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EVALUATION OF  
SINGLE-LOOP OPERATION

PILGRIM NUCLEAR POWER STATION, UNIT 1

1. INTRODUCTION

The Boston Edison Company (BEC), in its letters to the NRC dated November 17, 1975 and March 1 and 19, 1976, submitted information to support its proposed operation of the Pilgrim Station, Unit 1 with one recirculation loop out of service (single-loop operation). The above cited letters presented the licensee's analyses of significant events, based on its review of accidents and abnormal operational transients associated with power operations for the single-loop mode of operation. These analyses were performed by the General Electric (GE) on a generic basis. Conservative assumptions were employed in the GE analysis (NEDO-20999, dated October 1975, "Pilgrim Nuclear Power Station Unit 1 License Amendment for Single-Loop Operation") to ensure that its generic analyses were applicable to Pilgrim, Unit 1.

The licensee states in its submittals for single-loop operation, that the only changes to the protection system are modifications to the rod block setpoints of the Rod Block Monitor (RBM) system and to the scram trip settings, of the Average Power Range monitor (APRM) system.

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## 2. EVALUATION

The analysis for single-loop operation revealed that, because of reverse flow through ten of the twenty jet pumps (with the recirculation equalizer valves closed), the present rod block setpoint equation shown in the Technical Specifications for Pilgrim, Unit 1 has to be modified to provide adequate local core protection for the postulated rod withdrawal error. The new rod block monitor equation was developed from the results of tests performed during a period when the Pilgrim reactor was operated in the single-loop mode for short periods of time. The existing Technical Specifications permit operation in the single-loop mode for a period of up to twenty-four hours.

The APRM trip settings are flow-biased in the same manner and by the same flow signal as that for the RBM setpoints. Setpoint changes which require more conservative flow rate values must be set in the RBM system and APRM scram trip system. These settings will be delineated in the Technical Specifications. Power will be restricted to a maximum of 70% of rated power while operating in the single-loop mode, and only manual flow control will be allowed.

The Technical Specifications will be revised to allow operation in the single-loop mode for unrestricted periods. This mode of operation is desired by the licensee to facilitate more extensive emergency maintenance such as replacement of recirculation pump seals without the need for shutting down the reactor. The licensee states that

single-loop operation will not be a planned mode of operation. Past experience indicates that operation in this mode is typically required for periods of about 14 days during a ~~refueling~~<sup>OPERATING</sup> cycle.

The licensee states that approximately two to three hours are required to reset the RBM rod block and APRM scram setpoints with the present configuration. These adjustments entail readjusting the power and flow potentiometers in each of the six APRM channels and the two RBM channel modules in the power range cabinets which are located in the control room. We require that these adjustments be made with the plant in Hot Standby or shutdown. One channel of the multi-channel system will be adjusted at a time and then returned to service. Before all channels are returned to service the new trip setpoints will be verified by the instrument engineer following the readjustment and testing by the technician. Two operators will perform functional tests to double check the new setpoint settings. The sequence as outlined above is written into the plant operating procedures. We find this acceptable for the interim period until the 1978 refueling outage. At that time, the licensee will be required to make certain hardwire modifications to the systems to facilitate setpoint changes from the power range cabinets via control switches to preclude the need for entering the protection cabinets to make "screwdriver" adjustments. The licensee's proposed design for these modifications must be submitted to the staff for review.

The new rod block and trip setpoints vary linearly as a function of recirculation flow rate. For power increases by rod withdrawal, the RBM rodblock must be set up to the next higher trip level by manual operator action. The APRM scram trip follows automatically the new trip curve for both power increases and decreases.

During our review of the single-loop mode of operation, we found that interlocks are provided to allow pump start only if the recirculation pump discharge valve is closed, the bypass valve is open, and the suction valve is open. This configuration would limit the amount of cold water which could be transported through the reactor vessel from a cold loop startup, thereby limiting the effect of cold water slug event. While these interlocks are provided, no credit for their safety function is taken in the safety analysis for single-loop operation. During our review, we found that the Low Pressure Coolant Injection (LPCI) system loop selection logic is designed for operation in either the normal two-loop or single-loop mode of operation. However, since no credit is given for the ECCS function provided by the LPCI system; LPCI selection logic function has been determined to have no significance to the safety of single-loop operation. The ECCS meets the requirements of Appendix K, 10 CFR Part 50 exclusive of the LPCI system.

### 3. CONCLUSIONS

We have completed our review of the documentation submitted by the licensee, and we conclude that:

- a) The more conservative RBM rod block setpoints and APRM scram trip settings which have been selected for single-loop operation are consistent with the assumptions made in the safety analysis of the plant for single-loop operation.
- b) The interim procedure for setting the new RBM rod block setpoints and APRM scram trip settings into the system as outlined in this evaluation while in the Hot Standby operating mode will not degrade the integrity of the RBM or the APRM of the Reactor Protection System.
- c) The RBM rod block and APRM scram trip systems will be modified (hardwired) during the 19<sup>79</sup>/<sub>8</sub> refueling outage so that the rod block and trip settings for the single-loop operating mode can be more efficiently set into the system, i.e., use of a control switch(es).
- d) The plant operating power will be restricted to a maximum of 70% of rated power during single-loop operation with the recirculation loop equalizer valves closed and with recirculation loop flow controlled manually by the operator.

The proposed modifications to the plant for single-loop operation as described by Boston Edison Company satisfy the requirements of EICSB Branch Technical Position 12 of the Standard Review Plan and conform to the requirements of the single failure criterion. Accordingly, we conclude that the proposed modifications are acceptable.