10 CFR 50.73

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102-08628-CDH/DHD
June 7, 2023

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

Subject: **Palo Verde Nuclear Generating Station Unit 1**
Docket No. STN 50-528 /Renewed License No. NPF-41
Licensee Event Report 2023-001-00

Enclosed, please find the Licensee Event Report (LER) 50-528/2023-001-00 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER reports an event in which Unit 1 had an unplanned reactor trip following a main turbine trip on April 8, 2023.

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.

No new commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact Michael DiLorenzo, Department Leader, Nuclear Regulatory Affairs, at (623) 393-3495.

Sincerely,

Harbor, Cary (Z16762) Digitally signed by Harbor, Cary (Z16762)
Date: 2023.06.07 17:38:01 -07'00'

CDH/DHD/cr

Enclosure: Unit 1 Licensee Event Report 2023-001-00

cc: R. J. Lewis Acting NRC Region IV Regional Administrator
S. P. Lingam NRC NRR Project Manager for PVNGS
L. N. Merker NRC Senior Resident Inspector for PVNGS

ENCLOSURE

Unit 1 Licensee Event Report
2023-001-00

NRC FORM 366 (03-14-2023) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2023

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. Facility Name		2. Docket Number	3. Page
Palo Verde Nuclear Generating Station (PVNGS) Unit 1	■ 050 ☐ 052	00528	1 OF 5

4. Title

Unit 1 Reactor Trip Following a Main Turbine Trip

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved		
Month	Day	Year	Year	Sequential Number	Revision No.	Month	Day	Year	Facility Name	☐ 050	Docket Number
04	08	2023	2023	- 001 -	00	06	07	2023	Facility Name	☐ 052	Docket Number

9. Operating Mode	10. Power Level
1	100

11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*

10 CFR Part 20	☐ 20.2203(a)(2)(vi)	**10 CFR Part 50**	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)	☐ 73.1200(a)
☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)	☐ 73.1200(b)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)	☐ 73.1200(c)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.36(c)(2)	☑ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)	☐ 73.1200(d)
☐ 20.2203(a)(2)(i)	**10 CFR Part 21**	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(A)	**10 CFR Part 73**	☐ 73.1200(e)
☐ 20.2203(a)(2)(ii)	☐ 21.2(c)	☐ 50.69(g)	☐ 50.73(a)(2)(v)(B)	☐ 73.77(a)(1)	☐ 73.1200(f)
☐ 20.2203(a)(2)(iii)		☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(2)(i)	☐ 73.1200(g)
☐ 20.2203(a)(2)(iv)		☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(ii)	☐ 73.1200(h)
☐ 20.2203(a)(2)(v)		☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)		

☐ **OTHER** (Specify here, in abstract, or NRC 366A).

12. Licensee Contact for this LER

Licensee Contact	Phone Number (Include area code)
Michael DiLorenzo, Department Leader, Nuclear Regulatory Affairs	623-393-3495

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to IRIS		Cause	System	Component	Manufacturer	Reportable to IRIS
E	TG	Motor	GE	Yes		X	TL	RLY	GE	Yes

14. Supplemental Report Expected		15. Expected Submission Date	Month	Day	Year
☐ No	☑ Yes (If yes, complete 15. Expected Submission Date)		07	31	2023

16. Abstract (Limit to 1326 spaces, i.e., approximately 13 single-spaced typewritten lines)

On April 8, 2023 at approximately 2144 MST, following a turbine trip due to the loss of control oil header pressure, both 13.8 kV non-class buses de-energized, which caused a loss of power to the Reactor Coolant Pumps and resulted in a reactor trip. The B auxiliary feedwater pump was started to feed both steam generators due to the de-energization also having led to the main feed pumps tripping on low suction pressure. A Main Steam Isolation Signal was manually actuated due to a loss of circulating water flow to the condenser, which isolated the main steam header and required the use of Atmospheric Dump Valves for heat removal.

The cause investigation is in progress, and the results will be reported in a supplement to this Licensee Event Report.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. FACILITY NAME		2. DOCKET NUMBER	3. LER NUMBER		
			YEAR	SEQUENTIAL NUMBER	REV NO.
Palo Verde Nuclear Generating Station Unit 1	■ 050 ☐ 052	00528	2023	- 001	- 00

NARRATIVE

All times are in Mountain Standard Time.

1. REPORTING REQUIREMENT(S):

This Licensee Event Report (LER) is being submitted pursuant to 10 CFR 50.73(a)(2)(iv)(A), because the plant had a reactor trip due to a loss of Reactor Coolant Pumps (RCPs), manual actuation of the Main Steam Isolation Signal (MSIS) which affected multiple Main Steam Isolation Valves (MSIVs), and manual actuation of the B-train Auxiliary Feedwater Pump.

This event was reported to the NRC pursuant to 10 CFR 50.72(b)(2)(iv)(B) RPS Actuation as a 4-Hr Non-Emergency report and under 10 CFR 50.72(b)(3)(iv)(A) Specified System Actuation as an 8-Hr Non-Emergency report on April 9, 2023, via the Event Notification System (ENS #56459). An additional update to the ENS report was completed on May 3, 2023.

