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RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards response to NRC 831012 request for addl info re reactor protection sys power monitoring sys design mods. Tech Specs will be submited in future.W/12 oversize drawings.Aperture cards available in PDR.

"All drawings"
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TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

August 9, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

In the Matter of the	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

By letter from D. B. Vassallo to H. G. Parris dated October 12, 1983, we received a request for additional information regarding reactor protection system power monitoring system design modifications at the Browns Ferry Nuclear Plant. Enclosed is the information requested. Appropriate technical specifications will be submitted in the future.

If you have any questions, please get in touch with us through the Browns Ferry Project Manager.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

James A. Domer

James A. Domer
Nuclear Engineer

Subscribed and sworn to before
me this 9th day of August 1984.

Paulette H. White

Notary Public
My Commission Expires 9-5-84

Enclosure
cc (Enclosure):
U.S. Nuclear Regulatory Commission
Region II
ATTN: James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
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Mr. R. J. Clark
Browns Ferry Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20814 ENCL TO: REG FILE
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ENCLOSURE

ADDITIONAL INFORMATION REGARDING
MONITORING OF ELECTRIC POWER TO THE
REACTOR PROTECTION SYSTEM
BROWNS FERRY NUCLEAR PLANT
(REFERENCE: D. B. VASSALLO'S LETTER TO H. G. PARRIS
DATED OCTOBER 12, 1983)

In the enclosure of reference 1, NRC requested that TVA provide additional information pertaining to the RPS power monitoring system design modification for Browns Ferry units 1, 2, and 3. The following information has been prepared in response to NRC's request. The NRC questions are quoted below followed by each TVA response.

Question 1

The GE certified RPS component (relays and contactors) operating capability is $\pm$ 10% of 115 volts and -5% of 60 Hz on its terminal, resulting in a voltage range of 126.5 to 103.5 volts and a frequency range of 57 to 60 Hz. The output of the motor generator (MG) sets should be adjusted so as to provide (compensating for maximum line voltage drop) the GE recommended nominal operating voltage of 115 $\pm$ 2 volts at the RPS component terminals. The undervoltage and overvoltage trip setpoints (compensating for the maximum line voltage drop) and the underfrequency trip setpoint of the monitoring packages should then be selected so as not to exceed the operating capabilities of the RPS components. Verify that the proposed setpoints in Technical Specification (TS) 4.1.B.2 [Ref. 1] meet these requirements. Submit the nominal voltage and frequency values of the supplying sources.

Response

Calculations were performed to establish voltage specifications and relay settings that will maintain the RPS components within their ratings. The results of these calculations for the worst case system are:

1. Compensating for maximum line voltage drop from the MG set terminals to the RPS component terminals, and maintaining all components terminal voltages above 115 volts, minus 10 percent (103.5 volts) and within their operating capabilities, the undervoltage limit is 113 volts. Allowing 2 volts for relay setting accuracy and drift the recommended relay setting is 115 volts.

2. Based on an assumed 0-volt line drop from the MG set terminals to the closest 115-volt components the overvoltage limit is 126.5 volts. Allowing 2 volts for relay setting accuracy and drift, the recommended relay setting is 124.5 volts.

3. A review of the RPS components revealed that the nameplate rating for several of the components was not 115 volts. The operating capability of these components was determined from an analysis of manufacturer's data. Specifically, the following operating ranges were determined:

   A. Auxiliary relays - Nameplate voltage plus 10 percent, minus 15 percent:

Rating	Operating Capability
110V	93.5 to 121 Volts
120V	102 to 132 Volts

   B. Solenoid valves - Nameplate voltage plus 10 percent, minus 15 percent:

Rating	Operating Capability
120V	102 to 132 Volts
125V	106.2 to 137.5 Volts

   Based on analytical calculations, almost all of these components are maintained within their operating capability. Those components that are not maintained within their operating capability, based on these calculations, are the 110-volt coils on the scram contactors for all three units and the 125-volt coil on solenoid valve FSV-85-37B for unit 3. All of these components would fail in the safe condition if a coil failure occurred. The voltage verification test referenced in response to question 6 will be performed, by each unit's cycle 6 refueling outage, to determine the replacement requirements for these components.

4. The underfrequency limit is -5 percent of 60 Hz (57 Hz). Allowing 1 Hz for setting accuracy and drift the recommended setting is 58 Hz.

