TECHNICAL EVALUATION REPORT

ECCS REPORTS (F-47)

TMI ACTION PLAN REQUIREMENTS

JERSEY CENTRAL POWER AND LIGHT COMPANY
OYSTER CREEK NUCLEAR GENERATING STATION

NRC DOCKET NO. 50-219

FRC PROJECT C5506

FRC ASSIGNMENT 7

NRC CONTRACT NO. NRC-03-81-130

FRC TASK 206

Prepared by

Franklin Research Center
20th and Race Streets
Philadelphia, PA 19103

Author: B. Ludington
F. W. Vosbury
G. J. Overbeck

FRC Group Leader: G. J. Overbeck

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: E. Chow

January 27, 1983

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Franklin Research Center
A Division of The Franklin Institute
The Benjamin Franklin Parkway, Phila., Pa. 19103 (215) 448-1000

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Principal Author		Department Director
Date: 1/27/83	Date: 1-27-83	Date: 1-27-83

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FOREWORD

This Technical Evaluation Report was prepared by Franklin Research Center under a contract with the U.S. Nuclear Regulatory Commission (Office of Nuclear Reactor Regulation, Division of Operating Reactors) for technical assistance in support of NRC operating reactor licensing actions. The technical evaluation was conducted in accordance with criteria established by the NRC.

Mr. G. J. Overbeck, Mr. F. W. Vosbury, and Mr. B. W. Ludington contributed to the technical preparation of this report through a subcontract with WESTEC Services, Inc.

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report (TER) documents an independent review of the outages of the emergency core cooling (ECC) systems at Jersey Central Power and Light Company's (JCP&L) Oyster Creek Nuclear Generating Station. The purpose of this evaluation is to determine if the Licensee has submicted a report that is complete and satisfies the requirements of TMI Action Item II.K.3.17, "Report on Outages of Emergency Core-Cooling Systems Licensee Report and Proposed Technical Specification Changes."

1.2 GENERIC BACKGROUND

Following the Three Mile Island Unit 2 accident, the Bulletins and Orders Task Force reviewed nuclear steam supply system (NSSS) vendors' small break loss-of-coolant accident (LOCA) analyses to ensure that an adequate basis existed for developing guidelines for small break LOCA emergency procedures. During these reviews, a concern developed about the assumption of the worst single failure. Typically, the small break LOCA analysis for boiling water reactors (BWRs) assumed a loss of the high pressure coolant injection (HPCI) system as the worst single failure. However, the technical specifications permitted plant operation for substantial periods with the HPCI system out of service with no limit on the accumulated outage time. There is concern not only about the HPCI system, but also about all ECC systems for which substantial outages might occur within the limits of the present technical specification. Therefore, to ensure that the small break LOCA analyses are consistent with the actual plant response, the Bulletin and Orders Task Force recommended in NUREG-0626 [1], "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents in GE-Designed Operating Plants and Near-Term Operating License Applications," that licensees of General Electric (GE)-designed NSSSs do the following:

> "Submit a report detailing outage dates and lengths of the outages for all ECC systems. The report should also include the cause of the outage (e.g., controller failure or spurious isolation). The outage data for ECC components should include all outages for the last five years of

operation. The end result should be the quantification of historical unreliability due to test and maintenance outages. This will establish if a need exists for cumulative outage requirements in technical specifications."

Later the recommendation was incorporated into NUREG-0660 [2], "NRC Action Plan Developed as a Result of the TMI-2 Accident," for GE-designed NSSSs as TMI Action Item II.K.3.17. In NUREG-0737 [3], "Clarification of TMI Action Plan Requirements," the NRC staff expanded the action item to include all light water reactor plants and added a requirement that licensees propose changes that will improve and control availability of ECC systems and components. In addition, the contents of the reports to be submitted by the licensees were further clarified as follows:

"The report should contain (1) outage dates and duration of outages; (2) cause of the outage; (3) ECC systems or components involved in the outage; and (4) corrective action taken."

