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RECIP.NAME RECIPIENT AFFILIATION
GRIER,B.H. Region 1, Philadelphia, Office of the Director

SUBJECT: Final deficiency rept,originally submitted on 800523,re use of too large recesses w/Hilti shell anchors.Caused by erroneous valve bases.Hold placed on const & test program developed for static & cyclic test under shear-tension.

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November 21, 1980

Mr. Boyce H. Grier
Director, Region I
U. S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, Pennsylvania 19406

SUSQUEHANNA STEAM ELECTRIC STATION
FINAL REPORT OF A DEFICIENCY RELATING TO
USE OF HILTI HDI SHELL ANCHORS
ERs 100450/100508 FILE 840-4/900-10
PLA-578

References: PLA-549 dated 09/25/80
PLA-488 dated 05/23/80

Dear Mr. Grier:

This letter serves to provide the Commission with a final report of a deficiency relating to the use of Hilti HDI shell anchors. The condition was originally reported in PLA-488. The information contained herein is submitted in compliance to the provisions of 10CFR50.55(e).

The attachment to this letter contains a description of the problem, its cause, safety impact and significance. The test programs conducted by Teledyne Engineering and Bechtel are referenced and the test reports are retained at PP&L and are available for your review. A corrective action plan is also described. We expect to complete Unit I inspection, evaluation, and rework/repair by May, 1981.

We trust the Commission will find the information forwarded by this letter to be satisfactory.

Very truly yours,

NW Curtis

N. W. Curtis
Vice President-Engineering & Construction-Nuclear

Attachment
FLW:mcb

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cc: Mr. Victor Stello (15)
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FINAL REPORT ON HILTI-HDI SHELL ANCHORS

1.0 PURPOSE

The purpose of this report is to provide complete information, persuant to 10CFR 50.55(e), concerning Hilti shell anchors.

2.0 HILTI HDI SHELL ANCHORS

Concrete expansion anchors can be broadly categorized in three types, i.e., wedge, sleeve and shell. Hilti HDI anchors are of the shell type. The main difference between shell and other types of anchors is that the shell anchor consists of two principal parts—the shell (including expander plug) which is a female piece, and the bolt which is a male piece.
To achieve proper installation, a slightly oversized hole is drilled in the concrete and the shell is dropped/inserted in the hole. The plug is then driven into the shell to a set dimension using an appropriate setting tool. Driving the plug expands the shell against the surrounding concrete; this provides the holding capacity to withstand the design loads. Thus, unlike wedge and sleeve anchors, no torquing is required to set the shell anchors.

3.0 BACKGROUND AND CAUSE

On the Susquehanna project, a large number of Hilti shell anchors have been used to attach supports for mainly electrical items such as conduits, junction boxes and wireway gutters and also instrumentation tubing.

Project Specification 8856-C-72 is the governing document for the design, procurement, installation and inspection of all types of expansion anchors by Bechtel field personnel. Table 4.1 of the Specification which is common for all types of anchors, provides the details for embedment, installation torque, allowable loads, etc.

Hilti's latest published 'Anchor and Fastener Design Manual' states that for shell anchors, embedment length will be equal to anchor length plus 1/8 inch. However, computed recesses (defined as the distance between the top of shell and concrete surface) based upon the values given in the table of the aforementioned specification are generally larger than the manufacturer's recommendations.

In August 1979, Bechtel project engineering became aware that the actual recess provided generally ranged between 1/2 inch and 1 inch and in some cases greater than 1 inch.

4.0 ANALYSIS OF SAFETY IMPLICATIONS

Under tension loading, the recess would have no bearing on the proper functioning of anchors. However, under shear loading, as the bolt is unsupported within the recess, it would be subjected to bending moment in addition to shear load. With greater recesses, larger moments will result.

In order to evaluate the above condition, a static shear test program was under-

taken by Bechtel. The testing was performed at the jobsite in December 1979 and a report was issued in March, 1980 (see Reference 1). Test results indicated that the recess has no bearing on the ultimate static shear capacity. However, the anchor behavior was observed to be non-linear, even for the anchors with 1/8 inch recess.

When the project specification was developed, the allowable loads were based upon the static shear and tension test results and some limited data on cyclic and shear-tension test results. As the majority of the expansion anchors will be subjected to cyclic and combined shear-tension under a seismic event, the conclusion of the above mentioned report raised a question regarding the acceptability and structural adequacy of all Hilti shell anchors used on Susquehanna.

As noted above Hilti shell anchors have been used to attach safety related items. Therefore, unless further investigation is done, existing condition/ installation may have adverse safety impact. Accordingly, Bechtel Engineering determined this problem to be reportable under 10CFR50.55(e) and an interim report was issued on 5-27-80.

5.0 IMMEDIATE ACTION

In order to prevent further usage of shell anchors, a 'HOLD' was placed on construction by Bechtel engineering in February 1980.

A new test program was developed to perform static and cyclic tests under shear, tension and combined shear-tension.

6.0 NEW TEST PROGRAM

The testing was performed by Teledyne Engineering Services, Waltham, Mass. in accordance with the criteria provided in technical specification 8856-C-95.

Report No. 8856-C-100 (See Reference 2) includes the details of the testing, test procedures, and test results; and Report No. 8856-C-101 (See Reference 3) contains evaluation of the test results and also the proposed allowable loads.

As the new allowable shear loads are significantly smaller than those in the present design criteria, further evaluation is required, as described below.

7.0 CORRECTIVE ACTION

With the new allowable loads which are smaller than the present design loads, the following corrective action will be undertaken.

1. The project specification will be revised by November 1, 1980, to reflect the findings of the above test reports.

2. As mentioned previously, the majority of Hilti Shell anchors have been used to attach electrical and instrumentation supports.

For category IE electrical supports per drawing 8856-E-53, there are many typical supports, for which maximum allowable loads are indicated on the design drawings. Based upon new revised allowable loads for the anchors, these supports will be evaluated and categorized in two groups. Those supports for which the maximum allowable loads on the supports still satisfy the new criteria for the anchors will be included in the first group. The second group will consist of all other supports. The category IE supports in the second group including all other (electrical, instrumentation and other disciplines) supports will be inspected by Bechtel field personnel, to obtain actual loading imposed on these supports. This inspection will be performed in accordance with approved field procedure. Inspection results will be evaluated, and documented including appropriate disposition and details of repair/rework as necessary. If this evaluation indicates that the existing anchors are structurally inadequate, the existing support connections will be modified either by adding more anchors or by providing additional supports to reduce actual loading on the supports and thus on the existing anchors.

Above noted activities (inspection, evaluation and repair/rework) will be commenced in November 1980 and are scheduled for completion by May 1, 1981, for Unit 1 and common, to be followed by similar action for Unit 2.

8.0 CONCLUSION

On completion of the corrective action noted in section 7.0, existing Hilti shell anchors with 1" recess (max) will meet the new design criteria and thus will be structurally acceptable with adequate safety margin.

REFERENCE

1. Gore, Aravind S., 'Shear Test Report on Hilti HDI Shell Anchors for Susquehanna Steam Electric Station." Bechtel Power Corporation, San Francisco, California in March 1980.

2. Gore, Aravind S., 'Test Report on Hilti HDI Shell Anchors for Susquehanna Steam Electric Station' Report No. 8856-C-100, Bechtel Power Corporation, San Francisco, California. October 1980.

3. Gore, Aravind S., 'Technical Criteria for Hilti HDI Shell Anchors for Susquehanna Steam Electric Station'. Report No. 8856-C-101, Bechtel Power Corporation, San Francisco, California, October 1980.