LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Diablo Canyon Unit 1	0 5 0 0 0 2 7 5	1 OF 7

TITLE (4)

Voluntary - Turbine Building Siding Structural Supports Did Not Meet Design Requirements for Wind Load Resistance

EVENT DATE (5)				LER NUMBER (6)		REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	15	1998	1998	- 0 0 9 -	0 0	08	21	1998	Diablo Canyon Unit 2	0 5 0 0 0 3 2 3

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)	
1	____ 10 CFR	
POWER LEVEL (10)	X OTHER	. Voluntary
1 0 0		(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER	
	AREA CODE	
Vickie A. Backman - Senior Regulatory Services Engineer	805	545-4289

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MON	DAY	YR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines.) (16)

On January 15, 1998, PG&E determined that the concrete expansion anchors for the Turbine Building siding supports at the vital 4 kV switchgear rooms did not meet all engineering design requirements to support the Final Safety Analysis Report Update, Section 3.3, "Wind and Tornado Loadings," statements.

PG&E performed an operability evaluation demonstrating that the as-built condition of the civil/structural members would be maintained for the postulated inward and outward tornado wind loading conditions. This evaluation credits the available strength of materials and identified calculational conservatisms. It also requires plant operators to consider a plant shutdown if a tornado warning is received.

The root cause is presumed to be personnel error (cognitive) by utility engineers who failed to provide adequate design margin for concrete anchors for postulated outward forces due to tornado wind loading during initial design. The specific application of inward versus outward tornado wind forces was not addressed in the licensing basis.

Corrective actions include identification of the specific design criteria applicable to tornado wind loading calculations and incorporation of this information into the civil/structural design criteria. Additionally, the Turbine Building siding supports will be modified to provide an appropriate safety factor for concrete expansion anchors.

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I. Plant Conditions

Units 1 and 2 have been in various Modes during the condition described.

II. Description of Problem

A. Summary

On January 15, 1998, PG&E determined that the concrete anchors for the Turbine Building (NM)(BLDG) siding support at the 4 kV switchgear rooms did not meet engineering design requirements to support the Final Safety Analysis Report (FSAR) Update Section 3.3, "Wind and Tornado Loadings," statements.

PG&E performed an operability evaluation demonstrating that the as-built condition of the civil/structural members would be maintained for the postulated inward and outward tornado wind loading conditions. This evaluation credits the available strength of materials and identified calculational conservatisms. It also requires plant operators to consider a plant shutdown if a tornado warning is received.

B. Background

A tornado design criterion was not a condition of the Diablo Canyon Nuclear Power Plant (DCPP) Construction Permit for Unit 1 (CPPR-39 issued April 23, 1968) and Unit 2 (CPPR-69 issued December 9, 1970). However, the consequences of tornado-induced failures on the capabilities to safely shut down the reactor and limit radioactive releases were subsequently reevaluated as requested by the NRC during the DCPP licensing review process. In response to NRC concerns regarding the wind resisting capability of the Turbine Building steel siding at the vital 4 kV switchgear and cable spreading rooms, PG&E committed to add girts and bracing to strengthen the siding system.

During 1978, PG&E added support bracing and girts at the 140 foot elevation using concrete expansion anchors to provide additional wind resistance capability for the Turbine Building siding. These added girts prevent the exterior siding from becoming a missile during a tornado with 200 mph winds.

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These modifications were accepted by the NRC in Supplemental Safety Evaluation Report (SSER) Number 7, dated May 1978, as follows: "In addition, the applicant has determined that the rooms can withstand the effects of a 200 miles per hour tornado wind without missiles.....Girts are being added to the steel framing on the north, east and west sides of the rooms to provide the exterior steel siding with this capability. We have reviewed this design modification and find it acceptable."

C. Event Description

In January 1994, a review of design criteria memorandum (DCM) open items in support of FSAR Update documentation was performed. An open item regarding the lack of documentation for Turbine Building siding tornado wind resistance capability at the Class 1E 4 kV vital switchgear and cable spreading rooms was identified. The condition was evaluated and determined not to be a significant safety concern because the Turbine Building siding was not credited for protection of essential equipment. However, PG&E initiated a quality evaluation (QE) to resolve the open item.

To complete the QE for the tornado wind resisting capability PG&E Civil Engineering Department reviewed the 4 kV switchgear and cable spreading rooms inside the Turbine Building. A complete set of PG&E engineering design documents for the 1978 design Class II turbine siding modification could not be found. However, PG&E engineering design specifications from that time period required a that safety factor of three be provided for civil structural connections. PG&E's Civil Engineering Department believed that the 1978 modification met this design specification for the identified inward tornado wind loads.

During 1994, modifications to the Turbine Building siding were in progress to install new siding over the Turbine Building to upgrade the plant materiel condition. Civil engineering proposed additional concrete expansion anchors be installed coincident with this modification to ensure adequate design margins. The Turbine Building siding project for this area was scheduled to be performed during the seventh refueling outage (April through May 1996) consistent with PG&E long-term scheduling and planning.

