10 CFR 50.73

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102-07272-MLL/JR
June 9, 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 2016-001-00

Enclosed please find Licensee Event Report (LER) 50-528/2016-001-00 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER reports a degraded principal safety barrier and a condition prohibited by Technical Specifications that resulted from reactor coolant system pressure boundary leakage on the Unit 1 reactor coolant pump 2B discharge pipe instrument nozzle.

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,

Maria Lacal

MLL/JR/akf

Enclosure

cc: M. L. Dapas — NRC Region IV Regional Administrator
S. P. Lingam — NRC NRR Project Manager for PVNGS
C. A. Peabody — NRC Senior Resident Inspector PVNGS

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NRR

NRC FORM 366 (11-2015) U.S. NUCLEAR REGULATORY COMMISSION

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

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.

LICENSEE EVENT REPORT (LER)

(See Page 2 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 6

4. TITLE

Leakage from Reactor Coolant Pump 2B Discharge Pipe Instrument Nozzle

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
04	11	2016	2016	- 001	- 00	06	09	2016	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
5	☐ 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)
	☐ 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)
0	☐ 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, Nuclear Regulatory Affairs Department Leader	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	NZL	C490	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 April 10, 2016, at 2335, with Unit 1 in Mode 5, during a planned extent-of-condition inspection of the Unit 1 reactor coolant system (RCS), engineering personnel at the Palo Verde Nuclear Generating Station (PVNGS) identified white residue on a one-inch instrument nozzle on the reactor coolant pump 2B discharge pipe. Isotopic analysis confirmed the white residue resulted from leakage of RCS coolant and, at 0535 on April 11, 2016, engineering personnel determined that RCS pressure boundary leakage had occurred resulting in a condition prohibited by Technical Specification 3.4.14, *RCS Operational Leakage*.

The cause of the event was determined to be primary water stress corrosion cracking of the Alloy 600 instrument nozzle. To correct the condition, the nozzle was repaired utilizing a Mechanical Nozzle Seal Assembly. A final repair of the nozzle will be addressed in the Corrective Action Program.

PVNGS reported similar events in licensee event report numbers 50-530/2015-001-00 (on June 5, 2015, when RCS pressure boundary leakage was identified on a Unit 3 RCP 2A suction pipe instrument nozzle) and 50-530/2013-001-00 (on December 6, 2013, when RCS pressure boundary leakage was identified on a Unit 3 reactor vessel bottom mounted instrument nozzle).

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)(ii)(A) as a degraded principal safety barrier and 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by Technical Specification (TS) Limiting Condition for Operation (LCO) 3.4.14, *RCS Operational Leakage*, due to reactor coolant system (RCS) pressure boundary leakage.

On April 10, 2016, at 2335, with Unit 1 in Mode 5, during a planned extent-of-condition inspection of the Unit 1 RCS cold leg instrument nozzles, engineering personnel at the Palo Verde Nuclear Generating Station (PVNGS) identified white residue on a one-inch instrument nozzle on the reactor coolant pump (RCP) 2B discharge pipe. Isotopic analysis confirmed the white residue resulted from leakage of RCS coolant and, at 0535 on April 11, 2016, engineering personnel determined that RCS pressure boundary leakage had occurred resulting in a condition prohibited by Technical Specification 3.4.14.

This condition was reported to the NRC pursuant to 10 CFR 50.72 (b)(3)(ii)(A) at 1237 on April 11, 2016, via the Emergency Notification System (ENS 51861).

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

A primary function of the RCS (EIIS: AB) is to provide a barrier against fission product release to the environment. In order to ensure integrity of the RCS, piping and component joints are made by welding, bolting, rolling, or pressure loading, and valves are provided to isolate connecting systems from the RCS. During plant life, the joint and valve interfaces can produce varying amounts of reactor coolant leakage, through normal operational wear or mechanical deterioration.

