

**TENNESSEE VALLEY AUTHORITY**

CHATTANOOGA, TENNESSEE 37401

500C Chestnut Street Tower II

JUN 26 1979

Mr. James P. O'Reilly, Director  
Office of Inspection and Enforcement  
U.S. Nuclear Regulatory Commission  
Region II - Suite 3100  
101 Marietta Street  
Atlanta, Georgia 30303

**REGULATORY DOCKET FILE COPY**

Dear Mr. O'Reilly:

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2 - DEFECTIVE PHILLIPS SELF-DRILL  
CONCRETE ANCHORS - NCR 1433R - FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector  
McKensie Thomas on March 19, 1979, in accordance with 10 CFR 50.55(e).  
An interim report was submitted on April 18, 1979. Enclosed is our  
final report.

If you have any questions concerning this matter, please get in touch  
with D. L. Lambert at FTS 854-2581.

Very truly yours,

J. E. Gilleland  
Assistant Manager of Power

**Enclosure**

cc: Mr. John G. Davis, Acting Director (Enclosure)  
Office of Inspection and Enforcement  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

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ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2  
DEFECTIVE PHILLIPS SELF-DRILL CONCRETE ANCHORS  
NCR 1433R  
10 CFR 50.55(e)  
FINAL REPORT

Description

This deficiency was reported to TVA by the manufacturer of these self-drill concrete anchors, ITT Phillips Drill Division. This deficiency is considered reportable because some safety-related systems may be supported by deficient self-drill concrete anchors which have very little or no capability to carry loads that may be imposed by seismic events.

Cause of Deficiency

The cause of this deficiency is a manufacturing defect in the plugs used to expand the anchor sleeves of self-drill concrete anchors supplied by ITT Phillips Drill Division to the Watts Bar Nuclear Plant site. This defect can result in insufficient expansion of the anchoring mechanism.

The plug deficiency is essentially a lack of uniform taper. The taper of the deficient plugs is slightly concave in nature. As a result there is less plug surface area in contact with the anchor shell when the shell is driven over the plug to expand the base of the shell. Under these conditions a larger than normal force is required to fully expand the base of the shell and the plug must be driven farther into the shell than normal. The concave shape of the plug also allows the shell to slip back over the plug leaving the plug in the hole when the anchor is pulled to failure. This almost never happens with the properly shaped plugs.

TVA has determined that potentially defective Phillips 1/2-inch self-drill concrete anchors were not shipped to any other of TVA's nuclear plant construction sites except Hartsville. Examination of the potentially defective expansion anchor plugs at Hartsville (all of which are in the storeroom) has uncovered none of the defective plugs.

Safety Implications

If this deficiency had not been discovered by Phillips Drill Division of ITT, preliminary indications are that a seismic event may have led to failures in some safety-related systems supported by the deficient self-drill concrete anchors. Such failures as these may have adversely affected the ability of the plant to reach a safe shutdown condition.

Corrective Actions

A shipment of approximately 10,000 1/2-inch size anchors of questionable quality was received from ITT Phillips in October, 1978 but was not identified as questionable until March, 1979. The questionable shipment was identified by dates stamped on the anchor boxes and the questionable plugs were identified by color. ITT Phillips initiated a change in color of plugs after the deficiency was recognized. This color change enabled TVA to distinguish between good and questionable plugs of anchors which had been removed from cartons. All unused 1/2-inch anchors at Watts Bar Nuclear Plant were collected and a total of approximately 1,750 were identified as questionable. Thus, approximately 8,250 anchors of questionable quality may have been used.

Upon receipt of the deficiency notification Watts Bar Construction personnel installed and tested three anchors with deficient plugs. All three failed to meet the 4,000 pound proof load test requirement for 1/2-inch self-drilling anchors which is specified by TVA Standard Specification No. G-32. Subsequently, ten more deficient anchors were installed and tested in concrete which test cylinders indicated to have compressive strength in excess of 8,000 psi. At the same time three good anchors were installed and tested in the same concrete. The good anchors had an average strength of 10,400 pounds with a standard deviation for the three tests of only 220 pounds. (The qualification strength requirement of G-32 for this size anchor is 7,800 pounds.) By comparison the average strength of the ten deficient anchors was 4,054 pounds with a standard deviation of 1,912 pounds. This indicates that the minimum expected failure rate for deficient anchors in the proof load testing program should be in the order of 50 percent. It also follows that if the anchors were installed and tested in lower strength concrete, the percentage of proof load test failures for deficient anchors would be more than 50 percent.

The proof load testing program and acquisition of test data at Watts Bar lags anchor installation in general by an estimated five to six month time period. For this reason, no significant increase in failure rate was noted prior to receipt of ITT Phillips letter of nonconformance. The following table provides a breakdown of the testing of 1/2-inch anchors to date.

<u>Time Period</u>	<u>Prior to</u> <u>10/17/78</u>	<u>10/17/78</u> <u>to</u> <u>04/01/79</u>	<u>04/01/79</u> <u>to</u> <u>05/01/79</u>
Number of anchors in lots	13,968	4,755	-
Number of anchors tested	1,168	428	80*
Number of failures	8	13	28
Failure rate in percent	0.7	3	35

\*Taken from three individual systems obtained at a plant conference on 4/30/79 - Does not represent total testing.

The distribution of anchor utilization can be reasonably estimated from the following storeroom requisitions from October 17, 1978, through January 3, 1979.

<u>Craft</u>	<u>Number</u>	<u>Percent</u> <u>of Total</u>
Pipe Fitters	2,786	28
Iron Workers	522	5
Electricians	2,400	24
Instrumentation	3,800	39
Sheet Metal	74	1
Carpenters	<u>250</u>	<u>3</u>
Total	9,852	100

Questionable anchors are being replaced wherever they can be identified in safety-related piping systems or in any system with maximum design anchor loads in excess of 1,000 pounds. In the auxiliary building fire protection system, 12 of 16 tested anchors failed to meet proof load requirements and all anchors are being replaced. In addition, 1,653 questionable anchors have

been identified to date in pipe hanger systems, representing approximately 60 percent of the 2,786 anchors issued to Pipe Fitters during the period in question. Eight failures have occurred out of 36 tests of these anchors. To assure the replacement of faulty anchors in critical areas, the following procedure will be initiated.

1. Failure to meet proof load requirements for any test in lot sizes less than 60 anchors shall be cause to replace all anchors in the lot for any safety-related system having calculated design loads in excess of the test failure load or 25 percent of the proof load requirements whichever is less.
2. Failure to meet proof load requirements in more than 10 percent of the tests for lot sizes greater than 60 anchors shall be cause for replacement of the entire lot as per (1) above.

TVA feels that the testing and replacement program outlined above is sufficient to correct this deficiency.

#### Means Taken To Prevent Recurrence

TVA has discussed this deficiency with ITT Phillips Drill Division. ITT Phillips Drill has made some changes to their QA program which they feel will improve detection of any future deficiencies. Production changes have also been made to correct the deficiencies described in this report.