BOSTON EDISON
Pilgrim Nuclear Power Station
Rocky Hill Road
Plymouth, Massachusetts 02360

Ralph G. Bird
Senior Vice President — Nuclear

March 24 , 1988
BECo Ltr. #88- 059

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Docket No. 50-293
License No. DPR-35

Dear Sir:

This letter is being submitted in response to the Augmented Inspection Team (AIT) review of the November 12, 1987, loss of off-site power event at the Pilgrim Nuclear Power Station. The AIT review was conducted during the period of November 16-20, 1987, and was led by Mr. J.P. Durr of the Region I office. The scope, findings, and recommendations of the team were documented by Inspection No. 50-293/87-53, dated December 14, 1987.

During the AIT Inspection, Boston Edison Company (BECo) identified several actions that were being considered to improve the station's ability to respond to loss of off-site power events. These improvements included (1) installation of an additional standby diesel generator, (2) installation of a permanent backup air supply connection which provides the capacity for supplying an additional source of air to the Instrument Air System and, (3) the installation of additional instrumentation to analyze switchyard transients. The status of Boston Edison Company's actions regarding these improvements is discussed in Attachment A.

In addition, the AIT Inspection Report documented several recommendations made by the team. These recommendations were detailed in Section 2.3 of the AIT report. Boston Edison Company's plans and actions regarding these recommendations are discussed in Attachment B.

Additional comments and recommendations were noted within the AIT report, and are being resolved by BECo management. The discussion presented in Attachment B is directed to those recommendations contained in Section 2.3 as instructed by the AIT report.

Please contact me directly if there are any questions regarding this letter.

R.G. Bird

RLC/bl

Attachments:

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P737 146 166

cc:

Mr. William Russell
Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Sr. Resident Inspector - Pilgrim Station

Standard BECo distribution

ATTACHMENT A

Hardware Improvements/Installations

Boston Edison Company
Pilgrim Nuclear Power Station

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I. BLACKOUT DIESEL INSTALLATION

As a part of the Pilgrim Nuclear Power Station Safety Enhancement Program, Boston Edison Company (BECo) has installed an additional generator that can provide power in the unlikely event of a complete loss of off-site power and failure of the existing safety related diesel generators. The new blackout diesel generator can be manually started to provide 3 phase, 60 Hz, 4160 volt electrical power to safety busses A5 or A6 through new switchgear (A8).

The operation of the blackout diesel unit is self-contained and does not require the support of permanent plant systems, except a 480V AC feed for maintenance loads when the unit is not operating. Enough fuel oil storage is provided to operate the diesel at full standby rated power (2200 KW) for a minimum of one week without refueling. The unit is sized to supply one of three Emergency Core Cooling System (ECCS) pumps on either bus A5 or A6, including associated loads on that train required for loss of off-site power without a Loss of Coolant Accident (LOCA).

The installation and pre-operational testing of the blackout diesel generator has been completed.

The installation of the blackout diesel generator will significantly enhance available on-site power supplies and mitigate the effects of a station blackout.

II. INSTALLATION OF BACK-UP INSTRUMENT AIR SUPPLY CONNECTION

During the November 12, 1987, loss of off-site power, it was determined that a method for providing an additional, independent back-up air supply was needed to enhance the existing Instrument Air System. This back-up source of instrument air could be used for station blackout conditions and/or provide additional air during times when the existing system is not available due to maintenance.

Plant design Change (PDC) 87-82 provided the design for the installation of a 4" back-up air supply connection that ties into the Instrument Air System. This permanent tie-in connection was installed between air compressor K-111 and air receiver T-154. The back-up air supply connection consists of a tee, piping, isolation valve, check valve and a quick disconnect hose fitting. The back-up instrument air supply will be from a portable, oil free air compressor via a flexible hose connected to the permanent tie-in connection.

The back-up air supply connection will be isolated during normal Instrument Air System operation. The back-up air source would be used when an additional source of air is needed to support the Instrument Air System operations.

III. INSTALLATION OF ADDITIONAL INSTRUMENTS TO ANALYZE SWITCHYARD TRANSIENTS

During the loss of off-site power event on November 12, 1987, an actuation of the HU-1 differential relay occurred which tripped and locked-out the startup transformer. Because the cause of the actuation could not be readily established, significant delays were experienced in returning the startup transformer to service. Operation of the differential relay leading to lockout of the startup transformer requires thorough investigation of the transformer unit before it can be returned to service.

As a part of the Safety Enhancement Program (SEP) 345KV switchyard improvements, Boston Edison Company prepared and issued a Work Instruction (NEDWI No. 350) and Maintenance Request No. 83-46-600 to install a replacement Automatic Transient Recording System. Installation of this recording system will significantly aid in the reconstruction and analysis of transient events, such as those experienced in the switchyard and associated 345KV transmission lines during the loss of off-site power on November 12, 1987. Had the Automatic Transient Recorder (oscillograph) been installed during this event, the time required to restore the startup transformer to service would have been significantly reduced.