1.3 PLANT-SPECIFIC BACKGROUND

On February 10, 1981 [4], JCP&L submitted a report in response to NUREG-0737, Item II.K.3.17, "Report on Outages of Emergency Core-Cooling Systems Licensee Report and Proposed Technical Specification Changes." The report submitted by JCP&L covered the period from August 1, 1975 to August 1, 1980 for Oyster Creek Nuclear Generating Station. JCP&L indicated that, due to the high availability of ECC systems as calculated by JCP&L using forced outages, no recommendations to improve availability of ECC systems would be made.

2. REVIEW CRITERIA

The Licensee's response to NUREG-0737, Item II.K.3.17, was evaluated against criteria provided by the NRC in a letter dated July 21, 1981 [5] outlining Tentative Work Assignment F. Provided as review criteria in Reference 5, the NRC stated that the Licensee's response should contain the following information:

1. A report detailing outage dates, causes of outages, and lengths of outages for all ECC systems for the last 5 years of operation. This report was to include the ECC systems or components involved and corrective actions taken. Test and maintenance outages were to be included.

2. A quantification of the historical unavailability of the ECC systems and components due to test and maintenance outages.

3. Proposed changes to improve the availability of ECC systems, if necessary.

The type of information required to satisfy the review criteria was clarified by the NRC on August 12, 1981 [6]. Auxiliary systems such as component cooling water and plant service water systems were not to be considered in determining the unavailability of ECC systems. Only the outages of the diesel generators were to be included along with the primary ECC system outages. Finally, the "last five years of operation" was to be loosely interpreted as a continuous 5-year period of recent operation.

On July 26, 1982 [7], the NRC further clarified that the purpose of the review was to identify those licensees that have experienced higher ECC system outages than other licensees with similar NSSSs. The need for improved reliability of diesel generators is under review by the NRC. A Diesel Generator Interim Reliability Program has been proposed to effect improved performance at operating plants. As a consequence, a comparison of diesel generator outage information within this review is not required.

3. TECHNICAL EVALUATION

3.1 REVIEW OF COMPLETENESS OF THE LICENSEE'S REPORT

The ECC systems at JCP&L's Oyster Creek Nuclear Generating Station consist of the following two separate systems:

- o automatic depressurization system (ADS)
- o core spray system.

In Reference 4, JCP&L also included data on the emergency diesel generators which support the ECC systems in carrying out their design functions under various accident conditions. In addition, the Licensee included information on the containment spray system, which is used in conjunction with the core spray system under accident conditions to remove heat from the primary containment and to assure continuity of core cooling. Although the containment spray system is an essential support system for the core spray system, only the automatic depressurization system and the core spray system are considered in this review.

ECC system forced outage data were extracted from records of reportable occurrences and from the control room logs. If an outage duration could not be determined from these records, the best available estimate was provided for the event. For each forced outage event, JCP&L provided the outage date, duration, and the cause, plus sufficient description to discern the corrective action taken.

Surveillance testing outages which render ECC systems out of service were not reported separately, but only as total outage time for each system. JPC&L stated that the other type of planned outage, preventive maintenance, is performed when technical specifications do not require availability of the system or when the specifications allow operation of the ECC system in a degraded mode for the maintenance activity. The results of JPC&L's review were provided from August 1, 1975 to August 1, 1980 for the Oyster Creek plant.

Based on the preceding discussion, it is concluded that JCP&L has submitted a report which fulfills the requirements of review criterion 1 without exception.

3.2 COMPARISON OF ECC SYSTEM OUTAGES WITH THOSE OF OTHER PLANTS

The outages of ECC systems can be categorized as (1) unplanned outages due to equipment failure or (2) planned outages due to surveillance testing or preventive maintenance. Unplanned outages are reportable as Licensee Event Reports (LERs) under the technical specifications. Planned outages for periodic maintenance and testing are not reportable as LERs. The technical specifications identify the type and quantity of ECC equipment required as well as the maximum allowable outage times. If an outage exceeds the maximum allowable time, then the plant operating mode is altered to a lower status consistent with the available ECC system components still operational. The purpose of the technical specification maximum allowable outage times is to prevent extended plant operation without sufficient ECC system protection. The maximum allowable outage time, specified per event, tends to limit the unavailability of an ECC system. However, there is no cumulative outage time limitation to prevent repeated planned and unplanned outages from accumulating extensive ECC system downtime.

