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ACCESSION NBR:7910170315 DOC.DATE: 79/10/11 NOTARIZED: NO DOCKET #
FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
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SUBJECT: Forwards response to 790717 request for addl info re degraded grid voltage.Undervoltage relays will be added to protect safeguard continuous duty motors from long term degraded voltage operation.

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WISCONSIN PUBLIC SERVICE CORPORATION

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P.O. Box 1200, Green Bay, Wisconsin 54305

October 11, 1979

Mr. A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Adequacy of Station Electric Distribution Systems Voltages

We have received and reviewed the August 8, 1979, letter from William Gammil to all Power Reactor Licensees and had Fluor Power Services, the Architect-Engineer for the Kewaunee Plant, perform the requested analysis. The analysis in turn allows us to complete our September 19, 1979, response to your July 17, 1979, request for additional information regarding degraded grid voltage.

Kewaunee is a single unit Westinghouse PWR. Non-safeguard on-site AC power is supplied through the main auxiliary transformer when the plant is on line and through the reserve auxiliary transformer when the unit is off-line. (See FSAR Figure 8.2-2) Safeguard AC power is supplied by both the reserve auxiliary and tertiary auxiliary transformers with the diesel generators as the emergency back-up supply. The three case analysis described in the attachment looks at situations where the reserve auxiliary is out of service, both transformers are available, and the tertiary auxiliary transformer is out of service. In all cases sufficient capacity and capability to accommodate starting the emergency loads concurrent with full house loads with minimum expected grid voltage is available. For case three, long term operation of all loads at maximum loading and with the minimum grid voltage would be unacceptable. Therefore, undervoltage relays are being added to protect safeguard continuous duty motors from long term degraded voltage operation. This modification will be completed at the next refueling.

Very truly yours,

E. R. Mathews

E. R. Mathews, Vice President
Power Supply & Engineering

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Attach.

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ATTACHMENT

DEGRADED GRID VOLTAGE ANALYSIS SUMMARY

A voltage profile analysis of the A.C. Safeguards buses has been performed under the guidelines presented in the August 8, 1979, NRC letter. The voltage drops on the safeguards buses were calculated for a plant condition of Loss of Coolant Accident with a corresponding unit trip from full-load power operation. The assumptions of the analysis are as follows:

1) Manual stopping of loads by operator action as called for by the plant operating procedures was assumed not to have occurred.

2) All continuous duty motors except the Condensate and Heater Drain Pumps were considered loaded to motor nameplate rating. Actual plant measured load amps were used for the Condensate and Heater Drain Pumps as their motor loads decrease rapidly after a unit trip.

3) Motor operated valves, motor operated doors, cranes, hoists, and elevators were neglected in the analysis because of their exceptionally short duty cycle.

4) Steady state voltages corresponding to motors running were calculated, safeguard motor starting under reduced voltage conditions has been previously verified during the plant's formal testing with a more limited power source (diesel generator) than either of the off-site power source transformers.

5) The non-Class 1E buses were assumed to transfer from the Main Auxiliary Transformer to the Reserve Auxiliary Transformer after a 30-second period of turbine-generator motoring, by design automatic action. All Circulating Water, Condensate, and Heater Drain Pumps were assumed to be running prior to the unit trip.

Based on these assumptions, the steady state voltage drops on the A.C. Safeguards buses and selected motors were calculated for three (3) configurations:

Case 1 - Both 4.16 Kv safeguard buses connected to the Tertiary Auxiliary Transformer.

Case 2 - One 4.16 Kv safeguard bus (1-5) connected to the Tertiary Auxiliary Transformer and the other 4.16 Kv safeguard bus (1-6) connected to the Reserve Auxiliary Transformer (normal alignment).

Case 3 - Both 4.16 Kv safeguard buses connected to the Reserve Auxiliary Transformer.

Motor terminal voltages were not calculated for motors fed from Motor Control Centers (MCC's) because the MCC's are located at the areas of load concentration and motor branch circuit cable voltage drops are negligible compared to other system voltage drops. Motor terminal voltages for motors fed from the 4.16 Kv buses were not calculated because they were shown to be not the limiting concern compared to voltage drops within the 480V safeguard buses.

