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

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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

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 - 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 is 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. Enclosed is our final report.

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, Manager
Nuclear Regulation and Safety

Enclosure
cc: Mr. R. 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
Auxiliary Power System
10 CFR 50.55(e)
WBRD-50-390/81-16, WBRD-50-391/81-15
FINAL REPORT

Description of the Deficiency

Design review studies indicate that the present design of the Watts Bar Nuclear Plant (WBNP) transmission grid-auxiliary power system interface is such that the required grid voltage necessary to ensure adequate offsite (preferred) power to the safety-related buses during a design bases event cannot be achieved. This condition represents 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 cannot be shown that the transmission grid-auxiliary power system interface can provide voltage within the utilization limits of the safety-related equipment. The onsite (standby) power system is still available for use during this time. However, this is a loss of diversity to provide an essential safety function which could adversely affect the safety of operations of the plant.

Corrective Action

Engineering Change Notices (ECNs) 2786 and 2799 have been issued to modify the WBNP transmission grid-auxiliary power system interface in such a way that the required grid voltage necessary to ensure adequate offsite (preferred) power to the safety-related buses during a design bases event can be achieved.

The modifications involve the following:

1. The addition of two new 161-kV to 6.9-kV common station service transformers (C and D) that are dedicated to the safety-related buses of both units.

2. 480-volt Class IE ac auxiliary power distribution system changes:

   a. Splitting the 480-volt shutdown boards of both units by removing their current limiting reactors.

   b. Recabling several motors to ensure that adequate voltage is available at the motor terminals during starting.

c. Reassigning power supplies to given loads (within a train) in such a way that evenly distributes the total load on individual transformers.

The modified Watts Bar Nuclear Plant ac auxiliary power system is shown in attached sketches, APS 1 and 2. The Class IE ac power system is shown entirely in sketch APS 2.

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 IE 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 IE 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 three 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 IE 480-volt subsystems supply both safety-related and nonsafety-related electric equipment. A fourth 6900 - 480-volt transformer will be provided in each power train as an installed spare. It will not normally be connected to either the 6900-volt shutdown board or to the 480-volt buses.

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 breakers connecting to the offsite power circuits, and the standby breaker connecting to a diesel generator. As stated above, 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 transformer C, winding X. Either transformer C or D can supply the Class IE power system for both units, with one unit in a design basis accident and the other unit in a concurrent full load rejection, without exceeding 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 adequately establish the design requirements necessary to ensure that the transmission grid-auxiliary power system interface could meet the current requirements imposed during the design review.

The development of a system of design guides and design standards has been scheduled for completion during calendar year 1982. Issuing the guides and standards, along with an EN DES Engineering Procedure (EP) that invokes and defines their use should prevent the recurrence of this condition.

These modifications will be completed before unit 1 fuel loading.

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 WBNP 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 shedding 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).