Coltec Industries

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Document Control Desk
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Opposed Piston Engine (8-1/8) Piston Cracking

To Whom It May Concern:

On the 6th of February 1992, through an Internal Quality Assurance audit we found a cracked piston casting. Upon further investigation, it was found that three basic piston castings were involved from one supplier. These were F16402983 (first received from ACME Foundry on 01/03/89), F16401372 (first received on 03/18/88) and F16106631 (first received on 12/02/87). Since these parts make several pistons and subsequently many assemblies, their location, customer order number and quantity shipped will be included as Attachment 1 to this notification.

The defect has been evaluated as a mishandling crack, most probably a hot tear caused by a lack of a riser fillet under the riser pad at the parting line, and compounded by the process used to remove the riser. To discover the defect, which is predominately so tight that it cannot be seen to the unaided eye, a wet magnetic particle test was performed on all pistons in our inventory. We examined 1,939 pistons and found 50 cracked, or a 2.58% overall defective rate. During the evaluation, we attempted to inspect pistons in the rough state; however, since the defect is mid wall to 1/4 diameter subsurface, we met with no success. Pistons had to be at least rough turned to detect any cracking. We also found that finished tin plated pistons could be accurately examined.

Our investigation revealed that the cracks occur at the same riser location on each part number. However, due to piston design, the "983" pistons have the crack appear at and below the bottom of the top set of ring grooves, at the 3 o'clock position, with the part number as the 12 o'clock reference point. The other two part numbered pistons have ring grooves machined lower on the piston, such that the defect is found on the ring land between the 2nd and 3rd compression ring, predominately at 9 o'clock.

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Having completed inspection of all on hand stock pistons or assemblies, including several completed engines, the following rejection rates on ACME Foundry cast pistons were:

16402983 - 657 inspected, 42 rejected - 6.39% reject rate.
16401372 - 627 inspected, 5 rejected - 0.80% reject rate.
16106631 - 655 inspected, 3 rejected - 0.46% reject rate.
TOTAL 1939 inspected, 50 rejected - 3.58% reject rate.

No other pistons cast prior to use of ACME Foundry were found to contain cracks. The problem is confined to pistons made by ACME Foundry.

Our evaluation was completed on 17 March 1992. Our conclusion is that if such cracked pistons are installed in engines, two failure modes are possible. First, with extended time of engine operation, the crack may continue into the ring groove such that a small piece of the piston land could come loose. Second, the crack may propagate through and around the wall so that the skirt would separate from the crown. Either case could result in further engine damage.

Additionally, we still have several hundred pistons out for plating, which will be magnetic particle tested upon receipt at Coltec, Fairbanks Morse, before they go to stock. The exact date of return for these parts is not yet known.

Effective on the date of discovery, Fairbanks Morse went to 100% MT of all pistons. ACME Foundry has prime corrective action responsibility to produce castings that do not have cracks. Fairbanks Morse has a secondary corrective action responsibility to prevent existing "cracked" stock from being shipped to all customers. ACME was contacted on the 7th of February, an ACME Sales Representative was at Fairbanks Morse on the 10th, and cracked samples were sent to ACME on the 14th of February. There have been several meetings between ACME and Fairbanks Morse. A Quality Assurance corrective action audit was conducted at ACME on March 11. It is apparent that the root cause is in handling and riser removal techniques. Risers are now plasma arc cut, instead of being knocked off with a large hammer. Also, a pattern change has been made so that the risers contact the piston at a heavy section, which has not shown cracks. This was done to minimize the potential for handling damage. We are awaiting receipt of the sample castings poured on 3/10 and 3/11 to assess the effectiveness of corrective action taken by the foundry. Results of the foundries corrective action efforts with the pattern equipment should be known by 10 April 1992. We will continue to magnetic particle inspect pistons 100%.

In Attachment 1 to this report, we list the location of known ACME pistons and any licensee who has pistons of unknown origin to Fairbanks Morse at this time (meaning those pistons could have been cast by Fairbanks Morse, General Casting, or ACME; however from records alone we can not determine who cast the pistons). The utility is to remove all ACME pistons from their engines as soon as possible. These pistons must be returned to Fairbanks Morse for magnetic particle inspection. An RG number must be obtained prior to return.

Fairbanks Morse will replace all pistons found to be cracked, and return those that are acceptable.

