400 Chestnut Street Tower II

April 22, 1981

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 - OFFSITE POWER VOLTAGE FLUCTUATION - NCR SQN EEB 8034 - FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. W. Wright on October 20, 1980, in accordance with 10 CFR 50.55(e). Interim reports were submitted on November 19, 1980, and February 27 and April 6, 1981. Enclosed is our final report.

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
OFFSITE POWER VOLTAGE FLUCTUATION
NCR SQN EEB 8034
10 CFR 50.55(e)
FINAL REPORT

Description of Deficiency

During a degraded voltage study, it was discovered that the 161-kV voltage minimum limit imposed on the operation of the 161-kV grid was not correct. This was because the 161-kV limit did not ensure adequate starting voltage for all safety-related 460V motors. This discrepancy was based on the present configuration of unit 1 in full power operation and unit 2 in preoperational testing.

Safety Implications

Had the 460V motors not been provided with adequate starting voltage, the safe shutdown of the plant could have been affected.

Corrective Action

TVA has calculated the setpoints for future degraded voltage relaying in order to ensure adequate starting voltage for all safety-related 460V motors. For those motors without a documented minimum starting voltage, we assumed that a starting voltage of 85 percent of rated voltage at the motor terminals is adequate. The present loading configuration dictates that for a one-unit, full-load rejection, the 161-kV grid voltage at the primary of the common station service transformers (CSST) must be no lower than 164-kV with the CSST voltage taps set on the 0.95 position. These requirements are for unit 1 in full-load operation with unit 2 in preoperational status.

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 majority of 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 places no requirements on the starting voltage, TVA undertook an examination of the starting voltages available to the motors fed from the 480V Class 1E ac auxiliary power system on the basis of applying this standard during motor starting. We have determined that 133 motors could have less than 90 percent rated voltage at their terminals during starting. We have received documentation of the minimum required starting voltage for 22 of these motors from their vendors. Eleven of these 22 motors have been confirmed to require only 80 percent voltage to start them, nine to require 85 percent, and two to require 90 percent. However, the two motors stated to require a starting voltage of 90 percent are connected to reciprocating charging pumps and would require such a voltage to ensure acceleration of the pumps under full load compression. In actuality, these pumps are started under manual control with the pumps unloaded. Additionally, the operator will be required to verify that adequate voltage exists before starting the motors.

Of the 133 motors, the only other motors that may have less than 90 percent of rated voltage during starting and also possibly could be required to start under load are the backflow gate hoist, ice condenser bridge crane, and the reactor building jib crane, all of which are manually started and not required to mitigate an accident.

Any replacement motors to be fed from the Class 1E 480V buses will be rated to start with 80 percent voltage.

The lack of vendor documentation of the minimum starting voltage of the 460V motors fed from the 480V ac auxiliary power system has been identified in NCR SQNEEB8115, and TVA is continuing to request vendor documentation on the remaining motors. However, it is our firm belief, based on the motors of concern being NEMA type B, coupled with the results of our investigation presently completed, that the selection of a required starting voltage of 85 percent rated is satisfactory.

TVA is also proceeding to incorporate design improvements which will allow a wider range of operation of the 161-kV grid and improve equipment voltages in the 480V Class 1E ac auxiliary power system.

A minimum 161-kV grid voltage of 165-kV has been established to ensure that all safety-related motors are supplied with the minimum required voltage for operation for a full load rejection of two units. As the design improvements are implemented, this restriction will be reduced appropriately.