



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

MONITORING OF ELECTRIC POWER TO THE REACTOR PROTECTION SYSTEM (RPS)

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2 AND 3

DOCKET NOS. 50-259, 50-260 AND 50-296

**1.0 INTRODUCTION**

By letter dated August 7, 1978, pursuant to 10 CFR 50.54(f), we advised the Tennessee Valley Authority (TVA) of deficiencies identified in the E. I. Hatch Unit 2 nuclear power plant and the potential for similar deficiencies in the existing design of Reactor Protection System (RPS) power monitoring at other Boiling Water Reactors (BWRs). TVA was requested to evaluate the design of the Browns Ferry RPS and, promptly upon receipt of the letter, commence surveillance of the RPS power supply as described in Enclosure 1 of the letter. By letter dated December 13, 1978, TVA responded that the proposed RPS modifications were not necessary, that it did not plan to perform any modifications or propose any additional Technical Specification (TS) changes. The letter also advised us that although the surveillance program in our letter of August 7, 1978 had been implemented as required, TVA had concluded the surveillance was unwarranted and would be discontinued after January 1, 1979. Our letter of September 24, 1980 advised TVA that, based on our evaluation, Browns Ferry could experience the same adverse conditions as were found at Hatch 2 and that we had determined that modifications should be implemented at Browns Ferry, with specified TS.

A general outline of the design approach to be followed for the requested modifications was provided by TVA's letter of July 1, 1981. Proposed TS limits were submitted as part of the Unit 1 reload (TS-190, July 13, 1983). These submittals from the licensee did not provide sufficient information to substantiate design conformance to General Design Criteria (GDC) 2, 21 and IEEE 279-1971. Also, the proposed trip setpoints of the protective relays were not based on analysis and test verification. The staff concerns were transmitted to the licensee by our letter dated October 12, 1983. TVA responded by letter dated August 9, 1984, which resolved some issues. A Request for Additional Information was sent to TVA by our letter of October 31, 1984, to which the licensee responded by letter dated March 1, 1985.

**2.0 EVALUATION**

TVA, in its letters dated August 9, 1984 and March 1, 1985 has furnished all requested information except the test verification of the setpoints. However, the licensee maintains that the proposed setpoints are based on

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conservatisms in its calculation and are not expected to change by the test results, which are supposed to be only confirmatory. TVA will submit TS changes, revising the relays setpoints, after completion of the test.

The following design modifications and TS changes were proposed by TVA:

1. Installation of two Class 1E detection and isolation assemblies, similar to the General Electric (GE) designed protection assemblies, in each of the three sources of power to the RPS (RPS MG sets A and B and the one alternate source). Each assembly includes a circuit breaker and a monitoring module consisting of an undervoltage, an overvoltage and an underfrequency sensing relay.
2. The addition of trip setpoints, limiting conditions for operation and surveillance requirements in the TS associated with the design modifications cited above.

Our earlier evaluation of the proposed modification (October 31, 1984 letter to TVA) found it acceptable with the following open items:

1. Selection of relay trip setpoints ensuring protection of RPS components from abnormal voltage and frequency.
2. Verification that the proposed modification meets the requirements of GDC 2, "Design Basis for Protection Against Natural Phenomenon," and GDC 21, "Protection System Reliability and Testability," of Appendix A to 10 CFR 50 and IEEE-279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
3. Procedures for testing the design modifications after installation to ensure that acceptable voltages and frequency are present at the terminals of the RPS components.
4. TS incorporating the verified trip setpoints and time delays.

The subsequent submittal from TVA has provided sufficient information to close the first three of the above four open items as follows.

1. The protection assembly relays will operate to disconnect the abnormal source of supply (MG set or the alternate source) from the RPS bus. The following setpoints have been proposed by the licensee. The nominal voltage and frequency is  $120 \pm 2\%$  volts and 60 HZ with 1% slip, respectively.

<u>Condition</u>	<u>Relay Setpoint</u>	<u>Time Delay</u>	
		MG Set Supply	Alternate Source
Undervoltage	Greater than 115 volts	0.5 sec	Less than 1 sec
Oervoltage	Less than 124.5 volts	0.5 sec	Less than 1 sec
Underfrequency	Greater than 58 HZ	0.5 sec	Less than 1 sec

These setpoints are conservatively chosen allowing a maximum of 10 volts line voltage drop for undervoltage and a minimum of 0 volts line voltage drop for overvoltage trip settings. Relay setting accuracy and drift are further allowed to be  $\pm 2$  volts and 1 HZ applied conservatively to the overvoltage, undervoltage and underfrequency setpoints, respectively. These setpoints ensure protection of RPS components rated  $115 \pm 10\%$  volts and 60 - 5% HZ. However, the existing 110 volt coils on the scram contactors, in each of the three units, could get exposed to 4.5% in excess of their overvoltage capability. This could happen in a possible condition when a zero volts line voltage drop is compounded with the maximum drift in overvoltage relay setpoint. The licensee has proposed to replace these coils under the integrated modification program by the end of Cycle 6 on each respective unit. Until replacement of these coils by that of a higher rating, the RPS power supply voltages should continue to be monitored in accordance with the NRC letter of August 7, 1978.

2. The monitoring assemblies are seismically qualified and located in a seismic Category 1 structure, which meets the requirements of GDC 2. Two physically independent and fully redundant circuit interrupters in each power supply (MG set and alternate source) provide sufficient reliability, meet the testability requirements of GDC 21, and provide assurance that overall RPS protective function is not impaired by a single failure in the monitoring system. While reviewing the RPS power supply monitoring schematic diagram, we noted that the sensor and control power for the monitoring assemblies are not tapped from within the assembly. Rather, it originates from the non Class 1E control cabinet of the MG set and is separately brought to each of the two assemblies with their individual fuses mounted in the MG set control cabinet. Though the design has a non Class 1E control and sensor power (fuses do not qualify for an isolation device as they are mounted in a non Class 1E cabinet), no credible conditions or events could be identified which would impair the safe operation of the redundant circuit interrupters. Each circuit carrying the control and sensor power is routed in a separate, seismically mounted conduit and is not long enough to cause a notable voltage drop. Also, a blown fuse would cause initiation of circuit tripping which is in the safe direction.
3. In the letter of August 9, 1984, the licensee has provided procedures for testing the modification after its installation, test parameters and acceptance criteria. We find it acceptable.
4. The licensee will submit the revised TS after completion of the test and will include the test verified relay setpoint. Other surveillance requirements and limiting conditions for operation were previously submitted and found acceptable in our letter of October 31, 1984.

### 3.0 CONCLUSIONS

Our review concludes that (1) the proposed modification and the relay setpoints which are to be incorporated in the TS will adequately protect

the RPS electrical components from sustained abnormal voltage and frequency conditions of the power supplies; (2) during the interim period until the modifications are installed, the 110 volt coils of the scram contactors are replaced, and the testing is completed; the continued monitoring of the RPS power supply, in accordance with the NRC Letter to TVA of August 7, 1978 will assure protection of the RPS components from an undetected abnormal voltage and frequency.

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Dated: June 27, 1985