



**MARIA L. LACAL**  
Senior Vice President  
Nuclear Regulatory and Oversight

**Palo Verde  
Nuclear Generating Station**  
P.O. Box 52034  
Phoenix, AZ 85072  
Mail Station 7605  
Tel 623 393 6491

102-07683-MLL/SPD  
April 13, 2018

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS) Unit 1  
Docket No. STN 50-528 / License No. NPF 41  
Licensee Event Report 2018-001-00**

Enclosed please find Licensee Event Report (LER) 50-528/2018-001-00 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER reports an automatic actuation of the PVNGS Unit 1 reactor protection system due to a loss of power to two of four reactor coolant pumps.

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 Matthew Kura, Department Leader, Nuclear Regulatory Affairs, at (623) 393-5379.

Sincerely,

MLL/SPD

Enclosure

cc: K. M. Kennedy NRC Region IV Regional Administrator  
S. P. Lingam NRC NRR Project Manager for PVNGS  
C. A. Peabody NRC Senior Resident Inspector PVNGS

IEZZ  
NRR



**LICENSEE EVENT REPORT (LER)**

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
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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 and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollects.Resource@nrc.gov](mailto: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.

<b>1. FACILITY NAME</b> Palo Verde Nuclear Generating Station (PVNGS) Unit 1	<b>2. DOCKET NUMBER</b> 05000528	<b>3. PAGE</b> 1 OF 4
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**4. TITLE**  
Automatic Actuation of the Reactor Protection System Resulting from a Loss of Reactor Coolant Pumps

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
02	15	2018	2018	001	00	04	13	2018		05000
									FACILITY NAME	DOCKET NUMBER
										05000

<b>9. OPERATING MODE</b>  1	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §:</b> <i>(Check all that apply)</i>											
	<input type="checkbox"/> 20.2201(b)			<input type="checkbox"/> 20.2203(a)(3)(i)			<input type="checkbox"/> 50.73(a)(2)(ii)(A)			<input type="checkbox"/> 50.73(a)(2)(viii)(A)		
	<input type="checkbox"/> 20.2201(d)			<input type="checkbox"/> 20.2203(a)(3)(ii)			<input type="checkbox"/> 50.73(a)(2)(ii)(B)			<input type="checkbox"/> 50.73(a)(2)(viii)(B)		
	<input type="checkbox"/> 20.2203(a)(1)			<input type="checkbox"/> 20.2203(a)(4)			<input type="checkbox"/> 50.73(a)(2)(iii)			<input type="checkbox"/> 50.73(a)(2)(ix)(A)		
<b>10. POWER LEVEL</b>  100	<input type="checkbox"/> 20.2203(a)(2)(i)			<input type="checkbox"/> 50.36(c)(1)(i)(A)			<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)			<input type="checkbox"/> 50.73(a)(2)(x)		
	<input type="checkbox"/> 20.2203(a)(2)(ii)			<input type="checkbox"/> 50.36(c)(1)(ii)(A)			<input type="checkbox"/> 50.73(a)(2)(v)(A)			<input type="checkbox"/> 73.71(a)(4)		
	<input type="checkbox"/> 20.2203(a)(2)(iii)			<input type="checkbox"/> 50.36(c)(2)			<input type="checkbox"/> 50.73(a)(2)(v)(B)			<input type="checkbox"/> 73.71(a)(5)		
	<input type="checkbox"/> 20.2203(a)(2)(iv)			<input type="checkbox"/> 50.46(a)(3)(ii)			<input type="checkbox"/> 50.73(a)(2)(v)(C)			<input type="checkbox"/> 73.77(a)(1)		
	<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)(D)			<input type="checkbox"/> 73.77(a)(2)(i)		
	<input type="checkbox"/> 20.2203(a)(2)(vi)			<input type="checkbox"/> 50.73(a)(2)(i)(B)			<input type="checkbox"/> 50.73(a)(2)(vii)			<input type="checkbox"/> 73.77(a)(2)(ii)		
						<input type="checkbox"/> 50.73(a)(2)(i)(C)			<input type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A			

**12. LICENSEE CONTACT FOR THIS LER**

LICENSEE CONTACT Matt Kura, Department Leader, Nuclear Regulatory Affairs	TELEPHONE NUMBER <i>(Include Area Code)</i> 623-393-5379
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**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
X	MB	TL	G080	Y					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b> <input type="checkbox"/> YES <i>(If yes, complete 15. EXPECTED SUBMISSION DATE)</i> <input checked="" type="checkbox"/> NO	<b>15. EXPECTED SUBMISSION DATE</b>	MONTH	DAY	YEAR

