10CFR50.73

Palo Verde Nuclear
Generating Station

A subsidiary of Pinnacle West Capital Corporation

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102-05273-DMS/CKS/DJS
May 20, 2005

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

Dear Sirs:

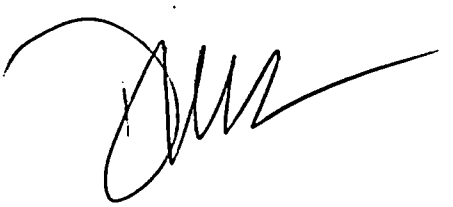
Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket No. STN 50-528, 50-529, and 50-530
License No. NPF 41, NPF 51 and NPF 74
Licensee Event Report 2005-003-00

Attached please find Licensee Event Report (LER) 50-528/2005-003-00 prepared and submitted pursuant to 10 CFR 50.73. This LER reports a condition that could have prevented the fulfillment of a safety function at some future point in time, if a revision to a calibration procedure was not implemented.

In accordance with 10 CFR 50.4, a copy of this LER is being forwarded to the NRC Region IV Office and the Senior Resident Inspector. If you have questions regarding this submittal, please contact Daniel G. Marks, Section Leader, Regulatory Affairs, at (623) 393-6492.

Arizona Public Service Company makes no commitments in this letter.

Sincerely,



DMS/CKS/DJS/ca

IE22

Attachment

cc:	B. S. Mallet	NRC Region IV Administrator	(all w/attachment)
	M. B. Fields	NRC NRR Project Manager for PVNGS	
	G. G. Warnick	NRC Senior Resident Inspector for PVNGS	

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to infocollects@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.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	1 OF 8

4. TITLE

Calibration method that might have failed to provide reactor protection during low power operation.

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
									PVNGS Unit 2	05000529
03	24	2005	2005	- 003 -	00	05	20	2005	PVNGS Unit 3	05000530

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☐ 50.73(a)(2)(iv)(A)
- ☒ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Daniel G. Marks, Section Leader, Regulatory Affairs	623-393-6492

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

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)*

A valid question was raised concerning the Excore Log Safety Channels. The condition is fundamentally a concern about the instrument channels, whether they are linear over their entire span. The condition is primarily related to the behavior of the cards in the channel drawer, not including the detector and the preamplifier. The channels are calibrated at essentially full power, which is in the Mean Square Voltage (MSV) region. However, the safety function is of concern at low powers in the Log Count Rate (LCR) region. The concern was that the LCR and MSV regions did not adequately align so that the channels would be unacceptably inaccurate at low powers. This appeared to be caused by the calibration method provided by the vendor and implemented by Palo Verde which introduced "tolerance creep" that might have failed to provide reactor protection during very low power operation. Corrective actions have been implemented to ensure there is no loss of a safety function.

There have been no previous similar licensee events reported in the last three years.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

1. REPORTING REQUIREMENT(S):

Pursuant to 10 CFR 50.73(a)(2)(v), this LER reports a condition that could have prevented the fulfillment of a safety function at some future point in time, if a revision to a calibration procedure was not implemented. Specifically, the condition is fundamentally a concern about the Excore Log Safety instrument channels, whether they are linear over their entire span. The condition is primarily related to the behavior of the cards in the channel drawer, not including the detector and the preamplifier. The channels are calibrated at essentially full power, which is in the Mean Square Voltage (MSV) region. However, the safety function is of concern at low powers in the Log Count Rate (LCR) region. The concern was that the LCR and MSV regions did not adequately align so that the channels would be unacceptably inaccurate at low powers. This appeared to be caused by the calibration method provided by the vendor and implemented by Palo Verde which introduced "tolerance creep" that might have failed to provide reactor protection during very low power operation.

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

The ex-core nuclear instrument (NI) (EIIS: JC) system used at Palo Verde was supplied by Combustion Engineering (now Westinghouse).

The four logarithmic (log) power channels provide input to the four channels of the plant protection system (PPS) (EIIS: JC). The primary function of the log power circuits is to provide reactor protection during very low power operation. The log power circuits provide reactor protection by monitoring the neutron flux level near the reactor vessel and providing an input to the PPS.

