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SUBJECT: Forwards responses to NRC 810313 request for addl info re degraded grid & adequacy of station electric distribution sys voltages,preliminary draft procedure, "Voltage Analysis Test" & proposed Amend 29b to Tech Specs 1.1,3.5 & 4.6.

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U.S. NUCLEAR REGULATORY COMMISSION

May 1, 1981

Mr. Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing
U. S. Nulcear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Degraded Grid Voltage Protection Technical Specifications and Responses to
March 13, 1981, Letter from S. A. Varga to E. R. Mathews

The referenced letter provided a summary of discussions held by NRC reviewers and members of our staff concerning our previous responses and analyses performed for degraded grid conditions. Enclosed is also a revision of our proposed Technical Specifications for undervoltage and degraded grid protection of our electrical safeguard equipment. We have previosuly submitted these proposed Technical Specifications as proposed Amendment No. 29 on August 4, 1977, and again as proposed Amendment No. 29a on January 28, 1981. Under this cover letter we are submitting proposed Amendment No. 29b which includes all the changes agreed to by the NRC reviewers and our staff and supersedes the previous two Technical Specification requests. Since this proposed revision was previously submitted to the staff and no new technical concerns are included, an additional amendment fee is not required.

Please find enclosed with this letter:

(a) Attachment 1 providing the additional information requested in Enclosure 1 of the referenced letter (1 copy).

(b) Attachment 2, preliminary draft procedure to verify assumptions made in degraded grid analysis.

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Mr. Steven A. Varga
May 1, 1981
Page 2

(c) Forty copies of Proposed Technical Specification Amendment No. 29b.

Very truly yours,

ER Mathews

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

snf

Enc.

cc - Mr. Robert Nelson, NRC Resident Inspector
RR #1, Box 999, Kewaunee, WI 54216

ATTACHMENT 1

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION ON DEGRADED GRID AND ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEMS VOLTAGES

1. The technical specification submittal of January 28, 1981, will be upgraded to include:

   a) Safeguards bus undervoltage setpoint of 87.5% $\pm$ 2%

      Table TS 3.5-1 item 8 has been revised to include this setpoint.

   b) Safeguards bus second level undervoltage setpoint of 95% $\pm$ 2%

      Table TS 3.5-1 item 9 has been revised to include this setpoint.

   c) Basis to justify a and b

      The basis has been provided on page TS 3.5-5.

   d) Operator action statement for when a single second-level trip has occurred when the system is not completely operative due to maintenance, calibration or equipment failure.

      The operator action statements in Table TS 3.5-5 column 6 has been revised to include this action.

   e) Five minute diesel load test. WPSCo indicated that they would look into placing this in the tech specs rather than in the basis. The tech spec is the placement preferred by the NRC.

      The 5 minute diesel load test requirement has been added to Tech Spec item 4.6.a.2 on page TS 4.6-1.

   f) Annual calibration as part of the surveillance requirements for both undervoltage setpoints.

      Tech Spec item 4.6.a.5 on page TS 4.6-2 has been added to include calibration once per refueling cycle (not to exceed 18 months).

2. Justification for not tripping the class 1E buses on a second-level undervoltage condition concurrent with a safety injection (rather than automatic tripping after 30 minutes).

   Our analysis has been performed under lowest expected grid voltage conditions and under maximum bus loading conditions, which occurs with a Safety Injection. We have demonstrated the successful starting of Safety Injection loads with a more limited source (the diesel generators) than a degraded grid and our analysis has shown that continued operation of these loads at a condition above the first-level (87.5% ± 2%) will not unacceptably degrade the equipment required to mitigate a Design Basis Accident. We maintain that preference to off-site power is in accordance with GDC 17, even under degraded grid situations protected with two-level undervoltage relaying.

3. State that all class 1E loads were examined for the voltage analysis and that the motors are the most limiting equipment.

   Class 1E loads that will be subjected to the effects of off-site power voltage degradation include motors, heaters, battery chargers and inverters.

