Attachment 1 to
Enclosure 2

TER C5257-40

TECHNICAL EVALUATION REPORT

CONTAINMENT LEAKAGE RATE TESTING

BOSTON EDISON COMPANY
PILGRIM UNIT 1

NRC DOCKET NO. 50-293

NRC TAC NO. 08836

FRC PROJECT C5257

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FRC TASK 40

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1. BACKGROUND

On August 5, 1975 [1], the NRC requested Boston Edison Company (BEC) to review the containment leakage testing program at Pilgrim Unit 1 Nuclear Plant (Pilgrim Unit 1) and to provide a plan for achieving full compliance with 10CFR50, Appendix J, including appropriate design modifications, changes to Technical Specifications, or requests for exemption for the requirements pursuant to 10CFR50.12, where necessary.

BEC responded to the NRC's request in a letter dated October 10, 1975 [2], in which it requested exemptions from the requirement of Appendix J in several areas. Additional supporting information was supplied to the NRC by BEC in two followup letters dated January 27, 1976 [3] and June 4, 1976 [4].

BEC's October 10, 1975 letter [2] also included proposed changes to the Technical Specifications for Pilgrim Unit 1. On July 23, 1976 [5], the NRC issued Amendment No. 17 to the Facility Operating License for Pilgrim Unit 1. Amendment No. 17 partially addressed BEC's proposed technical specification changes while leaving others outstanding pending generic review of specific exemption requests.

The need for further clarification of certain remaining requests was indicated by the NRC in a letter dated August 12, 1980 [6]. BEC replied in a letter dated October 27, 1980 [7], clarifying positions taken by BEC regarding testing procedure and exemptions for various check valves.

The purpose of this report is to provide technical evaluations of the outstanding requests for exemption from the requirements of Appendix J and proposed technical specification changes submitted by BEC relative to Pilgrim Unit 1.

2. EVALUATION CRITERIA

Code of Federal Regulations, Title 10, Part 50 (10CFR50), Appendix J, Containment Leakage Testing, was specified by the NRC as containing the criteria for the technical evaluations. Where applied to the evaluations in this report, the criteria are either referenced or briefly stated, where necessary, in support of the determinations. Furthermore, in recognition of plant-specific conditions that could lead to requests for exemption not explicity covered by the regulation, the NRC directed that the technical review constantly emphasize the intent of Appendix J, that potential containment atmospheric leakage paths be identified, monitored, and maintained below established limits.

3. TECHNICAL EVALUATION

3.1 REQUESTS FOR EXEMPTION FROM THE REQUIREMENTS OF APPENDIX J

Reference 2 outlines BEC's request for exemption from a number of requirements of 10CFR50, Appendix J, in response to the NRC's generic letter [1]. Technical evaluations of these requests for exemption, as modified by subsequent correspondence, are provided in the sections below.

3.1.1 Traveling Incore Probe System

According to Reference 3, BEC stated that traveling incore probe (TIP) system lines are not fit with appropriate testing connections and, thus, cannot be tested. To prevent leakage of containment atmosphere through TIP probe lines, BEC states that they are isolated by automatic closure of a ball valve. As additional support for their claim that TIP lines need not be tested, BEC stated that a shear valve can be manually actuated from the control room in the event that a probe fails to retract.

FRC EVALUATION:

Although TIP penetrations are small, because of the number of lines involved, the potential for leakage of containment atmosphere can be substantial and does not justify permanent exemptions. Furthermore, another BWR licensee has successfully tested these valves without installing additional valves in the lines. This was done by disconnecting the TIP tubes at fittings just inside the drywell. This technique is now in effect at several BWR units. Consequently, BEC's proposal to permanently exempt these lines from Type C testing is unacceptable and these valves should be tested in accordance with Appendix J.

3.1.2 Airlock Testing Procedures

According to Section II.G.2 of Appendix J, Type B tests are required to detect local leaks and measure leakage across pressure-containing boundaries

for airlock door seals and door-operating mechanisms. In Reference 2, BEC requested permission to modify their Type B testing procedure as follows:

3.1.2.1 After Each Opening

Section III.D.2 of Appendix J (prior to the 1980 rule change) stated that airlocks which are opened between 6-month test intervals should be retested "after each opening." BEC requested that a series of openings closely spaced in time be considered the same as a single opening and that testing occur after that series of openings.

