General Information or Other (PAR) Event # 41011

Rep Org: NAK ENGINEERING INC		**Notification Date / Time:** 09/02/2004 12:21 (EDT)	
Supplier: NAK ENGINEERING INC		**Event Date / Time:** 09/02/2004 08:38 (PDT)	
		Last Modification: 09/02/2004	
Region: 4	**Docket #:**		
City: WINDSOR	**Agreement State:** Yes		
County:	**License #:**		
State: CA			
NRC Notified by: ANDREW M. KATZIN	**Notifications:**	WILLIAM JONES	R4
HQ Ops Officer: ARLON COSTA		JOEL MUNDAY	R2
Emergency Class: NON EMERGENCY		VERN HODGE	NRR
10 CFR Section:			
21.21 UNSPECIFIED PARAGRAPH			

PART 21 REPORTING: HISTORY OF EMERGENCY DIESEL GENERATOR PISTON DEFECT

The Nordberg single piece, ductile iron piston, a component of the Nordberg Diesel Engine (Model FS 1316HSC) Emergency Diesel Generator, has a history of sub-surface porosity problems in the upper ring belt area. This porosity has resulted in the initiation of cracks in the compression ring grooves and ultimately the separation of the piston crown from the piston skirt. Once the crown comes loose from the skirt, it can result in catastrophic damage to the cylinder head, cylinder liner, cylinder bock, connecting rod, and crankshaft. This damage can result in the loss of the safety function of the emergency diesel generator.

The plant affected is owned by Progress Energy, Brunswick Nuclear Project (CP&L), Brunswick, NC. The component serial number is 1030-1328/1331, model FS 1316HSC. The manufacturer has described in details the concerns, conclusions and corrective action recommendations made regarding the current pistons in use at the facility.

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Facsimile TRANSMITTAL

To: Vernon Hodges
Operations Center

Of: Nuclear Regulatory Commission

Fax: 301-816-5151

Pages: 12

Date: 9/2/04

Re: 10 CFR Part 21 Reporting

Vernon Hodges,

Please find attached our 10 CFR Part 21 report. Please acknowledge receipt of this filing. Any questions or concerns please feel free to call me.

Regards,

Andrew M. Katzin
President
NAK Engineering, Inc.

From the desk of...
Andrew M. Katzin
President
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Nuclear Regulatory Commission
Operations Center
Washington D.C. 20555

September 2, 2004

Re: 10 CFR Part 21 Reporting
Fax: 301-816-5151

Ref: Nordberg Diesel Engine Emergency Diesel Generators
Location Brunswick Nuclear Project, Southport North Carolina

Subject: Potential Significant Safety Hazard of Nordberg Ductile Iron Pistons in use at BNP

Dear Sir;

In accordance with the requirements of Title 10, Chapter 1, Code of Federal Regulations, Part 21, NAK Engineering, Inc. hereby notifies the commission of a potential defect or condition in a component of the Nordberg Diesel Engine (Model FS 1316HSC) Emergency Diesel Generator. There exists a potential problem with the ductile iron pistons, a major component of the unit.

Utility	Site	Serial Numbers	Model
Progress Energy	Brunswick, NC	1030-1328/1331	FS 1316HSC

Piston Defect

The Nordberg single piece, ductile iron piston has a history of sub-surface porosity problems in the upper ring belt area. This porosity has resulted in the initiation of cracks in the compression ring grooves and ultimately the separation of the piston crown from the piston skirt. Once the crown comes loose from the skirt, it can result in catastrophic damage to the cylinder head, cylinder liner, cylinder bock, connecting rod, and crankshaft. This damage can result in the loss of the safety function of the emergency diesel generator.

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We have attached our report preface that was originally sent to Progress Energy BNP which describes in detail the concerns, conclusions and corrective action recommendations made regarding the current pistons in use at the facility. This preface describes the history overview of the piston failures and the root cause of the problem. We will be pleased to forward additional information should you require.

Please acknowledge receipt of this filing via return mail, fax or e-mail. Please feel free to call or write should you have any additional questions or concerns.

