10 CFR 50.73

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102-07367-MLL/JR
November 4, 2016

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 2016-002-00

Enclosed please find Licensee Event Report (LER) 50-528/2016-002-00 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER reports a manual actuation of the reactor protection system that resulted from a pressurizer spray valve malfunction.

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, Nuclear Regulatory Affairs Department Leader, at (623) 393-4972.

Sincerely,

Andrews, George W(Z99748)

Digitally signed by Andrews, George W(Z99748)
DN: cn=Andrews, George W(Z99748)
Reason: I am approving this document for Maria Lacal
Date: 2016.11.04 14:46:53 -07'00'

MLL/JR/akf

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

NRC FORM 366 (06-2016) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

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 http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	1 OF 5

4. TITLE
Reactor Trip due to Partially Open Pressurizer Main Spray Valve

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
09	07	2016	2016	- 002	- 00	11	04	2016	FACILITY NAME	DOCKET NUMBER

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

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
Mark McGhee, Department Leader, Nuclear Regulatory Affairs	(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	AB	PCV	F130	Y					

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

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

On September 7, 2016, at 2131, with Unit 1 in Mode 1 and 100 percent power, the reactor was manually tripped and reactor coolant pumps were secured due to a control malfunction which prevented closure of a pressurizer spray valve. This event initiated from an unsuccessful attempt to transfer a non-class 120VAC instrument power bus from its normal source to its emergency/alternate source. The transfer was attempted to facilitate an inspection of an electrical load center which was sprayed with water earlier in the day by a leaking sprinkler head following Fire Protection (FP) Department routine testing of a FP water line.

The cause of the spray valve malfunction was a failed pneumatic volume booster in the spray valve actuator system combined with a current to pressure converter (I/P) calibration offset which resulted from a voltage transient during the unsuccessful electrical transfer. These conditions caused the spray valve to stay approximately five percent open when it received a close demand from the spray valve controller. The I/P converter and pneumatic volume booster were replaced and the spray valve was returned to service. Additional corrective actions will adjust preventive maintenance frequency on the pneumatic volume boosters.

In the past three years, PVNGS has not reported a similar event to the NRC.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	2016	- 002	- 00

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)(iv)(A) as an event that resulted in a manual actuation of the reactor protection system (RPS).

This condition was reported to the NRC pursuant to 10 CFR 50.72(b)(2)(iv)(B) at 0127 on September 8, 2016, via the Emergency Notification System (ENS 52226).

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

Reactor coolant system (RCS) [EIIS: AB] pressure is controlled by the pressurizer [EIIS: AB] which provides a point in the RCS where liquid and vapor are maintained in equilibrium under saturated conditions to prevent bulk boiling in the remainder of the RCS. The pressurizer is connected to the RCS loop 1 hot leg through the 12-inch pressurizer surge line and to each of the RCS loop 1 (1A and 1B) cold legs by a 3-inch spray line. Differential pressure created by coolant flow through the reactor vessel provides the motive force necessary for spray flow. Since cold leg coolant temperature is cooler than the pressurizer water/steam mixture, coolant spray flow will cause some steam to condense and thereby reduce the system pressure. Electric heaters are used to add heat to the pressurizer water/steam mixture and thereby increase system pressure. Key functions of the pressurizer include maintaining required RCS pressure during steady state operation and limiting pressure changes caused by reactor coolant thermal expansion and contraction during normal load transients.

The two pressurizer spray control valves (spray valves) [EIIS: AB], 1JRCEPV0100E (100E) and 1JRCEPV0100F (100F), are parallel valves that regulate coolant flow from the discharge of the 1A and 1B reactor coolant pumps (RCPs) [EIIS: AB] to the pressurizer spray nozzle in the upper head of the pressurizer. The spray valves are Fisher air actuated 3-inch globe valves, with Model 667 actuators, Fisher 2625-11 pneumatic volume boosters, Fisher 3582G positioners, and Fisher Model i2p-100 current to pressure converters (I/Ps). The spray valve actuators are operated using the regulated instrument air system (IA) [EIIS: LD] and are spring loaded to close on loss of air supply pressure.

The pressurizer pressure control system (PPCS) [EIIS: AB] is an electronic control system which maintains RCS pressure within specified limits through automatic control of the pressurizer heaters and the spray valves. The operator can also take remote manual control of heaters and spray valves in the control room to regulate pressurizer pressure. Control of spray valve position (pressurizer spray flow) is provided by an electronic spray valve controller which receives input from the pressurizer pressure master controller. A 3-position (100E, 100F, BOTH) selector switch in the control room allows the operator to select the in-service spray valve(s). During normal operations, only one spray valve is selected.

Electrical power for the PPCS is provided from non-class 120VAC instrument power buses 1ENNND11 (D11) and 1ENNND12 (D12). For each of the instrument power buses, D11 and D12, the normal power source is provided from a voltage regulator which is supplied from a non-class 480VAC motor control center (MCC). Alternate power for each of the instrument power buses is provided from a separate voltage regulator which is powered from a class 1E 480VAC MCC. The normal or alternate power source is provided through an automatic transfer switch which is intended to maintain power to the instrument bus should the selected source be interrupted. Electrical power is provided to MCCs from respective 480 VAC load centers in the electric power distribution system.

During normal operation, with RCPs operating, pressurizer spray flowrate is controlled automatically. The spray valves start to open at 2275 psia and are fully open at 2300 psia. Operators can also manually adjust spray valve position using the spray valve controller in the control room.

