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

NRC REGION II
ATLANTA, GEORGIA
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August 27, 1982

SQRD-50-328/81-29

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:

SEQUOYAH NUCLEAR PLANT UNIT 2 - 460-VOLT MOTOR DOCUMENTATION - SQRD-50-328/81-29 - FOURTH INTERIM REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. V. Crlenjak on April 13, 1981 in accordance with 10 CFR 50.55(e) as NCR SQN EEB 8115. Interim reports were submitted on April 28, August 25, and November 17, 1981. Enclosed is our fourth interim report. We expect to submit our next report by August 5, 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, Manager
Nuclear Licensing

Enclosure
cc: Mr. Richard C. DeYoung, 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
460-VOLT MOTOR DOCUMENTATION
NCR SQN EEB 8115
10 CFR 50.55(e)
FOURTH INTERIM REPORT

Description of Deficiency

EN DES calculations for voltage analysis of the Class 1E 480-volt ac auxiliary power system assumed, where vendor documentation of minimum starting voltage was not available, that 460-volt motors could start with 85 percent of rated voltage at their terminals. NEMA MG-1-20.45, 1969, requires induction motors to operate within ± 10 percent of their rated voltage. There are 145 460-volt motors fed from the 480-volt Class 1E ac auxiliary power system of units 1 and 2 for which TVA did not have documented minimum starting voltage and that could have less than 90 percent rated voltage at their terminals during starting under worst case conditions (i.e., one-unit LOCA with a simultaneous full-load rejection of the other unit). A minimum starting voltage available at the motor terminals during accident conditions had not been determined during the design process.

Interim Action

The previous report indicated that of the 145 affected motors, 54 did not perform a safety-related function, 18 motors can be started at 85 percent of rated voltage, and 13 motors were being replaced in the TVA effort to comply with NUREG-0588. The specifications for these replacement motors require that the motors be capable of accelerating their connected loads from zero speed to rated speed within 5 seconds with a terminal voltage of 80 percent of rated motor voltage throughout the starting cycle except that for the first second of the starting cycle, the terminal voltage may drop to 75 percent of rated motor voltage. Information was still required for the remaining 60 motors.

Further evaluation on the remaining 60 motors shows that 14 additional motors do not perform a safety-related function. The 4 cooling tower fan motors are no longer used. Starting voltages of 85 percent of rated voltage have been confirmed by either vendors or the contract specification for 19 motor operators. A reanalysis of some of the motors has shown that 6 of them have at least 90 percent of rated voltage at the terminals. In the NUREG-0588 review, the 2 boric acid transfer pumps have been determined to be category C by safety analysis; therefore, failure to start at 85 percent rated voltage should not be detrimental to plant safety under an accident condition. One motor was counted twice and a heater load was inadvertently counted as a motor. At this time the remaining 13 motors will be reanalyzed. Any of these motors that still have less than 90 percent of rated voltage at the terminals will be tested in the field. Any of the tested motors that fail to start at 85 percent rated voltage will either be replaced by motors capable of starting at the reduced voltage level or recabled to provide a starting voltage of 90 percent rated voltage.

The effort undertaken by TVA in the resolution of the NCR generally reaffirms TVA's belief that those motors that perform a safety-related function and have 85 percent of rated voltage at their terminals will accelerate the driven equipment to rated speed without a loss of motor life in order to mitigate an accident under worst case conditions (i.e., one-unit LOCA with a simultaneous full-load rejection of the other unit).

TVA is currently investigating the motor starting voltages available during accident conditions at all plants. The completion of our investigation is expected during January of 1983. This deficiency will be present on those plants in which the motor starting voltages available at the motor terminals dips below 90 percent of rated voltage, and for which lower voltage start capability has not been documented. These motors will be identified through the ongoing design review process, and nonconformance reports will be issued on any application that vendor documentation does not show that the motor has the capability to start at the calculated reduced voltage. Any new motors bought for Class 1E service will specify a starting voltage of 80 percent to conservatively comply with the 85 percent starting requirement. The latest revision of our motor specification, E9.2.01, R2, incorporates this requirement.

Discussion

The TVA assumption of 85 percent of rated voltage being adequate for starting was selected because motors for nuclear service are conservatively applied (NEMA type B motors) and load torque requirements are usually well below starting torque requirements. If rated starting voltage corresponds to 100 percent motor torque, then 85 percent starting voltage corresponds to 72 percent motor torque. However, the speed-torque characteristics of NEMA type B motors provide 150 percent starting torque at full voltage (100 percent at 80 percent voltage). Many loads have torque requirements that are very low at zero speed and subsequently increase, e.g., fans, centrifugal blowers, etc. Other loads, such as positive-displacement compressors, start unloaded and thus, eliminate the need for a large starting torque from the drive motors. Valve operators are designed to allow the drive motor to accelerate before the load torque is applied. Also, it should be noted that the electrical industry accepts a starting voltage of approximately 80 percent of rated at the terminals of NEMA type B motors (paper IPSD 77-5, IEEE Transactions on Industry Applications, Volume IA-14, No. 4, July/August 1978). In consideration of the torque-voltage relationship of the motors to the starting torque requirements of the expected loads, it is anticipated that the motors will have no problem starting with 85 percent of rated voltage at their terminals. The actual verification of the minimum allowable starting voltage is proceeding on a case-by-case basis.

NEMA MG-1-20-45, 1969, requires induction motors to operate within ± 10 percent of their rated voltage. Although this standard placed no requirements on the starting voltage, TVA undertook an examination of the starting voltages available to the motors fed from the 480-volt Class 1E ac auxiliary power system on the basis of applying this standard during motor starting. We have determined that 145 motors could have less than 90 percent rated voltage at their terminals during starting, for which TVA does not have documented minimum starting voltage. It is our firm belief, based on the motors of concern being NEMA type B, coupled with the results of our investigations, that the selection of a starting voltage of 85 percent rated is satisfactory, and interim operation of units 1 and 2 is justified.