



**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

102-06789-DCM/NTA/FJO  
October 25, 2013

ATTN: Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS) Unit 2**  
**Docket No. STN 50-529 / License No. NPF 51**  
**Licensee Event Report 2013-001-01**

Enclosed please find Licensee Event Report (LER) supplement 50-529/2013-001-01 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER supplement provides the causes and corrective actions determined for the previously reported event involving the Unit 2 train B emergency diesel generator which did not reach the required generator output voltage when started for surveillance testing. This resulted in a condition prohibited by Technical Specification Limited Condition for Operation 3.8.1, AC Sources - Operating.

In accordance with 10 CFR 50.4, copies of this LER are being forwarded to the Nuclear Regulatory Commission (NRC) Regional Office, NRC Region IV, and the Senior Resident Inspector.

Arizona Public Service Company makes no commitments in this letter. If you have questions regarding this submittal, please contact Mark McGhee, Department Leader Nuclear Regulatory Affairs at (623) 393-4972.

Sincerely,

A handwritten signature in black ink, appearing to read 'D.C. Mims', is written over the word 'Sincerely,'.

FOR D.C. MIMS

DCM/NTA/FJO/hsc

Enclosure

cc:	S. A. Reynolds	NRC Region IV Regional Administrator
	J. K. Rankin	NRC NRR Project Manager for PVNGS
	J. P. Reynoso	NRC Senior Resident Inspector for PVNGS

JE22  
NRR

**LICENSEE EVENT REPORT (LER)**(See reverse for required number of  
digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

**1. FACILITY NAME**

Palo Verde Nuclear Generating Station (PVNGS) Unit 2

**2. DOCKET NUMBER**

05000529

**3. PAGE**

1 OF 6

**4. TITLE**

Condition Prohibited by Technical Specifications due to Emergency Diesel Generator Low Output Voltage

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
1	16	2013	2013	- 001 -	01	10	25	2013		

  

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: (Check all that apply)			
1	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
10. POWER LEVEL	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
	<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> OTHER
	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

**12. LICENSEE CONTACT FOR THIS LER**

FACILITY NAME

Mark McGhee, Department Leader Nuclear Regulatory Affairs

TELEPHONE NUMBER (Include Area Code)

623-393-4972

**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	EK	ECBD	P292	Y					

**14. SUPPLEMENTAL REPORT EXPECTED**☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE)☒ NO**15. EXPECTED SUBMISSION DATE**

MONTH DAY YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On January 16, 2013, during the conduct of monthly surveillance testing, the PVNGS Unit 2 train B emergency diesel generator (2B EDG) did not reach the required generator output voltage at startup. As a result, the 2B EDG was declared inoperable and Unit 2 entered LCO 3.8.1, Condition B.

The direct cause was failure of an operational amplifier on the instantaneous prepositioning (IPP) board used to provide the voltage setpoint to the 2B EDG automatic voltage regulator (AVR) during operation in the emergency mode. The IPP board was replaced on January 17, 2013, and post-maintenance testing was successfully completed. The 2B EDG was declared operable on January 18, 2013, and LCO 3.8.1, Condition B was exited. The root cause of this event was an inadequate preventive maintenance strategy for relay VR2 which resulted in degraded relay contact resistance that allowed a voltage transient to be seen on the operational amplifier on the IPP board. To prevent recurrence, a new preventive maintenance strategy for EDG voltage regulator components will be established.

In the past three years, PVNGS has not reported a similar event for the six EDGs at Palo Verde.

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Palo Verde Nuclear Generating Station Unit 2	05000529	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2 OF 6
		2013 --	001 --	01	

**NARRATIVE**

All times are Mountain Standard Time and approximate unless otherwise indicated.

**1. REPORTING REQUIREMENT(S):**

This Licensee Event Report (LER) is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B) for a condition prohibited by Technical Specification (TS) Limited Condition for Operation (LCO) 3.8.1, AC Sources - Operating. On January 16, 2013, during the conduct of monthly surveillance testing, the Palo Verde Nuclear Generating Station (PVNGS) Unit 2 train B emergency diesel generator (2B EDG) did not reach the required generator output voltage at startup. As a result the 2B EDG was declared inoperable and Unit 2 entered LCO 3.8.1, Condition B. On January 18, 2013, following completion of corrective maintenance and successful post-maintenance testing, the 2B EDG was declared operable and Unit 2 exited LCO 3.8.1, Condition B.

The discovery date of March 1, 2013, is based on the initial results of the investigation which concluded that a condition prohibited by TSs had occurred because an automatic voltage regulator (AVR) malfunction likely existed for longer than the completion times for LCO 3.8.1 Conditions B and H. TS LCO 3.8.1 requires that two EDGs be operable in Modes 1 through 4. Condition B.4 of LCO 3.8.1 requires that an inoperable EDG be restored to operable status within 10 days. If the completion time of Condition B is not met, Condition H then requires the unit be in Mode 3 within 6 hours and be in Mode 5 within 36 hours.

