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James D. Shiffer  
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May 11, 1988

PG&E Letter No. DCL-88-127



U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555

Re: Docket No. 50-275, OL-DPR-80  
Docket No. 50-323, OL-DPR-82  
Diablo Canyon Units 1 and 2  
Request for Additional Information  
Hilti Kwik-Bolts

Gentlemen:

In response to a request provided in an NRC letter dated March 8, 1988, PG&E has assessed the effects of postulated close spaced installation of Hilti Kwik-Bolts at the Diablo Canyon Power Plant (DCPP) (Enclosure 1). PG&E concluded that the failure mode of the Hilti Kwik-Bolts for the postulated installation configuration is due to slippage of the bolt and not due to failure of the concrete. Since slippage of the bolt is a function of friction and bolt installation torque, maximum anchor design capacity is provided because all installed anchor bolts meet the required torque criteria regardless of anchor spacing.

In addition, PG&E was requested to evaluate the applicability of IE Information Notice (IEIN) 86-94 to DCPP. As outlined in Enclosure 2, PG&E concludes that the information contained in IEIN 86-94 has negligible impact on DCPP and does not affect the safe operation of the plant.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

J. D. Shiffer

cc: J. B. Martin  
M. M. Mendonca  
P. P. Narbut  
B. Norton  
H. Rood  
B. H. Vogler  
CPUC  
Diablo Distribution

Enclosures

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## ENCLOSURE 1

## ASSESSMENT OF CLOSE SPACING OF HILTI KWIK-BOLTS

Background

In November 1987, PG&E provided to the NRC (Reference 1) the results of its evaluation of allegations received by the NRC in July 1987 regarding Hilti Kwik-Bolts at Diablo Canyon. One of these allegations involved deeply embedded bolts that are in close proximity to bolts installed from the opposite side of a concrete wall or slab such that the shear cones overlap. PG&E's evaluation of this allegation concluded that the expansion anchor bolts at Diablo Canyon are acceptable for the following reasons:

- Thin concrete slabs and walls, concurrent with deeply-embedded bolts from opposite sides, and near back-to-back bolt locations is a rare configuration. The majority of the concrete slabs and walls in safety-related structures at Diablo Canyon are 24 inches thick or thicker and the expansion anchor bolt embedments vary between 2-1/4 and 10-1/2 inches.
- The simultaneous loading of adjacent bolts from opposite sides of a structure to their maximum design load in tension is extremely unlikely. Typically, the loading pattern of a pipe support baseplate is a combination of tensile and compressive loads. The compressive zone of the plate does not load the bolts, and not all of the bolts in tension are loaded to their maximum allowable value. Maximum tensile loads due to seismic motion will not occur simultaneously for baseplates attached to opposite sides of a structure because the seismic responses of the two piping systems attached to opposite sides of the structure will generally not be in phase with each other.
- The allowable bolt loads used at Diablo Canyon are conservative. A factor of safety of four is applied to convert ultimate bolt strengths (determined by manufacturer's tests) to design allowable loads. In addition, these manufacturer's tests were performed on unreinforced concrete specimens. At Diablo Canyon, only concrete with reinforcing steel on both faces in both directions was used. Therefore, the allowable bolt loads used at Diablo Canyon are conservative beyond the required factors of safety for potential cone-type failures in reinforced concrete structures.

The allegation received by the NRC in July 1987 regarding deeply embedded bolts installed on opposite sides of thin concrete structures and near back-to-back locations is nearly identical to an allegation submitted to the NRC in 1984. In response to this earlier allegation (References 2 and 3), PG&E stated that the potential for this type of overlapping is extremely low, since the majority of the concrete slabs and walls in safety related structures at Diablo Canyon are greater than 12 inches thick and the majority of the expansion anchors require embedment depths less than 6 inches. This is similar to one of the reasons given in Reference 1. In addition, PG&E referred to tests being performed by Hilti Corporation for another utility



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(Reference 4) that indicated that there is no significant reduction in anchor strengths, even when the anchors are installed as close as 1-1/2 bolt diameters centerline-to-centerline. In Diablo Canyon SSER No. 28 (Reference 5), the NRC stated that the allegation was resolved based on the following evaluation:

Studies have shown that when drilled-in anchor bolts are installed from opposite sides of a wall and overlap, very little degrading of the bolt capacity results. This degrading would have no safety significance because of the high safety factors used for drilled-in anchor bolts.

