TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

June 3, 1983

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WBRD-50-390/81-16
WBRD-50-391/81-15

U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2 - AUXILIARY POWER SYSTEM - WBRD-50-390/81-16, WBRD-50-391/81-15 - REVISED FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector M. Thomas on September 25, 1980 in accordance with 10 CFR 50.55(e) as NCR WBN EEB 8006. This NCR was initially determined to be nonreportable and the NRC was notified on October 3, 1980. However, subsequent evaluation revealed that this problem was significant and the NRC was notified of this determination on January 23, 1981. Interim reports were submitted on February 24, July 7, and October 22, 1981, and our final report was submitted on January 18, 1982. Supplements to the final report were submitted on December 29, 1982 and March 23, 1983.

As discussed with NRC-OIE Inspector L. Watson on May 10, 1983, TVA has modified its resolution to the subject deficiency. Therefore, we are submitting the enclosed revised final report to define the revised corrective actions.

Additionally, TVA's Division of Engineering Design (EN DES) has determined that the engineering procedure, which as stated in previous submittals was to be issued to define the use of the recently issued design guides and standards (issued to prevent recurrence of the subject and similar deficiencies), is no longer required since EN DES policy already requires that issued design standards be used in the design of nuclear projects unless a valid reason for not using a standard is documented by responsible management and that design guides be considered for application.

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U.S. Nuclear Regulatory Commission June 3, 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 (Enclosure):
Mr. Richard C. DeYoung, Director
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Records Center
Institute of Nuclear Power Operations
1100 Circle 75 Parkway, Suite 1500
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WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
AUXILIARY POWER SYSTEM
NCR WBN EEB 8006
10 CFR 50.55(e)
REVISED FINAL REPORT

Description of the Deficiency

Design review studies indicated that the original design of the Watts Bar Nuclear Plant (WBN) transmission grid-auxiliary power system interface was such that the required grid voltage necessary to ensure adequate offsite (preferred) power to the safety-related buses during a design bases event could not be achieved. This condition represented a significant deficiency in the transmission grid-auxiliary power system interface to conform to 10 CFR 50, General Design Criteria 17.

Safety Implications

For a design basis event, it could not be shown that the transmission grid-auxiliary power system interface could have provided voltage within the utilization limits of the safety-related equipment. The onsite (standby) power system was still available for use during that time. However, this was a loss of diversity to provide an essential safety function which could have adversely affected the safety of operations of the plant.

Corrective Action

Engineering Change Notice (ECN) 2786 has been issued to modify the WBN transmission grid-auxiliary power system interface to ensure adequate offsite (preferred) power to the safety-related busses during design bases events. This change adds two new 161-kV to 6.9-kV common station service transformers (C and D) that are dedicated to the safety-related busses of both units.

ECN 3521 modifies the 480-volt Class 1E auxiliary power distribution system to reduce voltage regulation in the system. This is accomplished by removing current limiting reactors from the 480-volt shutdown board busses, and installing circuit breakers with a higher interrupting capability where necessary.

System analyses have been made that show for an acceptable range of transmission grid conditions, one offsite power circuit consisting of one transmission line and transformers A and D, or the other transmission line and transformers B and C, is capable of starting and running all required safety-related loads, and powering at least half of all running BOP loads for a design basis accident in one unit and a concurrent full-load rejection in the other unit. The analyses for the Class 1E power systems assumed that all equipment that is started by a safety injection signal (SIS) started at the same time, all equipment that is tripped off by a SIS was tripped, and that all continuous loads that could be operating immediately after the SIS, whether safety-related or not, were running.

The Class 1E ac power system for each unit is divided into two redundant power trains. Each train includes a 6900-volt shutdown board powering the larger safety-related motors, pressurizer-heaters, and two 480-volt distribution subsystems. The 480-volt subsystems each include a 6900-480-volt power transformer, 480-volt switchgear, and 480-volt motor control centers. The Class 1E 480-volt subsystems supply both safety-related and nonsafety-related electric equipment. A third 6900-480-volt transformer is provided in each power train as an installed spare.

