

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NO.: 50-293/95-16
LICENSEE: Boston Edison Company (BECo)
FACILITY: Pilgrim Nuclear Power Station (PNPS)
DATES: August 7-11, 1995
INSPECTOR: G. W. Morris, Reactor Engineer, ES, DRS

SUBMITTED BY: George W. Morris 9/7/95
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Date

APPROVED BY: William H. Ruiland 9/8/95
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Areas Inspected: This was an announced inspection to assess the safety impact and resolution of four areas associated with the unresolved items from the pilot station blackout inspection conducted at the Pilgrim Nuclear Power Station (PNPS) during October 1993. In addition, the inspector reviewed the timeliness and effectiveness of the corrective actions that resulted from the loose stator laminations found on the "A" emergency diesel generator.

The areas evaluated were:

- station blackout diesel generator maintenance;
- station blackout diesel generator reliability;
- secondary power supply (23 kV) degraded voltage protection;
- secondary power supply design and licensing bases; and
- corrective action taken for the "A" diesel generator loose stator lamination.

Results:

- Adequate procedures have been established and implemented for station blackout diesel surveillance and maintenance. This unresolved item was closed.

- While the reliability goal for the station blackout diesel of 95% had not been met due to early test program failures, recently completed operating and maintenance experience, coupled with BECo's active participation in the ALCO Owner's Group, provided adequate assurance of continued reliability improvements. This unresolved item was closed.
- The analytical evaluations of the capability of the 23 kV source have not been completed. BECo committed to complete the evaluation by September 11, 1995, and to submit the results of that evaluation to the NRC, Region I. Upon receipt and NRC review and acceptance of the results, this item will be closed.
- The licensing and design bases for the secondary ac power source had been defined in Revision 16 to the Final Safety Analysis Report (FSAR), Section 8.3. This source was designed to act as the secondary 10 CFR, Part 50, Appendix A, general design criterion 17 (GDC 17) ac supply with the capability for providing power to at least one safety division, following a design basis event. This unresolved item was closed.
- The timeliness of BECo's corrective actions required to quantify the stator lamination problem with the "A" diesel generator received inadequate plant management support in that it took almost 3 years to complete a formal safety evaluation. The corrective actions included generator repair and initiation of a 10-year boroscopic inspection. The inspector concluded it was not until the generator was tested and inspected at the vendor's facility that an operable determination could accurately be made. The inspector agreed with that determination and concluded that the final actions by the licensee were acceptable, and this unresolved item was closed.

DETAILS

1.0 PURPOSE

The purpose of this inspection was to assess the quality and effectiveness of BECo activities performed to resolve four unresolved items from the station blackout inspection conducted by the NRC in October 1993. The Pilgrim Nuclear Power Station (PNPS) uses a dedicated nonsafety-related diesel generator manufactured by ALCO, the same manufacturer as the emergency diesel generators. An additional unresolved item was reviewed regarding the identification of loose stator laminations found on the "A" diesel generator. This inspection was performed in accordance with the guidance provided in NRC Inspection Procedure 92903, "Followup - Engineering" and Temporary Inspection Procedure 2515/111, "Electrical Distribution System Followup Inspection."

2.0 STATION BLACKOUT INSPECTION FOLLOWUP ITEMS

2.1 (Closed) Unresolved Item 50-293/93-80-01, SBO Diesel Generator Maintenance Program

At the time of the station blackout (SBO) inspection in October 1993, BECo had failed to implement a maintenance program in accordance with the Nuclear Management and Resources Council (NUMARC) guidelines for their SBO diesel generator.

In the licensee's response letter to the NRC (Letter Number 94-027, dated March 11, 1994), BECo committed that a station maintenance procedure would be issued for the alternate ac (AAC) system which would implement a comprehensive maintenance program for the SBO diesel as specified in NUMARC 87-00, Appendix B, Criterion B.11. This procedure had been scheduled for issuance by June 30, 1994.

NUMARC 87-00 Appendix B, Criterion B.11 states that, unless otherwise governed by the Technical Specifications, surveillance and maintenance procedures for the AAC system shall be implemented considering manufacturer's recommendations or in accordance with plant-developed procedures. The inspector confirmed that the PNPS Technical Specifications did not address the AAC, therefore, surveillance and maintenance procedures for the SBO diesel generator were required.

