



A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear  
Generating Station

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102-05674-RSB/SAB/JAP/DFH  
March 22, 2007

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  
Supplement Licensee Event Report 2006-006-01**

Attached, please find Licensee Event Report (LER) 50-529/2006-006-01, which supplements a previously submitted report of an inoperable heat exchanger for Train B of the Essential Cooling Water System. The previous report incorrectly identified 10 CFR 50.73(a)(2)(v)(B) as a reporting criteria. Train A of the Essential Cooling Water heat exchanger was functional for the 78 day period that Train B was considered inoperable.

In accordance with 10 CFR 50.4, copies of this LER are being forwarded to the NRC Regional Office, NRC Region IV and the Senior Resident Inspector. If you have questions regarding this submittal, please contact James A. Proctor, Section Leader, Regulatory Affairs, at (623) 393-5730.

Arizona Public Service Company makes no commitments in this letter.

Sincerely,

RSB/SAB/JAP/DFH/gt

Attachment

cc: B. S. Mallett NRC Region IV Regional Administrator  
M. B. Fields NRC NRR Project Manager - (send electronic and paper)  
M. T. Markley NRC NRR Project Manager - (send electronic and paper)  
G. G. Warnick NRC Senior Resident Inspector for PVNGS

A member of the **STARS** (Strategic Teaming and Resource Sharing) Alliance  
Callaway • Comanche Peak • Diablo Canyon • Palo Verde • South Texas Project • Wolf Creek

JE22

**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: 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.

<b>1. FACILITY NAME</b> Palo Verde Nuclear Generating Station Unit 2	<b>2. DOCKET NUMBER</b> 05000529	<b>3. PAGE</b> 1 OF 5
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**4. TITLE**  
Technical Specification 3.7.7 Violation – Inoperable Essential Cooling Water Heat Exchanger

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
12	22	2006	2006	- 006 -	01	03	22	2007	None	05000
									FACILITY NAME	DOCKET NUMBER
									None	05000

<b>9. OPERATING MODE</b>  1	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§:</b> (Check all that apply)									
<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)							
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input checked="" 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 James A. Proctor, Section Leader, Regulatory Affairs - Compliance	TELEPHONE NUMBER (Include Area Code) (623) 393-5730
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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
E	BI	HX	S445	NO					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b> <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <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)

On December 22, 2006, the Palo Verde Nuclear Generating Station (PVNGS) received a Final Significance Determination letter from the Nuclear Regulatory Commission (NRC) for Apparent Violations received during an NRC Heat Exchanger Performance inspection. The NRC concluded in the letter that the Unit 2 Essential Cooling Water, Train B heat exchanger was Inoperable and a Technical Specification (TS) 3.7.7 violation for a period of 78 days occurred, ending on September 27, 2003 when Unit 2 was shutdown for a refueling outage (U2R11). The subject heat exchanger was restored to Operable during the refueling outage. Essential Cooling Water, Train A heat exchanger was functional for the 78 day period that EW 2B was considered inoperable.

As a result of other heat exchanger problems, in May 2006, Arizona Public Service (APS) initiated an investigation of the Essential Cooling Water heat exchangers and the chemistry controls for the Spray Pond System. The APS investigation identified system problems with chemistry control, equipment maintenance and organizational weakness which allowed the problems to develop and remain uncorrected for an extended period. A number of corrective actions were implement or are being implement which include restoring effective chemistry controls of the system, procedure changes, personnel training, and equipment modification.

In the past three years, there were no similar events reported.

## LICENSEE EVENT REPORT (LER)

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 5
		2006	-- 006	-- 01	

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

Note: All times listed in this event report are approximate and Mountain Standard Time (MST) unless otherwise indicated.