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

Atmospheric Dump Valve (ADV) (EIIS: SB): The ADVs are pneumatically operated and may be opened/closed by the control room operator to control pressure or primary plant cooldown in the event the main condenser and/or steam bypass control system is not available.

Auxiliary Feedwater (AF) Actuation Signal (AFAS) (EIIS: BA): During normal power generation, the two essential AF pumps are in a standby condition. The system is provided with two channels of AFAS (AFAS-1 or -2) corresponding to each Steam Generator (SG). An AFAS will automatically start and align the essential pumps to feed the affected SG upon receipt of a low steam generator water level signal. As long as the affected SG is intact, as evidenced by the existing SG differential pressure (relative to the other SG), the auxiliary feed system will automatically maintain SG level within a prescribed wide range indication band. AFAS is an Engineered Safety Features Action Systems (ESFAS) actuation.

Control Oil System (CO) (EIIS:TG): The main turbine control oil is the high-pressure fluid which comprises the hydraulic portion of the electro-hydraulic control system used to control turbine operation. The high-pressure fluid is provided to the main turbine stop and control valves, combined intercept valves, as well as the trip devices in the trip and overspeed protection circuits. There are two main hydraulic fluid pumps that are 100 percent capacity, motor-driven, variable-delivery piston pumps. They are designed to maintain a constant pressure through the entire delivery range using a pressure compensator provided for each pump.

During normal operations, only one pump operates with the second pump maintained in standby. If a pump trips and the standby pump does not auto-start, CO header pressure will continue to slowly drop. Main CO low header pressure acts as an input to the main turbine trip logic.

Fast Bus Transfer (FBT): With the plant in normal plant operations, during a turbine trip or loss of supply from the unit auxiliary transformer, (not involving an electrical fault or under frequency), the sequence of events includes an FBT. A FBT would be initiated when its control logic is satisfied, which includes a trip of the unit auxiliary transformer output breakers, resulting in the alternate supply breakers closing within a few cycles to connect the 13.8 kV buses to the startup transformers. Typically, the startup transformers supply buses during plant startup or at other times when the turbine generator or unit auxiliary transformer is out of service. Transfers of these buses can also be initiated by a plant operator from the control room.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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Turbine Generator Reverse Power Relays: The generator reverse power relays, one primary and one backup, are sensitive, three-phase, directional power relays used for turbine protection against motoring. This condition could occur if the steam supply to the turbine is lost while the generator is connected to the grid. Both relays are interlocked such that they are inoperative unless the generator is connected to the grid.

In the event of a turbine trip during normal plant operations, not involving an electrical fault or under frequency, the turbine generator will remain synchronized to the high voltage transmission network until residual energy in the turbine is dissipated. The generator will motorize for a short period of time and will not trip until a sustained reverse power condition exists and the reverse power relay actuates. The reverse power relay actuation will simultaneously trip the generator exciter, the 525 kV breakers and the unit auxiliary transformer output breakers, thereby initiating a fast bus transfer.

Main Steam Isolation Valves (MSIV) (EIIS: SB): Each of the main steam lines is equipped with one quick acting MSIV. The MSIVs close on a MSIS generated by either low steam generator pressure, high steam generator level or high containment pressure. The MSIVs fail closed on loss of control or actuation power. Closing the MSIVs isolates each steam generator from the other, and isolates the turbine, Steam Bypass Control system, and other auxiliary steam supplies from the steam generators.

Reactor Coolant System (RCS) (EIIS: AB): The RCS is comprised of two main flow loops each of which includes two Reactor Coolant Pumps (RCPs) and one SG. The primary function of the RCPs is to provide the necessary head to maintain forced circulation of reactor coolant through the RCS during normal operations. The reactor coolant leaving the core of the reactor vessel enters two “hot legs”, one per loop, and flows to the SG. Critical operation of the reactor requires all four RCPs to be in operation to ensure adequate RCS flow. The RCPs are powered from non-class 1E 13.8 kV buses with two RCPs per bus.

Reactor Protection System (RPS) (EIIS Code: JC): The system's functions are to protect the core Specified Acceptable Fuel Design Limits and RCS pressure boundary for incidents of moderate frequency, and to provide assistance in limiting initial conditions for certain infrequent events and limiting faults. The RPS consists of four independent, redundant channels and includes a number of sensors, calculators (including the core protection calculators (CPCs) (EIIS: JC)), logic circuits, and supporting equipment that monitor nuclear steam supply system (EIIS: AB) parameters. The RPS ensures the reactor is rapidly and reliably shut down to protect the fission product barriers and assist the engineered safety features systems in accident mitigation. When all four channels of RPS are in service, a reactor trip is actuated when two of four channels generate trip signals.