In July 1996, field construction of the support modification was deleted from the scope of work based upon management review that determined

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additional funding was required for the added work scope. The deletion of the support modifications was reviewed by personnel associated with the siding upgrade project who did not recognize the impact of deleting this work. PG&E engineering personnel assigned to resolve this issue believed that the as-built condition could be demonstrated to be acceptable based upon calculational margins that existed for inward wind forces, but they did not consider outward wind forces.

During December 1997, PG&E engineering personnel requested a design and licensing basis review of the Turbine Building siding tornado wind requirements.

On January 15, 1998, a licensing review determined that both inward and outward directed forces should conservatively be considered to fully satisfy the specified criteria. An operability assessment was written and approved based upon the concrete expansion anchor safety factor above the manufactures ultimate tested capacities pending additional investigative actions. A nonconformance report was initiated.

On February 13, 1998, the Plant Staff Review Committee directed that a formal operability evaluation (OE) be prepared for the tornado wind resisting capability of the Turbine Building 4 kV vital switchgear and cable spreading room areas.

On March 13, 1998, PG&E approved a formal OE which confirmed that there was not an operability concern. This evaluation was based on the extremely low probability of a tornado wind approaching 200 mph based on meteorological history and conservatisms used to derive the strength of the concrete attachments. It also requires plant operators to consider a plant shutdown if a tornado warning is received.

In May 1998, PG&E began construction modifications to increase the safety margin for the concrete expansion anchors for the Turbine Building siding at the 4 kV vital switchgear and cable spreading room areas.

D. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

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E. Dates and Approximate Times for Major Occurrences

1. January 15, 1998: PG&E determined that inward and outward forces should be considered for wind loading.

2. March 13, 1998: An OE was approved accepting the as-built condition of the civil/structural members.

F. Other Systems or Secondary Functions Affected

None.

G. Method of Discovery

PG&E engineering personnel identified the condition during a review of DCM open items in support of FSAR Update documentation.

H. Operator Actions

None.

I. Safety System Responses

None.

III. Cause of the Problem

A. Immediate Cause

No specific design evaluations or calculations could be found to support the initial 1978 Turbine Building siding tornado wind resistance capability.

B. Root Cause

The cause of the original design deficiency could not be determined due to limited documentation and the long time period since the design was completed (circa1978). PG&E presumes the cause to be personnel error (cognitive) by the utility design engineer responsible for the structural reinforcements accepted in SSER 7. Design documents suggest that the

reinforcements were designed to resist inward directed forces only.

An additional presumptive cause is that the specific application of inward versus outward tornado wind forces was not clearly documented. The failure to define the basis for the added tornado wind resistance capability requirement lead to nonconservative judgments regarding acceptability of the as-built condition during subsequent design and licensing basis reviews.

Therefore, additional engineering reviews performed since the initial design did not resolve the tornado wind resisting capability deficiencies.

IV. Analysis of the Event

The probability of a large tornado in the County of San Luis Obispo, California, is very small. No significant tornadoes have been observed in this region in recorded history. The Turbine Building siding at the 4 kV switchgear and cable spreading areas is qualified for inward directed wind effects. However, in the event of a large tornado with outward directed wind effects, it is postulated that the 4 kV switchgear siding base plate anchor bolts could fail, allowing the siding to become a missile hazard. The impact of this siding on other equipment or buildings is bounded by existing analyses for these components. It is considered unlikely that the siding could subsequently impinge on the 4 kV switchgear. Additionally, the three independent switchgear rooms are separated from each other by barriers. Finally, the failure of these anchor bolts does not affect the structural integrity of the Turbine Building.

Engineering performed walk downs of the Turbine Building siding anchorage to determine as-built conditions. The results of these walk downs were incorporated into calculations which determined the associated safety factor for the worst case outward directed force for each anchor. These calculations determined that a range of safety factors from 1.73 to over 2.0 existed for Unit 1, and from 1.34 to 1.58 existed for Unit 2. These safety factors are considered conservative since actual concrete strength is typically above the nominal values and the hand calculation methodology used is more conservative than computer model calculational methods. The resultant safety factors do not meet PG&E's design criteria for this type application; however, they do demonstrate that a margin of strength to resist the maximum loading is available.

Thus, this event did not adversely affect the health and safety of the public.

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V. Corrective Actions

A. Immediate Corrective Actions

1. An operability evaluation was performed to evaluate the as-built condition. This evaluation credited the available strength of materials and the low probability of a tornado event and concluded that siding attachment failure was not predicted. As a precaution the OE requires plant operators to consider a plant shutdown if a tornado warning is received.

2. PG&E performed a sampling review of design changes involving work scope changes implemented by the field construction organization and determined no required work had been inadvertently removed from the approved design changes without proper resolution.

B. Corrective Actions to Prevent Recurrence

1. PG&E will modify Units 1 and 2 Turbine Building siding attachments to achieve a safety factor greater than three.

2. PG&E will incorporate the civil structural design criteria applicable to tornado wind loading calculations into the memorandum DCM T-9, "Wind, Tornado and Tsunami."

3. PG&E will perform a review of selected tornado wind calculations to confirm that they are complete and contain appropriate margins.

VI. Additional Information

A. Failed Components

None.

B. Previous Similar Events

None.