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PG&E Letter DCL-07-067

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

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Licensee Event Report 1-2007-001-00
Emergency Diesel Generator Auto-start on Loss of Offsite 230kV Startup Power Due to an Insulator Failure and Unanticipated Relay Response at Substations

Dear Commissioners and Staff:

In accordance with 10 CFR 50.73(a)(2)(iv)(A), Pacific Gas and Electric Company is submitting the enclosed licensee event report regarding emergency diesel generator (EDG) system actuation on loss of offsite 230kV startup power due a transmission system insulator failure and unanticipated protective relay response. Two Unit 1 EDGs started to provide onsite power during the fourteenth refueling outage with the core offloaded. All three Unit 2 EDGs started as required but did not load due to normal power being supplied via the auxiliary transformers in Mode 1 (Power Operation).

There are no new or revised regulatory commitments in this report. This event did not adversely affect the health and safety of the public.

Sincerely,

James R. Becker

ddm/2246/A0696386
Enclosure
cc/enc: Terry W. Jackson, NRC Senior Resident Inspector
Bruce S. Mallett, NRC Region IV
Alan B. Wang, NRR Project Manager
INPO
Diablo Distribution

IE52

NRR

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

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.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Diablo Canyon Unit 1	05000275	1 OF 7

4. TITLE

Emergency Diesel Generator Auto-start on Loss of Offsite 230kV Startup Power

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
05	12	2007	2007	- 001 -	00	07	11	2007	Diablo Canyon Unit 2	05000323

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Lawrence M. Parker – Senior Regulatory Services Engineer	(805) 545-3386

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
				No					

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 May 12, 2007, at 10:25 PDT, with Unit 1 in no Mode (core offloaded to the spent fuel pool) and Unit 2 in Mode 1 (Power Operation) at approximately 100 percent power, an emergency diesel generator (EDG) system actuation was initiated on loss of 230kV startup power supply due an offsite transmission system nonceramic insulator (NCI) failure and unanticipated protective relay response. Two Unit 1 EDGs started and loaded to provide onsite power. Unit 1 had one EDG and auxiliary offsite power cleared for maintenance. All three Unit 2 EDGs started as required but did not load due to normal power supply being maintained via the auxiliary transformers. At 14:30 PDT, Operations restored 230kV offsite power to the site. Plant operators made a nonemergency event notification (EN 43360) in accordance with 10 CFR 50.72(b)(3)(iv)(A) at 15:09 PDT.

This event was due to an offsite transmission system NCI failure resulting in a phase to phase short and unanticipated instantaneous protective relay response.

Corrective actions include resetting the startup power protection relays to establish a time delay and replacing NCIs in the 230kV supply to Diablo Canyon Power Plant.

TEXT

I. Plant Conditions

Unit 2 was in Mode 1 (power operation) at approximately 100 percent power. Unit 1 was in No Mode (refueling - with the core offloaded to the spent fuel pool (SFP)) during the scheduled fourteenth refueling outage (1R14).

II. Description of Problem

A. Background

During normal operation, the 4.16kV vital buses are powered from the auxiliary power system. The 230kV system provides an immediately available source of offsite power to the 4.16kV system. The 230kV system provides power to Startup Transformers (SUTs) [EA][XFMR] 1-1 and 2-1 (230kV to 12kV), which feed the SUT 1-2 and 2-2 (12 kV to 4.16kV), respectively. SUTs 1-2 and 2-2 then supply power to each unit's 4.16kV vital bus.

The 230kV loop, which supplies power to the Diablo Canyon Power Plant (DCPP) startup transformers, receives power directly from the Morro Bay switchyard or through the Mesa switchyard and then to the Diablo switchyard. The Morro Bay switchyard receives power from the 230kV grid from the Morro Bay Power Plant, Midway, and/or Gates lines. The 230kV loop is designed to remain in service with any single line out-of-service. The 230kV feeds to the DCPP switchyard belong to the Transmission Service Provider (TSP) and are governed by an established Transmission Service Agreement.

