

LICENSEE EVENT REPORT (LER)

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FACILITY NAME (1)

Palo Verde Nuclear Generating Station - Unit 3

DOCKET NUMBER (2)

05000530

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TITLE (4)

Main Steam Safety Valve As-Found Lift Pressures Outside of Technical Specification Limits

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
09	02	1998	1998	003	01	04	13	1999	PVNGS Unit 1	05000528
									PVNGS Unit 2	05000529
OPERATING MODE (9)		1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
POWER LEVEL (10)		95	20.2201(b)			20.2203(a)(2)(v)		X	50.73(a)(2)(i)	50.73(a)(2)(viii)
			20.2203(a)(1)			20.2203(a)(3)(i)			50.73(a)(2)(ii)	50.73(a)(2)(x)
			20.2203(a)(2)(i)			20.2203(a)(3)(ii)			50.73(a)(2)(iii)	73.71
			20.2203(a)(2)(ii)			20.2203(a)(4)			50.73(a)(2)(iv)	OTHER
			20.2203(a)(2)(iii)			50.36(c)(1)			50.73(a)(2)(v)	Specify in Abstract below or In NRC Form 366A
			20.2203(a)(2)(iv)			50.36(c)(2)		X	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME

Daniel G. Marks, Section Leader, Nuclear Regulatory Affairs

TELEPHONE NUMBER (Include Area Code)

602-393-6492

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	SB	RV	D243	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

YES
(If yes, complete EXPECTED SUBMISSION DATE.)

X NO

EXPECTED
SUBMISSION
DATE (15)

MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On September 1, 1998, prior to Unit 3's seventh refueling outage, the Unit 3 main steam safety valves (MSSVs) were tested for lift pressure verification per surveillance procedure requirements. The testing revealed that as-found lift pressures for four Unit 3 MSSVs were outside of the Technical Specification limits of +/- 3 percent of design lift pressure and three failed to open on the first attempt. Based on an engineering evaluation of the Unit 3 conditions, additional Unit 1 and 2 MSSVs were also tested.

The out of tolerance as-found MSSV setpoints have been attributed to the bonding of the valve disc to the nozzle seat which occurs during extended periods of valve operation. The disc bonding phenomena predominately affects valves which have been in service less than one operating cycle and although APS has not conclusively determined the causes of the disc bonding phenomenon, evidence suggests that it occurs as a result of the valves being heated up and remaining at relatively constant temperatures for extended periods of time.

Previous similar events have been reported in LERs 528/98-004, 529/97-001, and 530/97-003.

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NOTE: THIS SUPPLEMENT IS A SUBSTANTIAL REWRITE OF THE ORIGINAL LER AND THEREFORE NO REVISION BARS HAVE BEEN INCLUDED.

I. REPORTING REQUIREMENT(S):

During the 18 month frequency Unit 3 main steam safety valve (MSSV) (EIS: RV, SB) surveillance testing which began on September 1, 1998, as-found lift pressures for seven of the twenty Unit 3 MSSVs were found to be outside of Technical Specification (TS) limits. Subsequent testing to determine transportability of the Unit 3 condition was performed in Units 1 and 2 from September 5, 1998 through September 9, 1998 and revealed additional instances where as-found results were outside of the +/- 3 percent Technical Specification limit. As part of the corrective actions for this condition, additional augmented testing was commenced on February 24, 1999 and additional instances where as-found testing results were outside of the +/- 3 percent Technical Specification limit were identified.

This LER is being submitted because the existence of similar out-of-tolerance conditions in multiple MSSVs is an indication that the condition developed over a period of time and it is reasonable to assume the condition existed during plant operation in excess of TS 3.7.1 completion times. Therefore, the condition is reportable under 10 CFR 50.73(a)(2)(i)(B) "Any operation or condition prohibited by the plant's Technical Specifications."