5. The normal supplying sources are MG sets with nominal output voltage and frequency values of 120 volts plus or minus 2 percent and 60 Hz with 1 percent slip. The alternate supplying source is a voltage regulating transformer with nominal output voltage and frequency values of 120 volts plus or minus 2 percent and 60 Hz.

Question 2

Submit the time delays associated with the undervoltage, overvoltage and underfrequency trip setpoints. Provide justification if the time delays selected exceed those recommended or accepted by GE. The time delays associated with the trip setpoints should be specified in the TS.

Response

For the normal MG set supplying sources the time delay associated with the undervoltage, overvoltage, and underfrequency trip setpoints is the 0.5 second nonadjustable operating time of the relays. For the alternate transformer supplying source time delay relays provide an additional 5 second time delay to prevent tripping on transients during motor starts or bus transfers. A setpoint of 5 seconds plus or minus 1 second for these alternate supply relays will be added in a future TS submittal.

Question 3

Correct the setpoint equality signs in TS 4.1.B.2 (e.g. OV $\leq$, UV $\geq$, and UF $\geq$).

Response

The setpoint inequality signs will be corrected in a future TS submittal.

Question 4

Reference 3 provided only a conceptual design for the source monitoring packages. Submit detail schematic drawings of the monitoring packages (include control power). Also, submit a current electrical one-line of the onsite distribution system showing RPS power supplies, buses, and connections.

Response

The schematic drawings and one-lines of the distribution system are included in attachment 1.

Question 5

Submit verification that the design and installation of the monitoring system (including control power. independence, etc.) meet the requirements of GDC 2, GDC 21, IEEE 279-1971, and IEEE 384-1974.

Response

A class 1E fully redundant monitoring system is being installed to deenergize the class 1E RPS components from their nonclass 1E power supplies during an unacceptable under/over voltage, or underfrequency condition. This monitoring system which is provided for the normal and alternate sources of RPS power on each unit (refer to section 7.2.3.2 of the Browns Ferry FSAR for existing power system description) consists of two physically independent power contactors. Each contactor and its respective control relays are enclosed in a seismic category 1 cabinet with each contactor controlled by contacts from an undervoltage relay, an overvoltage relay, and an underfrequency relay (refer to TVA drawing Nos. 45N232 and 45W701-3 for typical arrangement, respectively). The two contactors are electrically in series, between the power source and RPS panels, and located in the respective unit's 250V dc battery board rooms on elevation 593 in the control building (refer to TVA drawing No. 45N233 for typical physical layout).

Control power for each contactor's control relays is provided by its respective power source, with each contactor's 120V ac supply separately fused from the common source. All control and power cables for each monitoring system are routed in seismically mounted conduit. Since the contactors are in series electrically and due to their physical location, the control power cables for each monitoring system have been routed together from the common power source to the contactor's cabinets, along with the power cables. This is appropriate since the control and power cables voltage levels are compatible (both voltages are 120V ac) and the contactors open on loss-of-control power. Each contactor is provided with annunciation that alarms in the MCR should a trip of the contactor occur. The monitoring system provided for each RPS power supply will be designed and installed to comply with the applicable requirements set forth in General Design Criteria 2 and 21 and IEEE Standards 279-1971 and 384-1974. The following paragraphs discuss each of the requirements:

GDC 2

As stated above, the cabinets and conduits for each monitoring system are located in the control building, which is a seismic category 1 structure. This structure will provide protection from the effects of tornadoes, tornado missiles, and external floods.

All components of each monitoring system are seismically qualified for Class 1E application.

GDC 21

Each monitoring system provides Class 1E isolation for the RPS components powered from the RPS power system. This isolation function will automatically remove the Class 1E components from their non-Class 1E sources should an unacceptable overvoltage, undervoltage, or underfrequency condition exist. Since two physically independent and fully redundant circuit interrupters are provided for each RPS bus per unit, including the alternate supply, sufficient reliability is provided to ensure the RPS performs its safety function. In addition, the periodic testing of the RPS will not be affected by this modification.