Sincerely,

Andrew M. Katzin
President
NAK Engineering, Inc.
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Windsor, CA 95492
707-542-9996
707-542-6666 (Fax)

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NAK Engineering, Inc. TMF (Technical Manual File)
Report Number: 1556
Date: January 26, 2004

Title: Safety Warning regarding the use of ductile iron pistons in Nordberg FS Series Diesel and Duel Fuel Engines rated at 180 BMEP and above.

Purpose: To notify Brunswick Nuclear Project of the Safety Concern that exists in the FS1316HSC Nordberg EDG units and determine if there are conditions at BNP that could result in a catastrophic engine failure.

Engine Models: All Nordberg FS Series Engines of 180 BMEP and above.

Reference Units: Brunswick Nuclear Project. BNP will be referenced in the following report and is the same in any documentation that may be attached as Carolina Power & Light, Progress Energy, United Engineers.

Report Prepared by: _____
Date: 1-26-2004

Reviewed and Approved by: _____
Date: 1/26/04

Copies to: Russ Cusick - Brunswick Nuclear Project(CP&L)

_____

_____

_____

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Preface:

In response to your inquiry, NAK Engineering, Inc. has been asked to address any possible Safety issues that relate to the Nordberg Diesel Engines at BNP. We have been asked to offer our evaluation of potential Safety concerns following a recent Operational Experience Report: (OE17526-followup to Preliminary OE17431-Standby EDG (Emergency Diesel Generator) at the South Texas Project. Although the preliminary indication shows that the cause of the failure of the KSV engines at STP was likely a connecting rod failure, the fundamental cause of the failure was in the inadequate design, engineering, assembly and testing of that specific component. We have attached documentation showing the similar concerns in the design, engineering and testing of the Nordberg ductile iron piston used in the BNP Nordberg units.

This report will show the chronology and evolution of the Nordberg ductile piston and documents the history of failures of these pistons. The documents indicate that even after pattern and casting changes, additional machining and finishing changes and additional quality assurance and control, the Nordberg ductile iron piston continued to fail.

History:

We have attached documentation on the history of the Nordberg ductile piston failures and different remedies that Nordberg Manufacturing took to try to mitigate the inherent ductile iron piston flaws. We have put together this report for your evaluation. Some of the enclosed documents cover the BNP engines specifically and what Nordberg did regarding these engines. Other sections of the report document specific piston failures in the field and Nordberg's attempt to remedy the problem with a variety of fixes, from "stop gap" to "preferred" solutions.

In and around August, 1972, the ductile iron piston was deemed a "stop gap measure" (Nordberg Engineering Order E.O. 71498) until a fully developed effective replacement was available for the continuing failing of the ductile iron piston. Nordberg made "fixes" to the ductile iron piston, such as additional machining in the ring belt area and also shot peening in the crown area (revisions to the 5483-4529 piston). The documentation shows that these "fixes" were not solving the piston failures for the Nordberg units and that the failures were continuing for those units 180 BMEP and above.

The documentation shows that Nordberg Manufacturing Company had asked several piston manufactures to propose a replacement piston. Nordberg discussed developing their own design, but opted for the Mahle Piston Company's designed piston. The Mahle Style Piston (2 piece piston, steel crown and aluminum skirt) was eventually the replacement recommended and adopted by Nordberg for units of 180 BMEP and above.

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The documents show that the BNP units were certain candidates for the improved design. We have attached Nordberg TMF 1530 from 1973 stating that the BNP units were to have this change out of the problem ductile pistons. This TMF also goes further in that a torsional analysis was actually performed on the BNP units specifically in the anticipation of this piston change out. By the time this TMF was issued, Nordberg was in the process of selling the engine business to Cooper Industries. The documents show that there was a concern at Nordberg regarding the cost of replacement and other warrantee and liability issues. Much of this documentation has been discovered in our original Nordberg document archives and has been included in this report.