In addition, this LER is being submitted pursuant to 10 CFR 50.73 (a)(2)(vii) because it is reasonable to assume that a single cause or mechanism served as a common input to the multiple MSSV out-of-tolerance conditions in a single system designed to mitigate the consequences of an accident.

II. DESCRIPTION OF STRUCTURE(S), SYSTEM(S) OR COMPONENT(S):

There were no structures, systems, or components that were inoperable that contributed to this condition. There were no failures that rendered a train of a safety system inoperable and no failures of components with multiple functions were involved.

The MSSVs are Dresser/Consolidated 3700 series valves designed for nuclear service and certified under Section III, class 2, of the ASME Code. Palo Verde's specific valves are Maxiflow, spring-loaded, direct acting, model No. 3707-R with 6" 1500 pound inlet and a 10" 300 pound outlet. Five MSSVs are located on each of the four main steam lines, outside containment (EIS: NH), upstream of the main steam isolation valves (EIS: ISV, SB).

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The total relieving capacity of the MSSVs is divided equally between the main steam lines and is sufficient to pass the steam flow equivalent to 105% of the plant's maximum steam flow. The MSSV design includes staggered setpoints, so that only the number of valves needed will actuate.

The primary purpose of the MSSVs is to provide overpressure protection for the secondary system. The MSSVs also provide protection against overpressurizing the reactor coolant pressure boundary (EIS: AB) by providing a heat sink for the removal of energy from the reactor coolant system (EIS: AB) if the preferred heat sink, provided by the condenser (EIS: SG) and circulating water system (EIS: KI, KE), is not available.

MSSVs are required to be tested once per five years by Technical Specification (TS) Surveillance Requirement (SR) 3.7.1.1 and the ASME Code requirements, however, Palo Verde has committed to test the valves prior to each refueling outage in accordance with previously specified corrective actions. The MSSVs are tested in accordance with approved procedures under normal operating pressure and temperature conditions. SR 3.7.1.1 requires that each MSSV lift setpoint must be within +/- 3 percent of the design lift setting. Upon completion of valve testing, the MSSVs must be returned to +/- 1 percent of the design lift setting.

III. INITIAL PLANT CONDITIONS:

On September 1, 1998, Palo Verde Unit 3 was in Mode 1 (Power Operation) at approximately 95 percent power, coasting down in power in preparation for the seventh refueling outage (3R7). Units 1 and 2 were in Mode 1 (Power Operation) at approximately 100 percent power.

IV. EVENT DESCRIPTION:

During the period of September 1, 1998 through September 4, 1998 (prior to Unit 3's seventh refueling outage) the Unit 3 main steam safety valves were tested for lift pressure verification per surveillance procedure requirements. The testing revealed that the as-found lift pressures for four Unit 3 MSSVs were outside of the TS limits of +/- 3 percent of design lift pressure and three failed to open on the first attempt. A corrective action document was initiated to document the seven out-of-tolerance conditions and to initiate action to determine operability during the cycle, to determine reportability, and to determine the root cause of the failures. During the Unit 3 seventh refueling outage, on October 2-3, 1998, off-site testing of the pressurizer safety valves (PSV) (EIS: AB, RV) as-found testing demonstrated all four Unit 3 PSVs were within the Technical Specification limit of +3/-1 percent of the design lift setting.

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Upon review of the Unit 3 MSSV testing results, APS engineering observed that the subject valves had been replaced during the previous refueling outage. Four of the seven MSSVs had been procured from the PVNGS warehouse and the other three had been refurbished at Wyle Western Service Center just prior to being installed. Based on this observation, a potentially transportable condition existed with six MSSVs that had been replaced in Unit 1 and two MSSVs that had been replaced in Unit 2. APS engineering promptly tested the eight susceptible MSSVs and one of the six Unit 1 MSSVs and one of the two Unit 2 MSSVs exceeded the +/- 3 percent TS limit.

