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July 12, 1979

1-079-4

Director of Nuclear Reactor Regulation
ATTN: Mr. Robert W. Reid, Chief
Operating Reactors Branch #4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Arkansas Nuclear One-Unit 1
Docket No. 50-313
License No. DPR-51
Degraded Grid Voltage
Request for Additional Information
(File: 1510)

Gentlemen:

In response to your letter of June 20, 1979, the following is provided.

Item 1.

The proposed second level protection includes two-out-of-two coincidence to cause protective action. Describe the feature(s) of the design which will permit automatic protective action when one of the two channels is out of service (for calibration, repair, etc.).

Response:

The auxiliary power system has two load groups (Red and Green). Each load group is provided with two undervoltage relays (total of 4). The undervoltage protective action of the two load groups is independent. The protection action within a group is initiated when both relays in that group operate (two out of two).

If one of the channels is out of service, the protection actuation system for the other channel being independ is still functional. If one of the two relays in one channel is out of service for repair, maintenance or calibration, then two conditions will arise.

a. Relay is still mounted and undergoing testing. The actuation system will automatically revert to one out of one instead of two out of two relay logic.

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b. Relay is dismounted from the switchgear, wiring is removed. Administrative controls will be imposed to ensure the wiring continuity of the other relay. The protection actuation system will be one out of one.

Item 2.

Describe the design provision to automatically reinstate the degraded voltage protection system (both levels of protection) when the supply breaker from onsite source is oper ' and, conversely, blocking the under-voltage protection when the onsite source is supplying power to ESF buses.

Response:

The design of the U/V protective system is such that it operates only when the off-site breaker is closed. The protective action is blocked when the on-site power breaker is closed and off-site breaker is open i.e., diesel generator is the only source of power to the ESF buses. The protective action is automatically reinstated upon closure of the off-site breaker.

Item 3.

Describe the features of the under-voltage protection system that facilitate periodic testing.

Response:

The 4160 Volt undervoltage relays (two in parallel) are equipped with test plugs. Periodic testing when performed on one relay will be done by removing the plugs, and inserting test plugs. Operation of that relay in that mode will not affect the protection system. The protection actuation system will still be operational with the other relay in service reverting to one out of one instead of a one out of two logic.

The 480 Volt undervoltage relays are equipped with a test in service pushbutton. Actuation of the pushbutton will exercise the solid state circuitry, and close the relay contact. The protective action will not be executed when testing one relay at a time.

Item 4.

a. Describe the testing to be performed on the under-voltage protection system.

b. Describe how the testing program will demonstrate that, when the grid is at the defined "minimum-normal" condition, no unacceptable voltage is applied to ESF equipment. (If actual

test cannot fully simulate such a grid condition, sufficient tests should be conducted to facilitate extrapolation of the measured data with a high confidence level).

c. Describe how the testing program will demonstrate that, under the defined "minimum-normal" supply condition, no unacceptable electric power will be applied to ESF equipment during the starting of large non-Class 1E motors.

Response:

A. Every refueling outage two tests will be performed.

1. Calibration check to ensure proper set point.

2. Test trip check to ensure control wiring and integrity of the protective actuation system.

B. The undervoltage relays are always connected to the source and continuously monitoring the voltage. When voltage is below set point the relay dropout and protective action is initiated. This demonstrates that the ESF buses will not see low voltages.

C. The analytical results indicate that voltage dips may occur on the 480 Volt system during starting of the reactor coolant pump motor, under certain station loading configuration. The voltage dip is below the set point of 92% of 460 and exceeds the 8 second time delay. To prevent unwarranted spurious trips, the protective actuation system is blocked during the acceleration period of RCP, and automatically reinstated after twenty seconds.

Item 5.

The proposed under-voltage protection includes transformers tap changes. Provide the analysis that shows that, under high-normal conditions of grid voltage and no-load conditions, the voltages applied to ESF equipment will not exceed acceptable values.

Response:

The maximum voltage expected on the system is 1.05 per unit. Transformer taps were selected such that, under no load condition, and maximum expected system voltage, no significant overexcitation on motors will occur. Computer cases V-2A and V-3A (Attachment 1) indicate the results.

Item 6.

The proposed under-voltage protection modification includes a bypass of the second level protection during the starting of large, non-Class 1E motors. Provide the schematic diagrams involved in this aspect of the proposed modification. Discuss how this bypass satisfies IEEE-279, with particular consideration to the fact that the bypass originates in non-1E equipment and operates in both divisions of the Class 1E electric power system.

Response:

Drawings E-196 Sheet 1 Rev. 12-1 and E-99 Sheet 1 Rev. 8-1 (attached) covers the bypass of the second level protection during large motor startings.

a. Each reactor coolant pump, 6.9kv switchgear, will be provided with an off-delay timer. Each of the two contacts of this timer (for each reactor coolant pump) will be connected independently in separate schemes and will operate individual class IE relays mounted on redundant class IE 4.16kv switchgear. All the wiring for the two control schemes will be routed in separate raceways (Note 1 on scheme E-99 sheet 1). Relays mounted in class 1E 4.16kv switchgears shall provide a buffer to separate the two class 1E load groups from the non-class IE controls. The contacts of these buffer relays are connected in their respective load group protection schemes and are wired as class IE devices.

Item 7.

For each Section of IEEE 279, describe how the proposed under-voltage protection modification complies with the criteria.

Response:

The response to this item is being developed at this time and should be forwarded to you by August 3, 1979.