FRC EVALUATION:

Airlocks represent a potentially large leakage path which is more subject to human error than other isolation barriers; therefore, they are tested more often than other isolation barriers. For certain reactors, however, frequent usage of airlocks has occurred. Testing of airlocks after each opening may represent a situation in which a more rapid degradation occurs to the critical isolation barriers being tested. Moreover, data obtained since 1969 from the testing of airlocks indicates that very few airlocks tested have resulted in greater than allowable leak rates. This infrequent failure of airlock tests, plus the possibility that excessive testing could lead to a loss of reliability due to equipment degradation, leads to the judgment that testing after each opening may be undesirable.

As of October 22, 1980, Appendix J, Section III.D.2 was revised by the NRC to provide airlock testing requirements which met the intent of the previous rule but were more practical in light of the experience gained in airlock testing at operating reactors subsequent to the issuance of Appendix J. Basically, the revised section requires airlocks to be tested as follows:

1. Every 6 months, at an internal pressure not less than peak calculated accident pressure (Pa).

2. At the end of periods when integrity is not required and airlocks have been opened, at an internal pressure not less than Pa.

3. When integrity is required, within 3 days of opening (or every 3 days during periods of frequent openings) by:

   a. pressurizing testable seals, or

   b. pressurizing to less than Pa (as specified in the Technical Specifications).

In view of this modification of paragraph III.D.2.(b)(iii) (October 22, 1980) of 10CFR50, Appendix J, no exemption from 10CFR50, Appendix J, is needed because the revised requirements are compatible with BEC's request.

3.1.2.2 Reduced Pressure After Each Opening

Section III.B.2 of Appendix J states that all preoperational and periodic Type B tests shall be performed by local pneumatic pressurization of containment penetrations at a pressure not less than Pa. BEC requested an exemption from Appendix J which would allow testing of these door seals at a pressure of $\geq$ 10 psig as required by the Technical Specifications.

FRC EVALUATION:

In view of the recent rule change, BEC's request to confirm the integrity of airlock seals after each opening (or series of openings) by subjecting them to a pressure of $\geq$ 10 psig is acceptable. An exemption is no longer required. Intermediate tests may be performed at a reduced pressure without requiring the application of strongbacks, at pressures identified in the Technical Specifications. This provision of reduced pressure testing requires that leakage results be conservatively extrapolated to full pressure in order to determine acceptability in accordance with Appendix J.

3.1.2.3 Reduced Pressure at 6-Month Intervals

In Reference 2, BEC requested exemption from testing airlock door seals at a pressure of Pa during the 6-month test and proposed to test at a pressure of $\geq$ 10 psig according to the Technical Specifications.

FRC EVALUATION:

For plants designed prior to the issuance of Appendix J and with airlocks not designed to withstand test pressure in the reverse direction against the inner door, the installation of strongbacks or other holding devices to support the normal door operating mechanism is required in order to perform the test. Due to the necessity of proving the integrity of this potentially large leakage source at 6-month intervals, actions necessary to support this test must be undertaken with at least that frequency.

Consequently, BEC's proposal to confirm the integrity of airlock seals at 6-months intervals by subjecting then to a pressure less than Pa is unacceptable. The airlock test conducted every 6 months must be at a pressure of Pa.

3.1.3 Alteration of Local Leak Rate Test Sequence

In Reference 2, BEC requested an exemption from the requirements of Section III.A.1.a of Appendix J with regard to local leak rate testing. BEC proposed to conduct the local leak rate test before the integrated leak rate test (Type A) and then add subsequent leakage changes to the integrated leak test results. The modified results would be valid as the "as is" representation of the containment integrity at the beginning of the outage.

FRC EVALUATION:

The intent of the Appendix J requirement that the integrated leak rate test be conducted following the required containment inspection and prior to making any repairs or adjustments is to provide assurance that the containment be tested in as close to the "as is" condition as practical. Due to design considerations, many local leak rate tests are incapable of establishing what portion of the total measured leakage was into containment and what portion was out of the containment. Consequently, if the local leak rate tests were conducted before the integrated leak rate test, an element of uncertainty would exist as to its accuracy when correcting to establish the "as is" integrated leak rate results.

Provided that the total measured local leak rate is conservatively assumed to be out of the containment when correcting the results to establish the "as is" integrated leak rate, the proposed approach is acceptable.

3.1.4 Feedwater Check Valves

In Reference 3, BEC requested exemption from air testing of feedwater check valves to permit testing with water as a medium because these valves are not designed to be tested with air. BEC's justification for this request is as follows:

> "Immediately after the design basis LOCA water will be trapped in the feedwater vertical piping...", representing an "as is" condition. Although they state that "30-40% of the initially filled water volume" will flash to steam, no calculation of further water loss through the feedwater valve was shown. In closing they state "...replacement of the feedwater check valves with valves qualified for air testing is not justified."

