

Draft

TECHNICAL EVALUATION OF THE
ELECTRICAL, INSTRUMENTATION, AND CONTROL DESIGN ASPECTS
OF
THE PROPOSED LICENSE AMENDMENT REVISION 1 FOR SINGLE-LOOP OPERATION
OF
THE PILGRIM NUCLEAR POWER STATION
(Docket no. 50-293)

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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 Pilgrim Nuclear Power Station, Unit 1, 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 Pilgrim Nuclear Power Station, Unit 1, license amendment for single-loop operation has met the review criteria provided sufficient administrative controls are ~~put~~ into effect *and the anomalous control*

own indications are corrected or warning-tagged for
for the duration of single-loop operation.

FOREWORD

This report is supplied as part of the Selected Operating Reactor Issues Program II being conducted for the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Licensing, by Lawrence Livermore National Laboratory.

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I. INTRODUCTION

By letter to the U. S. Nuclear Regulatory Commission (NRC) dated May 12, 1981 [Ref. 1], the Boston Edison Power Company submitted information to support its proposed license amendment to operate the Pilgrim Nuclear Power Station, Unit 1 (PNPS-1) with one recirculation loop out of service (i.e., single-loop operation). This request supercedes all other submittals. 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-24268 dated June 1980 [Ref. 2] to ensure that the generic analyses for boiling water reactors (BWR 3 and/or 4) were applicable to the PNPS-1. In response to an NRC request, the licensee provided supplemental information in a letter dated April 11, 1983 [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 PNPS-1 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 ^{Multiple Setpoints,} 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.

The adjustments for single loop operation must be within, and therefore satisfy, the functional requirements of the reactor protection system.

II. EVALUATION AND RECOMMENDATIONS

The current PNPS-1 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. These 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 PNPS-1 reactor protection system (RPS). This modification adds the term $0.65W$ 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.

and performed by procedure

The licensee indicated in Reference 3 that the PNPS-1 procedure for adjusting the APRM scram trip set point and RBM rod block setpoint was modified to include the APRM gain adjustment to account for single-loop operation. The licensee further stated [Ref. 3] that the APRM gain adjustment is governed by administrative control. ~~The~~ The licensee did not state what the administrative control was. We recommend that the licensee provide NRC documentation to ensure the necessary APRM gain adjustments are performed with sufficient administrative controls, and are therefore consistent with Section 4.15 of IEEE Std. 279-1971.

III. CONCLUSIONS

are within, and therefore

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 Pilgrim Nuclear Power Station 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.

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.

~~Therefore~~
We recommend that the NRC accept, upon ~~successful~~ implementation of the above recommended actions, the proposed licensee amendment for single-recirculation-loop operation at Pilgrim Nuclear Power Station, Unit 1.

Section 4.15 of A4

REFERENCES

- (1) Boston Edison Company Letter (J. Edward Howard) to NRC (Thomas Ippolito), "Revised Request for Technical Specification Changes Concerning Single Loop Operations" dated May 12, 1981.
- (2) General Electric Company, Nuclear Power Systems Division, "Pilgrim Nuclear Power Station Single-Loop Operation," NEDO 24268, June 1980.
- (3) Boston Edison Company Letter (William D. Harrington) to NRC (Dominic B. Vassallo), "Single-Loop Operation for Pilgrim Nuclear Power Station, Response to Questions," dated April 11, 1983.
- (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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Ken,

9/15/83 10AM

Enclosed is the draft contractor's TER for Pilgrim on Single Loop Operation/Instrumentation and Control system review.

The open item on "sufficient" Administrative controls on the APRM gain adjustments may be handled by:

- 1 - phone call between contractor and licensee - with you and Clark (Lead Engineer) - to discuss briefly the admin. controls - who by title controls the change.

who by title & phone call. Follow by letter.

- 2 - Initialize the TER and you handle open item in SEK

What do you want to do?

Jack Donohew X27230

Have contract will set up phone call 1/30/84