IEEE 279-1971

As stated above, each monitoring system is designed to perform the isolation function (i.e., either or both of the contactors will automatically disconnect the RPS power supply during an unacceptable voltage and/or frequency condition) in the event of a single failure, thus ensuring proper operation at the RPS level for this condition. Also, each monitoring system is designed with adequate physical independence and separation to ensure the overall RPS protection function is not impaired by a single failure in the monitoring system. All components of each monitoring system are environmentally and seismically qualified for Class 1E application in accordance with IEEE 323 and 344, respectively. Based on this information it is concluded that each monitoring system is designed to meet the applicable sections of IEEE 279-1971 (i.e., sections 4.2, 4.3, and 4.4).

IEEE 384-1974

The monitoring system (components and cables) provided on each RPS power supply has adequate separation to ensure the isolation function required during and following any design basis event can be accomplished. This system has incorporated adequate physical separation between the redundant contactor cabinets to ensure proper operation. Since the cables for each monitoring system are routed entirely in conduit and only exit the 250V dc battery board rooms to connect to their respective MG sets, the cables are not exposed to any potential hazards such as high-pressure piping missiles, flammable materials, or flooding which could inhibit the isolation function. Therefore, each monitoring system is designed to meet the applicable sections of IEEE 384-1974 (i.e., sections 4.1, 4.2, 4.3, 4.4, 5.1.1 and 5.1.2).

Question 6

Provide outlining procedures for testing the design modifications after installation to ensure that acceptable voltages and frequency are present at the terminals of the RPS components, such as the scram discharge solenoid valve.

Response

The scoping document for the voltage verification test is included in attachment 2.

ATTACHMENT 1

Drawings:

45W641-3
45W641-4
45W641-5
45N701-2
45W701-3
45N702-2
45W702-4
45N703-2
45W703-3
45W710-4
45N232
45N233

ATTACHMENT 2

BROWNS FERRY NUCLEAR PLANT
RPS SYSTEM VOLTAGE VERIFICATION TEST

1.0 Purpose

The purpose of this test is to verify the adequacy of the minimum voltage specification by field measurement. The maximum voltage was based on an assumed 0 volt drop and no verification is required. The minimum voltage specification was based on calculated voltage drops to each part of the system.

2.0 Procedure

The procedure for determining the minimum system voltages is to determine the voltage drop from the MG set to the system components by field measurements of the system voltages under normal operating conditions. The minimum system voltages are then determined by subtracting the voltage drop from the minimum MG set voltage specification.

2.1 Test Conditions

The test shall be conducted with the unit in normal operation and with all RPS components in their normal operating configuration.

2.2 Field Measurements

Measure the voltages and currents for components in each part of the system listed in Table 1. Measure the MG set voltages and battery board currents several times during the test to ensure that they remain constant; once per hour is recommended.

2.3 Minimum System Voltage Determination

Determine the voltage drop to each part of the system as the difference between the measured MG set voltage and the measured component terminal voltages for that part of the system. Determine the minimum voltage for each part of the system as the minimum MG voltage specification minus the voltage drop.

3.0 Adequacy

The voltages at the terminals of the RPS components are adequate if the minimum system voltages for each part of the system are greater than or equal to the minimum component voltage specification for the components in that part of the system.

4.0 Margin

The minimum voltage specification was based on calculations for RPS system 3B where the worst case combination of cable length and current occurs. The specification includes a 10-percent margin for future load additions on this system. The test results for this system will be utilized to evaluate future load additions, and to determine the present need to replace the scram contactor coils and 3-FSV-85-37 B coil.

TABLE 1

Reactor Protection System A Voltages:

1. MG set A terminals.
2. Battery board RPS bus A.
3. RPS logic channel A-Pnl-9-15.
4. Power range neutron monitor Pnl-9-14.
5. Steam line radiation monitor Pnl-9-10.
6. Main steam line isolation valve, valve panel 9-42.
7. RPS A scram pilot valves (representative sample of feeds from panels 25-25A through H).
8. Analog trip panels 9-83, 9-84.

Reactor Protection System A Currents:

1. Battery board input to bus A.
2. Battery board each load feeder breaker.

Reactor Protection System B Voltages:

1. MG set B terminals.
2. Battery board RPS bus A.
3. RPS logic channel B-Pnl-9-17.
4. Power range neutron monitor system panel.
5. Steam line radiation monitor Pnl-9-10.
6. Main steam line isolation valve control Pnl 9-43.
7. RPS B scram pilot valves (representative sample of feeds from panels 25-215A through H).
8. Analog trip panels 9-85, 9-86.

Reactor Protection System B Currents:

1. Battery board input to RPS bus B.
2. Battery board each load feeder breaker.