The log power detectors generate electrical pulses when struck by neutrons. The number of pulses is proportional to the number of neutron strikes; consequently, the pulses are proportional to reactor power. The pulses are routed through a preamplifier to signal conditioning circuits in the nuclear instrumentation safety channel assembly. A bistable comparator card in the PPS system compares the output of the NI drawer to an adjustable setpoint. If the log power level exceeds the technical specification PPS

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reactor trip allowable value, which is less than or equal to 0.011 percent neutron rated thermal power (NRTP), a reactor trip signal is generated. The log power trip protects the integrity of the fuel cladding and helps protect the reactor coolant pressure boundary in the event of an unplanned criticality from a shutdown condition. In Modes 2, 3, 4, and 5, with the reactor trip circuit breakers closed and the control element assembly (CEA) (EIIS: AA) Drive System capable of CEA withdrawal, log power trip protection is required for CEA withdrawal events originating when logarithmic power is less than 1E-4 percent (0.0001 percent) NRTP. For events originating above this power level, other trips provide adequate protection. In Modes 3, 4, and 5, with the reactor trip circuit breakers closed, the log power trip also provides protection for boron dilution events.

The NI drawer contains the circuits necessary to convert the detector pulses to signals that represent log power. The NI drawer also contains test circuits, which allow testing of the NI drawer and preamps. The test circuits produce test signals that simulate various log power levels.

The electronics circuits in the NI drawer have two modes of operation. At lower power levels where fewer pulses are generated by the detectors, the electronic circuits operate in the Log Count Rate (LCR) Mode. As power level increases, and the number of pulses increase, the circuit changes mode and enters the Mean Square Voltage (MSV) Mode. The mode change occurs as power exceeds approximately 0.2 percent. It is the output of the LCR card that determines when the mode change between LCR and MSV occurs.

3. INITIAL PLANT CONDITIONS:

On March 24, 2005, Units 1, 2, and 3 were in Mode 1 (POWER OPERATION), operating at approximately 100 percent power. The log power safety function is not required to be operable when the Units are operating in Mode 1,

There were no major structures, systems, or components that were inoperable at the start of the event that contributed to the event. There were no failures that rendered a train of a safety system inoperable and no failures of components with multiple functions involved.

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There were no failures of components with multiple functions involved in this event.

4. CHRONOLOGY OF RELEVANT EVENTS:

On December 8, 2004 a valid question was raised concerning the Safety Log Channels.

As reported in Condition Reports/Disposition Request (CRDR) # 2760452:

- On December 9, 2004 at 08:44, the CRDR notes that a discussion was held on 12/08/2004 to try and determine the validity of this concern. Representatives from the Shift Technical Advisor group, I&C Design Engineering, Transient Analysis, I&C Maintenance, and I&C Maintenance Engineering, tentatively came to the conclusion that there is evidence to support the conclusion that at low power, there is additional uncertainties that may challenge the ability of the HI LOG POWER TRIP, LOG 1 and LOG 2 bistables to perform their intended safety function.

- On December 9, 2004 at 09:00, the CRDR notes that the STA representative recommended that this CRDR be marked for Control Room review, and the impact on Operations would be determined at that time.

The condition is fundamentally a concern about the instrument channels, whether they are linear over their entire span. The condition is primarily related to the behavior of the cards in the channel drawer, not including the detector and the preamplifier. The channels are calibrated at essentially full power, which is in the Mean Square Voltage (MSV) region. However, the safety function is of concern at low powers in the Log Count Rate (LCR) region. The concern was that the LCR and MSV regions did not adequately align so that the channels would be unacceptably inaccurate at low powers. This appeared to be caused by the calibration method provided by the vendor and implemented by Palo Verde which introduced "tolerance creep" that might have failed to provide reactor protection during very low power operation.

An Engineering evaluation (CRDR) was initiated to address these concerns. On March 25, 2005 the outcome of the Engineering study showed adjustments were need to continue to provide reactor protection during very low power operation. The corrective actions listed in section 8 below summarize what APS is doing to ensure that there is no loss of this safety function.

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5. ASSESSMENT OF SAFETY CONSEQUENCES:

The condition did not result in any challenges to the fission product barriers or result in the release of radioactive materials. Therefore, there were no adverse safety consequences or implications as a result of this condition and the condition did not adversely affect the safe operation of the plant or health and safety of the public.

The condition did not, but could have prevented the fulfillment of any safety function at sometime in the future resulting in a safety system functional failure as defined by 10CFR50.73(a)(2)(v).