Reactor Power Cutback System (RPCS) (EIIS:JD): The RPCS is a safety feature that is designed to automatically reduce the reactor's power output in the event of an abnormal event. At Palo Verde, this occurs following a loss of a feed pump or the main generator. The system is designed to then drop selected subgroups of CEAs to reduce reactor power to match secondary power. This prevents the power mismatch from creating a heat-up event in the primary and causing a reactor trip.

Steam Bypass Control System (SBCS) (EIIS:JI): The SBCS is a control system to regulate the flow of steam and maintain optimal operating conditions. At Palo Verde, the system is designed to automatically bypass the main turbine and send steam from the main steam header directly to the condenser, atmosphere, or a combination of both, while controlling steam header pressure at setpoint. Valves open on a loss of the turbine, helping to maintain secondary heat removal.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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3. INITIAL PLANT CONDITIONS:

On April 8, 2023, PVNGS Unit 1 was in Mode 1 (Power Operation) at 100 percent power with the RCS at normal operating temperature and normal operating pressure.

At the time of the event Unit 3 was in Mode 1 at 100 percent power and Unit 2 was in a planned refueling outage.

4. EVENT DESCRIPTION:

On April 8, 2023 at 2141, Unit 1 “A” Control Oil (CO) pump tripped and the “B” CO pump automatically started. The running amps for the “B” CO pump indicated low, and the CO system pressure continued to degrade until it reached the main turbine trip setpoint and tripped the main turbine at 2143. This resulted in a reactor power cut back (RPCB), but an automatic reverse power relay actuation did not occur to trip the generator switchyard output breakers.

At 2144, operators manually opened the generator switchyard output breakers per the applicable procedural guidance. A loss of power to the 13.8 kV non-class buses, 1E-NAN-S01 and 1E-NAN-S02 caused the Reactor Coolant Pumps (RCPs) to trip, which resulted in a reactor trip. The non-class loads were de-energized due to the loss of power to the non-class 13.8 kV buses, which included condensate pumps. The loss of the condensate pumps caused the main feedwater pumps to trip on low suction pressure. The B train Auxiliary Feed Pump, AFB-P01, was started manually to feed both steam generators.

At 2202, Unit 1 completed Standard Post Trip Actions (SPTA) and the Loss of Forced Circulation Emergency Operating Procedure (EOP) was entered. No Emergency Plan classification was required.

At 2204, operators manually actuated MSIS per the Loss of Forced Circulation EOP, due to the loss of the circulating water flow to the main condenser. This isolated the main steam header and prevented the use of the steam bypass control system, requiring the use of ADVs for heat removal.

At 2308, 13.8 kV power was restored to NAN-S01 through NAN-S03 from offsite power.

At 0124 on April 9, 13.8 kV power was restored to NAN-S02 through NAN-S04 from offsite power.

At 0310, RCP 1A and RCP 2A were restarted, restoring forced flow circulation of the RCS.

5. ASSESSMENT OF SAFETY CONSEQUENCES:

Given the initial turbine trip and the subsequent associated response of PRA modeled plant equipment, the conditional core damage probability (CCDP) for this event is 3.21E-06 and the conditional large early release probability (CLERP) for this event is 1.21E-07. The nuclear safety risk significance of the event was small, but greater than minimal due to the lack of fast bus transfer as a result of the generator output breakers not automatically opening. These results do not take credit for any potential realignment of available offsite power to the non-class buses and recovery of main feedwater or alternate feedwater via the condensate pumps.

There was no radiological or industrial safety significance involved in this event.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2023

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NARRATIVE

6. CAUSE OF THE EVENT:

A Level 1 Root-Cause Evaluation is in progress for this event and at the time of the Licensee Event Report submittal the evaluation has not been completed. A supplement to the LER will be provided at the completion of the root-cause evaluation.

The following includes the most current information available regarding the immediate causes:

The “A” CO pump tripped on an electrical protection ground fault. The ground fault was caused by a degraded motor cable splice connection, which exposed the B-phase bolted connection.

The “B” CO pump did not build up immediate pressure due to insufficient oil level in the CO reservoir. The “B” CO pump delay in developing pressure led to the main turbine trip on low CO header pressure.

The generator switchyard output breakers did not open and a FBT did not occur due to no signal from the reverse power relays.

7. CORRECTIVE ACTIONS:

A Level 1 Root-Cause Evaluation is in progress for this event and at the time of the Licensee Event Report submittal the evaluation has not been completed. A supplement to the LER will be provided at the completion of the root-cause evaluation, including additional corrective actions identified as part of the evaluation.

IMMEDIATE CORRECTIVE ACTIONS:
The degraded cable splice connection on the “A” CO pump was repaired.

Addition of hydraulic fluid to the CO reservoir, calibration of the CO level indicating switch, and retrieval/reinstallation of the missing float parts from the CO reservoir for the level indicating switch were completed for the “B” CO pump hydraulic fluid low level condition.

8. PREVIOUS SIMILAR EVENTS:

No similar events have been reported by PVNGS in the last three years due to the same initial cause.