There are many memos and documents regarding the Mahle Style Piston and it's suggested replacement of the ductile piston between Nordberg; Cooper and many of its customers. But the recommendation by Nordberg Senior Engineers of the Mahle Style Piston as the eventual approved replacement piston for the units rated at 180 BMEP and above was determined the solution for the continued failure of the ductile iron piston. Although Nordberg experienced piston problems in engines as low as 160 BMEP, the documents show that all Nordberg Engines rated at 180 BMEP and above were the subject of great concern. Some of the enclosed documented Nordberg FS Series ductile piston failures include units at the City of Wahoo, Nebraska, Duke Power Company, Starrett City, NY, Several United States Air Force Installations, Blue Circle Cement, SMEDE, Blue Earth Minn., American Samoa, Transcontinental (Williams) Gas Pipeline, Chiquita Corp. and several others mentioned for piston replacement.

We have read through thousands of pages of Nordberg Memos, Engineering Orders (E.O.'s) Quality Control Documents and other Nordberg piston related documentation, and have collated these relevant pages in the following report. We offer our recommendations based on the attached documentation and that Nordberg was in the process of making, should they have continued to support the Nordberg Diesel Engines.

We have included the following timeline showing the chronology of the Nordberg ductile iron piston failures. This list is specific in time from the first reported failures through the failures at Kings Plaza New York in the 1970's. This timeframe shows the discussions between Nordberg Manufacturing Company, Cooper Industries and several of their customers during the development and acceptance of the Mahle Style Piston as the replacement for the ductile iron piston.

NORDBERG PISTON FAILURE TIMELINE

04/10/1962 NORDBERG CONFIDENTIAL MEMO
PISTON FAILURE

01/11/1964 USAF PISTON FAILURE FORTUNA AFB NORTH DAKOTA

07/26/1964 USAF PISTON FAILURE FORTUNA AFB NORTH DAKOTA

10/15/1964 USAF PISTON FAILURE FORTUNA AFB NORTH DAKOTA

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12/18/1964 USAF LETTER TO NORDBERG RE: PISTON FAILURES

12/29/1964 NORDBERG INTER-OFFICE MEMO USAF PISTONS

01/13/1965 TMF-1178 PARTS FAILURE REPORT
PISTON IV 5483 4426 (USAF)

09/01/1970 BLUE EARTH PISTON FAILURE @ 7613 HRS.

10/06/1970 TMF-1452 PISTON FAILURE BLUE EARTH . .

03/31/1971 FIELD ENGINEERING REPORT 2897 PISTON FAILURE WAHOO NE.

9/17/1971 TMF-1479-A, PART II PISTON METALURGICAL INSPECTION

11/24/1971 NORDBERG INTER-OFFICE MEMO FROM ROBERT WICZYNSKI TO LEO BRINSON RE: UNITED ENGINEERS – CAROLINA POWER & LIGHT PROBLEMS EXPERIENCED AT DUKE POWER.

12/13/1971 NORDBERG INTER-OFFICE MEMO UNITED ENGINEERS

12/31/1971 PISTON #1, UNIT 1, KINGS PLAZA FAILS.

01/08/1972 PISTON #6, UNIT 1, KINGS PLAZA FAILS.

01/09/1972 PISTON #3, UNIT 3, KINGS PLAZA FAILS.

01/17/1972 PISTON #3, UNIT 1, KINGSPLAZA FAILS

01/19/1972 PISTON #8, UNIT 1, KINGS PLAZA FAILS.
03/02/1972 PISTON #2, UNIT 2, KINGS PLAZA FAILS

04/04/1972 NORDBERG ISSUES PAGE 901 FOR CP&L "AS BUILTS" SPECIFYING PISTON 5483 4522. LATER CANCELLED UNDER EO 83496.

05/06/1972 PISTON #3, UNIT 5, KINGS PLAZA FAILS.

05/24/1972 NORDBERG INTER-OFFICE MEMO TO LEO BRINSON FROM ROBERT WICZYNSKI
13 ½" PISTON PROGRAM WITH ATTACHMENTS

05/25/1972 PISTON #6, UNIT 2, KINGS PLAZA FAILS.

