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July 2, 2014

PG&E Letter DCL-14-059

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

10 CFR 50.73

Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Licensee Event Report 2-2014-001-01, Lightning Arrester Failure Resulting in Reactor Trip

Dear Commissioners and Staff;

Pacific Gas and Electric Company (PG&E) submits the enclosed Licensee Event Report (LER) supplement for a lightning arrester failure that resulted in a reactor trip. PG&E is submitting this LER supplement in accordance with 10 CFR 50.73(a)(2)(iv)(A). PG&E is submitting this supplement to add event cause and corrective action information.

PG&E makes no new or revised regulatory commitments (as defined by NEI 99-04) in this report. All the corrective actions identified in this letter will be implemented in accordance with the Diablo Canyon Power Plant Corrective Action Program.

This event did not adversely affect the health and safety of the public.

Sincerely,

Barry S. Allen

mjrm/4557/50607203
Enclosure
cc/enc: Peter J. Bamford, NRC Project Manager
Marc L. Dapas, NRC Region IV Administrator
Thomas R. Hipschman, NRC Senior Resident Inspector
INPO
Diablo Distribution

NRC FORM 366 (01-2014) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 01/31/2017

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)

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4. TITLE

Lightning Arrester Failure Resulting in Reactor Trip

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
02	02	2014	2014	- 001 -	01	07	02	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	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
100	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Michael Richardson, Regulatory Services Senior Engineer	805-545-4557

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	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 February 2, 2014, at 1129 PST, a failure of the Diablo Canyon Power Plant, Unit 2, Phase B, 500 kV lightning arrester resulted in a direct short to ground and actuated the 500 kV tie-line current differential relay. The actuation of the 500 kV tie-line current differential relay opened the Unit 2 generator output breakers to isolate the generator, which then actuated a turbine trip. Since Unit 2 was operating above the 50 percent power permissive, the reactor protection system initiated a Unit 2 reactor trip. Plant equipment responded as designed.

The cause was indeterminate due to the component damage. The corrective actions, including installing lightning arresters with increased capability to withstand, periodic cleaning of the arresters, and enhanced condition monitoring, address all probably causes.

There were no personnel injuries, no offsite radiological releases, and no damage to safety-related equipment associated with this condition. This condition did not have an adverse effect on the health and safety of the public.

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NARRATIVE

I. Plant Conditions

At the time of the event, Diablo Canyon Power Plant (DCPP) Units 1 and 2 were in Mode 1 (Power Operation) at approximately 100 percent reactor [RCT] power with normal operating reactor coolant temperature and pressure.

II. Description of Event

A. Background

DCPP is equipped with a Class IE alternating current (AC) electrical power distribution system [EB] that is divided into three load groups. The power sources for this system consist of two physically-independent offsite sources and multiple onsite standby power sources (three diesel generators (DGs) [DG] for each unit). These systems have independent controls, independent protection, and separate switchyards, transmission lines, and tie-lines to the plant. In the normal alignment, the power produced at DCPP is transmitted offsite via the 500 kV system [EL] and also feeds normal onsite loads via the auxiliary transformer [XFMR]. Backup power is available immediately via the 230 kV system [EK] and startup transformer. In the event of a loss of 230 kV power, backup power is available from onsite DGs. The AC electrical power sources provide sufficient capacity, capability, redundancy, and reliability to ensure the availability of necessary power to engineered safety systems so that the fuel, reactor coolant system [AB], and containment [NH] design limits are not exceeded.

Each phase of the main bank transformers has an associated lightning arrester (LA) connected to the 500 kV line between the transformer high voltage bushing and the first transmission line tower out from the transformer yard. The LAs are designed to protect the high voltage winding of its associated transformer against impulse and switching surges on the transmission line.

B: Event Description

On February 2, 2014, while experiencing a rainstorm, failure of Phase B 500 kV LA occurred resulting in a direct short to ground and actuated the 500 kV tie line current differential relay. The actuation of the 500 kV tie-line current differential relay opened the Unit 2 generator output breakers to isolate the generator, which then actuated a turbine trip. Since Unit 2 was operating above the 50 percent power permissive, the reactor protection system initiated a Unit 2 reactor trip. Plant equipment responded as designed. All three Unit 2 auxiliary feedwater (AFW) pumps [P] started, the containment fan [FAN] cooling units started and ran in slow speed, and the standby auxiliary saltwater train started, all as expected. All three Unit 2 DGs remained in standby and were operable throughout the event.

NARRATIVE

C. Status of Inoperable Structures, Systems, or Components that Contributed to the Event

N/A

D. Other Systems or Secondary Functions Affected

None

E. Method of Discovery

Annunciators in the control room alerted licensed control room operators of the 500 kV system problem.