3. INITIAL PLANT CONDITIONS:

On September 7, 2016, at 2131, PVNGS Unit 1 was in Mode 1 (Power Operation) at 100 percent power at normal operating temperature and pressure. No other major structures, systems, or components were inoperable that contributed to the event.

4. EVENT DESCRIPTION:

On September 7, 2016, at approximately 1407, a fire protection (FP) water line was re-pressurized following routine testing. A sprinkler head in the FP line on the 140 foot elevation of the turbine building began leaking as line pressure increased, spraying approximately 300 gallons of water onto the 480 VAC load center 1ENGNL25 (L25). Fire Protection Department personnel closed the FP line isolation valve and stopped the water flow. Several alarms were received in the control room including ground alarms on load center L25 and DC control power bus 1ENKNM45 (M45).

An inspection of load center L25 was planned to address problems resulting from the water intrusion event. Two MCCs are fed from load center L25: 1ENHNM03 (M03) and 1ENHNM13 (M13). Several loads required for continued operation of the plant are fed from these two MCCs and transfer of these loads to their emergency/alternate power sources was initiated. Selected loads from MCC M03 were transferred successfully. The transfer of D11 from its normal source, MCC M13, to its emergency/alternate source, MCC 1EPHAM31, was not successful due to a malfunction of the D11 automatic transfer switch which resulted in a voltage transient on D11 that caused multiple alarm conditions in the control room. The D11 voltage transient impacted the PPCS controllers causing the spray valve 100F to open. Spray valve 100F did not fully close after the voltage transient ended. The resultant pressurizer spray flow caused RCS pressure to decrease.

Control room personnel entered abnormal operating procedure (AOP) *Loss of Non-class Instrument Control Power,* and alarm response procedures were performed in an attempt to close spray valve

100F, however, spray valve 100F remained open. Pressurizer pressure continued to lower despite efforts to recover pressure. At 2132, on September 7, 2016, the reactor was manually tripped in accordance with procedures when pressurizer pressure reached 2075 psia and RCPs were secured placing the plant in natural circulation and stopping pressurizer spray flow. Control room personnel entered the *Standard Post Trip Actions* procedure and diagnosed a loss of forced circulation event and entered the *Loss of Offsite Power/Loss of Forced Circulation* emergency operating procedure (EOP). Pressurizer pressure was stabilized at 2235 psia.

Forced circulation was restored at 1215 on September 8, 2016 following isolation of spray valve 100F.

Troubleshooting was performed on the actuator system for spray valve 100F which determined the I/P converter had a calibration offset due to the voltage transient, and the pneumatic volume booster malfunctioned due to binding of internal booster components. These two issues combined caused spray valve 100F to stay approximately five percent open when it received a close demand from the controller. The I/P converter and pneumatic volume booster were replaced and a functional test was successfully performed on spray valve 100F.

Troubleshooting was also performed on the D11 transfer switch which determined a failed circuit component caused the transfer switch malfunction. The transfer switch was repaired and successfully tested.

Unit 1 was returned to full power on September 15, 2016, at 2200.

5. ASSESSMENT OF SAFETY CONSEQUENCES:

This event would not have resulted in a transient more severe than those analyzed in the Updated Final Safety Analysis Report Chapters 6 and 15. The condition did not result in any challenges to the fission product barriers or result in any releases of radioactive materials, and did not adversely affect plant safety or the health and safety of the public.

The nuclear safety risk associated with the subject condition was minimal. Acceptable RCS subcooling was maintained during the event. Per the PVNGS probabilistic risk assessment, no mitigating system function was lost due to this condition and no risk impacting initiating event occurred other than a forced unit shutdown. The conditional core damage probability associated with a miscellaneous unit trip (with or without RCPs running) is 1.2E-7. The risk level is considered 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*.

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

6. CAUSE OF THE EVENT:

The cause of the spray valve 100F malfunction, and resultant reactor trip, was a failed pneumatic volume booster in the spray valve 100F actuator system due to binding in the upper spring seat combined with an I/P converter calibration offset caused by the D11 voltage transient. These conditions caused spray valve 100F to stay approximately five percent open when it received a subsequent close demand from the spray valve controller.

The replaced pneumatic volume booster for spray valve 100F will be sent to the vendor for further analysis. The vendor analysis will be reviewed for cause determination.

If information is subsequently developed that would significantly affect a reader's understanding or perception of this event, a supplement to this LER will be submitted.

7. CORRECTIVE ACTIONS:

Immediate corrective actions replaced the I/P converter and pneumatic volume booster on the spray valve 100F actuator system and replaced failed components in the D11 transfer switch (which caused the voltage transient and unsuccessful power supply transfer). Spray valve 100F and the D11 transfer switch were both returned to service.

Additional corrective actions will change the frequency of the repetitive maintenance task for replacement of the pneumatic volume boosters on pressurizer spray valves from a four cycle (4C) frequency to a one cycle (1C) frequency.

8. PREVIOUS SIMILAR EVENTS:

PVNGS has not reported a similar event in the past three years.

Licensee event report number 50-529/2003-001-00 was submitted on September 29, 2003, for a reactor trip and loss of forced circulation due to a failed open pressurizer spray valve. The cause was determined to be a disengaged spray valve actuator positioner balance beam from its pivot point which came to rest in a position that obstructed the positioner air vent. This obstruction prevented the venting of the spray valve actuator positioner air relay, which then caused the maximum amount of air to be delivered to open the spray valve, overriding the close demand signal from the spray valve controller. The Fisher spray valve actuator positioners for the pressurizer spray valves in all three units were replaced with new positioners. Corrective actions from that event would not have prevented the condition being reported for this event.