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06/07/1972 NORDBERG INTER-OFFICE MEMO TO W. M. WALLACE FROM LEO BRINSON RE: 13 ½" PISTON

06/30/1972 NORDBERG INTER-OFFICE MEMO TO W. M. WALLACE FROM LEO BRINSON 13 ½" PISTON PROGRAM

07/27/1972 PISTON #5, UNIT 4, KINGS PLAZA FAILS

08/10/1972 EO 71498 PISTONS "STOP GAP" MEASURE

08/24/1972 NORDBERG INTER-OFFICE MEMO TO CARL PAYNE FROM FRANK MACEJKOVIC RE: INTERNALLY MACHINED 13 ½" PISTONS

10/12/1972 NORDBERG INTER-OFFICE MEMO FROM F. T. FINLEY RE: VISIT TO MAHLE

12/27/1972 NORDBERG INTER-OFFICE MEMO FROM FRANK MACEJKOVIC TO F. T. FINLEY RE: TEST OF MAHLE PISTONS

01/02/1973 TMF-1516 QUALIFTY ACCEPTANCE REQUIREMENTS PISTONS - FOUR CYCLE 13 ½" ENGINE.

01/29/1973 -01/31/1973 – TR-434 ENGINE TEST REPORT ISSUED FOR 1030-1328 ACTUAL ENGINE TESTED. FIELD REPORT 3394.

01/30/1973 DRAWING REVISION "A" TO 5483 4529 WITH EO 75226 SPECIFIED FOR S/N 1030-1349 "TO DESIGN FOR A PISTON WITH HIGHER LOAD CAPABILITIES. DETAIL "G" MORE CLEARLY DEFINES THE AREA TO BE SHOT PEENED.

02/15/1973 TMF-1520 PROCEDURE AND RULES FOR INSPECTING FINISHED PISTONS OF THE 5483 4513 TYPE FOR CASTING IMPERFECTIONS

03/01/1973 EMERGENCY DIESEL GENERATORS ARE TO BE INSTALLED AND READY FOR START UP AT BRUNSWICK (SEE NORD MEMO 12/13/1971

03/15/1973 PISTON #3, UNIT 2, KINGS PLAZA FAILS

03/27/1973 NORDBERG INTER-OFFICE MEMO TO BILL COBB FROM FRANK MACEJKOVIC RE: MAHLE PISTON

04/01/1973 PISTON #8, UNIT 1 KINGS PLAZA FAILS @ 3:35 PM. THIS PISTON

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WAS INSTALLED 01/19/1972 AS A NEW REPLACEMENT

04/04/1973 MEETING AT KINGS PLAZA – NORDBERG ACKNOWLEDGES THAT PISTONS ARE FAILING EVEN AFTER X-RAY INSPECTION AND FOUND TO BE FREE OF DEFECTS.

04/10/1973 12:00N KINGS PLAZA HAS MEETING WITH MAHLE PISTON CO WITHOUT NORDBERG TO DISCUSS PROS-CONS OF TWO PIECE PISTON.

04/12/1973 PISTON CYLINDER #7, UNIT 3, KINGS PLAZA FRACTURED @ 6:10PM. THIS PISTON HAD BEEN REMOVED FROM CYLINDER #7 UNIT 1, ON 02/14/1972, X-RAYED, FOUND TO FREE OF DEFECTS AND PUT BACK INTO SERVICE.

04/16/1973 MR. R.S. SOLOMON OF KINGS PLAZA CALLS MR. DWAYNE CHRISTIANSEN OF REDWOOD FALLS TO DISCUSS NORDBERG PISTON PROBLEMS. MR. CHRISTIANSEN STATED THAT THEIR ENGINE HAD ACCUMULATED 1997 HOURS SINCE 1969, BUT HAD EXPERIENCED BOTH WRIST PIN AND PISTON FAILURES. DURING A PISTON INSPECTION PROGRAM 8 PISTON WERE PULLED OUT AND SHIPPED TO NORDBERG FOR X-RAY INSPECTION.

04/26/1973 NORDBERG INTER-OFFICE MEMO RE: KINGS PLAZA PISTONS

04/24/1973 -04/26/1973 – TR-435 ENGINE TEST REPORT ISSUED FOR 1030-1329 ACTUAL ENGINE TESTED.

