

SINGLE LOOP OPERATION - PILGRIM UNIT 1One Pump Seizure Accident

The licensee has qualitatively compared the consequences of a pump seizure accident during single loop operation with a LOCA. Previous analyses have demonstrated that the pump seizure accident is not as severe as a LOCA for two pump operation. The same conclusion can be made for the one pump case by analyzing the two events. In both events the recirculation driving loop flow is lost instantaneously, in the seizure because of pump stoppage, in the LOCA because of a line severance. In the seizure event natural circulation flow continues, water level is maintained, and the core remains submerged; thus, a continuous core cooling mechanism is provided. However, for a LOCA complete flow stoppage occurs and the water level decreases resulting in core uncover and subsequent fuel rod cladding overheating. In addition, the reactor pressure does not decrease for a pump seizure event, whereas complete depressurization occurs for the LOCA. Since the potential effects of a pump seizure accident are bounded by the effects of a LOCA, the specific analyses of a pump seizure were not presented by the licensee.

The staff finds the bounding approach for the pump seizure event acceptable.

Abnormal Transients

The previous core wide transient analyses for two-pump operation are bounding for one-loop operation, except for the idle loop startup transient analysis. In the Pilgrim FSAR the idle loop startup transient was analyzed with an initial power of 70%. Therefore we require that Pilgrim restrict its one-loop operation to a maximum of 70% power. Before exceeding 70% power during one-loop operation Pilgrim must submit a revised idle loop startup analysis which is acceptable to the staff.

A large inadvertent flow increase could cause the MCPR to decrease below the Safety Limit MCPR for a low initial MCPR at reduced flow conditions. Therefore, the required MCPR must be increased at reduced core flow by a flow factor, K_f . The K_f -factors are derived assuming both recirculation loops increase speed to the maximum permitted by the scoop tube position set screws. This condition maximizes the power increase and hence the Δ MCPR for transients initiated from less than rated conditions. When operating on one loop the flow and power increase will be less than with two pumps increasing speed, therefore the K_f factors derived from the two-pump assumption are conservative for one loop operation.

The local event rod withdrawal error at rated power analysis indicated that the RBM will stop rod withdrawal at a CPR which is higher than the safety limit. The MCPR requirement for one loop operation will be equal to that for two loop operation because the nuclear characteristics are independent of whether core flow

is attained by one or two pump operation, if flow asymmetries are not incurred with one-loop operation. Tests at Quad Cities have shown that flow is uniform across the core for one pump operation with the equalizer valve closed. However, one-pump operation results in backflow through ten of the twenty jet pumps while flow is being supplied to the lower plenum from the two active jet pumps. Because of this backflow through the inactive jet pumps the present rod-block equation must be modified. The licensee has modified the two-pump rod block equation that exists in the Technical Specification for one-pump operation.

The staff finds that one loop transients (except the idle loop startup) are bounded by the two loop operation analysis and are therefore acceptable. The present idle loop startup analysis is acceptable for single loop operation up to 70% power.

MEMORANDUM FOR: K. R. Goller, Assistant Director for Operating Reactors,
Division of Operating Reactors

FROM: D. G. Eisenhut, Assistant Director for Operational
Technology, Division of Operating Reactors

SUBJECT: REVIEW OF LICENSE AMENDMENT REQUEST FOR SINGLE-LOOP
OPERATION

Plant Name: Pilgrim Unit 1
Docket Number: 50-293
Responsible Branch: ORB #2
Project Manager: P. O'Connor
Reviewing Branch: Plant Systems Branch
Status: Completed

The Plant Systems Branch has reviewed the Boston Edison Company's request for authorizations to operate Pilgrim, Unit 1 with one of its two recirculation loops out of service (single loop operation) as presented in its letters of November 17, 1975 and March 1 and 19, 1976.

The plant was initially designed to allow operation with either one or two recirculation pumps in service. The FSAR included single loop as well as double loop as proposed modes of operation. We have determined from a review of the operating license stage SER for the Pilgrim Station, dated August 25, 1971, that the instrumentation, control, and electrical power systems related to the safety of the plant were judged acceptable by the staff at the time when these systems were evaluated against both IEEE-279 and the General Design Criteria (GDC).

The staff also concluded in the operating license stage SER that the reactor protection system and redundant engineered safety features control systems have adequate independence for protection against single failures and other events such as missiles, fires, and flooding. The SER also found the onsite and offsite emergency power systems to be acceptable.

The matter of environmental and seismic qualification is covered in the SER by the statement: "We conclude that the accident environment testing of this equipment is acceptable."

K. R. Goller

The staff concluded from the ECCS review for two recirculation pump operation that:

1. No changes in any electrical or control system were required as a result of the Final Acceptance Criteria.
2. There were no submerged valves associated with ECCS performance.
3. The licensee has performed an analysis of the failure of manually-controlled, electrically operated valves associated with ECCS systems and concluded that the failure of these valves in either the "fail-to-function" sense or the "undesirable function" sense will not result in the loss of the ability to the ECCS to perform its required safety function.
4. The evaluation was performed in conformance with the requirements of Appendix K of 10 CFR Part 50, and demonstrated compliance with the single failure criteria.