This LER supplement provides additional information related to the causes and corrective actions for the Unit 2 train B emergency diesel generator AVR malfunction.

**2. DESCRIPTION OF STRUCTURE(S), SYSTEM(S) AND COMPONENT(S):**

In each PVNGS unit, the class 1E electrical distribution system AC sources consist of the preferred offsite power (EIS: EK) sources (normal and alternates) and the onsite standby power sources (train A and train B EDGs). Offsite power is supplied from startup transformers (EIS: EA) through intermediate buses (EIS: EA) to the two class 1E 4.16 kV buses. The design of the AC electrical distribution system provides independence and redundancy to ensure an available source of power to the engineered safety features (ESF)(EIS: JE) systems.

Each PVNGS unit's internal class 1E AC distribution system is divided into redundant load groups (trains). Either of the load groups is capable of providing power for safe plant shutdown and event mitigation so that the loss of any one group does not prevent the minimum safety functions from being performed. Each train has connections to two preferred offsite power sources (normal and alternate) and the related train EDG.

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Palo Verde Nuclear Generating Station Unit 2	05000529	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	3 OF 6
		2013 --	001 --	01	

**NARRATIVE**

Controls and instrumentation are provided in main and local control rooms for starting and stopping the EDGs, and for engine speed and voltage regulator adjustments. There are two modes of EDG operation, emergency mode and test mode. The test mode is used for non-emergency EDG operations and allows for automatic engine shutdown from lower priority engine protective features. Also, in the test mode, the generator voltage regulator and engine speed governor controls allow for parallel operations with other AC sources and the output frequency and voltage may be manually adjusted by operators in the main control room.

Operation in the emergency mode is a more reliable configuration which limits automatic engine shutdowns to only those conditions which will result in damage to the generator or engine. Automatic, emergency mode actuation of the EDG is initiated by the loss of power actuation, safety injection actuation system, or auxiliary feedwater actuation system. In emergency mode, the engine control system maintains engine speed and generator frequency at a preset value and generator output voltage is controlled to a fixed setpoint such that the required output voltage is maintained.

An AVR controls generator output voltage during all modes of operation. At startup, EDG field excitation is provided from battery supplied field flash power which is applied to the generator field winding to establish output voltage. Field flash power is removed when output voltage reaches greater than or equal to 60 percent of rated voltage and two voltage sensing relays, VR1 and VR2, are energized. With field flash removed, generator excitation is self-sustaining via generator output voltage and current.

The AVR functions by comparing the generator output voltage to an internal reference signal (setpoint) and then adjusting field excitation to maintain output voltage at the desired setpoint. In test mode, the AVR setpoint is a variable voltage provided by a motor operated potentiometer (MOP) which can be adjusted by the operator. In the emergency mode, the AVR setpoint is a fixed value provided by the instantaneous prepositioning (IPP) board.

For monthly surveillance testing, the EDG is typically started in the test mode. However, three times a year (January, May, and September) during monthly surveillance testing and during the 18 month (outage) surveillance testing, the EDG is tested in the emergency mode. The IPP board circuit functions are tested only during emergency mode testing. When the EDG is tested in the emergency mode, the test procedures also place the EDG in test mode to facilitate paralleled operation with offsite power and for engine shutdown such that the MOP portion of the AVR is also tested.

The station TSs provide the voltage, frequency and start time requirements for the EDG output to assure AC powered safety related equipment will function as required when offsite power is not available.

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Palo Verde Nuclear Generating Station Unit 2	05000529	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	4 OF 6
		2013 --	001 --	01	

**NARRATIVE**

**3. INITIAL PLANT CONDITIONS:**

On January 16, 2013, Palo Verde Unit 2 was in Mode 1 (Power Operation), at 100 percent power and normal operating temperature and pressure. There were no structures, systems, or components inoperable that contributed to the event.

**4. EVENT DESCRIPTION:**

On January 16, 2013, the 2B EDG was started in the emergency mode by operations personnel for scheduled monthly surveillance testing. The operator determined that the 2B EDG did not reach the required generator output voltage at startup. Operations personnel declared the 2B EDG inoperable and Unit 2 entered LCO 3.8.1, Condition B. Maintenance personnel performed troubleshooting and identified that the AVR malfunction was due to failure of an operational amplifier on the IPP board which provides the voltage setpoint for operation in the emergency mode. As an immediate corrective action, the faulty IPP board was replaced and the 2B EDG was successfully tested in the emergency mode on January 17, 2013. Operations personnel declared the 2B EDG operable on January 18, 2013, and Unit 2 exited LCO 3.8.1, Condition B, approximately 48 hours after entering the LCO.