As part of the ongoing investigation into the cause of the MSSV high as-found lift condition, APS engineering personnel hypothesized that the MSSVs which had been replaced during the previous outages would be susceptible to the disc bonding phenomena that occurs sometime after refurbished MSSVs are put into service. The phenomena was believed to be the result of refurbished MSSVs being installed and remaining at relatively constant temperatures for extended periods of time. Uninterrupted plant operating cycles was believed to contribute to the phenomena by exposing the MSSVs to longer periods of constant temperatures.

Subsequent to the initial MSSV testing in September, 1998, APS engineering formulated a plan to perform augmented testing of the recently refurbished MSSVs. Eight Unit 3 MSSVs were targeted and tested under the augmented testing plan; two lifted above the TS limit of +/- 3 percent of design lift setting on the initial lift, one MSSV did not lift on the initial test, and one initially lifted within limits but subsequently lifted 4.3 percent below the design lift pressure. The six Unit 1 MSSVs targeted and tested as part of the augmented testing plan all demonstrated as-found lift pressures within the TS limit.

The following sections chronologically describe the initial Unit 3 seventh refueling outage MSSV testing, the Unit 1 and Unit 2 testing initiated as part of the transportability review from the Unit 3 testing, and the augmented testing conducted as part of the ongoing corrective actions from the Unit 3 refueling outage testing.

On September 1, 1998, APS maintenance, APS engineering and Furmanite personnel began on-line testing of the Unit 3 MSSVs using the Furmanite Digital Trevitest method. Per SR 3.7.1.1 the allowable lift setting for all PVNGS MSSVs is +/- 3 percent of the designed lift setting (which is specified in TS Table 3.7.1-2). During the initial Unit 3 seventh refueling outage MSSV testing, the Unit 1 and Unit 2 testing initiated as part of the transportability review from the Unit 3 testing, and the augmented testing conducted as part of the ongoing corrective actions from the Unit 3 refueling outage testing, there were no safety system actuations and none were required.

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On September 2, 1998 at approximately 0829 MST, Unit 3 control room personnel declared SGE-PSV-573 inoperable and entered TS LCO 3.7.1 CONDITION A, because the as-found lift setting was greater than 7.0 percent above the 1290 pounds per square inch gauge (psig) design lift setting. During subsequent lift tests the valve lifted at 1304 psig, 1299 psig and the as-left setting was 1302 psig or 0.9 percent above the design lift pressure (1290 psig). After successful testing, SGE-PSV-573 was declared operable at approximately 0859 MST on September 2, 1998 and TS LCO 3.7.1 CONDITION A was exited and MSSV testing continued.

On September 2, 1998 at approximately 1012 MST, Unit 3 Control Room personnel declared SGE-PSV-691 inoperable and entered TS LCO 3.7.1 CONDITION A, because the valve did not lift when subjected to an upward force equivalent to 5 percent above the design lift setting of 1315 psig. The valve was tested again, without adjusting the valve lift settings, and it lifted at 1.7 percent above the design lift pressure. During subsequent lift tests the valve lifted at 1308 psig and 1311 psig and the as-left setting was 1313 psig or 0.2 percent below the design lift pressure. After successful testing, SGE-PSV-691 was declared operable at approximately 1118 MST on September 2, 1998 and TS LCO 3.7.1 CONDITION A was exited.

On September 2, 1998 at approximately 1322 MST, Unit 3 Control Room personnel declared SGE-PSV-576 inoperable and entered TS LCO 3.7.1 CONDITION A, because the valve did not lift during the first and second attempt when subjected to an upward force equivalent to 5 percent above the design lift setting. During the third attempt, SGE-PSV-576 lifted at 1.2 percent above the design lift pressure of 1315 psig. During subsequent lift tests the valve lifted at 1317 psig, 1321 psig and the as-left setting was 1313 psig, or 0.2 percent below the design lift pressure. After successful testing, SGE-PSV-576 was declared operable at approximately 1409 MST on September 2, 1998 and TS LCO 3.7.1 CONDITION A was exited.