F. Operator Actions

Plant operators verified appropriate plant trip response using Emergency Operating Procedure (EOP) E-O, "Reactor Trip or Safety Injection," and EOP E-O.1, "Reactor Trip Response."

G. Safety System Responses

Vital buses transferred from auxiliary power to startup power as designed.

III. Cause of the Problem

An internal failure of one section of the lightning arrester in conjunction with external moisture resulted in full internal arc through, subsequently grounding the "B" phase main generator output resulting in a unit differential trip of Unit 2. The cause of the internal failure, even with extensive forensics and tests performed, was inconclusive due to the damage to the lightning arrester. The following are the most probable causes:

- Asymmetric deposition of "extra heavy" levels of contaminants on the surface of the lightning arrester resulting in uneven voltage gradients across the lightning arrester causing a current path internally which led to a full internal arc through.
- Heavy contamination exceeded the external capacity to withstand causing an external failure which subsequently initiated an internal failure.
- Assembly errors resulting in internal contamination initiating an internal failure.

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NARRATIVE

IV. Assessment of Safety Consequences

There were no safety consequences as a result of this event. The transfer of plant loads to startup occurred as designed. Equipment necessary for Unit 2 decay heat removal was available and operated as required by plant design. Unit 1 remained at full power and all of its vital buses remained powered by auxiliary power. Therefore, the event is not considered risk significant and did not adversely affect the health and safety of the public.

V. Corrective Actions

Corrective Action to Prevent Recurrence (CAPR) 1:
Design, test, and install 500kV lightning arresters on Units 1 and 2, and 230 kV lightning arresters on Unit 2, with components having greater ability to withstand environmental factors.

CAPR 2:
Create procurement requirements to ensure quality control of the newly procured lightning arresters.

Interim Corrective Action (ICA) 1:
Clean the installed Units 1 and 2 500 kV and the Unit 2 230 kV LAs nominally every three months, or based on meteorological and contamination monitoring data using preventative maintenance program provisions.

ICA 2:
Design, procure, and install external leakage current monitors for the lightning arresters.

ICA 3:
Revise the contamination monitoring program.

ICA 4:
Establish a lightning arrester cleaning preventative maintenance strategy.

VI. Additional Information

A. Failed Components

Indeterminate. While it was possible to confirm the events of the lightning arrester failure, the root cause and initiating event cannot conclude a component failure due to the destruction of evidence from pressure relief in the Unit 2, B Phase, LA.

NARRATIVE

B. Previous Similar Events

On October 11, 2012, at 12:08 PDT, the DCPP Unit 2 500 kV line differential relay actuated, resulting in a unit trip. The 500 kV coupling capacitor voltage transformer (CCVT) bushing experienced a flashover to ground, resulting in a unit trip and turbine trip. With the turbine tripped and Unit 2 operating above the 50 percent power permissive, the reactor protection system initiated a reactor trip as designed. All plant equipment, including the auto-start of the AFW system, responded as designed.

At the time of the event, the environmental conditions consisted of light rain. PG&E determined that the causes of the bushing failure were inadequate insulator material performance and inadequate engineering design practices. Additionally, an unintended AFW pump restart occurred following this event as a result of a procedure deficiency that was created when the procedure was not revised following a plant modification. PG&E revised the procedure and supporting documents and performed tailboards with the procedure writing staff on use of the supporting documents to identify all changes required by a plant modification. CCVTs have now all been relocated to the switchyard and are no longer at the transformer location.

On July 10, 2013, at 09:50 PDT, while performing the periodic hot-washing of the 500 kV insulators, a flashover of the Phase A 500 kV to ground across the Phase A LA occurred and actuated the 500 kV differential relay. The actuation of the 500 kV differential relay opened the Unit 2 generator output breakers to isolate the generator, which then actuated a turbine trip. Since Unit 2 was operating above the 50 percent power permissive, the reactor protection system initiated a Unit 2 reactor trip. All plant equipment responded as designed.

DCPP staff determined the root cause of this event to be the hot-washing of the Phase A transmission line string insulators (500 kV dead-end insulators) with inadequate controls for oversight of supplemental PG&E transmission line personnel, and on-line maintenance risk analysis, that resulted in a conductive overspray, which induced an external arc around the LA insulation resulting in flashover. The corrective action to prevent reoccurrence involves the development and implementation of a maintenance strategy for 500 kV dead-end insulators to ensure they remain adequately contamination free, structurally sound, and minimize risk to DCPP.