Subsequent to this request for exemption, BEC modified the feedwater check valves with soft-seats (as stated in Reference 7). The Licensee states that they are presently testing this valve with air.

FRC EVALUATION:

The Licensee has essentially withdrawn its request for exemption for the feedwater check valves. No further evaluation is required. The valves are being tested in accordance with Appendix J.

3.1.5 Main Steam Isolation Valves

In Reference 2, BEC requested exemption from testing main steam isolation valves (MSIVs) according to Appendix J. BEC requested permission to test at 23 psig rather than Pa (45 psig).

FRC EVALUATION:

Section III.C. 2 of Appendix J requires that containment isolation valves be locally leak tested (Type C) at the peak calculated accident pressure, Pa. BEC has requested an exemption to allow a continuation of a 23-psig test

terminal end of the lines, the valves will remain water-covered throughout the accident. Consequently, these valves do not require Type C testing in accordance with Appendix J because they are not relied upon to prevent the escape of containment air to atmosphere, and therefore, are not containment isolation valves as defined in Section II.B of Appendix J. No exemption is needed.

3.1.6.2 Control Rod Hydraulic Drive System

In Reference 2, BEC requested exemption from Type C testing of Check Valve 301-98 on the control rod hydraulic drive (CRD) system. According to Note 5 in Reference 3, this valve cannot be leak tested because of system design, and consequently, BEC requested exemption from the requirement for testing. The Licensee requested this action be taken in preference to installing appropriate test fittings.

FRC EVALUATION:

Given that the Licensee has installed test fittings to enable testing of the feedwater check valves [7], it must follow that CRD System Check Valve 301-98, which connects to the same line, could be simultaneously tested by opening Valve 301-99. (Since a review of P&ID drawing M-250 does not verify the existence of Valve 301-98, FRC assumes Valve 301-95 is the true object of this review.)

In the event of a design basis accident, Check Valve 301-95 would be relied upon to perform a containment isolation function. For that reason, the requested exemption is unacceptable and the Licensee should conform to the guidelines of Appendix J.

3.1.6.3 Standby Liquid Control Injection System

In Reference 2, BEC requested exemption from requirements for Type C testing of Standby Liquid Control Injection Valve 1101-15. Further information provided in Reference 3 showed that this valve is inside containment

and also cannot be leak tested due to system design. For this reason, BEC requested exemption from the requirement to test this valve in accordance with Appendix J.

FRC EVALUATION:

In Reference 3, the Licensee stated that it is Type C testing another check valve (1101-16) on the same line of the standby liquid control system, which suggests that the Licensee considers this penetration to be a possible leakage path. In the event that Check Valve 1101-16 fails to seat properly during the course of an accident, Check Valve 1101-15 will be relied upon to operate successfully. For these reasons, the requested exemption is inappropriate. Action should be taken to enable Type C testing of Check Valve 1101-15 in order to conform to the requirements of Appendix J.

3.1.6.4 Reactor Water Cleanup Check Valves

In Reference 7, BEC stated that replacing these check valves with air-testable check valves was not considered justified since the purpose of these valves is to limit reverse direction flow in case of a postulated pipe break until downstream motor-operated isolation valves are shut.

FRC EVALUATION:

There is a need to test this valve in accordance with Appendix J since Valve 1201-82 is a normally open manual valve and containment integrity is dependent upon the leaktightness of Check Valve 1201-81.

Furthermore, Check Valve 1201-81 can be tested during the normal feedwater line testing by opening Valve 1201-82. Hence, containment leakage testing in accordance with Appendix J is both feasible and necessary. An exemption for Check Valve 1201-81 is inappropriate.

3.1.6.5 Reactor Core Isolation Cooling (RCIC) Pump Discharge

The RCIC pump discharge line taps into the feedwater injection piping between the inboard and the outboard feedwater check valves in Loop A. BEC

has withdrawn its exemption request for the Loop A feedwater check valves (Penetration 9A) and consequently has withdrawn its request for exemption from testing Valve AO-1301-50, RCIC pump discharge check valve [7]. This exemption request withdrawal is submitted in recognition that this valve is now testable and will be tested according to guidelines set forth in 10CFR50, Appendix J.

FRC EVALUATION:

Since the exemption request has been withdrawn, no evaluation is provided.

3.1.6.6 High Pressure Coolant Injection (HPCI) Pump Discharge

The HPCI pump discharge line taps into the feedwater injection piping between the inboard and outboard feedwater check valves in Loop B. Since the request for exemption has been withdrawn for the Loop B feedwater check valves (Penetration 9B), the HPCI pump discharge check valve is now also tested with air, and the Licensee has withdrawn its request for exemption [7].