On September 3, 1998 at approximately 1517 MST, Unit 3 Control Room personnel declared SGE-PSV-560 inoperable and entered TS LCO 3.7.1 CONDITION A, because the as-found lift pressure was 6.9 percent above the design lift pressure of 1290 psig. Adjustments were made to the valve and during subsequent testing the valve lifted at 1288 psig, 1286 psig and the as-left setting was 1285 psig or 0.4 percent below the design lift pressure. After successful testing, SGE-PSV-560 was declared operable at approximately 1549 MST on September 3, 1998 and TS LCO 3.7.1 CONDITION A was exited.

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On September 3, 1998 at approximately 1735 MST, Unit 3 Control Room personnel declared SGE-PSV-555 inoperable and entered TS LCO 3.7.1 CONDITION A, because the valve did not lift when subjected to an upward force equivalent to 7 percent above the 1290 psig design lift pressure. SGE-PSV-555 was tested again, without adjusting the valve, and lifted at 1327 psig, 1295 psig and the as-left setting was 1300 psig or 0.8 percent above the design lift pressure. After successful testing, SGE-PSV-555 was declared operable at approximately 1802 MST on September 3, 1998 and TS LCO 3.7.1 CONDITION A was exited.

On September 4, 1998 at approximately 0927 MST, Unit 3 Control Room personnel declared SGE-PSV-557 inoperable and entered TS LCO 3.7.1 CONDITION A, because the as-found lift setting was 1379 psig or 4.9 percent above the design lift pressure of 1315 psig. During subsequent lift tests the valve lifted at 1291 psig, 1285 psig and the as-left setting was 1300 psig or 1.1 percent below the design lift pressure. After successful testing, SGE-PSV-557 was declared operable at approximately 0959 MST on September 4, 1998 and TS LCO 3.7.1 CONDITION A was exited.

On September 4, 1998 at approximately 1020 MST, Unit 3 Control Room personnel declared SGE-PSV-695 inoperable and entered TS LCO 3.7.1 CONDITION A, because the as-found lift setting was 1364 psig or 3.7 percent above the design lift pressure of 1315 psig. The valve was adjusted and during subsequent lift tests the valve lifted at 1280 psig, 1314 psig and the as-left setting was 1311 psig or 0.3 percent below the design lift pressure. After successful testing, SGE-PSV-695 was declared operable at approximately 1129 MST on September 4, 1998 and TS LCO 3.7.1 CONDITION A was exited.

During the engineering review of the Unit 3 MSSVs testing results it was discovered that each of the seven valves that did not initially lift within +/- 3 percent of the design lift pressure had been replaced during the last Unit 3 refueling outage. Additionally, four of the seven valves which had been replaced had been taken from warehouse stock. Based upon the potential that a transportable condition existed, a decision was made to re-test six Unit 1 and two Unit 2 MSSVs that had been replaced during their most recent outages.

During transportability testing on September 5, 1998 at approximately 1806 MST, Unit 2 Control Room personnel declared SGE-PSV-556 inoperable and entered TS LCO 3.7.1 CONDITION A, because the as-found lift setting was 1361 psig or 3.5 percent above the design lift pressure of 1315. The valve was adjusted and during subsequent tests the valve lifted at 1321 psig, 1326 psig and the as-left setting was 1317 psig or 0.2 percent above the design lift pressure. After successful testing, SGE-PSV-556 was declared operable at approximately 2058 MST on September 5, 1998 and TS LCO 3.7.1 CONDITION A was exited.

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During transportability testing on September 9, 1998 at approximately 1611 MST, Unit 1 Control Room personnel declared SGE-PSV-695 inoperable and entered TS LCO 3.7.1 CONDITION A, because the as-found lift setting was 1371 psig or 4.3 percent above the design lift pressure of 1315 psig. The valve was adjusted and during subsequent tests the valve lifted at 1306 psig, 1307 psig and the as-left setting was 1309 psig or 0.5 percent below the design lift pressure. After successful testing, SGE-PSV-695 was declared operable at approximately 1739 MST on September 9, 1998 and TS LCO 3.7.1 CONDITION A was exited.