Each DCPP unit has three onsite emergency diesel generators (EDGs) [EK][DG], which supply power to the 4.16kV vital AC buses [EA][BU] whenever power is either unavailable, or voltage degrades below the point at which required loads could become inoperable. EDGs automatically start on a safety injection signal, degraded or loss of voltage on the associated vital bus, or undervoltage on the 230kV startup power system.

The protection of the transmission system is provided by relays, which sense line faults, and then send signals to their respective breakers to open the breaker and isolate the fault. The relays have a current input, provided by a current transformer (CT), and a voltage input, provided by a capacitance coupled voltage transformer (CCVT). These two signals are compared in the relay and trip signals can be developed from a high current condition, a low voltage condition, or a mismatch between the voltage and current conditions.

B. Event Description

On May 12, 2007, at approximately 10:25 PDT a nonceramic insulator (NCI) failed in service on 230kV tower 0/3 in Morro Bay creating a B-C phase electrical fault.

The protection relay for Breaker 532 in the Morro Bay switchyard correctly sensed this Zone 1 (a near electrical fault) fault and provided an instantaneous trip signal to open Breaker 532. However, due to its distance from Morro Bay, the DCPP switchyard breaker 262 did not immediately trip open as designed.

With Morro Bay Breaker 532 open, the fault current on the Mesa–Diablo line increased due to the fault current path shifting to the Morro Bay–Mesa–Diablo lines.

During the current increase, the CCVT providing reference voltage for Breaker 2332 in the Mesa switchyard could not respond as fast as the current, which allowed the Zone 1 element to pick-up tripping Breaker 2332. Mesa switchyard Breaker 2332 opened and 230kV startup power was lost to DCPP.

The Diablo switchyard Breaker 262 received a Zone 2 fault (a distant electrical fault) signal and opened to isolate the Morro Bay–DCPP 230kV line.

Unit 1, EDG 1-1 and EDG 1-2 started and loaded to busses H and G, respectively, and plant operators entered Operating Procedure (OP) Abnormal Procedure (AP) SD-1, "Loss of AC Power." Power from the 500kV systems was not available due to scheduled maintenance on the main bank transformers.

Unit 2 EDG 2-1, EDG 2-2, and EDG 2-3 started with the loss of 230kV startup power as designed but did not load since the vital busses remained energized from the auxiliary power system.

At 10:29 PDT Unit 1 SFP pump 1-2 was restarted to re-establish SFP cooling in accordance with OP AP SD-1.

At 11:01 PDT Unit 2 EDGs were shut down and returned to Auto.

At 13:54 PDT Unit 1 startup power was returned to operable status.

At 14:30 PDT, after determining the immediate cause for the loss of 230kV power, operators restored 230kV startup power to Unit 2.

At 15:04 PDT, Unit 1 EDGs were shut down and returned to standby service.

At 15:09 PDT, operators made a nonemergency event notification (EN 43360) in accordance with 10 CFR 50.72(b)(3)(iv)(A).

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

Unit 1 was relying on startup power as the allowed single source of offsite power. Unit 1 auxiliary power and EDG 1-3 were cleared for 1R14 scheduled maintenance.

D. Other Systems or Secondary Functions Affected

Unit 1 was relying on startup power as the single offsite source in accordance with the 1R14 outage safety plan. Two offsite power sources were not required since Unit 1 was in no mode with the reactor defueled. The two available EDGs started and were loaded onto their respective buses to provide electrical power required during refueling. SFP cooling was unavailable for less than 4 minutes since the SFP cooling pumps are not designed to automatically load onto a vital bus following transfer of the vital busses to EDG power.

Unit 2 was unaffected with power continuing to be supplied from the auxiliary transformers. The site lost the 12kV underground loop, which powers administrative loads and offices.

E. Method of Discovery

The event was self-revealing to licensed control room operators by annunciators indicating the startup bus loss of voltage condition and the automatic actuation of the Unit 1 and 2 EDGs.

