

# PHILADELPHIA ELECTRIC COMPANY

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SHIELDS L. DALTROFF  
VICE PRESIDENT  
ELECTRIC PRODUCTION

(215) 841-5001

February 24, 1986

Re: Docket Nos. 50-277  
50-278

Dr. Thomas E. Murley, Administrator  
Region I  
U. S. Nuclear Regulatory Commission  
631 Park Avenue  
King of Prussia, PA 19406

Subject: Peach Bottom Atomic Power Station  
Diesel Generators  
10 CFR Part 21 Report

Dear Dr. Murley:

Per paragraph (3) of 10 CFR 21.21(b), the following information is being provided on the recent failure of the air blower on the E-2 diesel engine at Peach Bottom Atomic Power Station.

1. Name of individuals informing the Commission:

S. L. Daltroff  
W. T. Ullrich

2. Identification of basic component which contains a defect:

Positive displacement lobe-type (roots)  
air blower on the 3800TD8-1/8 diesel engine.

3. Identification of firm supplying the basic component:

Fairbanks Morse Engine Division  
Colt Industries  
Beloit, Wisconsin

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4. Nature of defect and the safety hazard which could be created:

The lobes of a roots air blower fragmented and seized. This prevented the flow of air to the diesel engine. The diesel subsequently stopped running due to lack of air. The cause of the failure is believed to be thermal deformation of the air blower due to extended operation at no-load and light-load conditions. This cause has the potential to be a common mode form of failure of the air blowers of similar design.

Under a Loss of Coolant Accident condition on either Unit 2 or 3 at Peach Bottom Atomic Power Station, all four diesels would start and would remain unloaded, with offsite power available, for an indeterminate period of time. In the event of a subsequent loss of offsite power, the diesel generators must assume the safeguard loads in order to bring or maintain the units in a safe condition.

The Peach Bottom diesel generators are equipped with a turbo-blower parallel scavenging air system. A positive displacement lobe-type (roots) blower is located in a parallel flowpath to the normal scavenging air inlet path to the turbochargers, and driven by a flexible drive connected to the upper crankshaft. Under no-load or light load operation, the combustion air is drawn from the atmosphere and is compressed by the roots blower. The air is then forced over the turbocharger impellers, through the air coolers and into the scavenging air receiver, which runs the full length of the cylinder block and completely surrounds the cylinder liners at the air inlet ports. The air is admitted to each combustion chamber at the proper time within the crank cycle to sweep out the

exhaust gases and provide a fresh charge for the next compression stroke.

Under little or no engine load, the exhaust gas momentum is not sufficient to turn the turbocharger impeller. As the engine load increases, the turbocharger picks up speed due to increased exhaust gas flow and creates a suction in the air inlet piping. At high loads, roughly 50-60%, the air inlet check valve opens and allows air flow to the turbochargers directly from the atmosphere. As this occurs, the roots blower is unloaded since there is no discharge pressure buildup.

At Peach Bottom, the E-2 diesel generator operated at about 21% load for 51 continuous hours isolated on its associated emergency buses when the failure occurred. This means the air inlet check valve was closed and all combustion air was passing through the roots blower. Disassembly of the engine revealed an apparent seizure of the roots blower, which caused the engine to stall from a lack of combustion air. The blower drive gear had several teeth sheared off, and the lobes of the blower exhibited multiple fractures and severe scoring of the mating surfaces. Pieces of aluminum were found in the combustion air piping, the turbocharger impellers, the scavenging air receiver, and imbedded within the grooves on the compression rings on each of the upper and lower pistons. There was no scoring of either the cylinder walls or the piston.

The Peach Bottom diesel generators have been operated at no-load for extended periods of time in the past, with no detrimental effects. Routine testing, maintenance, and trouble shooting activities such as voltage regulator response testing, overspeed trip tests, governor oil changeouts, etc. have often

required operation of each diesel at no load for about 1/2 hour, and at times in excess of 1/2 hour. The E-2 diesel generator has experienced significantly more time at light-load than the other three Peach Bottom diesels. The practice of operating the E-2 diesel isolated on its associated emergency buses when a startup feed is out of service has been employed throughout the history of the plant. It appears the E-2 air blower failure may represent the cumulative effect of this practice.

5. Date on which the information of such defect was obtained:

The air blower failed on January 24, 1986. The evaluation to determine reportability of this defect was completed on February 21, 1986.