The inspector verified that the SBO diesel generator maintenance program was formalized in June 1994, with the initial issuance of Maintenance Procedure 3.M.3-61.6, "Blackout Diesel Generator General and Preventive Maintenance." This procedure had been recently revised by the licensee on July 28, 1995, to incorporate lessons learned from SBO diesel and emergency diesel generators problem reports (PR).

The maintenance procedure addressed the required actions for major components and supporting systems, referencing the manufacturer's instruction manual, V-0540, and the accompanying maintenance instructions. However, the inspector noted that the starting air receiver safety relief valve (PSV-4505) had not been included in the maintenance procedure, nor was it referenced in the PNPS master surveillance tracking program.

The maintenance procedure incorporated lessons learned from PNPS problem reports (PR). The inspector found that one of BECo's problem reports referenced in the latest maintenance procedure had been included prior to completion of the PR evaluation. This PR had been used to justify the increase in the acceptance criteria values for the starting air compressor and the fuel oil circulating pump motor running currents. In response to the inspector's concern regarding the potential for undetected motor overloads, the licensee stated, at the exit meeting, that they had evaluated the motor thermal protection provided for these two motors and found the protection to be acceptable.

The inspector accompanied the system engineer and operations personnel and observed the performance of the daily surveillance for the SBO diesel generator. This surveillance was conducted in accordance with Procedure 2.1.12.2, Revision 7, "Station Blackout Diesel Generator Daily Surveillance." This procedure addressed components located at the A801 switchgear panel for generator control, the B40 motor control center for diesel auxiliary motors, the C190 control panel for diesel control and indication, and locally, on and around the diesel for fluid levels and other indications. The inspector identified minor inconsistencies between the maintenance and operations procedures regarding equipment titles (BODG and SBO diesel generator) and coolant level acceptance criteria (upper/lower mark vs. 30-70%). These inconsistencies did not detract from the performance of the procedures. Although the daily surveillance procedure did not address general housekeeping, the inspector observed that the system engineer prepared work requests to fix or repair loose bolts and degraded thermal insulation located at the SBO diesel outdoor radiator.

The inspector concluded that the licensee's corrective actions to resolve this unresolved item were acceptable. This determination was based on the current revisions of the SBO diesel generator surveillance and maintenance procedures which satisfactorily addressed the requirements of NUMARC 87-00, Appendix B, Criterion B.11. The licensee appropriately based those procedures on the guidance presented in the manufacturer's instruction manual.

The inspector closed this item.

2.2 (Closed) Unresolved Item 50-293/93-80-02, SBO Diesel Generator Reliability

During the SBO inspection, the team noted that the SBO diesel generator reliability data did not support the 95% target reliability goal presented in NUMARC 87-00, Appendix B, Criterion B.13. Surveillance procedure requirements for start and load test frequency had been progressively increased to a quarterly testing schedule by the time of the SBO inspection conducted in 1993. Over the period of time from 1990 to 1993, ten tests had been performed and three failures had been experienced associated with the PNPS SBO diesel generator system.

In their reply letter to the NRC, dated March 11, 1994, BECo stated that their SBO diesel generator reliability met the intent of NSAC-108, "Reliability of Diesel Generators at US Nuclear Power Plants." Section 3 of that report presented unreliability values of diesel generators with few demands, similar to PNPS's SBO diesel generator.

BECo also indicated in their reply that Pilgrim's SBO diesel generator reliability was based on historical industry data and the results of their reliability-centered maintenance program. BECo stated that the elements of the program consisted of failure history, corrective maintenance history, industry operating experience and vendor recommendations. The PNPS SBO diesel generator station maintenance procedure was scheduled for issuance by June 30, 1994.

The inspector reviewed the results of the SBO diesel generator start and load-run tests conducted between April 4, 1990, and June 16, 1995. Two additional failures occurred in 1994. The inspector confirmed that the numbers failed to support the 95% reliability goals of NUMARC 87-00 and could not realistically be attained in the foreseeable future. At the present rate of quarterly testing, the inspector noted that it would take over 7 years to reach the 95% reliability goal without experiencing another failure. The combined tests total and the number of failures experienced to date showed an improving trend. PNPS had not had any failures of the SBO diesel generator in almost a year. During that time, they have had six successful starts and five successful load and runs. None of the previous failures have been repeated. During this inspection, the inspector witnessed a successful SBO diesel start and 4-hour run with 100% rated load.

