



10 CFR 50.73

DWIGHT C. MIMS

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Palo Verde

Nuclear Generating Station

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102-06977-DCM/DJH
December 19, 2014

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
Licensee Event Report 2014-001-01**

Enclosed please find Licensee Event Report (LER) supplement 50-529/2014-001-01 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER supplement provides additional information on the safety consequences, cause, and corrective actions determined for the previously reported event that resulted from corrosion of the cover of the Unit 2 train A emergency diesel generator fuel oil cooler that rendered train A Essential Spray Pond inoperable.

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

Sincerely,

 FOR DC MIMS

DCM/DJH/hsc

Enclosure

cc:	M. L. Dapas	NRC Region IV Regional Administrator
	B. K. Singal	NRC NRR Project Manager
	M. M. Watford	NRC NRR Project Manager
	C. A. Peabody	NRC Senior Resident Inspector PVNGS

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**LICENSEE EVENT REPORT (LER)**(See Page 2 for required number of
digits/characters for each block)

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 internet e-mail to Infocollections.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.

1. FACILITY NAME

Palo Verde Nuclear Generating Station (PVNGS) Unit 2

2. DOCKET NUMBER

05000529

3. PAGE

1 OF 5

4. TITLE

Inoperable Essential Spray Pond Train Due to Corrosion on the Diesel Generator Fuel Oil Cooler Cover

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	
06	11	2014	2014	- 001	- 01	08	11	2014	FACILITY NAME	DOCKET NUMBER	
9. OPERATING MODE			11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)								
1			<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 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)	
10. POWER LEVEL			<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 checked="" 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 checked="" 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 checked="" type="checkbox"/> 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT

Mark McGhee, Department Leader Nuclear Regulatory Affairs

TELEPHONE NUMBER (Include Area Code)

623-393-4972

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
A	SP	LB	A310	Y					

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)

On June 6, 2014, following planned maintenance on the train A emergency diesel generator (EDG) fuel oil (FO) cooler, essential spray pond (ESP) system water leakage was found on the FO cooler upper cover. The FO cooler upper cover was replaced with a new cover and the EDG and ESP systems were returned to service. A visual inspection of the removed cover identified corrosion related degradation of the cast iron cover. On June 11, 2014, an engineering analysis was completed to determine the required minimum wall thickness for the pressure boundary of the FO cooler upper cover. Measurements of the FO cooler upper cover wall thickness were found to be below the minimum wall thickness needed to maintain structural integrity for the full range of its design basis requirements. Consequently, it was determined the train A ESP system had been inoperable in excess of the completion time allowed by TS LCO 3.7.8. On June 28 and 29, 2014, the remaining five FO cooler upper covers (trains A and B for Units 1 and 3 and train B for Unit 2) were replaced with new covers.

The root cause of this event was latent design characteristics of the EDG FO cooler that resulted in a localized area in the cooler cover that was susceptible to galvanic corrosion. To prevent recurrence, a design modification will be implemented to remove the EDG FO cooler design function and isolate or remove the related ESP supply piping for the FO cooler.

No previous similar events have been reported to the NRC by PVNGS in the prior three years.

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

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 internet e-mail to 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.

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

This Licensee Event Report supplement is being submitted pursuant to 10 CFR 50.73 (a)(2)(i)(B), to update a previously reported condition prohibited by Technical Specification (TS) 3.7.8, Essential Spray Pond (ESP) System. On June 11, 2014, engineering personnel determined corrosion on the Unit 2 train A emergency diesel generator (EDG) fuel oil (FO) cooler upper cover resulted in the cover wall thickness being below the minimum needed to maintain structural integrity for the full range of its design basis requirements. Consequently, train A ESP was inoperable for a period in excess of the allowed completion time of TS Limiting Condition of Operation (LCO) 3.7.8.

Additionally, the train A FO cooler upper cover was degraded when train B ESP was removed from service for maintenance from March 28, 2014, until March 29, 2014. During that period of time both ESP trains were inoperable. This resulted in a safety system functional failure pursuant to 10 CFR 50.73 (a)(2)(v)(A), (B), and (D).

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

The ESP system consists of two independent trains each comprised of a spray pond, spray pond pump, and piping system and supporting auxiliary equipment that serve as the ultimate heat sink. Each ESP pump circulates cooling water through redundant safety-related flow trains comprised of the essential cooling water (EW) (EIS: BI) heat exchanger, EDG (EIS: EK) jacket water cooler (EIS: LB), EDG air aftercooler, EDG lube oil cooler (EIS: LA), and EDG fuel oil (FO) cooler (EIS: LB). The heat loads in the ESP system are arranged in parallel and each train is independently capable of providing the required heat removal capacity.

As described above, the heat removal function for the heat loads on each of the two safety-related EDGs in each unit is provided by the respective ESP train. Each EDG includes a FO subsystem which delivers fuel oil from an 1100 gallon day tank to the EDG high pressure injection pumps via an engine driven booster pump. Fuel oil supply pressure is maintained at the discharge of the booster pump by a relief valve that acts as a pressure regulator. When the engine is running at rated speed, excess fuel oil is diverted by the relief valve back to the day tank after passing through the shell side of the EDG FO cooler. The EDG FO cooler function is to remove heat from fuel oil that is recirculated back to the day tank and is not a critical function for EDG operation. At lower engine loads, when fuel oil consumption is low, the flow rate of fuel oil recirculated back to the day tank increases. Additional excess fuel oil from the twenty high pressure injection pumps is diverted back to the day tank without passing through the FO cooler. The EDG FO cooler is a four-pass, straight tube heat exchanger with a shell constructed of brass, tubes of copper, and upper

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and lower cast iron covers. ESP cooling water supply and return flow paths to the FO cooler are through one-inch stainless steel pipes threaded into the FO cooler upper cover. The FO cooler also provides an anchorage point for the ESP supply and return piping for the EDG, and therefore, serves as a seismic restraint for the ESP piping.

