UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

November 30, 1992

NRC INFORMATION NOTICE 92-78: PISTON TO CYLINDER LINER TIN SMEARING ON COOPER-BESSEMER KSV DIESEL ENGINES

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to problems that could result from specific diesel engine (piston and cylinder) wear characteristics that may lead to crankcase explosions. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

In 1989, two emergency diesel generator (EDG) crankcase explosions occurred at the Susquehanna Steam Electric Station. Following these events, Pennsylvania Power and Light (PP&L), the licensee, conducted a root cause evaluation. PP&L determined that the root cause of the crankcase explosions was excessive friction between the piston and the cylinder liner. PP&L found that the synergistic effects of rapid loading, piston and cylinder lubrication conditions, and possibly other factors such as the quality of the lubricating oil and the temperature of the engine intake air led to an excessive transfer of tin from the piston to the cylinder liner and a breakdown of the lubrication film, resulting in overheating of engine parts. These overheated components provided an ignition source for the oil vapor in the crankcase, causing an explosion. The licensee has taken actions to correct these problems and has successfully operated the EDGs at Susquehanna since 1990 with no indications of damage or malfunctions.

Discussion

PP&L conducted an investigation over a two year period following the crankcase explosions at Susquehanna in 1989 with assistance from Cooper-Bessemer, the EDG vendor, and other consultants. PP&L determined that engine components

overheated after an excessive amount of the tin from the 0.05 to 0.075 millimeter [2 to 3 mil] thick tin plating on the piston was transferred to the pores in the cylinder liner. The pores in the liner, which has a porosity of 15 to 25 percent, would normally be filled with oil for lubrication between the piston and the cylinder liner. The loss of liner porosity inhibited the formation of an oil film and caused excessive friction between the piston and the cylinder liner. The excessive friction caused overheating of components inside the engine, most likely bearings associated with the drive train. The presence of overheated components in the engine caused an explosion in the crankcase. PP&L personnel noted that the tin from the piston was transferred or smeared predominantly from the non-thrust side of the piston.

PP&L improved the lubrication of the piston and liner by permanently removing the wrist pin end caps and the bottom oil scraper ring from the piston. This change increases the oil flow to the area where the piston and the liner make contact. The EDG vendor, Cooper-Bessemer, considers these modifications to be acceptable.

The Cooper-Bessemer Owners Group wrote a draft document, "Inspection Manual for Cooper-Bessemer Model KSV Diesel Engine Cylinder Liners, Pistons, and Bearings," dated April 8, 1992. Although the inspection manual was in draft format and only partially completed, the Niagara Mohawk Power Corporation followed the guidance in the manual and detected degraded pistons and liners at its Nine Mile Point Nuclear Station, Unit 1. Licensee and Cooper-Bessemer personnel were in the process of completing a 5-year preventive maintenance inspection on the engines using previously approved inspection procedures and the inspection personnel had not considered any of the pistons and liners unacceptable based on those procedures. However, on the basis of the new inspection criteria in the draft inspection manual, the licensee rejected and replaced 15 of 32 pistons and liners on 2 engines because of excessive tin smear from the pistons to the liners.

The owners group plans to periodically revise the inspection manual when new problems or solutions are discovered, including changes to the inspection procedures and photographic examples of conditions that have been found.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: J. R. Rajan, NRR
(301) 504-2788

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(215) 337-5261

Attachment: List of Recently Issued NRC Information Notices
See file jacket

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-77	Questionable Selection and Review to Determine Suitability of Electropneumatic Relays for Certain Applications	11/17/92	All holders of OLs or CPs for nuclear power reactors
92-76	Issuance of Supplement 1 to NUREG-1358, "Lessons Learned from the Special Inspection Program for Emergency Operating Procedures (Conducted October 1988 - September 1991)"	11/13/92	All holders of OLs or CPs for nuclear power reactors.
92-75	Unplanned Intakes of Airborne Radioactive Material by Individuals at Nuclear Power Plants	11/12/92	All holders of OLs or CPs for nuclear power reactors.
92-74	Power Oscillations at Washington Nuclear Power Unit 2	11/10/92	All holders of OLs or CPs for nuclear power reactors.
92-61, Supp. 1	Loss of High Head Safety Injection	11/06/92	All holders of OLs or CPs for nuclear power reactors.
92-73	Removal of A Fuel Element from A Research Reactor Core While Critical	11-04/92	All holders of OLs or CPs for nuclear power reactors.
92-59, Rev. 1	Horizontally-Installed Motor-Operated Gate Valves	11/04/92	All holders of OLs or CPs for nuclear power reactors
92-72	Employee Training and Shipper Registration Requirements for Transporting Radioactive Materials	10/28/92	All U.S. Nuclear Regulatory Commission Licensees.

OL = Operating License
CP = Construction Permit

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