The RCS piping is arranged with two flow loops connected in parallel to the reactor vessel. Each of the two loops consists of one 42-inch outlet (hot leg) pipe, one steam generator, two 30-inch RCP inlet (cold leg) pipes, two RCPs, and two 30-inch RCP outlet (cold leg) pipes. The RCS piping is configured with various penetrations which serve to provide connections to interfacing systems and instrumentation. Each instrumentation penetration is provided with a nozzle which creates the interface between the pipe and the connected instrumentation. There are 47 instrument nozzles on RCS piping including 27 hot leg pipe nozzles and 20 cold leg pipe nozzles. Specific to this event, the nozzle is a thermowell instrument nozzle and is located on the 2B RCP cold leg discharge pipe. The cold leg instrument nozzles were fabricated from Alloy 600 and were connected to the RCS piping with internal J-groove welds made with Alloy 82/182 weld materials. The thermowell instrument nozzle was welded using Alloy 182 weld material. These weld materials and Alloy 600 have been determined to be susceptible to primary water stress corrosion cracking (PWSCC). Three factors must be present for PWSCC to occur: susceptible material, a corrosive environment, and stress. Stresses that make Alloy 600 nozzles and their Alloy 82/182 J-groove attachment welds susceptible

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO.	
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	2016	- 001	- 00	3 OF 6

NARRATIVE

to cracking are inherent residual stresses induced by the welding of the nozzle to the inside surface of the pipe during fabrication.

To monitor the integrity of the RCS pressure boundary, the PVNGS In-service Inspection (ISI) Program requires the conduct of bare metal visual examinations of RCS cold leg pressure retaining welds fabricated with Alloy 600 and Alloy 82/182 once per 10 year interval in accordance with American Society of Mechanical Engineers (ASME) Code Case N-722-1 as conditioned by 10 CFR 50.55a. In addition to the ISI Program inspections, the PVNGS Boric Acid Corrosion Control Program requires the performance of boric acid walk-down inspections of the RCS in each refueling outage to identify boric acid deposits which may be indicative of leakage. All 20 of the RCS cold leg nozzles in all 3 units have undergone extent-of-condition bare metal inspections by engineering personnel during refueling outages as a corrective action from the Unit 3 RCP 2A suction pipe instrument nozzle leak in June, 2015.

PVNGS TS LCO 3.4.14, *RCS Operational Leakage*, is applicable in Modes 1 through 4 when the RCS is capable of being pressurized and provides limitations for RCS leakage. The LCO specifies the types of leakage and provides required actions when leakage rates exceed allowable values. The LCO specifies that no RCS pressure boundary leakage, defined as non-isolable leakage (except primary to secondary leakage) through a component body, pipe wall or vessel wall, is allowed because such leakage could cause further deterioration and result in higher leakage rates.

3. INITIAL PLANT CONDITIONS:

At approximately 2335 on April 10, 2016, PVNGS Unit 1 was stable in Mode 5 with RCS temperature at approximately 94 degrees Fahrenheit and RCS pressure at approximately 50 pounds per square inch absolute. Unit 1 had been shutdown at 0000 on April 9, 2016, to commence the 19th Unit 1 refueling outage (1R19). There were no structures, systems, or components inoperable that contributed to the event.

4. EVENT DESCRIPTION:

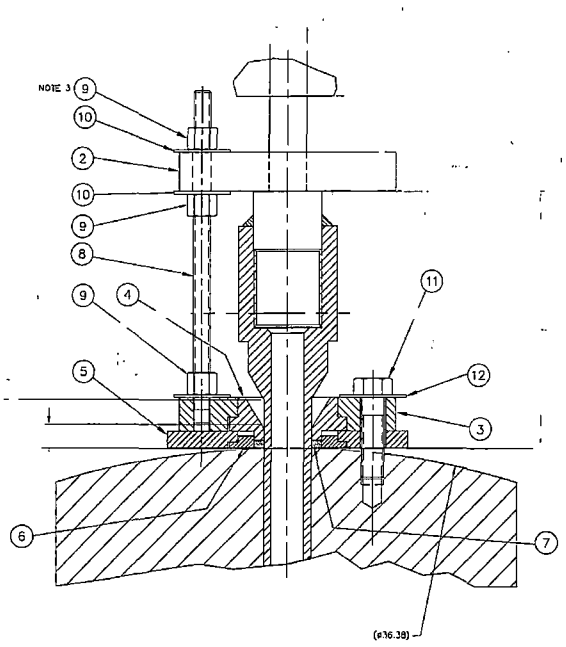
At approximately 2335 on April 10, 2016, during a planned extent-of-condition inspection of the Unit 1 RCS, engineering personnel identified white residue on a one-inch instrument nozzle on the RCP 2B discharge pipe (thermowell instrument nozzle). This residue appeared to have originated at the penetration for the thermowell instrument nozzle (nozzle). Visual inspections were performed in the immediate area and directly above the nozzle, but no other evidence of leakage was found.