6. The number and location of the basic component that contains a defect:

The air blowers on the E1, E3 and E4 diesel engines at Peach Bottom Atomic Power Station contain the original clearances between the lobes and the casing. The failed air blower on the E2 diesel generator has been replaced with a new air blower with increased clearances between the lobes and the casing.

7. Corrective action that has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action:

A. Repairs to the E-2 diesel generator included a complete disassembly of the engine for removal of aluminum fragments, replacement of both turbochargers and the roots blower, and replacement of the piston rings. The work was performed by our Maintenance Division with a representative from Colt. The E-2 diesel

generator returned to service on February 3, 1986.

- B. Operation of the diesel engines under no load and light load conditions will be minimized. Station personnel are aware of this guidance.
  
- C. It appears to us that a similar failure of these same model diesel generators occurred at Iowa Electric's Duane Arnold plant in June, 1984. The Duane Arnold failure was analyzed by Colt Industries, and it was concluded that the failure was due to excessive operation of the engine at no-load conditions. It was Colt's assessment that, under these conditions, the duty of the blower remains high and its housing deforms unevenly due to the resulting thermal gradient, eventually reaching the point that rubbing occurs between the blower lobes and the housing. It is suspected that long term creep deformations may have contributed to this problem. The Duane Arnold experience prompted Colt to redesign the blower to increase the clearance between the lobes and the casing so as to eliminate this problem. Since that time, all new or rebuilt blowers handled by Colt have been provided with this new clearance. No formal recommendation has been made by Colt to replace existing blowers in those diesels in nuclear use; however, Colt has recommended that all nuclear utilities perform dimensional checks of the roots blower clearances during each annual diesel generator inspection and that no load operation of the engine should be held to a minimum (a five minute maximum was specified). These recommendations were made by Colt in a Service Information Letter issued on November 15, 1984.

Mechanical Engineering personnel have investigated with Colt personnel the basis for the five-minute time limit, and



have concluded that it was only intended as a conservative guideline for routine operations. Exceeding it will not result in an immediate and catastrophic diesel failure; thus, operation of the diesels at no-load conditions for a period of 1/2 hour following a LOCA, with offsite power available, is acceptable. The following forms the basis for this conclusion.

- 1) The five-minute time limit has no analytical or operational basis. Colt senior engineering personnel indicated that the controlling factor was a desire to limit the temperature rise across the blower and that five minutes represented a conservative safe operating period.
  - 2) The determination of a limiting temperature differential likewise is supported by little, or no, meaningful analysis by Colt. Due to the complex geometry of the blower casing it would be impossible to draw any meaningful conclusion from a simplistic analysis. Finite element or finite difference simulation of the thermal deformation, or comprehensive laboratory testing, would be required.
  - 3) Operation of the Peach Bottom diesels at no-load conditions for 1/2 hour periods in the past has not caused air blower failures.
- D. In order to enhance the reliability of the Peach Bottom diesels, a modification will be installed to allow manual tripping of the diesels within the 1/2 hour time period. Although the capability presently exists to trip the diesels while a LOCA signal is present, the required actions are time consuming and necessitate operator actions outside of the control room. As a result, Electrical Engineering Division has begun to implement a modification to add the capability for an operator to manually

trip the diesels from the control room while a LOCA signal exists. A time delay relay will prevent this action within the first ten minutes following a LOCA. This modification will have no effect on the automatic start capability of the diesels in the event of the loss of offsite power. A number of procedural revisions will be required to reflect this change. These changes will be implemented by station personnel after the modification has been tested. The completion of this modification is estimated to be March 8, 1986.

- E. Colt has indicated that the increased clearance between the lobes of the blower and its housing has been incorporated into all blowers manufactured or rebuilt at Colt since the Duane Arnold incident. This increased clearance will provide sufficient room for thermal expansion during extended periods of no-load or light-load operation. Mechanical Engineering Division is working with Colt to establish a schedule for the earliest possible replacement or remachining of the E-1, E-3 and E-4 air blowers in order to provide the required clearance. The new air blower installed on the E-2 diesel generator already has this increased clearance.
- F. Mechanical Engineering Division will formally request by March 3, 1986 that Colt revise its Service Information Letter on this subject so it is more fully descriptive of the appropriate concerns and operating limits.
- G. Colt has been asked to complete a thorough evaluation of the damaged components from the E-2 diesel to confirm the cause of failure.

8. Notification

The industry was notified of the air blower failure via INPO's Nuclear NETWORK on February 5, 1986.

Very truly yours,

A handwritten signature in cursive script, appearing to read "T. Murley", written in dark ink.

cc: Director, Office of Inspection & Enforcement (3 copies)