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

At approximately 2153 Mountain Standard Time on February 15, 2018, an automatic reactor trip of PVNGS Unit 1 occurred when two of four Reactor Coolant Pumps (RCPs) lost power and the Reactor Protection System (RPS) generated trips on all four channels for low departure from nucleate boiling ratio and high local power density following a main turbine generator trip. The two RCPs lost power due to the fast bus transfer feature being blocked in support of planned maintenance activities on Start-up Transformer (SUT) AENANX02. This prevented the RCPs from receiving power from the SUT after receipt of a trip signal from the main turbine generator.

The preliminary root cause of the Unit 1 main turbine generator and reactor trip has been attributed to the susceptibility of the Unit 1 excitation and voltage regulation system (EX2100e) Exciter Auxiliary I/O Interface Board (EAUX) to electrical noise which led to an excitation trip of the Unit 1 main turbine generator. This condition was corrected on February 17, 2018, by replacing the Unit 1 EX2100e EAUX with an updated version that is less susceptible to electrical noise and thereby reduces the possibility of a spurious main turbine generator trip. The root cause is still considered preliminary as the event investigation is still in progress. Any significant changes identified will be reported in a supplement to this Licensee Event Report upon completion of the investigation.

No other RPS actuation signals or actuations of plant engineered safety features systems occurred and all control element assemblies fully inserted into the reactor core. PVNGS Unit 2 and Unit 3 were operating at 100 percent power at the time of the event and were not impacted by the Unit 1 reactor trip.

No previous similar events have been reported by PVNGS in the last 3 years.



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

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000-528	2018	001	00

**NARRATIVE**

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

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

This Licensee Event Report is being submitted pursuant to 10 CFR 50.73 (a)(2)(iv)(A) to report an automatic actuation of the PVNGS Unit 1 reactor protection system (RPS) (EIS: JC) due to an automatic reactor trip when two of four reactor coolant pumps (RCPs) lost power and the Reactor Protection System (RPS) generated trips on all four channels for low departure from nucleate boiling ratio (DNBR) and high local power density (LPD).

This event was initially reported pursuant to 10 CFR 50.72 (b)(2)(iv)(B) at 2350 on February 15, 2018, via the event notification system (EN # 53215).

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

The reactor coolant system (RCS) (EIS: AB) is comprised of two main flow loops each of which includes two RCPs and one steam generator (EIS: AB). The primary function of the RCPs is to provide the necessary head to maintain forced circulation of reactor coolant through the RCS during normal operations. Critical operation of the reactor requires all four RCPs to be in operation to ensure adequate RCS flow. The RCPs are powered from non-class 1E 13.8 kilovolt (kV) buses with 2 RCPs per bus.

The RPS consists of four independent, redundant channels and includes a number of sensors, calculators (including the core protection calculators (CPCs)), logic circuits, and supporting equipment that monitor nuclear steam supply system (EIS: AB) parameters. The RPS ensures the reactor is rapidly and reliably shut down to protect the fission product barriers and assist the engineered safety features systems in accident mitigation. When all four channels of RPS are in service, a reactor trip is actuated when two of four channels generate trip signals.

The CPCs monitor the operation of the RCPs as inputs to the calculations of DNBR and LPD and send trip signals to the RPS when setpoints are exceeded. The RPS actuation then causes simultaneous trips of the four reactor trip switchgear breakers (EIS: AA) which are aligned in a selective two of four configuration to de-energize the control element drive mechanisms so that all control element assemblies (CEAs) are released to insert into the reactor core and shut down the reactor.

The offsite power system consists of eight independent circuits from the power grid to the PVNGS 525 kV alternating current switchyard. The switchyard provides offsite power through three Startup Transformers (SUTs) (AENANX01, AENANX02, and AENANX03). The SUTs feed 13.8 kV intermediate buses with the ability to supply electrical power to the PVNGS units in various combinations to support maintenance on the SUTs.

During normal power operation, the unit non-class 1E auxiliaries are supplied from the main turbine generator via the Unit Auxiliary Transformer and when the unit is shut down, the non-class 1E auxiliaries are powered by the SUT. A fast bus transfer feature provides the ability to transfer power supply from the main turbine generator to offsite power via the SUT in the event of a main turbine generator trip to maintain power to all four RCPs.