The inspector confirmed that BECo had a number of programs in place to ensure continued reliability. Those programs included a daily surveillance of the SBO diesel and the development of a reliability-centered maintenance program. The inspector reviewed evidence that the maintenance program incorporated elements from the diesel failure history, corrective maintenance performed and vendor recommendations. BECo had also taken an active leadership role in the ALCO Owners Group and hosted the last owner's group meeting at Pilgrim. The system engineer also indicated he planned to initiate a trending program on significant system parameters, similar to the program already in place for the emergency diesel generators.

This corrective action approach for the SBO diesel generator was also consistent with Generic Letter 94-01, SECY 93-044 and the associated Staff Requirements Memorandum. Based on the above review and the acceptable actions taken by the licensee, the inspector closed this item.

2.3 (Updated) Unresolved Item 50-293/93-80-03, Lack of Degraded Voltage Protection when the Emergency Buses are Powered by the 23 kV Source

During the 1993 SBO inspection, the team was concerned with the ability of the degraded voltage protection to protect safety-related loads when powered from the 23 kV supply. This concern was identified because the degraded voltage relays were found to be located on the startup transformer side of the

emergency 4.16 kV bus incoming breaker. This relay would not be capable of sensing a degraded voltage condition on the 23 kV supply. The team was concerned the Class 1E loads could be damaged by a degraded voltage condition before a SBO condition was declared.

In their March 11, 1993, response, BECo indicated that the 23 kV line did have degraded voltage protection when connected to the safety buses. The licensee stated that undervoltage relays were provided on the safety 4.16 kV buses. These relays were designed to alarm in the control room at 3950 Volts. BECo also stated that a final evaluation of the 23 kV source, including bus loadings and degraded voltage protection, was expected to be completed by June 30, 1994.

The inspector reviewed drawing E7, Revision E14, "4160 Volt System Single Line Meter and Relay Diagram," and confirmed that undervoltage relays 127A-A5 and 127A-A6 were shown connected to their respective bus voltage transformers. Drawing E5-200, Sheet 3, Revision E4, "4160 Volt Switchgear Relay Settings," indicated that these relays would drop out between 3948.9 and 3976.9 volts, based on a voltage transformer ratio of 35.07:1.

The inspector reviewed Alarm Response Procedure (ARP) C3LC, Window A3, which indicated that the annunciator window would alarm between 3949 and 3978 volts. The ARP directs the operator to Procedure PNPS 2.4.144, "Degraded Voltage." The inspector observed that a draft revision to Procedure PNPS 2.4.144 would direct the operator to Procedure 2.2.146, "Station Blackout Diesel Generator" if the bus had been powered from the shutdown transformer and the 23 kV source. The inspector confirmed that Revision 12 to Procedure PNPS 2.2.146 would direct the operator to manually load the SBO diesel generator when voltage drops below 3879 Volts.

The inspector attempted to review the final evaluations BECo had indicated would be completed by June 1994. Preliminary evaluations had been performed in June and July 1994. However, the inspector found that the analyses, required to support the final evaluation, had only recently gone through the peer review process and the preparer had not yet addressed the reviewer's comments. The inspector performed a cursory review of the unfinished calculation and did not find any acceptance criteria contained within the calculation. The calculation also did not include a computer run to demonstrate the capability to start the safety-related loads required to support an accident response. BECo committed to complete these calculations by September 11, 1995.

BECo indicated that a test of the ability of the 23 kV source to power the required loads had been satisfactorily performed on May 31, 1995. This test used Procedure PNPS 8.2.7, Revision 3, "Special Test for Shutdown Transformer Load Test." The details of this test had not been verified by the inspector during the inspection.