04/26/1973 NORDBERG LETTER TO KINGS PLAZA RE: PISTON CHANGEOUT

05/01/1973 PISTON #3, UNIT 5, KINGS PLAZA FAILS.

05/13/1973 TWO-PIECE MAHLE PISTON INSTALLED IN CYLINDER #8, UNIT 1, KINGS PLAZA FOR TESTING. REMOVED 07/01/1973 FOR INSPECTION

05/13/1973 PISTON #3, UNIT 2, KINGS PLAZA FAILED @ 6:20 AM. THIS PISTON WAS INSTALED ON 3/22/1972 AS A NEW REPLACEMENT?

06/26/1973 EO83496 PISTON CHANGE UNITED ENGINEERS
"TO PROVIDE ENGINES WITH BEST PISTONS AVAILABLE BECAUSE OF SEVERE SERVICE REQUIREMENTS."

06/29/1973 NORDBERG INTER-OFFICE MEMO TO BILL COBB FROM FRANK

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MACEJKOVIC PISTON AND PISTON RING CHANGEOUT
UNITED ENGINEERS 1030-1328/31
AMERICAN SAMOA 1030-1346/47

07/05/1973 NORDBERG ANNOUNCES DECISION TO DISCONTINUE THE MANUFACTURE OF ENGINES.

07/06/1973 COOPER & NORDBERG ENTER INTO NEGOTIATIONS TO SELL/BUY THE PARTS BUSINESS

07/09/1973 NORDBERG INTER-OFFICE MEMO TO CARL PAYNE FROM FRANK MACEJKOVIC UNITED ENGINEERS ENGINES.

07/11/1973 TMF-1529 INSPECTION OF MAHLE PISTONS AFTER FIRST 600 HRS

07/16/1973 TMF-1530 TORSIONAL CRITICAL SPEED ANALYSIS FOR EXISTING ENGINES LIKELY TO BE FITTED WITH MAHLE PISTONS.

07/17/1973 NORDBERG INTER-OFFICE MEMO TO ED KAVANAGH FROM FRANK MACEJKOVIC RE: INSPECTION OF 5483 4522 PISTONS REMOVED FROM UNITED ENGINEERS ENGINES 1030-1328/31

07/25/1973 NORDBERG ISSUES NEW PAGE 901 FOR "AS BUILTS" SPECIFYING PISTON 5483 4529 REV.A FOR ENGINE S/N 1030-1328.

07/25/1973 NORDBERG ISSUES NEW PAGE 901 FOR "AS BUILTS" SPECIFYING PISTON 5483 4529 REV.A FOR ENGINE S/N 1030-1330/31.

08/07/1973 NORDBERG INTER-OFFICE MEMO FROM LEO BRINSON RE: 13 ½" PISTON DESIGN

08/08/1973 PISTON #7, UNIT 2 AT KINGS PLAZA FAILS. PISTON HAD BEEN REMOVED FROM CYL #3, UNIT 4, AND X-RAYED ON 3/14/1972. DECLARED FREE OF DEFECTS, REINSTALLED ON 3/28/1972

08/28/1973 -08/29/1973 – TR-436 ENGINE TEST REPORT ISSUED FOR 1030-1330 ACTUAL ENGINE TESTED.

10/30/1973 -11/01/1973 – TR-437 ENGINE TEST REPORT ISSUED FOR 1030-1331 ACTUAL ENGINE TESTED.

11/19/1973 PISTON 3#, UNIT 5, KINGS PLAZA FAILS.

11/19/1973 – NORDBERG ISSUES MANUFACTURING STANDARD 07-01-22

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"QUALITY ACCEPTANCE REQUIREMENTS PISTONS 13" & 13 1/2"
FOUR CYCLE DIESEL ENGINE"

12/12/1973 PISTON #3, UNIT 4, KINGS PLAZA FAILS @ 2:30 PM

02/11/1974 COOPER BESSMER INTER-OFFICE MEMO
MAHLE PISTONS FOR NORDBERG 4-CYCLE, 13 ½" BORE ENGINES

02/13/1974 COOPER BESSMER INTER-OFFICE MEMO
ADDENDUM TO MEMO

03/01/1974 CAROLINA POWER & LIGHT'S UNIT #1 TO GO INTO
COMMERCIAL OPERATION (SEE NORD MEMO 12/13/1971)

03/04/1974 COOPER-BESSMER LETTER TO NORDBERG
REPLACING NORDBERG PISTONS IN 13 ½" ENGINES WITH MAHLE
PISTONS.