As a result of the Unit 1, 2 and 3 MSSV as-found conditions, actions were commenced in accordance with the APS corrective action program to determine the cause of the high out-of-tolerance lift pressures and to take actions to prevent recurrence. Based upon the as-found MSSV testing data, APS engineering personnel hypothesized that the refurbished MSSVs which had been replaced during the previous outages would be susceptible to a disc bonding phenomena that occurs sometime after the valves are put into service. APS engineering believed the phenomena resulted from refurbished MSSVs remaining at relatively constant temperatures for extended periods of time. Improved plant performance and extended plant operating cycles was believed to contribute to the phenomena by exposing the MSSVs to longer periods of relatively constant temperatures.

APS engineering developed a plan to perform augmented testing of the recently refurbished MSSVs to confirm their hypothesis and gather additional data points to gauge the progression of the disc bonding. The plan called for a Trevitest of each of the target MSSVs using a method similar to the 18 month surveillance test, however, acceptable results achieved during the augmented testing would not be used to reset the normal surveillance testing schedule. By performing the augmented testing, APS engineering believed that the MSSVs would be less susceptible to the disc bonding phenomena. The augmented testing plan was commenced on February 23, 1999 and was completed on February 25, 1999.

Eight MSSVs had been replaced during the Unit 3 seventh refueling outage and were targeted for augmented testing (the seven out-of-tolerance valves described above and one additional valve which had met as-found acceptance criteria but had observable leakage). Of the eight Unit 3 MSSVs tested under the augmented testing plan, two MSSVs initially lifted above the TS limit, one MSSV did not lift on the initial test, and one MSSV initially lifted within limits but subsequently lifted 4.3 percent below the design lift pressure. Specifically, SGE-PSV-695 lifted at 1386 psig (5.4 percent above setpoint), SGE-PSV-557 lifted at 1372 psig (4.3 percent above setpoint) and SGE-PSV-555 did not lift during the initial lift test and lifted at 1348 psig (4.5 percent above setpoint) on the second attempt. The as-found lift setting for SGE-PSV-573 was 1298 psig (0.6 percent above setpoint), however the third lift was at 1235 psig (4.3 percent below setpoint). The remaining four Unit 3 MSSVs as-found were: 1329 psig (1.1 percent above setpoint) for

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SGE-PSV-691; 1309 psig (0.5 percent below setpoint) for SGE-PSV-576; 1297 psig (0.5 percent above setpoint) for SGE-PSV-560; and 1270 psig (1.6 percent above setpoint) for SGE-PSV-561. The as-left settings for all eight Unit 3 MSSVs were within +/-1 percent of setpoint.

Six MSSVs had been replaced during the Unit 1 seventh refueling outage and were targeted for augmented testing. All six of the refurbished Unit 1 MSSVs tested under the augmented testing plan demonstrated acceptable as-found lift settings within Technical Specification limits of +/- 3 percent of setpoint. Unit 2 MSSVs were excluded from the augmented testing because they were already scheduled to be tested prior to the Unit 2 eight refueling outage, which was to begin on March 28, 1999.

Based upon the findings from the augmented testing and industry operating experience, APS engineering concluded that performing a number of lifts at normal operating pressures reduces the likelihood that subsequent disc bonding will occur.

V. SAFETY CONSEQUENCES:

During the Unit 3 seventh refueling outage, on October 2 and 3, 1998, off-site testing of the Pressurizer Safety Valves (PSV) (EIS: AB, RV) demonstrated all four Unit 3 PSVs were within the Technical Specification limit of +3/-1 percent of the design lift setting. The PSV as-found data was used in conjunction with the Unit 3 seventh refueling outage as-found data and a "Safety Valve As-Found Setpoint Analysis" was generated to evaluate the operability of the Unit 3 MSSVs. The analysis demonstrated that Unit 3, under accident conditions, would not have exceeded the overpressure protection limits for the primary and secondary systems and would not have violated the steam-only acceptance criteria for PSV operability.