The condition did not result in a transient more severe than those analyzed in the Updated Final Safety Evaluation Report Chapters 6 and 15. The condition did not have any nuclear safety consequences, or personnel safety impact.

6. CAUSE OF THE EVENT:

There appear to be two primary reasons for the nonlinearity of the log channels.

Calibration Tolerances

The calibration method provided by the vendor and implemented by Palo Verde involved adjusting the various calibration points to account for power level and the neutron flux for that power level. For the MSV region, both the input voltages and the desired output voltages were adjusted. For the LCR region the desired output voltages were adjusted. The general approach is reasonable; however, the as-left value from the previous adjustment for power became the new desired value for the calibration. There was not a connection back to some sort of "ideal" value. This would allow for the possibility of tolerance creep. That is, at one point in time, the as-left value might be within tolerance, but higher than ideal. This sets the new ideal for the next time. If this time the as-left is again within tolerance, but higher than ideal, then a condition whereby the ideal gradually changes away from what would have been the ideal, just shifted to account for power level and neutron flux.

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Tolerance creep is a gradual effect. Therefore, there is no way of determining when the creep became enough to cause a condition that would have resulted in the loss of the Log Power trip function.

No Alignment of MSV and LCR Regions.

Originally there was to be an alignment of the MSV and LCR regions based on data collected during a reactor shutdown. However, during the initial start-up of the Palo Verde reactors the flux was shown to be significantly less than expected. This effectively moved the crossover region up to approximately 0.2% power, instead of the original nominal value of 0.02% power. Comparing this to the plots of power vs. time for the Unit 1 shutdown of 09 Feb 2005, indicates that 0.2% is just below the place where the slope of the curve decreases. In other words, the crossover may have already occurred by the time the curve is dependent on the delayed neutron precursors, the main region of the curve. If it has not occurred then there is not much plot to use to compare slopes.

Accordingly, this method of aligning the LCR and MSV regions was not performed. No records are readily available to indicate this was ever done. A substitute method for comparing the output of the MSV and LCR cards is recommended in the corrective actions listed below.

Any offset that may have initially existed or crept in over time has not been detected and adjusted out.

7. TRANSPORTABILITY:

The general condition applies to all Palo Verde Units and all channels of Excore log instruments. However, each channel has its own variation from the ideal. Therefore, most channels are adequate for performance of their safety function, whereas other channels may need conservative consideration of additional uncertainty.

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8. CORRECTIVE ACTIONS:

- Use the "High Variation of Flux" trip voltages described in site Calculation 13-JC-SE-201 until calibration methods are improved and the channels are calibrated using those methods, which will provide adequate margin to the trip setpoints. This is an interim measure.

- Adjust the bias of the LCR regions for the affected Units. The bias adjustments were required for one channel in Unit 2 (U2 B) and one channel in Unit 3 (U3 D).

- Engineering Department will develop an Engineering Study to provide guidance for improved calibration methods (regular calibration, functional test, and comparison to secondary calorimetric). This study will incorporate, as appropriate, instructions from the vendor Operations and Maintenance Manual, and supersede the calibration information provided in the vendor manual. The study is to be the basis for revising calibration procedure, 36ST-9SE01, the calorimetric adjustment procedure, 36MT-9SE14, and the function test procedure 36ST-9SE01. Among other things it will include the determination of the effect of the flux multiplier. Completion of the study and implementation of the calibration methods will eliminate the need for the interim measure "Use the High Variation of Flux trip voltages" stated above.

- Revise procedure 36ST-9SE06, Log Power Functional Test in accordance with the instructions from the Engineering study above.

- Revise the vendor manual ("Operation-Maintenance Instructions for Ex-core Neutron Flux Monitoring System") to reference the study to be developed above as the source for the calibration method for the Excore log channels. The calibration method information in the vendor manual is superseded by the information in the study.

- Develop a repetitive task to collect the output voltages from the MSV, LCR and CC cards on a high speed data recorder of at least one channel for planned reactor shutdowns. This data collection is intended to allow alignment of the LCR and MSV regions. The results of the recording of the measurements are to be forwarded to I&C Design Engineering for review and evaluation.

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9. PREVIOUS SIMILAR EVENTS:

There have been no previous similar events in the past three years that had a similar failure mechanism or that should have prevented this event from previously implemented corrective actions.