Unavailability, as defined in general terms in WASH-1400 [8], is the probability of a system being in a failed state when required. However, for this review, a detailed unavailability analysis was not required. Instead, a preliminary estimate of the unavailability of an ECC system was made by calculating the ratio of the ECC system downtime to the number of days that the plant was in operation during the last 5 years. To simplify the tabulation of operating time, only the period when the plant was in operational Mode 1 was considered. This simplifying assumption is reasonable given that the period of time that a plant is starting up, shutting down, and cooling down is small compared to the time it is operating at power. In addition, an ECC system was considered down whenever an ECC system component was unavailable due to any cause.

It should be noted that the ratio calculated in this manner is not a true measure of the ECC system unavailability, since outage events are included that appear to compromise system performance when, in fact, partial or full function of the system would be expected. Full function of an ECC system

would be expected if the design capability of the system exceeded the capacity required for the system to fulfill its safety function. For example, if an ECC system consisting of two loops with multiple pumps in each loop is designed so that only one pump in each loop is required to satisfy core cooling requirements, then an outage of a single pump would not prevent the system from performing its safety function. In addition, the actual ECC system unavailability is a function of planned and unplanned outages of essential support systems, as well as of planned and unplanned outages of primary ECC system components. In accordance with the clarification discussed in Section 2, only the effects of outages associated with primary ECC system components and emergency diesel generators are considered in this review. The inclusion of all outage events assumed to be true ECC system outages tends to overestimate the unavailability, while the exclusion of support system outages tends to underestimate the unavailability, of ECC systems and components. Only a detailed analysis of each ECC system for each plant could improve the confidence in the calculated result. Such an analysis is beyond the intended scope of this report.

The planned and unplanned (forced) outage times for the two ECC systems (automatic depressurization and core spray) and the emergency diesel generators were identified from the outage information in Reference 4 and are shown in number of days and as percentage of plant operating time per year in Table 1 for the Oyster Creek plant. Outages that occurred during nonoperational periods were eliminated, as were those caused by failures or test and maintenance of support systems. Data on plant operating conditions were obtained from the annual reports, "Nuclear Power Plant Operating Experience" [9, 10, 11, 12], and from monthly reports, "Licensed Operating Reactors Status Summary Reports"[13]. The remaining outages were segregated into planned and unplanned outages on the basis of JCP&L's description of the cause. The outage periods for each category were calculated by summing the individual outage durations.

Observed outage times of the two ECC systems at the Oyster Creek Nuclear Generating Station were compared with those of other BWRs. Based on this comparison, it was concluded that the historical unavailability of the ADS has

Table 1. Planned and Unplanned (Forced) Outage Times for Oyster Creek

Year	Days of Plant Operation	Core Spray Outage in Days		Automatic Depressurization Outage in Days		Diesel Generator Outage in Days	
		Forced	Planned	Forced	Planned	Forced	Planned
1976	290.25	3.90 (1.3%)	13.00 (4.5%)	0.0	0.36 (0.1%)	0.46 (0.2%)	18.37 (6.3%)
1977	255.88	0.27 (0.1%)	13.00 (5.1%)	0.0	0.36 (0.1%)	4.40 (1.7%)	18.37 (7.2%)
1978	271.29	0.0	13.00 (4.8%)	0.0	0.36 (0.1%)	0.23 (0.1%)	18.37 (6.8%)
1979	313.50	1.21 (0.4%)	13.00 (4.6%)	0.31 (0.1%)	0.36 (0.1%)	6.50 (2.1%)	18.37 (5.6%)
1980	157.97	0.13 (0.1%)	13.00 (8.2%)	0.08 (0.1%)	0.36 (0.2%)	0.0	18.37 (11.6%)
Total	1288.89	5.51 (0.4%)	65.00 (5.0%)	0.39 (<0.1%)	1.80 (0.1%)	11.58 (0.9%)	91.85 (7.1%)

*Numbers in parentheses indicate system outage time as a percentage of total plant operating time.

been consistent with the performance of this system throughout the industry. The observed unavailability was less than the industrial mean for the ADS, assuming that the underlying unavailability is distributed lognormally. The outage times were also consistent with existing technical specifications.