Installation of the Automatic Transient Recording System was completed on February 10, 1988 and is now operational.

ATTACHMENT B

Augmented Inspection Team Recommendations

Boston Edison Company
Pilgrim Nuclear Power Station

BECo Ltr. #88-
Docket No. 50-293
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I. Recommendation:

The operators were not aware of the alarm indicating the reduced voltage on the 345kv offsite power source prior to the loss of offsite power. They were also unaware of the alarm indicating the blown fuses in the analog trip system power supply. The failure to utilize these alarms should be reviewed and appropriate corrective actions developed.

Response:

Since the loss of off-site power (LOOP) event, increased emphasis has been stressed to the Pilgrim Operators regarding prompt acknowledgement and response to Control Room alarms. Night order entries and a special two week upgrade of each crew in the use of emergency operating procedures have been used to sensitize Operators to properly respond to alarms and indications.

The 345KV off-site power alarm is indicated on the plant process computer, not on a control panel annunciator. This alarm is sensitive and produces spurious alarms. This problem has been traced to transmitter calibration. A priority Maintenance Request (MR) has been issued to recalibrate the transmitter.

A recent plant Design Change (PDC) added the Analog Trip Units (ATU's) to the plant. The Operators have been trained on this system, including the associated alarm indications. Additionally, Night Order entries were also used as a reminder of ATU alarms.

II. Recommendation:

The operation of the startup transformer differential lockout relay was apparently the result of a transient for which the protection was not designed. The transformer did not experience an internal fault and the operation of the lockout delayed the re-energization of the station from offsite power sources. The actual cause of the differential lockout needs to be conclusively established.

Response:

The operation of the Start Up Transformer's differential relay, HU-1, was correct and appropriate for the incident and conditions that occurred. Further investigation will be conducted with Westinghouse concerning the behavior of this relay under conditions of motor backfeed. Presently, these relays protect the transformer from damage due to over excitation and thus increase the availability of the preferred off-site power supply.

A replacement oscillograph has been installed at Pilgrim Station. This device will provide fault data to reduce the time for analysis of future events.

III. Recommendation:

The blown fuses in the analog trip system were the apparent result of a common cause. The cause of this condition should be identified and corrected or determined to be acceptable before the reactor is restarted.

Response:

During the loss of off-site power (LOOP) event on November 12, 1987, four (4) fuses blew in the ATS cabinets resulting in a scram trip signal, a Primary Containment Isolation system actuation and a Reactor Building Isolation system actuation. Preliminary assessment of the blown fuses attributed the cause to high in-rush current during multiple energizing and de-energizing cycles of the ATS cabinets during the LOOP event. The apparent root cause was insufficient margin in the type/size fuses being used on this system under these conditions.

In order to confirm the apparent root cause, Temporary Procedure (TP) No. 87-259 was prepared and issued to determine the amplitude and duration of the in-rush current that energizing and de-energizing the ATS cabinets will produce. Although this testing could not duplicate the conditions (blown fuses) which occurred during the LOOP event, it was determined that the cumulative heating effect of rapid energization and de-energization of the ATS cabinets could blow the installed fuses. Performance of TP 87-259 determined that the existing power supply fuses have a small margin between the power supply current in-rush and the clearing time of the fuse. Based on the results of the testing performed under TP 87-259 and Engineering analysis of the time current characteristics of the installed fuses versus in-rush current measured for the Analog Trip Cabinet Current Drain, the existing ATS cabinet fuses will be changed from KWN to FNM type fuses in accordance with Field Revision Notice (FRN) 84-70-344. Installation of the FNM type fuses will increase the margin between current in-rush and the clearing time of the fuse. Completion of this action will minimize the possibility of blown fuses in the ATS Cabinets during a LOOP event.

Installation of the FNM type fuses is scheduled to be completed in March 1988.

IV. Recommendation:

The inoperability of the 'B' emergency diesel generator during the event resulted from inadequate or incomplete maintenance procedures. The binding of the prelubrication pump and the leaking fuel injectors could have been prevented from interfering with the recovery operations if adequate procedures for repair and post maintenance testing were employed.

Response:

A. PRELUBE PUMPS

Since the loss of off-site power event on November 12, 1987, an additional prelube pump failure has occurred. The cause of the prelube pump failures has not yet been fully determined. The investigation and evaluation of these failures are continuing by the Systems Engineering Division, the pump manufacturer (Viking Pump), and the diesel vendor (ALCO Power).

The failed pumps show identical casting flaws (porosity) and pitting of the idler gear teeth (similar to cavitation pitting). One of the failed pumps was sent to Massachusetts Materials Research, Inc., for failure analysis. Failure was determined to be due to a loss of internal clearance, resulting in idler gear chafing against the pump head. Chafing continued to the point of spot-melting. A metal chip tore from the running surface, welded to the rotor, and gouged the head casting. The second failed pump is being provided to the manufacturer (Viking Pump) for their analysis and repair.