## 1. REPORTING REQUIREMENT(S):

This LER (50-529/2006-006-01) is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B) and 10 CFR 50.73(a)(2)(ii)(B), to report an Inoperable Essential Cooling Water (EW), Train B, Heat Exchanger which was determined to be a Technical Specification (TS) 3.7.7 violation. This condition left Unit 2 in an unanalyzed condition that significantly degraded plant safety and challenged the plant's residual heat removal capability. Specifically, for 78 days, ending on September 27, 2003 when Unit 2 shutdown for a refueling outage, less than optimal chemistry controls for the Spray Pond (SP) System caused fouling on the EW 2B heat exchanger. The degraded condition was significant enough to render the heat exchanger inoperable.

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

The Spray Pond system (SP) (EIS Code – BS) is the ultimate safety-related heat sink and is an open water, standby cooling system. The primary function of the spray pond system is to cool the Emergency Diesel Generator (EDG) (EIS Code – EK) and Essential Cooling Water (EW) (EIS Code – BI) systems. The primary function of the EW system is to provide cooling for the shutdown cooling system. There are multiple EDG heat exchangers (i.e., jacket water, lube oil, air intercooler and fuel oil) that are cooled by the spray pond system. Additionally, the EW system is used as an alternate means for cooling the spent fuel pool. The design bases for the spray pond system assume the system will function for 26 days without makeup water, losing approximately 85% of its original volume of water to evaporation and drift.

## 3. INITIAL PLANT CONDITIONS:

On December 22, 2006, Palo Verde Unit 2 was in Mode 1 (power operations), operating at approximately 100 percent power. There were no major structures, systems, or components inoperable at the start of the event that contributed to the event.

## 4. EVENT DESCRIPTION:

On December 22, 2006, the Palo Verde Nuclear Generating Station (PVNGS) received a Final Significance Determination letter from the Nuclear Regulatory Commission (NRC) for Apparent Violations received during an NRC Heat Exchanger Performance

## LICENSEE EVENT REPORT (LER)

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

Inspection. In its Final Significance Determination letter, the NRC concluded that the Unit 2 Essential Cooling Water, Train B, Heat Exchanger was inoperable and a Technical Specification (TS) 3.7.7 violation for a period of 78 days, ending on September 27, 2003 when Unit 2 was shutdown for a refueling outage.

## 5. ASSESSMENT OF SAFETY CONSEQUENCES:

APS performed an evaluation to predict the degradation that may have occurred over the operating cycle (2N11) for EW 2B heat exchanger (HX) during the period April 2002 and September 2003. The lowest coefficient of heat transfer (U) value that would be expected for this HX at the beginning of a Design Bases Accident (DBA) was 238.5 BTU/hr ft<sup>2</sup> °F. Also the degradation that would be expected during the first day and 26 days of the DBA would result in U values of 234.6 BTU/hr ft<sup>2</sup> °F and 231.3 BTU/hr ft<sup>2</sup> °F respectively.

An evaluation has also performed to calculate the minimum required U value that would have been necessary for the EW 2B HX to perform its design bases function for the same operating cycle. Based on this calculation, the highest value for the minimum required U is 224 BTU/hr ft<sup>2</sup> °F. This value already includes a degradation of 3.9 units of U during the 1st day following a DBA. During the following 25 days, an additional loss of 3.3 units of U is anticipated. Therefore, during the 26 day mission time, the minimum required U would be (224 + 3.3) = 227.3 BTU/hr ft<sup>2</sup> °F. Since the predicted U for the HX at the end of the 26 day time-frame of 231.3 BTU/hr ft<sup>2</sup> °F is greater than the U needed for a postulated DBA, the EW 2B HX would have been able to perform its intended design bases function during the period of interest (cycle 2N11).