The 23 kV source initiates from the Commonwealth Electric Company (COM-Electric) 115 kV system at the Manomet substation. BECo produced a letter, dated May 14, 1986, from COM-Electric confirming an agreement to notify BECo of any condition at Manomet that could affect the 23 kV line from Manomet to

Pilgrim. Although no procedures could be located at COM-Electric, a printout of the computer screen from the COM-Electric System Control Center for the Manomet substation contained a window instruction to notify Pilgrim of any condition alarm or any outage affecting this supply to Pilgrim. That window instruction also included the telephone numbers for the PNPS control room and PNPS electrical maintenance. BECo called both numbers to confirm their operability and learned that the control room line listed on the Con-Electric screen had recently been disconnected. The recently disconnected contact phone number was immediately corrected as a result of this inspection.

The inspector confirmed that the established order of powering the safety-related loads was:

- auxiliary transformer from the main generator;
- startup transformer from the 345 kV grid;
- emergency diesel generators;
- shutdown transformer from the 23 kV supply; and
- station blackout diesel generator.

The inspector concluded that the combination of the existing undervoltage alarm and response procedures, the agreement with COM-Electric regarding the Manomet substation, and the order of selecting the 23 kV power source, provided adequate measures for the interim. Completion of the overdue evaluation, required to support the capability of the 23 Kv source to provide acceptable voltage for the safety-related loads, will resolve this item.

BECo committed to complete the evaluation by September 11, 1995, and to submit the results and conclusions of that evaluation to the NRC, Region I. Upon receipt and NRC review and acceptance of the results, this item will be closed.

2.4 (Closed) Unresolved Item 50-293/93-80-04, Lack of Quality Documentation to Support the 23 kV Transmission Line

During the 1993 SBO inspection, the team noted that the PNPS Technical Specification 3.9.A.2a permitted plant startup with the 23 kV supply and one 345 kV source. The team questioned the capability of the 23 kV source as a backup power source as discussed in report Section 2.3.

In their March 11, 1994 response, BECo stated that they would review and evaluate Pilgrim's final safety analysis report (FSAR), technical specifications, and their associated amendments that updated the design of Pilgrim's offsite power source. The licensee also agreed to review the technical specifications to ensure consistency with the original design.

The inspector reviewed the changes implemented by the licensee to Chapter 8 of the FSAR, submitted in response to this unresolved item. The licensee determined that no revisions to the Technical Specifications were required to be made. BECo indicated that Revision 16 to FSAR Section 8.3.4.4 stated that

the secondary power source was their alternate GDC 17 required offsite power supply. BECo concluded that even though the design basis for this source was a backup supply for only one safety bus following a LOCA, the analyses (see Item 2.3 above) would demonstrate additional margin exists.

Based upon the multiple power sources available to PNPS and that the design basis station blackout did not include a design basis event, the inspector concluded that this approach was acceptable. In addition, the inspector reviewed this approach with NRR regarding the acceptability of a GDC 17 power source only being required to supply one safety bus following a design basis event. The inspector therefore closed this item.

3.0 (CLOSED) UNRESOLVED ITEM 50-293/95-09-01, REPAIR OF EMERGENCY DIESEL GENERATOR (EDG) A

The resident inspectors documented the history related to the noise from the "A" EDG in Inspection Report 50-293/95-09. The NRC's concern was that the emergency diesel generators are important safety-related components and deserve priority attention. This potential problem was first identified in 1992 by the PNPS operations personnel. However, a formal analysis and safety evaluation was not performed or documented until the last (1995) refueling outage.

Following the initial observation, the licensee had the suspected sound verified by the generator manufacturer's representative. The system engineer made a number of requests to obtain funding for further analysis, but these requests were denied. Funding was finally approved for additional generator work during the 1995 refueling outage. The safety significance of the suspected loose generator stator laminations had not been acknowledged by BECo management until the generator was disassembled at the motor repair facility. The tear down and inspection revealed extensive missing epoxy on the lamination ends. The April 27, 1995, BECo safety evaluation concluded that the "A" EDG had been operable throughout the period of concern. This evaluation was based, in part, upon tests that had been performed by their generator repair vendor. These tests included stator insulation resistance, polarization index, and high potential tests. The inspection following disassembly of the generator confirmed that the loose laminations were protruding into the air gap, but were held in place and had not damaged the stator. The inspector concluded that the generator tests did not provide any evidence that the "A" EDG had been inoperable during the 3-year period since 1992.