   The effects of low voltage at the device terminals for each of these types of loads was analyzed as follows:

   a. *Battery Chargers - The battery chargers will maintain design regulation voltage output over a voltage input fluctuation of nominal (480VAC) ± 10%; the effect of a voltage below the -10% design voltage will be a decrease in charger output voltage. This condition is not deemed critical since the station batteries will assume the load until the battery terminal voltage decreases to the new charger output voltage; the station batteries are designed to a load cycle duration in excess of the time delay associated with the second-level (95% ± 2%) under voltage protection.*

Item 3 (Cont'd)

b. The instrument bus inverters are provided with a diode auctioned station battery input in addition to the normal rectified A.C. input; the A.C. input will be effected by a degraded grid voltage. If the A.C. input voltage decreases such that the rectified A.C. voltage becomes less than the station battery voltage, the battery will assume the inverter load, and the A.C. input will become unloaded. This condition is not deemed critical since the A.C. input portion of the inverter goes to an "idling" condition and the inverter load on the batteries is part of the station battery design load cycle.

c. Heaters - All devices in this category are of a resistance heating type. The effect of a decreasing terminal voltage will be a decrease in Thermal BTU output from the heater. This is not deemed critical from an equipment degradation point of view since the heaters will run cooler and insulation life is shortened by increases in operating temperature.

d. Motors - All motors meet, as a minimum, the requirements of NEMA MG-1; NEMA MG-1 states an acceptable limit of nameplate voltage ± 10% for long term motor operation. The effect of prolonged motor operation with a terminal voltage less than 90% of nameplate voltage will be a shortening of the motor insulation system life due to above design operating temperature from motor winding losses.

Of the above types of loads, motors are the most vulnerable to damage from prolonged operation at low voltages.

4. Discussion on the acceptability of the high grid/lightly loaded buses condition on the 480V buses.

The initial calculation was of voltage drops across various transformers with no load current. Under this situation voltage on the 480V safeguard buses was 109.8% of the motor nameplate rating of 460V. All 460V motors were thus determined to be within their ± 10% operating band.

A few motors were rated at 440V and for these motors the 0A load current calculation was 114.8% of 440V. To determine more realistically whether these motors would ever actually experience voltages of 110% of 440V a second calculation was performed.

Item 4 (Cont'd)

This calculation started by setting the voltage at the MCC containing the most limiting 440V motor at 484V. Normal plant operation loads were then used to calculate voltages and load currents elsewhere on buses 1-5 and 1-6. Normal operation loads were used since this resulted in the lightest loading on buses 1-5 and 1-6. Table 4-1 shows the voltages resulting from this calculation on buses 1-5 and 1-6.

The voltage at Bus 1-5 and Bus 1-6 and their respective load currents were then used to calculate a primary voltage on the 13.8KV/4.15KV Tertiary Aux. Transformer. In both cases this calculated voltage was found to exceed the maximum possible voltage of 14.2KV on the TAT. Since the voltage at the TAT primary must be lower than that calculated using 484V on the worst case 480V MCC, the voltage at this MCC must be less than 484V.

A similar calculation was not performed for the Reserve Auxiliary Transformer (RAT) due to the erroneous assumption that it was supplying buses 1-3 and 1-4. During normal operation these buses are supplied by the Main Auxiliary Transformer (MAT). With the RAT supplying Bus 1-6 (the normal operation line-up) calculated primary voltage on the RAT exceeded the maximum possible voltage of 141.6KV. In the abnormal line-up of the RAT supplying Bus 1-5 calculated primary voltage on the RAT was 0.5% below the maximum possible voltage.

This means that given a combination of two unlikely events, high grid voltage at the 138KV substation and Bus 1-5 fed from the RAT, voltage on MCC 1-52A could reach 110.5% of 440V (486V). There are four 440V rated loads on MCC 1-52A. Of these, 2 are not motors (they are heaters) and another is off during normal operation. The only load of interest is Diesel Generator 1A Keep Warm Lube Oil Pump. This is a 1hp motor with a service factor of 1.25. It should not be harmed by a voltage only 0.5% above its listed ± 10% operating range.

The major effects of 110% voltage on an induction motor are an increase in starting current of 10 to 12% and a decrease in full load current of 7%. In the case at hand the motor would not be required to start as it runs continuously when the diesel is off. In this case the overvoltage would actually improve operating conditions for the pump by reducing full load current.

We, therefore, conclude that high grid voltage with light loading is not a problem on the 480V safeguard buses at Kewaunee.

