; however, deviations may be required to accommodate outage schedules, development and demonstration of modification options, complexities discovered in modeling analyses, software and hardware availability, manufacturer delivery capabilities, licensing delays, or similar issues.
- Any deviation from the industry OPC initiative schedule will be documented through the deviation/exemption process described in NEI 13-12, *Open Phase Condition Industry Guidance Document*.