The inspector met with the system engineer and electrical design engineering supervisor to review the previously raised concern regarding the loose laminations on the "A" EDG. The safety evaluation, the licensee's problem time line, generator repair, root cause analysis and corrective action were reviewed with the inspector. The inspector was concerned that the apparent decisions to delay examination of the generator were based on personnel hearing ability and budget constraints. No attempt was made to scientifically quantify and trend the noise level using acoustic monitors.

The corrective action following the examination at the repair facility was to rebuild the generator stator and seal the laminations with epoxy. Future corrective action will be to perform a boroscopic inspection of the generators on a 10-year interval. The inspector reviewed the PNPS master surveillance tracking program system cross-reference and confirmed that boroscopic inspection of both emergency generators had been added as 10-year interval tasks S007780 and S007781. The schedule also documented that the "B" EDG was also inspected during the last refueling outage.

The review of the safety evaluation, root cause, and interviews with engineering and operations personnel indicated that the evaluation of the diesel generator "A" noise was untimely in that it took 2 years for management to provide the necessary funding for the diagnostic examination to confirm the extent of the problem. The inspector concluded that this was an example of PNPS management failing to support timely problem resolution and corrective action.

Based on the inspector's review of BECo's actions once the analysis and safety evaluation had been completed, and the corrective actions taken by the licensee and noted above, the inspector concluded that adequate response to preclude this problem in the future had been taken. This item was closed.

4.0 MANAGEMENT OVERSIGHT

The inspector observed three examples where management oversight was ineffective. Two of these examples concerned the commitment to complete the evaluation to confirm the capability of the 23 kV power source. Neither regulatory compliance nor engineering management questioned the failure to complete the final analysis to support the 23 kV power source.

Regulatory compliance maintains the tracking system for commitments made in response to NRC inspection reports. Licensing Compliance Work Instruction 3.02-01, "Regulatory Commitment Control," Revision 3, was issued December 27, 1994. Subsection 6.3 addresses subsequent processing, including updating and closeout, of items listed for tracking. This new revision directs personnel to identify issues or concerns that could impact commitment completion.

Engineering management failed to recognize that the preliminary computer runs, required to support the 23 kV evaluation, were performed after the original commitment date. In addition, management failed to reassign the responsible engineer's work load during the time the responsible engineer left on medical leave.

The third example of ineffective management oversight was their untimely support for the "A" emergency diesel generator noise concern. In spite of the safety-related nature of the emergency diesel generator and the multiple requests from engineering for funding to provide further analysis to resolve the concern, it took almost 3 years for management to respond. During this same period, no formal safety evaluation was performed.

5.0 EXIT MEETING

The inspector met with BECo personnel, denoted on the Attachment, at the conclusion of the inspection on August 11, 1995. At that time, the scope of the inspection and the inspection results were summarized.

BECo personnel present did not dispute the summary or conclusions of the inspection. They acknowledged that no proprietary material was reviewed during this inspection. BECo management agreed with engineering's commitment to complete the evaluation of the secondary power source (23 kV) by September 11, 1995 and submit the results to NRC, Region I.

ATTACHMENT

Personnel Contacted

Boston Edison Company (BECo)

R. N. Anderson	Senior Engineer, Electrical		
B. Chenard	Division Manager, Electrical Engineering	*	+
S. Das	Senior Engineer, Electrical	*	+
W. DiCroce	Chief Operating Engineer		
D. W. Ellis	Supervisor, Compliance		+
K. Kee	Senior Engineer, Diesel Systems		+
W. G. Lobo	Senior Engineer, Licensing	*	+
R. J. Markovich	Department Manger, RA & EP	*	
F. J. Mogolesko	Project Manager		
H. V. Oheim	Department Manager, Engineering	*	+
L. J. Olivier	Vice President, Nuclear Operations	*	+
W. J. Riggs	Deputy Department Manager, Plant	*	+
W. C. Rothert	General Manager, Technical	*	
A. R. Shiever	Division Manager, Regulatory Affairs		+
T. A. Sullivan	Department Manager, Plant (Plant Manager)		+
T. E. Trepanier	Section Manager, Operations	*	

Nuclear Regulatory Commission (NRC)

R. A. Laura	Senior Resident Inspector	*	+
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* Denotes attendance at entrance meeting August 7, 1995.
 + Denotes attendance at exit meeting August 11, 1995