In its Final Significance Determination letter, the NRC concluded that the EW 2B HX was Inoperable for 78 days, ending on September 27, 2003. The NRC concluded, "...the most appropriate value for the change in core damage frequency associated with these issues is  $2.3 \times 10^{-7}$  per year, allowing for some incidental cleaning credit, using actual pond and weather conditions during the period of greatest degradation, using midrange credit for operator recovery actions, and using upper bound values (conservative values) for the remaining assumption. To assess uncertainty, the maximum upper bound for the change in core damage frequency associated with these issues was determined to be  $1.3 \times 10^{-6}$  per year, allowing for no credit for incidental cleaning, and using actual spray pond and weather conditions during the period of greatest degradation, and using a high value for failure probability for operator recovery actions, and applying a maximum dependency on pump room cooling. Given that the majority of core damage frequency lies within the Green region, and considering the uncertainty involved as defined by the significance determination process, we have concluded that the most appropriate characterization of the significance of this issue is Green, i.e., very low safety significance".

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For the time frame that Unit 2 operated with the degraded condition, Unit 2 did not experience an event that called for the Essential Cooling Water System to perform its safety function(s) for a DBA. This condition did not result in any challenges to the fission product barriers or result in any offsite releases. Using its Significance Determination Process, the NRC assessed a 'Green' None Cited Violation for failing to meet TS 3.7.7. Additionally, EW 2A was functional for the 78 day period that EW 2B was considered inoperable.

## 6. CAUSE OF THE EVENT:

The direct cause of the loss of thermal performance from the EW 2B HX was the formation of an insulating precipitant on the SP side of the heat exchanger surfaces.

Root causes identified were:

- Inadequate Chemistry Control Program – Parameters were not being adequately controlled.
- Managed to Inadequate Chemistry Metrics – Metrics were not established for inorganic fouling
- Inadequate Resolution of Performance Problems – Opportunities to fix problems were missed.
- Over-reliance on a Single Expert – Incorrect actions were taken based on direction from an expert.
- Ineffective Change Management – Multiple changes to the plant, processes and people occurred ultimately causing the formation of the calcium-zinc-phosphate precipitant.

## 7. CORRECTIVE ACTIONS:

The action to restore EW 2B HX to an Operable condition was accomplished during the Unit 2 fall 2003 refueling outage (U2R11).

In May, 2006, APS identified that the EDG 2B intake air temperature was higher than the maximum limits specified in the data collection logs. APS declared the EDG inoperable and inspected and cleaned the intercooler. As a result of these issues, APS initiated an investigation team that consisted of individuals from the Chemistry Department (Palo Verde and APS Corporate Chemistry), Engineering Department, Performance Improvement Team members with plant operations experience, and industry consultants. The scope of the investigation included a review of all heat exchangers that are cooled by spray pond water and addressed the lack of dispersant

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control for the SP from approximately March of 2004 until June of 2005. The investigation team evaluated both past and current plant documents including sampling results, reviewed industry information, obtained independent chemistry analysis and conducted limited inspections of the system to support their investigation and to draw their conclusions.

The APS investigation identified associated problems and actions were developed to resolve a long standing problem with chemistry controls for the EW and SP systems.

The SP system chemistry was corrected as follows:

- Dispersant additions were resumed in all spray ponds.
- Additional acid was added to lower pH in all ponds.
- Feed and bleed was used to reduce calcium and phosphate concentrations in each spray pond.

EW heat exchangers were cleaned in all three units.

EDG intercoolers were cleaned in all three units and an Operations Department Standing Order was issued to increase the EDG test frequency to assess intercooler performance. This standing order continued through September 29, 2006. It was removed after APS gained confidence that the immediate corrective actions were effective.

Procedure 40DP-9OP08, "Diesel Generator Test Records," was revised to require a work order to be generated to clean any EDG intercooler if temperature exceeds 120°F in order to ensure the system does not exceed its Design Basis Manual (DBM) limit of 130°F.

The SPs have been cleaned, facilitating improved chemistry control and accessibility for inspections.

Additional cleaning and inspection activities of the EDG and EW heat exchangers have been scheduled to ensure the effectiveness of the completed corrective actions and to ensure there are no unintended consequences of the chemistry changes.

Additionally, modifications will be installed to add higher capacity acid and dispersant pumps.

## 8. PREVIOUS SIMILAR EVENTS:

In the past three years, no similar event was reported.