The as-found MSSV results from the Unit 1 and Unit 2 transportability testing, conducted September 5 through September 9, 1998, yielded analysis results which were bounded by previous acceptable evaluation results and therefore no further analysis was required.

The as-found MSSV results from the Unit 1 augmented testing were within TS limits and therefore no analysis was required for these findings.

A preliminary safety analysis has been performed to evaluate the as-found results from the Unit 3 augmented testing. This analysis included the two MSSVs that initially lifted above the TS limit, the one MSSV that did not lift during the initial test, and the one MSSV that lifted below the TS limit on the third lift. The analysis has found that the as-found condition of the Unit 3 MSSVs would not, under accident conditions, have resulted in peak pressures that would have exceeded the overpressure protection limits for the primary or secondary systems.



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Therefore, the MSSV as-found out-of-tolerance conditions discovered prior to the Unit 3 seventh refueling outage, the as-found conditions discovered during the Units 1 and 2 transportability testing, and the as-found conditions discovered during the Unit 3 augmented testing, would not have resulted in a condition where the overpressure protection limits for the primary or secondary systems would have been exceeded. There were no adverse safety consequences or implications as a result of this event; this condition did not adversely affect the safe operation of the plant or health and safety of the public; and there were no challenges to fission product barriers or any releases of radioactive materials as a result of this condition.

VI. CAUSE OF THE EVENT:

The out of tolerance as-found MSSV setpoint condition has been attributed to the valve disc bonding with the nozzle seat. The disc bonding phenomena predominately affects valves which have been in service less than one operating cycle and although APS has not conclusively determined the root causes of the disc bonding phenomenon, evidence suggests that it occurs as a result of the MSSVs being heated up and remaining at relatively constant temperatures for extended periods of time. It is believed that improved plant performance has contributed to the phenomena by exposing the MSSVs to longer run cycles.

APS is continuing to investigate the root cause of this condition and based upon the findings from the augmented testing and industry operating experience, APS engineering has reasonable indication that by performing a number of lifts at normal operating pressure and temperature reduces the likelihood that subsequent disc bonding will occur.

No unusual characteristics of the work location (e.g., noise, heat, poor lighting) directly contributed to this event. No personnel or procedural errors contributed to this event.

VII. CORRECTIVE ACTIONS:

Unit 3 MSSVs (SGE-PSV-555, SGE-PSV-557, SGE-PSV-560, SGE-PSV-573, SGE-PSV-576, SGE-PSV-691 and SGE-PSV-695) discovered to have as-found lift pressures outside of the TS limit prior to the seventh refueling outage were either adjusted and retested or simply retested and successfully completed testing and were returned to service. Each Unit 3 MSSV which had as-found lift pressures outside of the TS limit was replaced with a refurbished and re-certified MSSV prior to completion of the seventh refueling outage.

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Unit 1 MSSV SGE-PSV-695 and Unit 2 MSSV SGE-PSV-556 were adjusted to within +/- 1 percent of TS limits and returned to service.

APS has implemented an augmented testing program to gather information and evaluate the bonding phenomena. APS is continuing to evaluate industry operating experience for other plausible actions to correct the disc bonding phenomenon and may implement additional actions if they are determined to be effective.

VIII. PREVIOUS SIMILAR EVENTS:

Previous similar events have been reported in LERs 528/98-004, 529/97-001 and 530/97-003. The effectiveness of previous corrective actions have reduced the failure rates of the MSSVs, however, as-found out of tolerance conditions continue to occur. Previous corrective actions included controls to limit the time refurbished/recertified MSSVs are stored in the PVNGS Warehouse, and an increase in testing frequency from five years to 18 months. Although these corrective actions have been proven effective in reducing MSSV test failures, they have not completely eliminated the disc bonding phenomenon.

