TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

September 23, 1982

WBRD-50-390/81-71
WBRD-50-391/81-67

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 - QUALIFICATION OF EPOXY GROUT FOR SAFETY-RELATED APPLICATIONS - WBRD-50-390/81-71, WBRD-50-391/81-67 - SIXTH INTERIM REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. V. Crlenjak on August 27, 1981 in accordance with 10 CFR 50.55(e) as NCR 3567R. Interim reports were submitted on September 18 and December 16, 1981 and February 11, April 17, and June 3, 1982. Enclosed is our sixth interim report. We expect to submit our next report on or about May 28, 1983.

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

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

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, D.C. 20555

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ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
QUALIFICATION OF EPOXY GROUT FOR SAFETY-RELATED APPLICATIONS
NCR 3567R
WBRD-50-390/81-71, WBRD-50-391/81-67
10 CFR 50.55(e)
SIXTH INTERIM REPORT

Description of Deficiency

Epoxy grout was specified on design drawings at specific anchor bolt locations inside containment where temperatures may exceed 120°F. Epoxy grout may have its load-carrying capabilities reduced at temperatures above 120°F. Also, the epoxy grout has not been qualified to a radiation environment inside containment.

The apparent cause of this deficiency is that the technical specifications, "General Anchorage to Concrete," Civil Design Standard DS-C6.1, and General Construction Specification No. G-32, "Bolt Anchors Set in Hardened Concrete," did not include limitations on use of epoxy grout for grouting anchors in areas exposed to radiation or elevated temperatures.

Interim Progress

TVA conducted an investigation regarding the use of epoxy grout for supports at Watts Bar Nuclear Plant (WBN). As a result, it was determined that two brands of epoxy grout were used: Sika Hi-Mod and Niklepoxy No. 9. The Hi-Mod was listed by its manufacturer for grout of anchor bolts. The Niklepoxy was not explicitly listed by the manufacturer as an epoxy for grouted anchor applications, but this epoxy system did meet the requirements specified in the purchase requisition.

TVA has reviewed the available technical data on the Sika Hi-Mod epoxy compound. Published information on epoxy polymers of this type show no loss of strength due to radiation dose levels expected during the life of the plant or during a loss-of-coolant accident (LOCA). These resins have been shown to have approximately five times the radiation tolerance as the worst case dosage.

To our knowledge, there is no published information on radiation tolerance for the epoxy system used in Niklepoxy. The Hi-Mod and Niklepoxy use basically the same epoxy resin but utilize a different catalyst or hardener, so it is considered very unlikely that the effects of radiation on the two are significantly different. Wyle Laboratories has conducted an analysis which concludes that the radiation damage threshold for epoxy-based material is at least 130 percent of the total integrated radiation dose required (including accident dose).

To address the issue of elevated temperature effects, TVA has conducted a mathematical model analysis of the steam generator anchor bolts to develop the temperature profile which would be expected during a main steam line break. This "worst case" situation would have an expected duration and associated high temperatures that would raise the temperature of the epoxy at the head of the anchor to about 160°F.

TVA has conducted tests at our Singleton Materials Engineering Laboratory (SME) on epoxy-grouted anchors at elevated temperatures. These test results indicate that for Sika Hi-Mod, the reliable mean capacity at temperatures between 120°F and 160°F is 20 percent of the normal capacity. For Niklepoxy No. 9, the reliable mean capacity at 120°F is 60 percent of the normal capacity and for temperatures betwen 140°F and 160°F is 40 percent of the normal capacity.

TVA has identified 64 supports inside containment for which epoxy grout was specified. Each support in question was reviewed to determine the epoxy type used, the design loading, and the maximum anticipated sustained temperatures for the compartment in which the support was installed. These design temperatures were utilized to determine the reduced allowable capacities of the epoxy based on the SME laboratory test results. These reduced allowable loads were compared with the actual design loading and as a result, approximately 40 supports were found to be inadequate.

The usage of epoxy grout has been halted on safety-related systems since the subject NCR was written. Corrective action such as support modifications or additional supports has been recommended for the inadequate supports and revision to drawings are in the process of being issued. The revisions to the drawings will be accomplished by mid-May 1983. TVA anticipates no problems with the remaining support anchors which utilized epoxy grout. General construction specification for bolt anchors set in hard concrete was revised on to preclude the use of epoxy grouted anchors in safety-related applications. The "General Anchorage to Concrete" Civil Engineering Design Standard DS-1.7.1 implementing the aforementioned changes is scheduled to be completed by October 30, 1982. These revisions to the procedures will specifically preclude use of epoxy-grouted anchors in safety-related applications.

Wyle Laboratory has conducted tests to evaluate the effects of aging on epoxy material similar to those used at Watts Bar Nuclear Plant. The analysis shows that the minimum calculated expected life for these materials is greater than three times the desired 40-year service in an environment of 120°F.