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TECHNICAL EVALUATION OF THE
ELECTRICAL, INSTRUMENTATION, AND CONTROL DESIGN ASPECTS
OF
THE PROPOSED LICENSE AMENDMENT REVISION 1 FOR SINGLE-LOOP OPERATION
OF
BROWNS FERRY NUCLLAR PLANTS

- (Docket No. 50-259) - Unit 1
- (Docket No. 50-260) - Unit 2
- (Docket no. 50-296) - Unit 3

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ABSTRACT

This report documents the technical evaluation of the proposed changes to the plant reactor protection system by the licensee of Browns Ferry Nuclear Power Stations, Units 1, 2, and 3, to account for single-loop plant operation. This evaluation is restricted to only the electrical, instrumentation and control design aspects of proposed changes to the plant technical specifications for single-loop operation beyond 24 hours. The conclusion of the evaluation is that the Browns Ferry Nuclear Power Stations Units 1, 2, and 3 license amendment for single-loop operation has met the review criteria provided sufficient administrative controls are put into effect. X

FOREWARD

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I. INTRODUCTION

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated March 4, 1982 [Ref. 1], the Tennessee Valley Authority (TVA) submitted information to support its proposed license amendment to operate the Browns Ferry ^{Nuclear Plant,} Units-1, 2, and 3 (BF-1, BF-2, and BF-3, respectively) with one recirculation loop out of service (i.e. single-loop operation). This information included the licensee's analysis of significant events, which were based on a review of accidents and abnormal operational transients associated with power operations in the single-loop mode provided by General Electric Company, Nuclear Energy Division (GE-NED), the nuclear steam supply system designer. Conservative assumptions were employed, as discussed in the GE-NED report NEDO-24236 dated May, 1981 [Ref. 2], to ensure that the generic analyses for boiling water reactors (BWR 3 and/or 4) were applicable to the Browns Ferry. In response to an NRC request, the licensee provided supplemental information in a letter dated September 3, 1982 [Ref. 3].

The purpose of this report is to document the evaluation of the electrical, instrumentation, and control (EI&C) design aspects of the proposed license amendment change to the Browns Ferry technical specifications. The consideration of proper plant variables, computer models, and the licensee's conclusions on core performance and clad temperature are outside the scope of this evaluation. This review was conducted using 10CFR50, Appendix A, "General Design Criteria for Nuclear Power Plants" (G.D.C. 20 through 24) [Ref. 4] and ANSI/IEEE Std 279-1971 [Ref. 5] with the following guidance from the NRC staff for the application of Section 4.15 of the ANSI/IEEE Standard:

Manual switching to the more restrictive setpoint for the APRMs in the reactor protection system is acceptable for BWRs if sufficient administrative controls exist to assure that the more restrictive setpoints are in effect when required by the plant Technical Specifications.

II. EVALUATION AND RECOMMENDATIONS

The current Browns Ferry Technical Specifications do not permit single-loop plant operation at reduced power for more than 24 hours. The licensee's proposed Technical Specification changes would allow the reactor to operate at reduced power (not greater than 50%) with one recirculation loop inoperable for more than 24 hours if certain changes are made to the reactor protection systems. Specifically, the changes are to the Average Power Range Monitor (APRM) scram trip setpoint and the Rod Block Monitor (RBM) rod block setpoint.

A different flow pattern is established in the vessel during single recirculation loop operation as compared to the normal two loop operation [Ref. 2]. In single-loop operation, there is backflow through the jet pumps in the idle loop. The jet pump core flow measurement system is calibrated only when both loops are in operation and all jet pumps are in forward flow. The total core flow is the sum of the measured jet pump flows. In single loop operation, the measured flow in the back-flowing jet pumps must be subtracted from the flow through the other jet pumps. Also, the jet pump flow coefficient is different for reverse flow than for forward flow to the jet pumps. Because of the different flow rate and flow path during single recirculation loop operation, the APRM SCRAM trip settings, which are flow-biased according to the equation in the proposed technical specifications, require resetting to protect the reactor from overpower. The rod-block setpoint equation is flow-biased in the same way and with the same flow signal as the APRM setpoint, and must also be modified to provide adequate core protection for a postulated rod withdrawal error.

The manual APRM gain adjustment to accommodate single-loop operation is the only change imposed upon the Browns Ferry reactor protection system (RPS). This modification adds the term $0.66 W$ to the APRM readings to compensate for backflow through the jet pumps in the idle loop. The licensee stated that sufficient range exists in the APRM gain settings to make the necessary changes to the RPS for single-loop operation [Ref. 3]. This change will not cause the RPS to violate General Design Criteria 10 to 24 of 10CFR50 Appendix A.

The licensee indicated in Reference 3 that procedures cover the APRM gain adjustment to account for single loop operation. The procedures are in surveillance instruction (SI) 4.1.5.15 and 2.1. The licensee did not state what administrative controls were to be used to assure that the gain adjustments are performed correctly. We recommend that the licensee provide NRC documentation to ensure the necessary gain adjustments have sufficient administrative controls and are therefore consistent with Section 4.15 of IEEE STD 279-1971.

III. CONCLUSIONS

Based on our review of the information and documents provided by the licensee in Ref. 1, we conclude that the more conservative reactor protection system (RPS) setpoint trips for the APRM and RBM will satisfy the functional requirements (i.e., parameters to be monitored, setpoints, etc.) for single-recirculation-loop operation.

The manual APRM gain adjustment settings to accommodate single loop operation is the only change imposed upon the Browns Ferry Nuclear Plant reactor protection system (RPS) instrumentation. This change will not cause the RPS instrumentation system to violate 10CFR50 Appendix A General Design Criteria 20 through 24 [Ref. 4] or IEEE-279-1971 [Ref. 5] with the exception of the IEEE Standard discussed below. X

Because of the backflow through the jet pumps during single-recirculation-loop operation, indications in the control room of individual jet-pump flow and total summed core flow will be misleading. We recommend that these anomalous control room indications must be corrected or warning-tagged for the duration of the single-recirculation-loop operation, as required by section 4.20 of IEEE Std-279-1971 [Ref. 5].

We recommend that the licensee provide assurance that manual switching to the more restrictive setpoint for the APRMs has sufficient administrative controls to assure that the more restrictive setpoints are in effect when required by the plant Technical Specifications.

We recommend to NRC that upon successful implementation of the above recommended actions the proposed licensee amendment for single-recirculation-loop operation at Browns Ferry Units 1, 2 and 3 meets the requirements. *are requirements*

REFERENCES

- (1) Tennessee Valley Authority Letter (L. M. Mills^{Mills} to NRC (Harold Denton), "In the Matter of the Tennessee Valley Authority", March 4, 1982. X X
- (2) General Electric Company, Nuclear Power Systems Division, "Browns Ferry Nuclear Plant; Units 1, 2 and 3 Single-Loop Operation", NEDO 24236, May 1981. X
- (3) Tennessee Valley Authority Letter (L. M. Mills) to NRC (Harold Denton), "Single-Loop Operation for Browns Ferry, Response to Questions," dated September 3, 1982.
- (4) Code of Federal Regulations, Title 10, Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants", 1981.
- (5) IEEE Std-279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations", dated 1971.

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