



PECO NUCLEAR

A Unit of PECO Energy

Michael P. Gallagher, P.E.
Plant Manager
Limerick Generating Station

PECO Energy Company
Limerick Generating Station
PO Box 2300
Senatoga, PA 19464-0920
610 718 2000

T.S. 6.9.2

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

Subject: Limerick Generating Station, Unit 2
Supplemental Report to NRC letter dated
August 4, 1997

References: (1) Technical Specifications Sections 4.8.1.1.3 and 6.8.2
(2) Special Report to NRC dated August 4, 1997

This letter is a supplement to a Special Report sent to the NRC dated August 4, 1997. The original letter was submitted to the requirements of Technical Specifications (TS) Section 6.9.2 as required by TS Surveillance Requirement 4.8.1.1.3. TS Surveillance Requirement 4.8.1.1.3 requires reporting of all diesel generator failures, valid or non-valid, within 30 days. The report is required to include the information recommended in Regulatory Position C.3.b of Regulatory Guide (RG) 1.108, "Periodic Testing of Diesel Generator Units as Onsite Electric Power Systems at Nuclear Power Plants," Revision 1, August 1977.

The Special Report dated August 4, 1997 stated that specific identified components would be sent to their respective manufacturers for failure analyses. The components included the motor operated potentiometer, electronic and mechanical governors, rectifier and scavenging air blower.

PECO Energy has received analyses for the above listed components, except for the voltage regulator, and these are provided in Attachment 1. The voltage regulator requires a more in-depth failure analysis from Fairbanks Morse. If the manufacturer identifies a generic concern with the voltage regulator, that information will be forwarded to the NRC. Otherwise, this supplemental letter provides closure to all outstanding items listed in the letter dated August 4, 1997.

For additional information, please contact Mr. Keith Bersticker at (610) 718-3400.

Very truly yours,

Attachment

cc: H. J. Miller, Administrator Region I, USNRC
A. L. Burritt, USNRC Senior Resident Inspector, LGS

IE22

ATTACHMENT 1

A. Governor Control System

On July 3, 1997 at 1400 hours, the D21 Emergency Diesel Generator (EDG) was prepared for a slow start in accordance with Surveillance Test (ST) procedure ST-6-092-311-2, "D21 Diesel Generator Slow Start Operability Test Run." This ST is performed on a monthly basis. During this test run the governor control system failed, reference NRC letter dated August 4, 1997. Additional tests were run on July 10, 17 and 24. Due to difficulty in troubleshooting intermittent problems during the previous tests both the electronic and mechanical governors were replaced on July 24, 1997. The governor control system was sent to the Original Equipment Manufacturer (OEM), Fairbanks Morse, for failure analysis. The system has three components that failed:

- Mechanical Governor/Actuator
- Motor Operated Potentiometer (MOP)
- Electric Governor

Failure Analyses

I. Failure analysis of the Mechanical Governor/Actuator identified the following problems:

- A. The following wear related items were not associated with the frequency problem
1. The Ballhead Governor pilot valve plunger was chipped on its control land.
 2. The Electronic Actuator rotating bushing was chipped on the control port and scored around the bushing ID.
 3. The Electronic Actuator pilot plunger was chipped on the control and corners and scored on the land OD.
 4. Power Case - The Accumulator springs were compressed ¼ inch below minimum.
 5. Power Case - Oil gauge elbow broken off in power case mounting hole.
 6. Column and Dial Panel - Load limit cam bent
 7. Column and Dial Panel - Panel bushing ID worn oversize
 8. Column and Dial Panel - Speed setting pinion OD worn 0.0005 beyond minimum limit.

- B. The following items were most likely related to the intermittent frequency problem:
1. The Electronic Actuator Transducer magnet field strength had decreased below the minimum limit.
 2. The Electronic Actuator centering/restoring spring was separated at its center seat.

II. Failure analysis of the Motor Operated Potentiometer (MOP) identified the following problem:

The electric motor was found to operate intermittently. This would cause speed change to be intermittent when the speed control was operated from the control room. During operation of the speed control knob, actual observations made by I & C Technicians indicated that the motor operated smoothly without stopping whenever the speed control knob was operated. The actual observed problem was that movement of the MOP caused immediate jumps in speed or no corresponding speed changes. Thus the problems identified with the MOP during failure analysis most likely did not contribute to the engine speed changes observed during the ST.