The class 1E buses are continuously supplied from the SUTs during power and shutdown operations. The ability to block the fast bus transfer is provided to ensure the supply from the SUT to the class 1E buses will meet the required capabilities under certain conditions such as the removal of a SUT from service for maintenance as was the case during this event. The fast bus transfer feature was blocked on Unit 1 in support of planned maintenance activities on SUT AENANX02.



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The main turbine generator rotor field excitation is provided by the General Electric excitation and voltage regulation system (EX2100e). The EX2100e replaced the original PVNGS excitation and voltage regulation system (GENERREX) in all three units. The first installation was done in Unit 2 during the 2015 fall refueling outage, Unit 3 EX2100e was completed in the 2016 fall refueling outage, and the Unit 1 installation was completed in the 2017 fall refueling outage.

**3. INITIAL PLANT CONDITIONS:**

On February 15, 2018, PVNGS Unit 1 was in Mode 1 (Power Operation) at 100 percent power with the RCS at normal operating temperature and normal operating pressure. Startup Transformer AENANX02 was out of service for planned maintenance and the fast bus transfer feature to the associated non-class 1E 13.8 kV buses was blocked during the maintenance. There were no other structures, systems, or components out of service that contributed to this event.

**4. EVENT DESCRIPTION:**

At approximately 2153 on February 15, 2018, an automatic reactor trip of PVNGS Unit 1 occurred when two of four RCPs lost power and the RPS generated trips on all four channels for low departure from nucleate boiling ratio and high local power density following a main turbine generator trip. The two RCPs lost power due to the fast bus transfer feature being blocked in support of planned maintenance activities on SUT AENANX02. This prevented the RCPs from receiving power from the SUT after receipt of a trip signal from the main turbine generator.

No other RPS actuation signals or actuations of plant engineered safety features systems occurred and all CEAs fully inserted into the reactor core. Control room personnel performed the standard post trip actions, main feedwater remained in service, and the Class 1E 4.16 kV buses remained energized following the trip. The plant was stabilized in Mode 3.

PVNGS Unit 2 and Unit 3 were operating at 100 percent power at the time of the event and were not impacted by the Unit 1 reactor trip. Neither Units 2 nor 3 have experienced similar trips related to the EX2100e.

**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 to the environment. There were no actual safety consequences as a result of this event and it did not adversely affect the health and safety of the public.

The RPS functioned as designed and initiated an automatic reactor trip that placed the plant in a safe condition. Control room staff entered the standard post trip actions and diagnosed an uncomplicated reactor trip. All CEAs fully inserted into the reactor core.

The Unit 1 reactor trip did not result in a transient more severe than those already analyzed. The primary system and secondary pressure boundary limits were not approached. The nuclear safety risk significance associated with the event was minimal and the core damage probability for the uncomplicated reactor trip was 1E-7.

**6. CAUSE OF THE EVENT:**

The preliminary root cause of the Unit 1 reactor trip was attributed to the susceptibility of the Unit 1 EX2100e Exciter Auxiliary I/O Interface Board (EAUX) to electrical noise which led to the excitation trip of the Unit 1 main turbine generator. The root cause is still considered preliminary as the event investigation is still in progress. Any significant changes identified will be reported in a supplement to this Licensee Event Report upon completion of the investigation.



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**7. CORRECTIVE ACTIONS:**

This condition was corrected on February 17, 2018, by replacing the Unit 1 EX2100e EAUX with an updated version that is less susceptible to electrical noise and thereby reduces the possibility of a spurious turbine trip. The EX2100e EAUX in Unit 2 and Unit 3 are scheduled to be replaced during the next refueling outages.

**8. PREVIOUS OCCURRENCES:**

On December 2, 2013, Unit 2 was operating in Mode 1 at 100 percent power. At approximately 1758 Mountain Standard Time a reactor trip was automatically actuated when a reactor coolant pump (RCP) motor circuit breaker tripped on excessive phase differential current. The RCP speed dropped below 95 percent of rated speed and the RPS generated trips on all four channels for low DNBR and high LPD (LER 2013-002-00). The cause of the 2013 reactor trip was not related to the main turbine generator excitation system and the corrective actions from that event had no pertinence to this event.