### Assessment

This assessment is in response to an NRC letter received by PG&E in March 1988 (Reference 6). Reference 6 acknowledges that PG&E's reasons (given in Reference 1) may be valid for concluding that the bolts at Diablo Canyon are acceptable. Specifically, the NRC requested PG&E to justify the acceptability of bolts installed from opposite sides of a wall spaced less than 1-1/2 bolt diameters (centerline-to-centerline), or to demonstrate that this configuration is nonexistent at DCCP.

The Hilti tests were conducted for 3/4 inch x 10 inch Hilti Kwik-Bolts with 7-1/2 inch embedment installed from opposite sides of a 12 inch thick reinforced concrete wall with centerline-to-centerline spacings at 3, 2, and 1-1/2 bolt diameters. The results of these tests indicated that there was no significant reduction (less than 10 percent) in the ultimate tensile capacities of the bolts due to proximity of installation. For all of the tests, the failure mode was slippage of the bolts rather than the concrete shear cone failures. Therefore, the ultimate tensile capacities of these types of bolts (deeper embedment) depended upon the friction force between the expansion wedges of the bolts and the surrounding concrete and not upon the concrete shear cone capacity. This friction force was developed by torquing of the anchors. All Hilti Kwik-Bolts installed at Diablo Canyon are required to be torqued to a minimum specified value. If there are existing overlapping expansion anchor bolts at Diablo Canyon with centerline-to-centerline spacings less than 1-1/2 bolt diameters, sound interface between the anchor and the concrete has been verified by achieving the minimum required torque. If the bolts fail to meet the torque criteria, they are substituted by a new bolt at a new location. Accordingly, this practice assures that the maximum anchor design capacity is provided since the failure mode is slippage. In addition, as previously stated, further assurance of acceptability is provided by virtue of the large factor of safety between the anchor design capacity and the ultimate tensile strength and by the fact that simultaneous loading of adjacent bolts from opposite sides of a structure to their maximum design capacity in tension is extremely unlikely. Therefore, all expansion anchor bolts at Diablo Canyon are acceptable.



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## REFERENCES

1. PG&E Letter No. DCL-87-275, dated November 12, 1987, from J. D. Shiffer (PG&E) to U.S. NRC, "Response to Allegations Regarding Hilti Kwik-Bolts (Allegation No. NRR-87-A-0008)."
2. PG&E Letter No. DCL-84-203, dated June 1, 1984, from J. O. Schuyler (PG&E) to D. G. Eisenhut (NRC, "License Condition 2.C (11) - Final Report."
3. PG&E Letter No. DCL-84-243, dated June 29, 1984, from J. O. Schuyler (PG&E) to H. R. Denton (NRC), "GAP Allegations."
4. Hilti Corporation Test Report ENT #134-82E dated May 25, 1984, "Pullout Tests of Hilti Kwik-Bolts with Overlapping Cones of Influence in Walls and Corners."
5. U.S. NRC NUREG-0675, Supplement No. 28, "Safety Evaluation Report for Diablo Canyon Units 1 and 2," Appendix A, Attachment 2, p. 72.
6. NRC Letter dated March 8, 1988 from H. Rood (NRC) to J. D. Shiffer (PG&E), "Safety Evaluation and Request for Additional Information on Hilti Bolt Issue (TAC Nos. 65292 and 65293)."



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## ENCLOSURE 2

ASSESSMENT OF NRC IE INFORMATION NOTICE 86-94  
APPLICABILITY TO DIABLO CANYON POWER PLANT

PG&E was requested in an NRC letter dated March 8, 1988 to assess the applicability of NRC IE Information Notice 86-94 to Diablo Canyon Power Plant and to take appropriate actions, if necessary, to ensure bolt integrity. IE Information Notice 86-94 indicated revised ultimate tensile capacities for 1/2" diameter Hilti Kwik-Bolts installed with embedments deeper than minimum. The revised values were lower than those published in the Hilti catalog. A review of calculations other than pipe support calculations determined that the design allowables used for these calculations are based on a minimum embedment per PG&E standard drawing 054162. Therefore, the revised tensile capacities indicated in IE Information Notice 86-94 have no impact on these calculations.

Approximately 1500 pipe supports, which represents approximately 10% of the supports in both units at Diablo Canyon, were reviewed.

Four of the 1500 pipe supports have designs which take credit for 1/2" Hilti Kwik-Bolts with embedment lengths longer than the minimum embedment length. The review indicated that a factor of safety of at least 4.0 is maintained even when using the derated Hilti capacity specified in IE Notice 86-94. Therefore, PG&E concludes that there is no adverse impact from derating the capacity of the 1/2" Kwik-Bolts, since all of the reviewed concrete expansion anchor designs meet the requisite safety factor of four required by IE Bulletin 79-02.



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