TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

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WBRD-50-390/86-45
WBRD-50-391/86-43

U.S. Nuclear Regulatory Commission
Region II
Attention: Dr. J. Nelson Grace, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Dear Dr. Grace:

WATTS BAR NUCLEAR PLANT - UNITS 1 AND 2 - DEFICIENCIES IN SAMPLING AND CONTROL OF CONCRETE - WBRD-50-390/86-45, WBRD-50-391/86-43 - FINAL REPORT

The subject deficiency was initially reported to NRC-Region II Inspector Steve Weise on April 2 1986, in accordance with 10 CFR 50.55(e) as NCRs WBN 6719, 6720, and 6721. Our interim report was submitted on April 30, 1986. Enclosed is our final report. We no longer consider 10 CFR 50.55(e) applicable to this deficiency.

If you have any questions, please get in touch with J. A. McDonald at (615) 365-8527.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. L. Gridley, Director
Nuclear Safety and Licensing

Enclosure
cc (Enclosure):
Mr. James Taylor, Director
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
DEFICIENCIES IN SAMPLING AND CONTROL OF CONCRETE
WBRD-50-390/86-45, WBRD-50-391/86-43
NCRs 6719, 6720, AND 6721
10 CFR 50.55(e)
FINAL REPORT

Description of Deficiency

In evaluating Quality Technology Company's investigation of employee concerns, IN-85-995-002, TVA determined that conditions adverse to quality (CAQs) existed in three areas: compliance with specification requirements for concrete compressive strength, use and testing of bedding mortar in structural concrete placements, and the sampling frequency for concrete. To document these CAQs, TVA wrote Nonconformance Reports (NCRs) 6719, 6720, and 6721 which are summarized as follows:

NCR 6719 - Concrete Compressive Strength

TVA General Construction Specification No. G-2 for plain and reinforced concrete specifies that compressive strength of the concrete be monitored and controlled. The average strength of the concrete is to be maintained such that no more than 10 percent of the compressive strength test results are less than the specified compressive strength (20 percent of concrete with specified strengths less than 3000 lb/in^2). During some periods of time, the percentage of tests with results less than the specified compressive strength exceeded the allowable.

The deficiency was caused by the failure to effectively implement some of the concrete strength requirements of General Construciton Specification G-2, Section 4.3. Adjustments to the concrete mix were made based on the moving average of five consecutive three-day tests. These adjustments were not always effective in preventing the number of strength tests which were less than the specified strength from exceeding the allowable.

NCR 6720 - Sampling and Control of Bedding Mortar in Concrete Placements

Bedding mortar was used in concrete placements for congested areas joint preparation. While the use of bedding mortar was permitted by ACI 318-71, no procedures were in place to sample and control the use of bedding mortar. Therefore, during initial construction (December 1973 to July 1975), sufficient strength tests were not performed on the bedding mortar and, when performed after 1975, low strength test results were encountered.

The deficiency was caused by the failure to adequately sample and procedurally control the use of bedding mortar used in structural members. Specifications and procedures did not adequately reflect construction engineering technical instructions, and available specifications and procedures were not always followed.

NCR 6721 - Sampling Frequency for Concrete

TVA General Construction Specification No. G-2, for plain and reinforced concrete, specifies the frequency for in-process testing of concrete during production. On some occasions, the frequency of sampling was less than specified.

The deficiency was caused by the failure to adequately monitor the concrete sampling. This resulted in occasional periods of time when the frequency of sampling was less than specified in General Construction Specification G-2.

The deficiencies (NCRs 6719, 6720, and 6721) related to implementation of General Construciton Specification No. G-2 are not generic to other TVA nuclear plants. The deficiency (6720) related to the use of bedding mortar could exist at other TVA plants since G-2 did not address the use of bedding mortar.

Safety Implications

A review of the concrete production and testing records has been completed. The following actions were taken:

1. Reviewed concrete strength test results:

   a. Identified all periods of time when the compressive strength test results did not meet the requirements of G-2.

   b. For the time periods identified in item a, determined an equivalent compressive strength for use in design evaluations.

   c. Identified all concrete placements represented by concrete with equivalent compressive strengths less than used for design.

   d. Determined a conservative long-term concrete strength gain to add to the equivalent concrete strength to obtain the in-place concrete strength.

   e. Performed structural evaluations on all concrete members which included concrete placements with in-place compressive strengths less than the strength used for design.

   f. Evaluated concrete anchorages for surface mounted plates and embedded plates.

2. Reviewed concrete production records to determine locations and volumes of bedding mortar in structural concrete placements.

   a. Identified concrete placements which included singificant volumes of bedding mortar.

b. For placements with significant mortar quantities, determined the equivalent compressive strength and included the results in the structural evaluation detailed in item 1.

3. Reviewed concrete production records to determine when the sampling frequency was less than specified in G-2.

   a. Determined if any mixes appeared to not be randomly sampled.

   b. Identified concrete placements that are not adequately represented by test results.

   c. Performed engineering evaluations with equivalent strengths reduced by approximately 10 percent which was conservatively assumed to be the maximum reduction in strength which could have existed and not been identified by the actual inspection program implemented.

A procedure was developed to conservatively estimate in-place strength considering strength test results, use of bedding mortar, sampling frequencies, and strength gains with age. A consulting panel reviewed and agreed with the procedure. Because of the high fly ash content of TVA concrete, significant strength gains with age are realized. This, coupled with the original adequacy of most of the strength test results, limited the need for detailed engineering review to localized areas and building features. Where necessary, design calculations were reviewed, and it has been determined that the concrete is structurally adequate. Detailed information pertaining to the resolution of these three NCRs is contained in CEB Report CEB-86-19-C "Watts Bar Nuclar Plant - Concrete Quality Evaluation."

TVA has determined that there are no safety implications to this matter, consequently, NCRs 6719, 6720, and 6721 have been dispositioned "use-as-is." As such, 10 CFR 50.55(e) does not apply.