FRC EVALUATION:

Since the exemption request has been withdrawn, no evaluation is provided.

3.1.6.7 Core Spray to Reactor Check Valves

The Licensee stated that replacing these check valves with air-testable check valves is not considered justified since the function of these valves is to limit reverse flow in case of a postulated upstream pipe break until downstream motor-operated isolation valves are shut.

The Licensee also quoted FSAR 5.2.3.5.1. of the Pilgrim Nuclear Power Station, which states that "automatic isolation valves in the usual sense, are not used on the inlet lines of the reactor core and containment cooling systems, and reactor feedwater systems, since operation of these systems is essential following a design basis loss-of-coolant accident. Since normal flow of water in these systems is inward to the reactor vessel or the primary containment, check valves in these lines will provide automatic isolation if necessary."

Further, the Licensee stated that the core spray to reactor piping was not designed or constructed to allow testing of Valves AO-1400-9A and B and therefore these valves (AO-1400-9A and B) cannot be tested in accordance with Appendix J.

FRC EVALUATION:

In the event of a design basis accident, the core spray system motor-operated valves MO 1400-25A and B and MO 1400-24A and B would open, permitting flow to the core spray discharge. Assuming a single active failure of one core spray pump, a potential leak path would then exist through the untested check valves to the condensate transfer system which is vented to the atmosphere.

Consequently, Check Valves (AO-1400-9A and B) should be tested in accordance with Appendix J to substantiate their integrity as qualified containment boundaries. A testing exemption for these valves is not appropriate.

3.1.6.8 Residual Heat Removal (RHR) Vessel Injection Lines

The Licensee stated that the residual heat removal piping was not designed or constructed to allow testing of Valves AO-1001-68A and B. Therefore, the RHR vessel injection line check Valves AO-1001-68A and B cannot be tested in accordance with Appendix J. However, the Licensee stated, "An engineering evaluation to determine a possible method for future leak testing of these valves has been initiated."

FRC EVALUATION:

Section III.A.1.(d) of Appendix J requires Type C testing of containment isolation valves in systems which penetrate containment. Section II.B of Appendix J defines containment isolation valves as those valves relied upon to perform a containment isolation function. Valves AO-1001-68A and B are normally water-covered after an accident.

Further, sufficient redundancy exists in the RHR input pumping capability to prevent loss of water pressure in this system in spite of a possible single active failure, which therefore prevents escape of containment accident air following a design basis LOCA. Consequently, there is no possibility for leakage of containment atmosphere through this path. Testing of these valves is not required by Appendix J and no exemption from Appendix J is necessary.

3.1.7 Reverse Direction Testing of Isolation Valves

In Reference 4, BEC requested an exemption from the requirements of Appendix J regarding the testing of approximately 11 containment isolation gate valves in a direction opposite to that of post-accident containment pressure. BEC stated:

> Due to the design of the installed system, these gate valves are tested in a reverse direction. While this reverse testing may be equivalent or conservative with respect to forward testing, this cannot be conclusively demonstrated. Accordingly, an exemption to the forward testing requirements of Appendix J has been requested. The outboard valve is tested in the forward direction thereby assuring that leakage through that line will not be excessive. Overall leakage is monitored by Type A leak tests.

FRC EVALUATION:

Appendix J authorizes reverse direction testing of containment isolation valves where the results will be equivalent to or more conservative than the results of testing in the direction of accident pressure. BEC believes that reverse direction testing may be equivalent to testing in the direction of accident pressure for these valves, but this belief cannot be conclusively demonstrated. Further, these valves are tested in the direction of accident pressure by the Type A test, and the other isolation valves in each line are Type C tested in the direction of accident pressure. In view of the above discussion, reverse direction testing of these valves is considered to be acceptable. No exemption from the requirements of Appendix J is necessary.

3.2 TECHNICAL SPECIFICATION CHANGE REQUESTS

In Reference 2, BEC submitted proposed changes to the Technical Specifications for Pilgrim Unit 1. In Amendment No. 17 to the Facility

Operating License [5], the NRC approved certain proposed changes and indicated that the remainder would be addressed at a later date. The proposed changes of Reference 2 that were not addressed by Amendment No. 17 are evaluated below.

