

TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

August 30, 1982

WBRD-50-390/81-58  
WBRD-50-391/81-54

U.S. Nuclear Regulatory Commission  
Region II  
Attn: Mr. James P. O'Reilly, Regional Administrator  
101 Marietta Street, Suite 3100  
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2 - IMPROPER ANCHOR INSTALLATION -  
WBRD-50-390/81-58, WBRD-50-391/81-54 - FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. V. Crlenjak on June 24, 1981 in accordance with 10 CFR 50.55(e) as NCR 3289R. Interim reports were submitted on July 31 and October 21, 1981 and March 1, 1982. Enclosed is our final report.

As discussed with Inspector Crlenjak on August 13, 1982, the description of condition has been modified to more accurately describe the potentially safety-related concerns of this item. The submittal date of this report was also discussed with Mr. Crlenjak.

If you have any questions, please get in touch with R. H. Shell at FTS 858-2688.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

*D S Kammer*

*for* L. M. Mills, Manager  
Nuclear Licensing

Enclosure

cc: Mr. Richard C. DeYoung, 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**  
**IMPROPER ANCHOR INSTALLATION**  
**NCR 3289R**  
**WBRD-50-390/81-58, WBRD-50-391/81-54**  
**10 CFR 50.55(e)**  
**FINAL REPORT**

**Description of Deficiency**

In December 1979, the construction project was requested by TVA's Division of Engineering Design (EN DES) to perform qualification tests on expansion anchors as part of the resolution to NRC-OIE Bulletin 79-02. The tests were performed during September 1980. All sizes of Phillips self-drilling anchors (snap-off type), except the 3/8-inch, met the qualifications. Although requested by EN DES to repeat the tests, the retests were never performed. The failure to perform repeat tests was identified by an NRC inspection (NRC report Nos. 50-390/81-09 and 50-391/81-09). In June 1981, additional qualification tests were performed on 3/8-inch anchors installed in in-place concrete. The anchors developed only 75 percent of the required ultimate tensile capacity. Therefore, the potential for use of defective anchor bolts exists. This NCR was written as a result of the NRC inspection and the results of those additional tests.

After submittal of report No. 1, TVA identified the following additional problems relating to qualification of expansion anchors:

1. The additional qualification tests on the 3/8-inch self-drilling anchors which did not meet requirements were performed in in-place concrete with a specified strength of 3000 lb/in<sup>2</sup> at 90 days. The acceptable qualification tests on other sizes were performed in concrete with a specified strength of 4000 lb/in<sup>2</sup> at 28 days. All qualified sizes may not be acceptable in the lower strength concrete.
2. Several sizes and brands of nondrilling expansion shell anchors were installed. This type of anchor is not equivalent to the specified self-drilling anchors.
3. Several sizes of Hilti Kwik-bolt wedge anchors were installed and were subsequently suspected to be unqualified.

**Safety Implications**

Since the anchors had been used on systems with either primary or secondary safety functions, a failure of the subject anchors could have compromised the integrity of safety-related systems. However, since the subject anchors have been tested in place and determined fully adequate to perform their intended function, no condition adverse to safety exists.

Corrective Action

## EXPANSION SHELL ANCHORS

Since questions on the ability of the anchors to meet their intended function existed, it was appropriate to determine the acceptability of the expansion shell anchors on the basis of an analysis of tests on the in-place anchors.

Two independent sets of data were available on the in-place anchors. The first set was for the random proof load tests required by Construction Specification G-32 and performed for in-process evaluation of expansion shell anchors. The second set was for an independent program performed at WBN for resolution of NRC-OIE Bulletin No. 79-02.

The G-32 testing consisted of loading the anchors in tension to a proof load which is approximately 140 percent of the maximum allowable design load (factored design load in the TVA design standard). For proof load tests, the anchor was considered to have failed if it exhibited sudden slip or slipped slowly without an increase in load. The tests were performed on a specified portion of the anchors in a lot. A lot was generally defined as a group of anchors installed by the same crew in one system or over a period of time.

A tabulation of the results of the proof load tests has been made. It includes virtually all the test results on expansion shell anchors from the beginning of construction. The analysis of the test data resulted in the following proof load failure rates:

<u>Size</u>	<u>Tested</u>	<u>Number of Failures</u>	<u>Failure Rate (%)</u>
All	17548	349	1.99
3/8	3005	19	0.63
1/2	8666	230	2.65
5/8	1871	10	0.86
3/4	2788	72	2.58
7/8	1218	12	0.99

Even without reducing the failure rates to account for the fact that the proof load is 40 percent greater than the maximum design load, the proportion of defective anchors is less than the 5-percent limit recommended in 79-02.

The results of this investigation were compared to the results of the 79-02 inspection for unit 1. The overall failure rate for the 79-02 inspection was 2.04 percent. This compares favorably with the overall failure rate given above. The analysis of the proof load failure rates and the 79-02 inspection indicates that the in-place anchors are acceptable.

The construction project has been informed that based on the above test results all sizes of the Phillips self-drilling anchors (snap-off type) are approved for use at WBN in concrete with a specified strength of 3000 psi or greater at 28 or 90 days. The other brands and types will be used as-is. To prevent further questions on acceptability of anchors, future installation will be restricted to the approved Phillips anchors. QCP 1.14, section 6.3.2, has been revised to restrict future use to the approved Phillips anchors.

#### WEDGE BOLT ANCHORS

Item 5 above covers the suspected use of unqualified Hilti-Kwik bolts. Information from the field shows that 250 3/4- by 4-1/4-inch Hilti-Kwik bolts were issued by the project warehouse. Six 1/2- by 7-inch Hilti-Kwik bolts were also issued.

G-32 did not include requirements for wedge bolt anchors until revision 5 which was issued in July 1977. The field determined that the 3/4-inch anchors were installed before issue of revision 5. Since the anchors were installed before issue of revision 5, they were designed and installed in accordance with manufacturer's recommendations. Since those recommendations are acceptable, the anchors may be used as-is.

The 1/2-inch anchors were previously accepted for use as-is by a nonsignificant NCR (NCR 3519R). The disposition of the NCR required torque testing of all the 1/2-inch wedge bolts.

Since G-32 and site procedures now cover qualification, installation, and in-process testing of wedge bolt anchors, all new types of wedge bolt anchors will be fully qualified before use at Watts Bar.