Item 8.

The proposed under-voltage protection includes shedding of non-essential loads.

a. What is the maximum load (MVA) that may be transferred to ST-1/ST-2 (worse case)?

b. Identify specifically which loads must be shed.

c. Provide appropriate electrical diagrams which portray this shedding.

Response:

The load shedding of non-essential loads is proposed only when the station auxiliaries are supplied power from start-up transformer No. 2 (#ST2). The load shedding is not a function of voltage magnitude but rather a line up.

a. The calculated maximum load (per the computer load flow study) that can be fast transferred to ST-1 is of the order of 41 MVA. This does not include the ESF load which after transfer shall be sequenced in case of an ESF signal.

The calculated maximum load that can be transferred to ST-2 is of the order of 30 MVA which includes the ESF as well as the non-ESF loads.

b. When the source of power supply to station auxiliaries is ST-2, the following loads are proposed to be shed:

i. Two reactor coolant pumps tripped (two running)

ii. Three circulating water pumps tripped (one running)

iii. Two condensate tripped (one running)

iv. Two chiller pumps tripped (none running)

There is not load shedding when the source of supply is ST-1.

c. The following drawings show the load shedding (attached):

E-118 Rev. 0-1, E-306 Sheet 2 Rev. 2-1 Sheet 3 Rev. 2-1, E-271 Sheet 1 Rev. 11-2 Sheet 2 Rev. 11-2 Sheet 3 Rev. 0-1, E-372 Sheet 1 Rev. 8-2, E-196 Rev. 12-1, E-92 Rev. 12-1, E-89 Rev. 13-1

Item 9.

The ANO-1 analysis assumed that protective action would be executed at (or above) the calculated value of 92% (motor-base) voltage. Indicate: (a) nominal value of this setpoint, (b) the allowance (above 92%) used to accommodate all inaccuracies, and (c) allowance (above 92%) used to accommodate drifts. Describe the basis for determining these allowances. Describe the bases for determining the

nominal setpoint which provides maximum protection consistent with minimum spurious shedding form the perferred power source (i.e., electric grid).

Response:

a. The nominal value of the 92% under voltage relay is 105.8 volts drop-out which at 480 volt system level corresponds to 423.2 volts ($105.8 \times \frac{480}{120}$ and on a motor base of 4600 is 92%. The basis of selection of 92% of 460 as a nominal set point NEMA standards allows 90% voltage on motor terminal plus an added 2% voltage drop between motor terminal and load center buss was considered in the selection of set point (90% + 2% = 92% of 460).

b. The relays were factory set to drop out at 105.8 volts (92% of 460 ÷ 4 pt ratio). No inaccuracies are accounted for.

c. As these relays are not installed at ANO-1 as yet, the necessity for determining setpoints (and corresponding inaccuracies) has not risen. However, in response to your question and in preparation of installation, setpoints are being developed and will be forwarded to you as soon as they are available.

Item 10.

The AP&L submittal dated August 23, 1978 indicated that the setpoint for the under-frequency trip would be 59.9Hz. We understand this value is erroneous. Please indicate the correct value for this setpoint.

Response:

The 59.9 Hz value is indeed incorrect due to a typographical error. The correct value is 59.5 Hz.

Item 11.

We understand that AP&L proposes to use interposing relays to improve control circuitry voltage situation. Provide typical diagrams showing these circuit changes and state the criteria and design voltage limits that will be imposed.

Response:

The diagram E-84 sheet 5 shows the typical changes proposed to add interposing relays. The criteria and design voltage limits are listed below.

a. Starter minimum pick-up voltage 80% of 115% (obtained from Motor Control Centers supplier, Allis-Chalmers).

b. Control transformer voltage applied to primary 90% of 460V.

c. Maximum control wire length were calculated for various sizes of starters so that the voltage at the starter terminals does not fall below the minimum required under item 11.a). The formula used for voltage drop calculations are as follows:

$$\% \text{ Regulation} = \frac{V_{NL} - V_L}{V_{Rated}} \times 100 = \left[(P\ r) + (qx)\ \frac{(Px - qr)^2}{200}\right] \frac{\text{Load Current}}{\text{Rated Current}} \times$$

Where:

V_{NL} = No load voltage on secondary of control transfer

V_L = Load voltage on secondary, given load current.

V_{Rated} = 115V AC., Control transformer

0 = Load power angle (starter inrush)

P = Load power factor - Cos 0

q = Sin 0

x = % reactance control transformer

r = % Resistance control transformer

Load Current = Starter Inrush Current

Rated Current = Control Transfer Rated Current

The data for the starters and control transformer is supplied by the Vendor.

With regard to your request for proposed technical specifications, our letter of August 23, 1978, committed to provide proposed Technical Specifications following NRC approval of our proposed modifications. As the proposed modifications have not been approved by NRC and have been the subject of extensive review and question, we are uncertain, at this time, as to the status and likelihood of NRC approval of the proposed modifications. Based on this we do not believe it prudent or in the interest of expeditiously resolving this issue to propose Technical Specifications based on speculations with regard to the outcome of

NRC's review. However, repeating our previous commitment, we will submit proposed Technical Specifications immediately upon your approval of our proposed modifications.

We hope you are sympathetic with our above concerns and recognize that our efforts are those which we believe will resolve this issue in the most rapid and effective manner possible.

Very truly yours,

David C. Trimble

David C. Trimble
Manager, Licensing

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