The pistons involved are only those 8-1/8 pistons supplied under basic part number 1642983, 16401372, and 16106631, which were cast starting with the dates of November 1988, February 1988, and November 1987 respectively. The heat date can be found on the bottom flat area of the piston skirt. The supplier logo (AF) is located inside the piston just above the casting part number. It is to be emphasized that the above work need only be done to ACME Foundry pistons with heat codes (dates) such as 0198, as an example. Piston heat codes (dates) are identified on Attachment 1. Fairbanks Morse or General Casting pistons will exhibit a cast date such as 10-21-82, and can be readily segregated from ACME Foundry pistons. Suspect pistons in engines can be identified, using an appropriate engine inspection methodology check the bottom of the piston skirt for cast heat dates.

Sincerely,

Michael S. Horinka

M. S. Horinka
Manager Quality Assurance
Nuclear and Military

MSH/dkc

Attachment

Attachment 1

Part #	Utility	Plant	Casting	Qty	Customer	Mt.Code
16608?00	Alabama Power	Farley	16402983	2	QP-4914	unknown
16603301	Alabama Power	Farley	16402983	2	QP-4914	unknown
16608300	Arkansas Power	ANO#1	16402983	15	P0211059	unknown
16608301	Entergy	Unit 2	16402983	9	P0901295	unknown
16608301	Arkansas Power	Unit 2	16402983	8	P0899262	unknown
16608301	Arkansas Power	Unit 2	16402983	16	P0211059	unknown
16608300	Detroit Edison	Fermi II	16402983	18	NM-227290	unknown
16608301	Detroit Edison	Fermi II	16402983	22	NM-227291	unknown
16606468	GPU Nuclear (Sold as CGI)	TMI 1	16106631	2	0101258	unknown
16401372	Iowa Electric	Duane Arnold	16401372	10	S54313	9050,9051, 9055,9054, & 9052
16102802	Iowa Electric	Duane Arnold	16106631	11	S54313	9149,9150, & 9172
16611224	PECo	Limerick	16402983	1of26	LS606667	9109
16611224	PECo	Limerick	16402983	5	GS279725-000037	9108, 9109 (3), & 9110
16608300	PECo	Limerick	16402983	1	LS630611	0057 or 0089
16608301	PECo	Limerick	16402983	1	LS630611	0057 or 0089
16606468	PECo	Peachbottom	16106631	2	BW640809	0037,0039
16401372	Vermont Yankee	Vermont Yankee	16401372	2	45708	0128

Pooled Equipment Inventory Company-16402983 castings in all cylinders.
Uppers: 0032, 0057, 0056, 0057, 0057, 0056, 0056, 0056, 0056, 0033, 0057, 0056
Lowers: 0029 (all 12 cylinders)

Attachment 1

Entergy Operations, Inc.
Arkansas Power Company
William E. Converse
Operations Assessment Superintendent
Nuclear Operations
Route 3 Box 137G
Russellville, AR. 72801

Iowa Electric Company
3277 Daec Road
Palo, Iowa 52324
Attention: Dave Wilson
Plant Superintendent

Philadelphia Electric Company - Peachbottom
R.D. # 1
Box 208
Delta, PA. 17314
Attention: Kenneth Powers,
Plant Manager

Philadelphia Electric Company
965 Chesterbrook Boulevard
63B-3
Wayne, PA. 19087-5691
Attention: Mr. Hufnagel,
Branch Head,
Balance of
Plant Systems
cc: Bill McFarland, Systems Eng.

Alabama Power Company
J. E. Gallington
General Manager, Nuclear Support
P. O. Box 1295
Birmingham, AL. 35201

Vermont Yankee Nuclear Power Corp
Governor Hunt Road
Vernon, VT. 05354
Attention: Rick McCullough
Experience Assessment
Coordinator

Detroit Edison
6400 N. Dixie Highway
Newport, MI. 48166
Attention: Jerry Bragg,
Supervisor,
Procurement QA

Pooled Equipment Inventory Co.
c/o Southern Electrical
International
P.O. Box 2625
Birmingham, AL 35202
Attention: Q.A. Manager

GPU
1 Upper Pond Road
Parsippany, New Jersey 07054
Attention: Charles Paczalt
Mgr Nuclear Assurance