3. INITIAL PLANT CONDITIONS:

On June 6, 2014, PVNGS Unit 2 was in Mode 1 (Power Operation), at 100 percent power and normal operating temperature and pressure. Plant conditions on June 11, 2014, remained unchanged from the conditions shown for June 6. There were no structures, systems, or components inoperable that contributed to the event.

4. EVENT DESCRIPTION:

On June 6, 2014, the Unit 2 train A EDG FO cooler (American Standard Inc, Model 5-241-05-024-001) was disassembled during a planned train A ESP and EDG outage. The EDG FO cooler and associated piping showed no signs of leakage prior to commencement of the outage on June 2, 2014. After re-assembly and subsequent system restoration, ESP water was identified leaking from a defect in the FO cooler upper cover outlet nozzle. The FO cooler upper cover was removed from the system and subsequent examination by engineering personnel identified corrosion related degradation of the cast iron cover.

The EDG FO cooler upper cover was replaced with a new cover on June 6, 2014, and the system was restored following completion of the maintenance window.

On June 11, 2014, an engineering analysis was completed to determine the required minimum wall thickness for the pressure boundary of the EDG FO cooler upper cover. Measurements of the FO cooler upper cover wall thickness were found to be below the minimum wall thickness needed to maintain structural integrity for the full range of its design basis requirements. Based on the results of this analysis, it was determined that the ESP system had been inoperable in excess of the completion time allowed by TS LCO 3.7.8. Additionally, the train A FO cooler upper cover was degraded when train B ESP was removed from service for maintenance from March 28, 2014, until March 29, 2014.

On June 28 and 29, 2014, the remaining five EDG FO cooler upper covers for Units 1, 2 and 3 (trains A and B for Units 1 and 3 and train B for Unit 2) were replaced with new covers. The removed cooler upper covers were delivered to a vendor for detailed inspection and analysis. The event investigation was completed to determine the cause of this condition and establish corrective actions. The investigation concluded the FO cooler design, with a cast iron cover (electrical anode) installed between stainless steel pipe and a brass cooler shell (multiple electrical cathodes), results in a complex galvanic system with

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the cooler cover as the common sacrificial anode. Also, the internal surface area of the associated piping presents a disproportionately large cathode when compared to the smaller cooler cover anode which creates the potential for further acceleration of galvanic corrosion. With this design, defects with the FO cooler cover internal coatings expose the cast iron material and result in focused areas of localized corrosion.

5. ASSESSMENT OF SAFETY CONSEQUENCES:

This event did not result in a challenge to fission product barriers or result in the release of radioactive materials. The event did not adversely affect the safe operation of the plant or health and safety of the public and did not result in a potential transient more severe than those analyzed in the Updated Final Safety Analysis Report.

The investigation determined the EDG 2A FO cooler cover outlet nozzle wall thickness was degraded such that structural integrity requirements were not met. A fracture mechanics evaluation was performed on the 2A FO cooler cover outlet nozzle to determine the loading at which the degraded nozzle would sever under earthquake conditions and render the attached ESP piping unrestrained. Additional finite elemental analysis assessed the impact of the unrestrained piping on surrounding equipment. The results of these analyses demonstrated no impact to surrounding equipment that would have affected performance of equipment functions and established that the means to isolate ESP water to the cooler (installed isolation valves) would remain intact.

A probabilistic risk assessment (PRA) was then performed to evaluate the functional impact of the postulated pipe shear on ESP inventory, EDG operation, diversion of ESP flow from other loads, and flooding. Several cases were developed that considered uncertainties in the seismic PRA modeling. The assessment included events below and above the design basis Safe Shutdown Earthquake. The PRA concluded the condition resulted in very low safety significance with the bounding incremental core damage frequency for the limiting cases of $2.2\text{E-}7/\text{yr}$.

The train A FO cooler upper cover was degraded when train B ESP was removed from service for maintenance from March 28, 2014, until March 29, 2014. During that period of time both ESP trains were inoperable, resulting in a safety system functional failure.

6. CAUSE OF THE EVENT:

The direct cause of the defect on the EDG 2A FO cooler cover and subsequent ESP leak was loss of structural integrity due to corrosion.

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Root cause analysis determined latent design characteristics of the EDG FO cooler resulted in a localized area in the cooler cover that was susceptible to galvanic corrosion.

7. CORRECTIVE ACTIONS:

As an immediate corrective action the train A EDG FO cooler upper cover was replaced with a new cover. Additionally, to address the extent of condition, the remaining five EDG FO cooler upper covers for PVNGS Units 1, 2 and 3 (trains A and B for Units 1 and 3 and train B for Unit 2) were replaced with new covers.

To prevent recurrence, a design modification will be implemented to remove the EDG FO cooler design function and isolate or remove the related ESP supply piping for the FO cooler.

8. PREVIOUS SIMILAR EVENTS:

No previous similar events have been reported to the NRC by PVNGS in the prior three years.