The cause for the loss of internal pump clearances has not yet been fully determined. The pumps appear to be unable to compensate for thermal expansion. The pumps are direct-coupled to the motor with what appears to be a splined slip fit at the drive gear. The pumps have exhibited rust between the motor shaft and the drive gear, thus precluding freedom of axial movement at the splined, slip-fit coupling. The casting defects, while of concern regarding the quality of manufacturing, are probably not causal to the pump failures. This is believed to be true because a third prelube pump removed from the "A" EDG contained identical casting defects, but no chafing or gouging indications were identified, and the pump was running satisfactorily when removed.

During replacement of the failed prelube pump on November 13, 1987, Boston Edison Company (BECo) contacted the pump manufacturer regarding torqueing of the pump mounting bolts and head bolts. The manufacturer stated that they do not specify a recommended torque value and stated that the pumps are assembled with air wrenches. Head bolt tension is not used to set internal pump clearances. The clearances are established during pump assembly by shim-gaskets between the pump head and casing.

BECo's final determination regarding the root cause of the prelube pump failures is pending receipt of Viking Pumps failure analysis. Based on the above discussion, the prelube pump failures were not the result of inadequate procedures for repair and post maintenance testing.

B. FUEL LEAKS

During the LOOP event on November 12, 1987, the "B" Emergency Diesel Generator (EDG) cooled significantly during the period that power was unavailable to Motor Control Center (MCC) B18 and during the period that the "B" EDG prelube pump was out-of-service for replacement. When the "B" EDG was restarted on November 13, 1987, multiple fuel leaks occurred at the fuel inlet "banjo" fittings on the fuel injection pumps. These fittings are sealed using copper washer gaskets. The thermal contraction of the engine components that resulted from the drop in engine temperature from normal standby conditions was sufficient to unseat the copper washer gaskets. The manufacturer does not specify torque values for either the "banjo" fittings or the fuel inlet pipe flange bolts. The manufacturer recommends that the fittings/bolts be tightened (torqued) sufficiently to preclude leakage. In accordance with the manufacturer's recommendation, the torque on the "banjo" fittings was increased until no further fuel leakage was observed.

The investigation into this matter identified that, following overhaul of the "B" EDG, Post Maintenance testing (24 hour run) was successfully performed in April 1987. Additionally, the "B" EDG was run monthly for accomplishment of surveillance testing during the time interval from April 1987, to November 1987. During this period, no fuel leaks had been experienced at the fuel inlet "banjo" fittings.

It is recognized that, in the absence of a specified torque value for these fittings the actual torque applied during overhaul and other maintenance activities is subject to individual interpretation. It is believed that the torque applied to these fittings during overhaul of the "B" EDG was sufficient to seat (seal) the copper washer gaskets and to maintain the seal under normal operating and standby temperature conditions, but was insufficient to maintain the seal during the thermal contraction that resulted from cooldown of the engine when the prelube pump failed. The fuel leaks that resulted are not believed to be the result of inadequate maintenance procedures, but rather the result of individual interpretation of needed torque in the absence of a specified torque value by the manufacturer.

Boston Edison Company (BECo) requested the manufacturer (ALCO) to provide torque values for the fuel inlet pipe fittings that will be sufficient to prevent leakage under conditions such as those experienced during the LOOP event. In response to BECo's request, ALCO has agreed to update the diesel technical manual to include torque values for those fittings associated with the fuel inlet pipe. This action will enhance diesel maintenance activities and will minimize recurrence of this condition.

V. Recommendation:

The plant configuration before the event, and the equipment that was out of service for maintenance purposes, created operational situations that could have been more serious under other circumstances with substantial decay heat. Describe what considerations will be made in the future to assure that essential and non-essential equipment removed from service for outage maintenance do not create undue operational inflexibilities.

Response:

Prior to the loss of off-site power event on November 12, 1987, plant electrical configuration was placed in an abnormal lineup to allow for modification work to the shutdown transformer and the associated alternate 4160 volt power supplies. Although abnormal, the configuration was within the Technical Specification (TS) Limiting Condition for Operation (LCO) for the cold shutdown condition. With the plant in an operating condition, the Technical Specifications would not have permitted such an inflexible configuration and the Operator would not have allowed essential equipment, such as the shutdown 4160 volt power supply to be removed from service for modification work.

In order to improve work coordination with the plant shutdown, the work control system at the Pilgrim Nuclear Power Station is under review. Initially, an experienced Nuclear Watch Engineer (NWE) has been removed from the watch bill and temporarily assigned to work with the Maintenance and Outage Planning Groups to facilitate, prioritize and sequence work to assure that work is efficiently performed without undue impact on the operational condition of the plant. Future plans may include building on the work now being performed by the temporarily assigned Nuclear Watch Engineer.