F. Operator Actions

Plant operators verified that EDGs 1-1 and 1-2 auto-started on the loss of startup power and powered their loads as aligned. Since SFP cooling is not automatically loaded on the EDGs, Operators restarted a SFP cooling

pump. This re-established decay heat removal via component cooling water (CCW) (two of three pumps remained operable) and auxiliary saltwater pump 1-2. SFP temperature remained at approximately 105°F. At 15:09 PDT, operators made a nonemergency event notification (EN 43360) in accordance with 10 CFR 50.72(b)(3)(iv)(A).

G. Safety System Responses

Prior to this event, Unit 1 auxiliary power and EDG 1-3 were cleared for 1R14 scheduled maintenance. All three vital buses were powered from startup power with two associated EDGs in Auto. Following recovery of the 230kV startup power system, startup power remained as the Unit 1 operating power source and the EDGs were returned to Auto.

Prior to this event, Unit 2 was in Mode 1 (Power Operation) at full power. The vital buses were powered from auxiliary power and EDGs were in Auto. With the loss of 230kV startup power, the emergency EDGs received a start signal and started but did not load as designed. Following the event, auxiliary power remained the normal power source with startup power available for transfer and the EDGs were returned to Auto.

III. Cause of the Problem

A. Immediate Cause

The loss of 230kV power was initiated when a dead-end NCI on the Morro Bay-Diablo line tower 0/3 failed. This caused a B-C phase short circuit. The protection relays for Breaker 532 in the Morro Bay switchyard and Breaker 2332 in the Mesa switchyard provided instantaneous trip signals to their breakers and the breakers opened. The onsite 230kV switchyard de-energized and startup power to DCPP was lost.

B. Root Cause

The root cause for the 230kV loss has been determined to be an unanticipated voltage transient in a CCVT output signal supplying the protection relay for Breaker 2332. The CCVT output did not reflect actual line voltage during recovery from the fault induced voltage transient. The protection relay in the Mesa switchyard sensed a Zone 1 (DCPP-Mesa line) fault due to the low voltage from its CCVT and sent a trip signal to Breaker 2332. The instantaneous trip signal was transmitted in approximately 2 milliseconds.

TEXT

IV. Assessment of Safety Consequences

There were no safety consequences as a result of this event. Unit 1 EDG 1-1 and EDG 1-2 automatically started and loaded onto their respective vital buses as designed. Equipment necessary for resumption of decay heat removal was manually started by plant operators as required by plant procedures. Unit 2 EDG 2-1, EDG 2-2, and EDG 2-3 automatically started but did not load as designed. Unit 2 remained at full power and all vital buses remained powered by auxiliary power.

Therefore, the event is not considered risk significant and it did not adversely affect the health and safety of the public.

V. Corrective Actions

A. Immediate Corrective Actions

1. The Mesa–DCPP line tower 0/3 dead-end insulators were replaced with new insulators (see Electric Utility Operation Event Report 4679)
2. A time delay was added to the protective relays in the Mesa-DCPP switchyards (see Electric Utility Operation Event Report 4680)
3. Additional 230kV startup power lines and insulators were inspected for potential defective conditions.

B. Corrective Actions to Prevent Recurrence

1. The breaker protection relays in the Mesa and Diablo switchyards have been reconfigured to establish a 16 millisecond (one cycle) time delay in their Zone 1 protection scheme as a corrective action to prevent repetition. This action was taken in accordance with the requirements of FERC/NERC Standard PRC-004-1 "Analysis and Mitigation of Transmission and Generation Protection System Misoperations."

2. NCIs manufactured by Reliable Power Products Inc. will be removed from the 230kV transmission lines that provide power from the Gates and Midway substations to the Morro Bay Switchyard.

TEXT

VI. Additional Information

A. Failed Components

NCI insulators, similar to the failed NCIs manufactured by Reliable Power Products Inc., were the subject of a prior IEEE Electrical Insulation Magazine, Feature Article, "Failure analyses of Nonceramic Insulator: Part II – The Brittle Fracture Model and Failure Prevention," published in July/August 2005 edition.

B. Previous Similar Events

None.