TENNESSEE VALLEY AUTHORITY

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OFFICIAL COPY

To: Don Quick
NRC-ATL

From: D.L. Lambert
TVA

4 pages

June 15, 1981

SQRD-50-328/81-36

81-044-03L

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:

SEQUOYAH NUCLEAR PLANT UNIT 2 - MOTORS RATED 440 VOLTS ON A 480-VOLT SYSTEM - SQRD-50-328/81-36 - FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. V. Crlenjak on April 27, 1981 in accordance with 10 CFR 50.55(e) as NCR SQN EEB 8111. An interim report was submitted on May 28, 1981. Enclosed is our final report as discussed with Inspector T. Gibbons on June 12, 1981.

If you have any questions, please get in touch with D. L. Lambert at FTS 857-2581.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills, Manager
Nuclear Regulation and Safety

Enclosure
cc: Mr. Victor Stello, Director (Enclosure)
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

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ENCLOSURE
SEQUOYAH NUCLEAR PLANT UNIT 2
MOTORS RATED 440 VOLTS ON A 480-VOLT SYSTEM
SQRD-50-328/81-36
10 CFR 50.55(e)
FINAL REPORT

Description of Deficiency

There are six motors in unit 2 that have a nameplate voltage rating of 440 volts ac and are supplied from the 480-volt ac Class 1E auxiliary power system of units 1 and 2. NEMA MG1-12.43, 1967, requires that induction motors must be capable of operating under the steady-state running conditions with a voltage variation of plus or minus 10 percent at rated frequency. The maximum voltage these motors can withstand is 484 volts. This contrasts with 506 volts that a motor rated 460 volts can withstand. TVA design allows a maximum voltage of 506 volts at the motor terminals which is 15 percent above rated voltage for those motors rated 440 volts. This discrepancy was discovered in the preparation of the field nameplate verification list on the 480-volt shutdown board load. This deficiency also exists at Watts Bar Nuclear Plant and is documented as nonconformance report WBNEEB8104. The affected motors at Sequoyah unit 2 are:

(1) Component Cooling System Pumps 2A-A and 2B-B to C-S Inlet Isolation Valve (2-FCV-70-78)

(2) Component Cooling System Pumps 2A-A and 2B-B to C-S Inlet Isolation Valve (2-FCV-70-76)

(3) Diesel Generator 2A-A Engine 2A1 Lube Oil Circulation Pump Motor

(4) Diesel Generator 2A-A Engine 2A2 Lube Oil Circulation Pump Motor

(5) Diesel Generator 2B-B Engine 2B1 Lube Oil Circulation Pump Motor

(6) Diesel Generator 2B-B Engine 2B2 Lube Oil Circulation Pump Motor

Safety Implications

The maximum voltage available at the motor terminals from the 480-volt ac, Class 1E auxiliary power system is 460 volts plus 10 percent, or 506 volts ac, which is in excess of 110 percent of 440 volts. Assuming unit availability of 80 percent maximum voltage conditions should occur only during plant shutdown which would be approximately 20 percent of the time. However, if the motors are continuously exposed to terminal voltages in excess of 110 percent of their rated values, the motors may suffer some loss of life over an extended period of time. This loss of life could be attributed to the following two conditions that would be present.

1. The available locked rotor current would increase but would be accompanied by a corresponding decrease in the accelerating time characteristic of the motor.

2. There may be a very slight rise in the total temperature of the motor. Although a decrease of approximately 4°C could result due to a decrease in the full load amperes at 115 percent rated voltage, an increase in the core losses may offset the decrease. The core losses would increase due to an increase in the total flux.

Loss of life depends upon several factors such as how often the motors are started and how long the motors remain under locked rotor conditions. The core losses are predominantly a function of the reluctance of both the core and the air gap and the total flux. The reluctance of the iron core is usually disregarded due to its relatively small magnitude in comparison with the reluctance of the air gap. Therefore, what increase occurs in the iron core losses may offset the temperature decrease cited in No. 2.

In any case, whether the loss of life is realized due to condition No. 1 or 2, the destructive mechanism would be a loss of mechanical durability and dielectric strength of the motor insulation system. The total failure of the insulation system would result in a surge of current, the magnitude of which should trip the motor circuit breaker. If the motor breaker failed to open, the feeder breaker to the board would be required to trip. This would constitute a failure in that train.

Simultaneous failure of "identical" motors subjected to identical operating conditions is very unlikely. The destructive mechanism discussed above works on the "weak link" of the motor insulation system. It is not probable that this vulnerability will occur in the same location and to the same degree in each motor. As a result, the destructive mechanism will act upon the vulnerable areas of different motors at a different rate, thereby making the probability of simultaneous failure of these motors quite small.

This situation should not affect the ability of the plant to operate safely. The component cooling system pump inlet isolation valves are infrequently energized for short periods of time in order to isolate sections of the component cooling water system. In all cases, these motors are opened (or closed) under manual control. Because of their infrequent use and the short periods of operation (essentially these motors only operate long enough to open or close associated valves), the 440V rating of these motors will not result in any detectable loss of life.

The four lube oil circulation pump motors are not required either for startup or operation of the diesel generators. The one-horsepower motors are required solely to circulate lube oil and maintain minimum lube oil pressure when the diesels are not operating and to assist in removing heat from bearings when the engine is shut down. Failure of these motors would result in an indication of low lube oil pressure in the MCR.

The diesel generator engine lube oil circulation pump's purpose is to maintain lube oil pressure while the diesel generator is inoperative and to remove heat from the bearings upon shutdown. Although failure of these pumps' motors would result in a low lube oil pressure indication in the main control room (which would initiate operator action to investigate and resolve any problem) it is possible that the diesel engines could be required to start during the period of time that a lube oil circulation

pump motor was not operational. This would result in wear to moving engine parts that could have been prevented had the lube oil circulation pumps been operational. This could not prevent diesel generator startup unless the engine had repeatedly (and negligently) been started without the benefit of lube oil circulation.

TVA had addressed this possibility by issuing a report of nonconformance and has submitted a final report to the NRC (NCEB 79-26, October 4, 1979, L. M. Mills to J. P. O'Reilly) which documents procedures which are now in effect at Sequoyah which administratively preclude the possibility of repeated startup of the diesels without the benefit of lube oil circulation.

Corrective Action

In light of the results of TVA's recent analysis of the subject deficiency, it is no longer necessary (as stated in our previous interim report) to contact vendors of the affected motors. This analysis has clearly illustrated that no corrective action is required for the component cooling system isolation valve motors as these motors are adequately rated for their intended purpose.

In addition, TVA will install a redundant direct current motor for the lube oil circulation pumps. The installation of this motor will take place during the first unit 2 refueling outage. Installation of this motor will ensure lube oil circulation redundancy during all phases of diesel operation.

No significant effects of loss of life (i.e., extensive loss of mechanical durability or dielectric strength of motor insulation) should register in these motors during the period from now until the first refueling outage.