Historical unavailability of the other ECC system, core spray, did not compare favorably with the performance of similar systems throughout the industry. The average unavailability for this system, shown in Table-1, is well above the industrial mean plus one standard deviation. Due to the higher unavailability of the core spray system, the outage times were reviewed in detail using the JCP&L submittal [4]. This review established that 90% of the system unavailability was due to a series of surveillance testing procedures involving various motor-operated valves, isolation valves, and instruments. The Licensee was contacted for more information concerning the effects of the testing on the availability of the core spray trains. The Licensee verified [14] that one core spray system is rendered inoperable during each of the surveillance tests listed in Reference 4. A motor-operated block is closed and its motor breaker racked open prior to the start of each test procedure, preventing any core spray water from reaching the core.

During the discussion of surveillance testing procedures with the Licensee [14], it was noted that the tests are performed monthly, whether the plant is operating or in shutdown. Therefore, periods of core spray inoperability that occurred when the plant was not in mode 1 operation should be subtracted from the unavailability indicated in Table 1. Although the number of times that surveillance testing occurred during shutdown periods is not known, an estimate can be made by using the ratio of days during Mode 1 operation to the days in the year. Using this estimated adjustment for Oyster Creek Station yields an overall planned outage for the core spray of 55 instead of 65 days, and an unavailability percentage of 4.2 instead of 5.0.

3.3 REVIEW OF PROPOSED CHANGES TO IMPROVE THE AVAILABILITY OF ECC EQUIPMENT

In Reference 4, JCP&L indicated that, as forced outage time for the ECC systems was so minor, no changes to improve reliability would be made.

Although the total unavailability for core spray is substantial, it is almost entirely comprised of surveillance testing procedures that are required by technical specifications to ensure operability of the core spray equipment. Hence, no changes in procedures or equipment are recommended.

4. CONCLUSIONS

JCP&L has submitted a report for the Oyster Creek plant which contains (1) outage dates and durations, (2) causes of the outages, (3) emergency core cooling (ECC) systems or components involved in the outages, and (4) corrective actions taken. It is concluded that JCP&L has fulfilled the requirements of NUREG-0737, Item II.K.3.17.

In addition, the historical unavailability of the automatic depressurization system has been consistent with the performance of similar systems throughout the industry. The observed unavailability was less than the industrial mean. The outages were also consistent with existing technical specifications.

The historical unavailability of the core spray system has been higher than that of similar systems throughout the industry. The observed unavailability was above one standard deviation plus the industrial mean. However, since most of the outage time is due to required surveillance testing, no changes to equipment or procedures are recommended.

5. REFERENCES

1. NUREG-0626
"Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents in GE-Designed Operating Plants and Near-Term Operating License Applications"
NRC, January 1980

2. NUREG-0660
"NRC Action Plan Developed as a Result of the TMI-2 Accident"
NRC, March 1980

3. NUREG-0737
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NRC, October 1980

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8 WASH-1400
"Reactor Safety Study"
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9. NUREG-0366
"Nuclear Power Plant Operating Experience 1976"
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10. NUREG-0483
"Nuclear Power Plant Operating Experience 1977"
NRC, February 1979

11. NUREG-0618
"Nuclear Power Plant Operating Experience 1978"
NRC, December 1979

12. NUREG/CR-1496
"Nuclear Power Plant Operating Experience 1979"
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13. NUREG-0020
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December 10, 1982