Table 4-1: Bus 1-5 and 1-6 Voltages
With Normal Operation Loads

Load	Voltage	Load	Voltage
4160V Bus 1-5	4343V	4160V Bus 1-6	4392V
480V Bus 1-51	493V	480V Bus 1-61	499V
480V Bus 1-52	485V	480V Bus 1-62	486V
480V MCC 1-52A**	484V*	480V MCC 1-62A**	484V*
480V MCC 1-52B	482V	480V MCC 1-62B	486V***
480V MCC 1-52C	483V	480V MCC 1-62C	484V
480V MCC 1-52D	482V	480V MCC 1-62D	481V
480V MCC 1-52E	483V	480V MCC 1-62E	484V
480V MCC 1-52F**	480V	480V MCC 1-62F	481V
120V Bus BRA-105	119V	120V Bus BRB-105	120V
Tertiary Aux. Trans. Primary Voltage	14.22KV	(max. possible TAT prim. voltage = 14.2KV)	14.39KV
Reserve Aux. Trans. Primary Voltage	140.9KV	(max. possible RAT prim. voltage = 141.6KV)	142.5KV

* Initial voltage on MCC 1-52A and 1-62A set at 110 percent of 440V.
** Indicates MCC with 440V rated loads, not including motor valves.
*** MCC 1-62B has 0A load current during normal operation.

5. Verify that the start of large motors (including a reactor coolant pump) will not cause drop out of motor cont actors or a trip of the safeguard bus undervoltage relays at the high limit (89.5%, 1 second time delay) under degraded grid, full plant load conditions.

   The condition of starting one Reactor Coolant pump under degraded grid (134.4KV) and full plant load conditions (trip from full power operation coincident with Safety Injection) has been analyzed. The transient voltage dip during pump starting, as seen by Bus 1-5 and 1-6 undervoltage relays, will be to 91.7% of bus nominal voltage with both the 138KV and 345KV lines available (90.1% with only the 138KV line available). This transient voltage is above the upper technical specification limit for the first-level undervoltage relays (89.5% of bus nominal voltage); thus, the safeguard undervoltage relays will not trip. Motor contactor dropout will not occur since this transient voltage drop is above the transient dips during sequence loading of the diesel generators, which the contactor are known to ride through without dropout.

6. Supply the test procedure and results that verify the assumptions used in the voltage analysis. The results can be submitted separately and will include (but not be limited to) data on loading, baseline data, measured voltages and corresponding analyzed voltages, for the voltage drops from the switchgear to the most limiting motor control center and to the most limiting loads.

   The voltage analysis assumptions that can have a significant impact on the analysis results are as follows:

   1. *The voltage drop on feeder cables from motor control centers to loads is neglected;*

   2. *The motor control centers present an assumed aggregate load power factor to the 480V switchgear buses based on the "mix" of motor control center loads as follows:*

      a. *70% p.f. for motor control centers with only motor loads.*

      b. *80% p.f. for motor control centers with a mix of motor and resistance heater loads.*

   3. *The voltage drop on feeder cables from the 480V switchgear bus to motor control centers is based on representative cable data from the IEEE Red Book (IEEE-141-1976).*

Item 6 (Cont'd) To assess the accuracy of these assumptions, we are proposing to perform the following test:

1. Motor Control Center 1-52F (408' feeder cable from Bus 1-52) will be loaded with the following motor loads:

1-601	CRDM Fan Coil Unit 1A
1-449	Zone SV Filter Assembly 1A Heating Coil
1-265	Control Room Post Accident Recirc Fan 1A
1-315	Control Room Air Conditioner Compressor 1A
1-317	Control Room Air Conditioner Fan 1A
1-463	Control Room Air Conditioner Chiller Pump 1A
1-126	Zone SV Vent Exhaust Fan 1A

2. The total load current drawn from 480V switchgear Bus 1-52 by MCC 1-52F will be measured.

3. Bus voltages will be measured at 480V switchgear Bus 1-52 and at MCC 1-52F.

4. Motor terminal voltages will be measured at motors 1-601, 1-126, 1-317, and 1-463.

5. With a load current equal to that measured under item 2, a voltage drop from 480V switchgear bus 1-52 to MCC 1-52F will be calculated using the analysis model (IEEE-141-1976 cable voltage drops and an assumed 80% power factor) and compared to the results measured under item 3.

6. The voltage drop to motor terminals will be evaluated against the distribution system voltage drops in the voltage analysis to determine if significant error occurs by neglecting the voltage drop of motor control center feeder cables.

A preliminary draft procedure is enclosed for your review. This procedure will be finalized prior to implementation and a copy of the results will be sent at a later date.