Each 6900-volt shutdown board can be powered through one of four supply breakers. For normal unit startup and operation, the power is from the 6900-volt unit board connection, the breaker shown normally closed on sketch APS 2. Shown normally open are the first and second alternate supply breaker connecting to a diesel generator. For unit trips, both 6900-volt shutdown boards for the tripped unit automatically fast transfer to offsite power via their first alternate breakers.

Each 6900-volt shutdown board is equipped with loss-of-voltage relaying and degraded voltage relaying. The loss-of-voltage relays initiate slow bus transfers (supervised by residual voltage relays) from the normal source to the first alternate, second alternate, or standby supply, in that order of preference. When a 6900-volt shutdown board is powered from an alternate supply, the loss-of-voltage relays will initiate automatic transfer from first alternate to second alternate or standby supply, or from second alternate to standby supply. Relays monitor each source and permit connection only if adequate power is available. Protective relays are provided in each shutdown board that lock out all supply breakers if the loss of voltage is caused by overload or electrical fault. Transfer between power sources in the reverse order are operator controlled only.

The first alternate power connection for train A shutdown boards is to common transformer C, winding Y, and for train B shutdown boards is to common transformer D, winding X. The second alternate power connection for train A shutdown boards is transformer D, winding Y. For train B shutdown boards, the second alternate connection is to Class 1E power system for both units, with one unit in a design basis accident and the other unit in a concurrent full load rejection, without exeeding its self-cooled power rating.

The initial design of the transmission grid-auxiliary power system interface was established around 1972. The design philosophy used did not ensure that the transmission grid-auxiliary power system interface would meet the current requirements used as acceptance criteria in the as-built system design review.

To prevent recurrence of this problem, TVA's Division of Engineering Design (EN DES) has issued two electrical design standards (DS-E2.2.1 and DS-E2.3.2) which establish auxiliary power system performance and equipment application criteria and have issued a design guide (DG-E2.4.3) which identifies the need for comprehensive in-progress and as-built auxiliary power system design review analyses.

The auxiliary power system modifications will be completed by November 30, 1983.

TVA has not identified any other nuclear plants under construction that failed to meet the requirements of 10 CFR 50, General Design Criteria 17, because of inadequate transmission grid-auxiliary power system interface.

The following information was also sent to the Power Systems Branch of the NRC in response to a related open item of the WBN preliminary safety evaluation report (SER).

The staff degraded voltage positions are addressed as follows:

1. Overvoltage relays alarm in the control room. Undervoltage relays operate if a 6900-volt shutdown board bus voltage drops below the level required to successfully start all safety-related equipment that would be started for a SIS. The undervoltage relays initiate two time delay sequences. The first sequence will ride through normal system voltage transients, but is short enough to allow safety-related equipment to be powered within the time required by the safety analysis. At the end of the first sequence, the undervoltage will be alarmed in the control room, and if a SIS has been initiated, or is subsequently initiated, the shutdown board will transfer to its diesel generator. The second time delay is long enough to allow operator action but not allow damage to connected safety-related equipment. At the end of the second sequence, the shutdown board will transfer to its diesel generator. The undervoltage relaying system design meets all the staff requirements.

2. Degraded voltage relaying will not open the standby supply breaker and will not initiate load shedding and resequencing if a 6900-volt shutdown board is supplied by its diesel generator. The loss-of-voltage relays will initiate load and resequencing. However, the voltage set point and time delay for these relays prevent their operation for any motor starting transients when adequate power is being supplied to the shutdown board. Maximum and minimum limits for the loss-of-voltage relay set points will be included in the Technical Specifications.

3. The auxiliary power system analyses for Watts Bar Nuclear Plant satisfy the staff position and TVA's quality assurance requirements for documentation. The analyses are being issued in a formal TVA internal report.

4. The requirement to verify the auxiliary power system analyses has been included in preoperational test instructions (TVA-67).