03/07/1974 COOPER BESSMER LETTER TO UNITED BRANDS (CHIQUITA)

03/20/1974 NORDBERG LETTER TO COPPER BESSMER
REPLACING NORDBERG SINGLE PIECE PISTONS IN THE 13 ½"
ENGINES WITH MAHLE PISTONS.

03/22/1974 NORDBERG LETTER TO COOPER-BESSMER

04/24/1074 NORDBERG MEETING MINUTES

03/01/1975 CAROLINA POWER & LIGHT'S UNIT #2 TO GO INTO
COMMERCIAL OPERATION (SEE NORD MEMO 12/13/1971)

09/24/1975 COOPER MEMO MAHLE PISTONS

09/26/1975 COOPER MEMO TO MEL HELMICH FROM JIM MATTHEWS

05/12/1978 KINGS PLAZA PISTON NEW REPALCEMENT REMOVED
AND DURING INSPECTION IS FOUND TO HAVE CRACKS.

Comments and Recommendations:

The documents indicate that the Nordberg ductile iron piston fallures occurred with much

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irregularity regarding the number of hours of operation until failure. There were pistons that failed early in service life and others that failed later in the service life.

Most importantly, there is also documentation that even after Nordberg Manufacturing Co. performed additional radiographic and other required NDE showing the ductile iron pistons met the strict acceptance criteria, those pistons placed in service subsequent to that testing were also failing. Please see the enclosed reports for differing hours of operation until failure and the Kings Plaza reports detailing the failures after RT, UT, MP NDE and acceptance of those tests.

Most late style (1971 and later FS Series) Nordberg units were equipped or retrofitted with the Mahle Style Piston (2 Piece Piston: Steel Crown and Aluminum Skirt). We have attached Nordberg documents showing the recommendation of Nordberg to change out ductile iron pistons to the Mahle Style Piston. BNP is on this list along with several others, including Duke Power Company, the only other Nuclear Facility to use the Nordberg Diesel Engines as EDGs. Duke Power Company made this change years ago to alleviate any potential catastrophic problem the Nordberg ductile iron piston could cause. There have been no reported failures of the Nordberg Mahle Style Piston in nuclear or commercial applications.

Also, in consideration that Progress Energy is in the process of applying for a license extension/renewal for the BNP we feel that over the next 20 years, there will be a larger demand for EDG power from the Nordberg units, thus requiring higher output from these engines, such as what happened at McGuire Nuclear Station Also by adding 20 more years to the life of the existing pistons, even with today's demands, would be a safety concern and should be evaluated.

NAK Engineering, Inc finds evidence in the attached documents which indicates that there are design and engineering inadequacies on the Nordberg ductile iron piston and is a likely Safety Concern resulting from those inadequacies. We find virtually no documentation that exists that support the continued operation of the 5483-4529 ductile iron piston on Nordberg units rated at above 160 BMEP.

As the current Nordberg OEM and considering all the Nordberg related documentation on the subject pistons, we strongly recommend that all the BNP Nordberg Diesel Engine pistons should be changed out to the Mahle Style Piston to eliminate the possibility of severe consequences of a ductile iron piston failure. This recommendation was in process of being recommended almost thirty years ago. This would be the "bulletproof" remedy to any possible piston failure.

As an alternative, short of immediate piston replacement, we make the following recommendation for the short term. Brunswick Nuclear Project should embark, on an accelerated pace, for the inspection of all existing ductile iron pistons both in the engines and any spares in inventory by way of performing radiograph, magnetic particle and ultrasonic testing in accordance with the Nordberg testing and acceptance requirements. This recommendation is made, in part, due to the fact that there is no known verifiable evidence that the existing BNP pistons were ever inspected to these levels.