We conclude based on our review of the submittals for single loop operation that the only change to the electrical or control system are modifications to the rod block monitor (RBM) rod block setpoints and to the average power range (APRM) rod block and scram trip settings. The new rod block setpoints and APRM scram trip settings for single loop operation have been listed in the Technical Specifications and are to be manually set into the rod block and scram systems within 24 hours after shifting to single loop operation. The existing Technical Specifications permit single loop operation up to 24 hours without any change in rod block or APRM scram setpoints.

Based on our review, we find that the proposed modifications to the rod block setpoints and the APRM scram trip settings as presented by the Boston Edison Company in its submittals for single loop operation satisfies the requirements of EICSB Branch Technical Position 12 of the Standard Review Plan and complies with the single failure criterion.

Our detailed evaluation of Single Loop Operation for Pilgrim, Unit 1 is enclosed.

D. C. Eisenhut, Assistant Director
for Operational Technology
Division of Operating Reactors

Enclosure: As stated

Contact: J. Burdoin, DOR
492-8077

CC: V. Stello, W. Butler, R. Rosa, J. Burdoin, D. Ziemann, P. O'Connor
R. Bear, L. Olshan

EVALUATION OF

SINGLE-LOOP OPERATION

PILGRIM NUCLEAR POWER STATION, UNIT 1

1. INTRODUCTION

The Boston Edison Company (BEC) presented documentation in its letters of November 17, 1975 and March 1 and 19, 1976, to support its proposed operation of the Pilgrim Station, Unit 1 with one recirculating loop/pump out of service (single loop operation). This documentation presented evaluations of significant events which resulted from BEC's review of accidents and abnormal operational transients associated with power operations for single loop operation. For these evaluations, the reactor was assumed to be operating at some reduced flow and power on or below the rated flow control line, except for the loss-of-coolant accident (LOCA) blowdown calculations in which the reactor was assumed to be operating at 102% of rated power with corresponding core flow and steam flow. These evaluations are valid only when the recirculation equalizer valve is closed.

These analyses have been performed on a generic basis. Conservative assumptions have been employed in the analysis to insure the generic applications of the results. Special application of the generic analysis of LOCA to Pilgrim was discussed.

It is concluded from our review of the submittals for single loop operation that the only changes to the electrical or control systems are modifications to the rod block monitor (RBM) rod block setpoints and to the average power range (APRM) rod block and scram trip settings.

2. EVALUATION

Jet pump flow characteristics differ between one and two pump operation. The analysis for single loop operation revealed that because of reverse flow through ten of the twenty jet pumps, the present rod block setpoint equation shown in the Technical Specifications for Pilgrim, Unit 1 had to be modified to provide additional local core protection for the postulated rod withdrawal error. The new rod block equation was developed from tests performed during a period when the reactor was being operated in the single loop mode. The APRM trip settings are flow biased in the same manner as the RBM rod block settings. Therefore, the APRM rod block and trip settings are subject to the same procedural changes as the RBM rod block settings. The existing Technical Specifications permit single loop operation up to 24 hours without changing the rod block or APRM scram setpoints. For periods of operation in the single loop mode greater than 24 hours the revised Technical Specifications will require that the rod block setpoints and APRM scram trip settings be changed to those settings for single loop operation within the first 24 hours of operation.

We understand that it requires approximately three hours to reset the rod block and scram setpoints. These changes entail readjusting various potentiometers in the amplifier modules located in the power range

cabinets which are located in the control room. These adjustments are made while the plant is operating by removing from service one channel of a multi-channel system, making the adjustments and then returning the channel to service.

Once the new rod block setpoints are set-in the system, the rod block monitor trip will vary linearly with the recirculation flow. For power decreases, the trip is automatically set to the lower level. However, for power increases, the block must be set up to the next higher level by operator action.

The design for the low pressure coolant injection (LPCI) system recirculating loop selection logic was also reviewed. We conclude that it will perform as designed following an initiating signal when the reactor is being operated in the single loop mode.

Also, the onsite emergency power system was re-examined during this review. The design of the onsite A.C. emergency power system is comprised on two redundant and independent distribution systems except at the 480 voltage level. One 480 volt bus, B-6, which supplies power to the LPCI injection system and containment isolation valves can be connected to either of the redundant buses, B-1 and B-2. This bus, B-6, also supplies power to certain non-safety equipment such as the turning gear motor and oil pump, the fire protection system, backup battery charger and air compressor. The swing bus, B-6, is automatically transferred to the alternate source upon loss of voltage on the normal supply. The connection between B-1 and B-6 is through two circuit breakers and likewise for the connection between B-2 and B-6. Consequently, the automatic transfer feature includes redundant interlocks to prevent the independent buses from being connected together and, therefore, meets the single failure criterion. No credit is taken for the LPCI system in the ECC's analysis for Pilgrim, Unit 1.

3. CONCLUSIONS

We conclude from our review that:

- a. The more conservative RPM rod block setpoints and APRM rod block and scram trip setting have been adopted and the procedure for setting the new values into the system does not alter the integrity of the rod block or reactor protection system;
- b. The LPCI system loop selection logic will operate as designed in the single loop operating mode; and
- c. The onsite emergency power system is redundant and independent.

The proposed modifications to the plant for single loop operations 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.