Central files

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September 5, 1980

U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region V
1990 North California Boulevard
Suite 202, Walnut Creek Plaza
Walnut Creek, California 94596

Attention: Mr. R. H. Engelken, Director

DOCKET No. 50-206
SAN ONOFRE - UNIT 1

Dear Sir:

IE BULLETIN No. 79-02
REVISION 2, PIPE SUPPORT
BASE PLATE DESIGN USING
CONCRETE EXPANSION ANCHOR BOLTS

Reference:

(1) SCE (A. Arenal) to NRC (R. H. Engelken), letter dated August 15, 1979. Subject: Testing of Concrete Expansion Anchors per IE Bulletin 79-02 Rev. 1.

(2) SCE (J. T. Head, Jr.) to NRC (R. H. Engelken), letter dated December 7, 1979. Subject: Response to IE Bulletin 79-02 Rev. 2.

(3) SCE (Robert N. Coe) to NRC (R. H. Engelken) letter dated February 8, 1974. Subject: Regulatory Operations Information Request No. 74-1.

In accordance with Reference 1 above, a continuation of our concrete expansion anchor testing and inspection program was performed at San Onofre Unit 1 during the 1980 refueling outage. In addition, a walkdown of all safety-related piping greater than 2-1/2 inches in diameter was conducted to ensure that all pipe supports were included in our program. A total of 60 pipe supports involving 78 base plates located inside containment and 37 additional pipe supports involving 37 base plates located outside containment were identified to be within the scope of the program.

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The program inside containment included the test of all anchor bolts in each base plate. This ensured that retesting in an area of limited accessibility would not be required if a high failure rate were observed. For supports located outside containment only one bolt per base plate was tested providing that the test was successful. Among the items included in our program were torque testing expansion anchors with torque values corresponding to a pullout of at least one fifth the bolt ultimate capacity, and inspecting for proper thread engagement, anchor expansion and imbedment depth. The details of the testing and inspection procedure have been discussed and reviewed by your staff and portions of the test program observed by an NRC staff member. The results of the program are summarized below:

	INSIDE CONTAINMENT	OUTSIDE CONTAINMENT
Total Base Plates	78	37
Total Anchors Tested	211	75
Successful Torque Test	205	73
Failed Anchors (rotated in hole)	6	2
Not Tested (Damaged during removal)	19	10
Not Tested (Bolt removal not possible)	23	0

For piping supports inside containment it should be noted that 5 of the 6 failed anchors were located on one support involving a feedwater line. It appears that the anchors on this support were installed properly but were subsequently subjected to a force which caused the anchor sleeves to loosen in the concrete. A water hammer event which could have caused such a force has been previously reported to you in Reference 3. We are presently conducting a program to evaluate the adequacy of our feedwater support design in the event of a water hammer. The one remaining failed anchor appeared to be a result of original installation.

For piping supports outside containment the 2 failed anchors were located on one support involving the feedwater pump recirculation line. The failures appear to have occurred during original installation as a result of limited accessibility due to surrounding installations. The remaining two anchors on this support were tested successfully.

During the inspection program inside containment 8 indications of inadequate imbedment depth were observed where steel reinforcement bar imbeded in the concrete prevented proper anchor imbedment during installation. These anchors were subsequently replaced. No such indications were observed for supports located outside containment.

During our inspections for proper anchor to bolt thread engagement, there were 6 instances inside containment and 17 instances outside containment where thread engagements were less than the minimum required by our inspection procedure. The majority of the thread engagement deficiencies were of such a nature that they would not be a primary failure mechanism during loading conditions. In all cases where thread engagement deficiencies were observed the remaining bolts in the plate were inspected, the bolts replaced as necessary to achieve the required thread engagement, and the new bolt torque tested.

The anchors reported as not tested were damaged during bolt removal or removal was not possible due to geometrical and/or safety considerations (e. g. pipe operability required). In addition to the above there were 3 supports involving the residual heat removal (RHR) system which could not be tested due to high radiation levels. Since only 2 of the 60 total pipe supports inside containment were found in a failed condition, expansion of the sampling program to include these three RHR system supports was not considered warranted.

In all cases each support included in our program was repaired as necessary to ensure a safety factor of five for existing shell type expansion anchors and a safety factor of four for instances where defective or damaged anchors were replaced with wedge type anchor bolts. Based on the results of our recent testing program and the results previously reported in Reference 1, we consider that the operability of all safety-related piping is assured in the event of a design basis earthquake.

In accordance with item 4 of Reference 2 we are providing the following information concerning our investigation into the effects of preload on the ultimate capacity of anchor bolts under dynamic loading:

1. Regarding shear strength, Report No. CEB 75-32 by the Tennessee Valley Authority Division of Engineering Design Thermal Power Engineering states, "There was no difference in the ultimate strength between preloading bolts or tightening nuts finger tight, however, under service load conditions the preloaded bolt connections were much stiffer." This report states further, "Preloading of expansion anchors to any degree of

certainty does not appear to be practical because of the slip characteristics of these anchorages." In addition, preload is lost on expansion anchors at a fast rate, further obscuring the degree of preload with the passage of time. Based upon this latter fact, it would be difficult to justify taking credit for preload in the support design.

2. Sequoyah Nuclear Plant performed tests on wedge anchors and embedded anchors in order to determine the effects of preload. The test considered combined shear and tension loads. A summary of test results and the interpretation of the test data can be found in "Sequoyah Nuclear Plant, Information on Anchorage Analysis." The report concludes that, "As seen by these tests, installation torque has a significant impact on the stiffness characteristics of the anchorage. It has no effect, however, on ultimate capacities."

3. In order to account for the loss of stiffness as a result of decreasing preload over time both of the aforementioned references suggest the use of larger safety factors. By utilizing the safety factors suggested in IE Bulletin 79-02 it is our feeling that this recommendation is fulfilled.

Should you have any further questions regarding this matter, please do not hesitate to contact me.

Sincerely,

J. G. Haynes

J. G. Haynes
Manager of Nuclear Operations

cc: Director, Office of Inspection and Enforcement,
Division of Reactor Operations Inspection