Isotopic analysis confirmed the white residue resulted from leakage of RCS coolant and was most likely greater than 420 days old, based upon the radionuclide half-lives, and that the leak stopped after the initial leakage. At 0535 on April 11, 2016, engineering personnel determined that RCS pressure boundary leakage had occurred. The degraded condition of a principle safety barrier was reported to the NRC pursuant to 10 CFR 50.72 (b)(3)(ii)(A) at 1237 on April 11, 2016, via the Emergency Notification System (ENS 51861).

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO.	
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	2016	- 001	- 00	4 OF 6

NARRATIVE

An investigation was initiated to evaluate the condition and to establish necessary corrective actions. Scheduled refueling outage activities were continued and Unit 1 transitioned from Mode 6 to a Defueled condition on April 18, 2016, when all fuel was removed from the reactor vessel. The RCS piping was drained as necessary to allow repairs to the nozzle. To characterize the problem, engineering personnel conducted additional inspections of the nozzle and piping penetration. This included visual (VT) and dye-penetrant exams as well as eddy-current testing. The VT exam of the nozzle interior and seal weld revealed an axial crack in the nozzle in the region of the seal weld. The eddy-current testing results aligned with the VT exam. Repairs to the nozzle were performed per application of Code Case N-733 (no exceptions) with the utilization of a Mechanical Nozzle Seal Assembly (MNSA). Figure 1 illustrates the MNSA.



ITEM NO.	NAME
2	TOP PLATE
3	UPPER FLANGE
4	COMPRESSION COLLAR
5	FLAT LOWER FLANGE
6	FLAT SEAL RETAINER
7	MNSA GRAFOIL SEAL
8	TIE ROD
9	HEX NUT
10	RETAINER WASHER
11	HEX HEAD BOLT
12	RETAINER WASHER

Figure 1 – Mechanical Nozzle Seal Assembly

5. ASSESSMENT OF SAFETY CONSEQUENCES:

This event did not result in a potential transient more severe than those analyzed in chapters 6 and 15 of the Updated Final Safety Analysis Report or result in the release of radioactive materials to the environment. There were no actual safety consequences as a result of this event and the event did not adversely affect the health and safety of the public.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO.	
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	2016	- 001	- 00	5 OF 6

NARRATIVE

The noted leakage from the nozzle is bounded by the Probabilistic Risk Assessment (PRA) analysis for Very Small Loss of Coolant Accident or Leak events (NUREG/CR-5750 category G1) which is defined as pressure boundary leakage within the capacity of three charging pumps. These events are modeled as Miscellaneous Events in the PVNGS PRA model. The conditional probability of core damage given a Miscellaneous Event is 1.2E-7 in the PVNGS PRA. This risk impact is characterized as "very small" per NRC Regulatory Guide 1.174. Therefore, this condition had minimal safety significance.

The condition would not have prevented the fulfillment of a safety function, and the condition did not result in a safety system functional failure as defined by 10 CFR 50.73 (a)(2)(v).

6. CAUSE OF THE EVENT:

The cause of the event was determined to be primary water stress corrosion cracking of the Alloy 600 instrument nozzle in the region of the seal weld.

7. CORRECTIVE ACTIONS:

Repairs to the nozzle were performed per application of Code Case N-733 (no exceptions) with the utilization of a MNSA. A final repair of the nozzle will be evaluated and addressed in the Corrective Action Program.

To address the extent-of-condition, the following actions were performed or are planned:

- During 1R19, bare metal visual inspections were performed for the remaining 19 RCS cold leg instrument nozzles. All inspection results were satisfactory.
- Bare metal visual inspections have been performed on each of the 20 RCS cold leg instrument nozzles during the most recent refueling outages for Unit 2 (2R19) and Unit 3 (3R18).
- RCS nozzles will continue to be inspected as part of the Boric Acid Corrosion Control Program and the In-Service Inspection (ISI) Program.

8. PREVIOUS SIMILAR EVENTS:

PVNGS reported the following similar events:

- Licensee event report number 50-530/2015-001-00 was submitted on June 5, 2015, when RCS pressure boundary leakage was identified on a Unit 3 RCP 2A suction pipe instrument nozzle. An ASME code approved and NRC endorsed half-nozzle repair was performed to correct the instrument nozzle leakage.
- Licensee event report number 50-530/2013-001-00 was submitted on December 6, 2013, when RCS pressure boundary leakage was identified on a Unit 3 reactor vessel bottom

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO.	
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	05000528	2016	- 001	- 00	6 OF 6

NARRATIVE

mounted instrument (BMI) nozzle. The BMI nozzle leakage was corrected with an ASME code approved and NRC endorsed weld pad/half-nozzle repair method.