3.2.1 Proposed Revised Pages 152, 153, 154, and 155

Proposed revised pages 152, 153, 154, and 155 were attached to Reference 2. These pages revised the technical specifications as follows:

- Updated Type A pre-test requirements to conform to Appendix J.
- Added a provision for performing local leak rate tests prior to the Type A test.
- Added a requirement to extend the Type A test in order to verify results in accordance with Appendix J.
- Provided leakage rate acceptance criteria for both the full pressure (Pa) and reduced pressure (Pt) Type A test in conformance with Appendix J.
- Required local leakage tests to be performed at Pa in accordance with Appendix J except for main steam isolation valves which are to be performed at 1/2 Pa.
- Required semiannual testing of containment airlocks at $\geq$ 10 psig, and airlock testing after each opening when opened between the 6-month tests.
- Added acceptance criteria for local leak rate tests in conformance with Appendix J.

FRC EVALUATION:

The proposed changes to pages 152, 153, 154, and 155 are either in conformance with Appendix J or have been evaluated to be acceptable exemptions to Appendix J in Sections 3.1.3 and 3.1.5 of this report, except for the airlock testing requirements. The airlock testing requirements should be modified to conform to Appendix J.

3.2.2 Duration of the Type A Test

In Reference 2, BEC stated that existing Technical Specifications required

a Type A test duration of 24 hours but that, since Appendix J does not require this minimum duration, the requirement was being deleted.

FRC EVALUATION:

Appendix J, Section III.A.3, requires Type A tests to be performed in accordance with ANSI N45.4-1972. ANSI N45.4-1972 requires a 24-hour Type A test unless it can be demonstrated to those responsible for acceptance of the test that adequate results can be obtained in less than 24 hours. To date, however, licensees have been unsuccessful in demonstrating to the NRC that the 24-hour requirement should be abandoned. Consequently, the 24-hour requirement should be reinserted into the Technical Specifications for Pilgrim Unit 1.

3.3 LOCAL LEAK RATE TESTING PROGRAM

In Reference 3, as subsequently modified by Reference 4, BEC submitted a listing of primary isolation valves requiring local leakage rate testing. An evaluation of this local leak rate testing program is presented below.

FRC EVALUATION:

The revised local leak rate testing program submitted in Reference 4 (Table I to BEC Letter of January 27, 1976) has been reviewed and found to be in compliance with Appendix J with the exception of Note 2, which deals with a testing exemption of the feedwater check valves. Since BEC has withdrawn this exemption request [7], Note 2 should be removed.

4. CONCLUSIONS

Technical evaluations of BEC's requests for exemption from requirements of 10CFR50, Appendix J, for Pilgrim Unit 1 have been performed. The following conclusions are provided:

- A request to exempt Type C testing of traveling incore probe (TIP) lines is unacceptable. These lines should be tested in accordance with Appendix J.
- Containment airlocks should be tested in accordance with the revision to Section III.D.2 of Appendix J (effective October 22, 1980). No exemption is required.
- Local leak rate tests may be performed prior to Type A testing provided that correction of the Type A results to determine the "as is" condition includes the conservative assumption that the change between pre- and post-repair local leakage was entirely containment out-leakage.
- Testing of main steam isolation valves at 1/2 Pa by pressurizing between the valves is acceptable.
- Valves in lines terminating below the level of the suppression pool do not require Type C testing.
- The following valves should be tested in accordance with Appendix J because exemptions are inappropriate:

  1. CRD Check Valve 301-98
  2. Standby Liquid Check Valve 1101-15
  3. RWCU Check Valve 1201-81
  4. Core Spray Check Valves AO-1400-9A and B

- Reverse direction testing of certain containment isolation valves is acceptable.

Technical evaluations of outstanding proposed technical specification changes have been performed. These proposed changes are in accordance with Appendix J or represent acceptable exemptions to Appendix J with the following exceptions:

- The airlock testing requirements should be changed to conform to the latest requirements of Appendix J (Section III.D.2, revised as of October 22, 1980).

- The requirement to perform a 24-hour Type A test should not be deleted.
- The reference to an exemption from Appendix J relative to testing feedwater check valves should be deleted from the list of isolation valves which are local leak rate tested.

5. REFERENCES

1. K. Goller (NRC)
Generic letter to M. J. Feldman (BEC)
August 5, 1975

2. J. E. Howard (BEC)
Letter to NRC Division of Reactor Licensing
October 10, 1975

3. J. E. Howard (BEC)
Letter to D. L. Ziemann (NRC)
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4. J. E. Howard (BEC)
Letter to D. L. Ziemann (NRC)
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5. D. L. Ziemann (NRC)
Letter to J. E. Larson (BEC)
July 23, 1976

6. T. M. Novak (NRC)
Letter to G. C. Andoguini (BEC)
August 12, 1980

7. A. V. Morisi (BEC)
Letter to T. A. Ippolito (NRC)
October 27, 1980