The station initiated an investigation to identify and correct the cause of the IPP board failure in January, 2013. On March 1, 2013, the investigation team completed the initial investigation and determined that the IPP board operational amplifier failure was likely caused by malfunction of circuit components outside of the IPP board. The circuit components which could potentially cause a failure of the operational amplifier on the IPP board were replaced on March 18, 2013.

Review of the recent operational history for the 2B EDG found that the last emergency mode test (prior to the January 16, 2013 failure) was a simulated loss of power start during periodic 18 month surveillance testing on October 26, 2012, which occurred during a refueling outage. During that outage, Unit 2 entered Mode 4, when LCO 3.8.1 becomes applicable to require that both EDGs are operable, on November 3, 2012. The unit returned to Mode 5 for unrelated activities and returned to Mode 4 again on November 4, 2012. Based on the current results of the investigation, the condition prohibited by LCO 3.8.1 existed from November 3, 2012, through January 18, 2013.

The 2B EDG was started in the test mode during the monthly surveillance tests in November and December of 2012. Those test mode starts would not have provided an opportunity to detect a problem with the IPP board components because the IPP board output is not used as the AVR setpoint in test mode operations.

Reviews of operational history determined that the Unit 2 train A EDG was not removed from service during the period from November 3, 2012, through January 18, 2013.

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Palo Verde Nuclear Generating Station Unit 2	05000529	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	5 OF 6
		2013	-- 001	-- 01	

**NARRATIVE**

**5. ASSESSMENT OF SAFETY CONSEQUENCES:**

This event did not result in a challenge to the fission product barriers or result in the release of radioactive materials; and the event did not adversely affect the safe operation of the plant or health and safety of the public. This event did not result in a potential transient more severe than those analyzed in the Updated Final Safety Evaluation Report.

The probabilistic risk significance associated with this condition, based upon a review of the PVNGS probabilistic risk assessment model is small. In this condition, the 2B EDG was considered to be unavailable. Since the time of failure is indeterminate, established methods dictate that exposure time be taken as one half the time since the last successful test/operation of the EDG where the subject failure would have been detected. For this event, the exposure time was determined to be the 42 days between October 26, 2012, and January 18, 2013. The incremental conditional core damage probability due to this event over the exposure period of 42 days is 7.4E-7. This increase in risk is characterized as very small per NRC Regulatory Guide 1.174, An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis.

This condition would not have prevented the fulfillment of a safety function as defined by 10 CFR 50.73 (a)(2)(v).

**6. CAUSE OF THE EVENT:**

The direct cause was failure of an operational amplifier on the IPP board used to provide the voltage setpoint to the 2B EDG AVR during operation in the emergency mode. The operational amplifier failure was caused by intermittent contact resistance on relay VR2 which allowed a coupled noise transient to build-up a voltage across the operational amplifier.

The root cause of this event was an inadequate preventive maintenance (PM) strategy for relay VR2 which resulted in degraded contact resistance that allowed a voltage transient to be seen on the operational amplifier on the IPP board.

The contributing cause is the existing field routing of IPP board wiring which makes the IPP board components susceptible to electromagnetic interference (EMI noise coupling).

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Palo Verde Nuclear Generating Station Unit 2	05000529	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	6 OF 6
		2013 --	001 --	01	

**NARRATIVE**

**7. CORRECTIVE ACTIONS:**

As an immediate corrective action, the IPP board was replaced and post-maintenance testing was successfully completed on January 17, 2013.

The following corrective actions are planned or have been implemented:

- Monthly testing of PVNGS EDGs now includes emergency mode operation to ensure monitoring of the IPP board performance.
- 2B EDG electrical circuit components, which could potentially have caused the IPP board malfunction, were replaced on March 18, 2013.
- The IPP board wiring will be field routed to minimize noise coupling.

To prevent recurrence, a PM strategy for EDG voltage regulator components will be established. This will include relays VR1, VR2 and the AVR board assembly.

**8. PREVIOUS SIMILAR EVENTS:**

In the past three years, PVNGS has not reported any similar events.

A malfunction of the 2B EDG AVR occurred during post-maintenance testing following a planned EDG maintenance outage on February 22, 2011. Troubleshooting determined that the AVR malfunction resulted from failure of an operational amplifier on the IPP board that was in use at that time. The IPP board was replaced. The investigation of the 2011 AVR malfunction did not identify firm evidence that the condition existed prior to the maintenance outage and no event report was required.

The root cause of the event in 2013 was an inadequate PM strategy for relay VR2 which resulted in degraded contact resistance that allowed a voltage transient to be seen on the IPP board operational amplifier. A root cause could not be determined in the 2011 event. The probable cause was attributed to electronic static discharge that occurred sometime in the past. Both the 2011 and the 2013 EDG failures could not be directly compared because the VR relays were not analyzed during the 2011 failure.