III. Failure analysis of the Electric Governor identified the following problems:

- A. The 50 and 60 Hz speeds were out of tolerance.
- B. The unit was found to have a broken terminal block.

Neither of the problems found would cause the intermittent frequency fluctuations. The 50/60 Hz setting is compensated by the speed reference in the MOP and would not be intermittent. Although a broken terminal block could cause intermittent operation, the unit was found to be operating satisfactorily.

Conclusion

The failure analysis of the three governor control components indicates that the most likely cause of the failure was due to the separation of the centering spring from its center seat on the electronic actuator of the Mechanical Governor/Actuator.

Corrective Measures

The probable cause of the failure analysis has been addressed through periodic replacement of the governor control components. Preventive Maintenance tasks have been initiated to address aging related failures of governor components by periodically replacing governor components with refurbished spares.

B. Scavenging Air Blower

On August 1, 1997 a 24-hour endurance run for D21 Emergency Diesel Generator (EDG) was being performed to test a replaced governor. Typically a 24-hour endurance run is performed after each overhaul 2-year inspection. During this test, an unrelated problem was identified with the Scavenging Air Blower. During the test run, a leak was detected in the air bleed drain to the labyrinth seal, reference NRC letter dated August 4, 1997. The EDG was immediately shut down and inspected. On August 4, 1997 the Scavenging Air Blower was replaced and successfully tested. The failed blower was shipped to Fairbanks Morse, for failure analysis.

Failure Analysis

Failure analysis identified the following:

Disassembly indicated that foreign material might have attempted to enter the labyrinth seal where pressurized seal air is introduced. This material caused localized grooving of the bronze seat. This continued until the seat became attached to the labyrinth seal and then rotated with the seal such that the two rotated with the blower shaft.

The origin of the foreign material that caused the failure is not certain. It may have been introduced: (a) When the blower was assembled to the engine. (b) In connecting the various oil and air vent lines. (c) During a maintenance activity. (d) During an excessive vibration problem experienced before a failure of the #4 cylinder lower piston connecting rod joint with the crankshaft on October 9, 1997, reference NRC letter dated November 10, 1997.

Corrective Measures

The scavenging air blower failure on EDG D21 was determined to be a one-time failure due to foreign material. The scavenging air blowers are disassembled and inspected during their 2-year examination and general maintenance (Procedure M-020-024). The inspection would identify any blower abnormalities. Corrective actions would be taken at the time of discovery.

C. Voltage Regulator

On July 26, 1997 at 1018 hours, Operations personnel were performing Special Test SP-178 on D21 EDG, Governor test. The D21 EDG output voltage increased above its setpoint of 4160 VAC to 5118 VAC and remained at that level despite the opening of the load breaker. Subsequent troubleshooting revealed that a silicon controlled rectifier (SCR) in the EDG output voltage regulator's rectifier bridge was continuously conducting in the forward direction. On August 1, 1997 the Rectifier Bridge was switched to a parallel bank and testing was completed without further voltage regulator problems. The Rectifier Bridge Bank was removed and returned to the Fairbanks Morse, for further analysis.

Failure Analysis

Failure analysis of the rectifier bridge bank was inconclusive. Fairbanks Morse is conducting a more in depth analysis at this time.

Corrective Measures

1. Switched to the alternate voltage regulator rectifier bank and retested successfully on August 1, 1997
2. Removed and replaced the defective Voltage Regulator Rectifier Bank on February 26, 1999.

Unavailability

There were 156 hours of unplanned unavailability for D21 during the month of July 1997. The unplanned unavailability resulted from:

1. The replacement of the motor operated potentiometer,
2. The replacement of the engine governor control system components due to engine frequency fluctuations,
3. Swapping and subsequent testing of rectifier banks in the voltage regulator system due to failure of an SCR, and
4. The replacement of the Scavenging Air Blower due to a degraded Labyrinth Seal.

There were 72 hours of unplanned unavailability for D21 during the month of August 1997. The unplanned unavailability resulted from the replacement of the scavenging air blower due to degraded labyrinth seal and the repair of a fuel oil leak that is unrelated to this report.

These failures were the 2nd and 3rd in the last 20 valid tests.