The analysis was based upon maintaining the voltage at each safeguard load within a minimum value for an indefinite period of time. The minimum acceptable voltage has been established to be 90% of the nameplate voltage of safeguard motors based upon NEMA MG1 standard which requires that motors operate successfully for an indefinite period with a motor applied voltage within a ± 10% range of nameplate voltage. Maintaining this criterion and calculating voltage drops upwards in the distribution system established a required voltage of 3952V at the 4.16 Kv buses (95% of nominal) to maintain the limiting motors (i.e., those motors fed power through the largest impedances) at 90% of nameplate voltage.

The results of the analysis are presented in Table I. The grid voltage ranges of the Reserve and Tertiary Auxiliary Transformers are 134.4 Kv to 141.6 Kv and 13.4 Kv to 14.2 Kv respectively. As can be seen in Table I, for all but Case 3, the low value of the grid exceeds that voltage necessary to maintain all safeguard motors at or above 90% of nameplate voltage. In the Case 3 analysis, the calculated, required Reserve Auxiliary Transformer primary voltage exceeds the low grid value by less than one (1) percent. In light of the intent of conservatism in the analysis assumptions, we feel this to not be a concern.

Based upon this analysis, we have elected to install a second set of under-voltage relays on each 4.16 Kv safeguard bus with a setpoint of 3952V (95% of bus nominal voltage). The relays will be provided with a voltage restoration logic initiation time delay set to ensure protection of safeguard motors from long term degraded voltage operation while allowing the operators a period of time to shed unnecessary loads and restore voltage to above 90% of rated for all loads. The existing undervoltage relays will be retained, currently a setpoint of 87.5 percent of bus nominal voltage with a logic initiation time delay of one (1.0) second. This configuration will allow rapid restoration of safeguard bus voltage should an offsite power source transformer fail and yet maintain protection against long term grid voltage decay that would prevent maintaining adequate voltage at continuous duty motors. The under-voltage relays monitoring the voltage of the offsite transformers as a permissive in the voltage restoration logic for energizing a safeguard bus will be reset to the nominal bus voltage (4.16 Kv).

Of the three cases analyzed, the long term degraded voltage protection might be needed for Case 2 only where the tertiary transformer is out of service, all loads are assumed to be a fully loaded condition, and the grid voltage is at the minimum allowed value. If the operators remove unnecessary plant loads, as prescribed by procedures, the minimum voltage seen by all the safeguard continuous duty motors will return to above 90% of their rated value. It should be noted that Case 2 is the normal plant alignment and the preferred under-voltage search alignment. Case 2 would apply for all conditions unless a transformer is lost or taken out of service.

Load	Case 1	Case 2	Case 3	Load	Case 1	Case 2	Case 3
4 Kv Bus 1-5	———	3952V	———	4 Kv Bus 1-6	———	3952V	———
480V Bus 1-51	———	430V	———	480V Bus 1-61	———	430V	———
Cont. Fan Coil 1C	———	416V	———	Cont. Fan Coil 1A	———	419V	———
Cont. Fan Coil 1D	———	414V	———	Cont. Fan Coil 1B	———	419V	———
Cont. Spray Pump 1A	———	422V	———	Cont. Spray Pump 1B	———	425V	———
Component Clg Pump 1A	———	423V	———	Component Clg Pump 1B	———	422V	———
480V Bus 1-52	———	431V	———	480V Bus 1-62	———	430V	———
480V MCC 1-52A	———	429V	———	480V MCC 1-62A	———	426V	———
480V MCC 1-52B	———	426V	———	480V MCC 1-62B	———	428V	———
480V MCC 1-52C	———	429V	———	480V MCC 1-62C	———	427V	———
480V MCC 1-52D	———	427V	———	480V MCC 1-62D	———	423V	———
480V MCC 1-52E	———	430V	———	480V MCC 1-62E	———	428V	———
480V MCC 1-52F	———	419V	———	480V MCC 1-62F	———	419V	———
120V Bus BRA-105	———	103.8/179.8V	———	120V Bus BRB-105	———	103.5/179.3V	———
Tertiary Aux Xfmr Primary Voltage	13.45Kv	13.14Kv	--		13.45Kv	13.14Kv	--
Reserve Aux Xfmr Primary Voltage	--	133.7Kv	135.2Kv		--	133.7Kv	135.2Kv

TABLE I