Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

August 16, 1991

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Dresden Nuclear Power Station Units 2 and 3
Response to Request for Additional Information
Regarding the August 9, 1991 Exit for Dresden
Electrical Distribution System Functional
Inspection (EDSFI)
NRC Docket Numbers 50-237 and 50-249

Enclosed (Attachment 'A') are Commonwealth Edison Company's (CECo) responses to the request for additional information regarding 120 V-ac control power, motor operated valve (MOV) terminal voltage calculations, and MOV starting torque at low voltage conditions.

If there are any questions or comments regarding this response, please contact Rita Radtke, Compliance Engineer, at 708/515-7284.

Very truly yours,

T. J. Kovach
Nuclear Licensing Manager

Attachment 'A': Response to Dresden Station EDSFI Exit Meeting Commitments

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ATTACHMENT 'A'

Response to Dresden Station

EDSFI Exit Meeting Commitments

ZNLD/1138/2

During the Dresden Station Electrical Distribution System Functional Inspection Exit Meeting held on August 9, 1991 several specific short term commitments were made by Commonwealth Edison to the NRC. These commitments were in regards to:

1. Calculation of "a few more" 120 V-ac control power cases to establish an envelope on the availability of control power to all Class 1E loads at the degraded voltage condition.
2. Completion of design calculations of terminal voltage values for certain Motor Operated Valves initially exhibiting terminal voltages less than 70 percent of rated voltage at the degraded voltage condition.
3. Clarification of the ability of MOVs to develop adequate starting torque at voltages greater than or equal to 70 percent of rated voltage.

The NRC requested Commonwealth Edison to respond to each of these issues by August 16, 1991. This document provides that response.

120 V-ac Control Power

Five 120 V-ac control power circuits were selected for determining whether or not sufficient voltage is available to ensure the closure of motor contactors or interposing relays for Class 1E loads at low switchyard voltages. The five circuits selected are:

1. Unit 2 Emergency Diesel Cooling Water Pump,
2. Stand-by Gas Treatment System Fan 7506,
3. Stand-by Gas Treatment System Damper 7505A,
4. Reactor Recirc Discharge Valve 202-5B, and
5. LPCI Injection Valve 1501-22B.

The five circuits were chosen based on; 1) enveloping NEMA starter sizes 1 through 4; 2) low MCC voltages, and; 3) representative control cable lengths found in the plant. Circuits number 1 and 4 were already discussed with the inspection team prior to the exit meeting.

All five circuits are determined to perform their intended function at voltage levels representing the degraded voltage compensatory setting of 3850 Volts at the 4160 V-ac safety buses.

The bases used in this evaluation include:

- MCC voltages determined utilizing an ELMS-AC model which is consistent with the input assumptions of the analysis performed during the EDSFI of the diesel cooling water pump under degraded voltage conditions. This ELMS model is conservative with respect to the analysis of diesel cooling water pump.
- Control cable lengths based on SLICE tabulations for cables in pans and from estimates based on drawings for cable lengths in conduit.
- Contactor resistances of 10 milli-ohms per contact. This resistance is a conservative assumption based on actual resistance measurements taken of a representative population of contacts.
- Circuit numbers 1, 2, and 3 contactor voltage acceptance criteria based on the General Electric recommended voltage of 85 percent of nominal terminal voltage. Actual voltage results determined contactor or interposing relay voltages approximately 7 to 15 percent greater than the acceptance criteria.
- Circuit numbers 4 and 5 contactor voltage acceptance criteria are based on the measurement of the minimum pick-up voltage of a single CR106 contactor. A single CR106 contactor was tested due to the availability of similar contactors. The current replacement contactor for the CR106 is either the CR306 or CR309 contactor. These new contactors are the direct replacement for the old CR106 and CR109 contactors.

  The minimum pick-up voltage of the CR106 was determined by measuring the pick-up voltage where "strong" contactor closure was observed (these voltages are well above the voltage at which the contactor will pick-up and "chatter"). This test was repeated twenty times to assess the repeatability of the pick-up voltage. This method of determining minimum contactor pick-up voltage was discussed with General Electric and found to be adequate.

  The calculated voltage drop results determined for circuits number 4 and 5 represent a margin of between 1 and 2 percent above the as tested contactor pick-up voltage. Additional margin is known to exist due to the calculational method.

Follow-up activities for this issue include the completion of design calculations for circuits numbers 1 through 5 by August 23, 1991. An action plan will be developed by August 30, 1991, to address the limited margin between available voltage and pick-up voltage exhibited for the NEMA type 2 contactors (circuits 4 and 5).

MOV Terminal Voltage Calculations

A total of 172 motor operated valves (MOVs) at Dresden Station are contained in the safety related population reviewed under the program defined by Generic Letter 89-10. During the initial calculation of terminal voltages at low voltage conditions, seven MOVs exhibited terminal voltages of less than 70 percent of rated voltage. Based on revised design calculations correcting input errors, or by utilizing more refined input data, all Dresden Station motor operated valves exhibit terminal voltages greater than or equal to 70 percent of rated voltage for the low voltage condition.

The initial calculation methodology for determining terminal voltages at low voltage conditions included several inherent conservatisms. These conservatisms included:

- A multiplier of 1.5 to the estimated cable length from the MCC to the terminals of the MOV.
- MCC bus voltages which had been reduced by an additional one percent from the low voltage condition assumed in the auxiliary power system analysis.
- Cable resistances based on a conductor temperature of 90 degrees Celsius. This assumption is based on the entire length of the conductor subjected to the highest drywell temperature calculated for the Design Basis LOCA analysis. MOV conductors may be routed for a portion of their length outside the drywell or in conduit within the drywell which will result in conductor temperatures less than the 90 degrees Celsius.
- Locked rotor current based on motor curve data.
- Power factors were generally based on generic motor curves. A revised power factor was utilized based on test data received from Limitorque.

In refining the calculations for the seven MOVs in question, two calculations were found containing input errors associated with the selection of correct thermal overload heater. The remaining calculations used combinations of revised cable lengths, more refined locked rotor currents or power factors, or removed the uncertainty associated with the additional 1 percent MCC bus voltage reduction. As discussed during the exit meeting, one calculation reduced the temperature assumption of the conductor for the length of conductor found in pans outside the drywell and conductor in conduit within the drywell.

MOV Starting Torque At or Above 70 Percent Terminal Voltage

During the exit meeting the NRC requested that Commonwealth Edison provide a clarification of the acceptance criteria of 70 percent of nominal starting voltage for MOVs found in the Generic Letter 89-10 program. The acceptance criteria is more clearly stated as the ability of an MOV to develop adequate starting torque at voltages greater than or equal to 70 percent of rated voltage.

Both theoretical principles and testing of ac and dc valve actuator motors substantiate that the use of 70 percent as a minimum starting and operating criteria for motor terminal voltage is conservative.

Commonwealth Edison, with input from Limitorque, Bechtel, and others, has developed the following technical justification for use of 70% rated voltage as the minimum acceptable voltage for the evaluation of ac and dc valve actuator motors.

AC Valve Actuator Motors

The torque developed by a three phase induction motor is a function of applied voltage. Based upon linear magnetic induction theory the torque is proportional to the square of the applied voltage for all ac induction motors.

Reliance Corporation has performed tests on five Limitorque ac motors. This test data includes equipment ranging from 60 foot-pound two pole to 250 foot-pound four pole motors. The test results concluded that the torque-voltage relationship is proportional to the square of the applied voltage for applied terminal voltages down to at least 50 percent of rated voltage.

Based on this relationship, the torque available at 50 percent of rated voltage is 25 percent of rated torque. Limitorque induction motors are designed with the running torque as 20 percent of the rated torque. Therefore the torque developed at 50 percent of rated voltage is higher than the designed running torque.

The frictional torque that will be experienced during the starting of an ac motor is less than the running torque. This is true because the running torque includes the torque of the actuator gearing and other system resistance which is not experienced as the motor starts.

DC Valve Actuator Motors

The torque developed by a compound dc motor is a function of applied voltage. Based upon linear magnetic theory, the torque is directly proportional to the applied voltage for all compound dc motors.

Peerless Corporation has performed a single test on a Limitorque dc motor. The test data substantiates the torque-voltage relationship for applied terminal voltages down to 20 percent of the rated voltage.

Based on this linear relationship, the torque available at 50 percent of rated voltage is 50 percent of rated torque. Limitorque compound dc motors are also designed with the running torque as 20 percent of the rated torque. Therefore, the torque developed at 50 percent of rated voltage is higher than the designed running torque.

In addition, it is common practice to start dc motors using reduced voltage starters. DC valve actuator motors at Commonwealth Edison stations do not use reduced voltage starters. Therefore, the maximum torque is available for starting the motor. This further substantiates the ability of dc motors to start under reduced voltage conditions.

In conclusion, the frictional torque that will be experienced during the starting of either an ac or dc motor is less than the running torque. This is true because the running torque includes the torque of the actuator gearing and other system resistance which is not experienced as the motor starts.

Therefore, since the torque developed at 50 percent of rated voltage for both ac and dc motors is sufficient to overcome the torque experienced when starting, the acceptance criteria of 70 percent of rated voltage is sufficient.