



**ENGINE SYSTEMS, INC.**

175 Freight Road  
Rocky Mount, NC 27804

Telephone: 252/977-2720  
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March 29, 2022

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, DC 20555-0001

Subject: 10CFR21 Reporting of Defects and Non-Compliance -  
Engine Systems, Inc. Report No. 10CFR21-0134, Rev. 0

EMD Cylinder Head with Fireface Thickness Below Specification  
Cylinder Head P/N 40121485

Dear Sir / Madam:

The enclosed report addresses a reportable notification on an EMD cylinder head with fireface thickness below specification, Cylinder Head P/N 40121485.

A copy of the report has also been mailed to our affected nuclear customers.

Please sign below, acknowledging receipt of this report, and return a copy to the attention of Document Control at the address above (or, fax to number 252/446-3830) within 10 working days after receipt.

Yours very truly,

ENGINE SYSTEMS, INC.

Susan Woolard  
Document Control Coordinator

*IE19*  
*NRR*

**Please let us know if ANY of your mailing information changes - name of recipient, name of company/facility, address, etc. Mark the changes on this acknowledgment form and send to us by mail or FAX to the number above.**

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RECEIVED: \_\_\_\_\_

DATE: \_\_\_\_\_



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**Report No. 10CFR21-0134**

Rev. 0: 03/29/22

## 10CFR21 REPORTING OF DEFECTS AND NON-COMPLIANCE

COMPONENT: EMD Cylinder Head with Fireface Thickness Below Specification  
Part Number 40121485  
Date Code 18K

SYSTEM: Emergency Diesel Generator

CONCLUSION: Reportable in Accordance With 10CFR21

Prepared By: *Ju Lin*  
Engineering Manager

Date: 3/29/22

Reviewed By: *Dan Potat*  
Quality Manager

Date: 3/29/22

REV	DATE	PAGE	DESCRIPTION
0	03/29/22		Original Issue.

**Pursuant to 10 CFR 21.21(d)(4), ESI is presenting the required information as follows:**

(i) Name and address of the individual or individuals informing the Commission.

Dan Roberts  
Quality Manager  
Engine Systems Inc.  
175 Freight Rd.  
Rocky Mount, NC 27804

John Kriesel  
Engineering Manager  
Engine Systems Inc.  
175 Freight Rd.  
Rocky Mount, NC 27804

(ii) Identification of the basic component supplied within the United States which fails to comply or contains a defect.

*EMD Cylinder Head, P/N 40121485, D/C 18K*

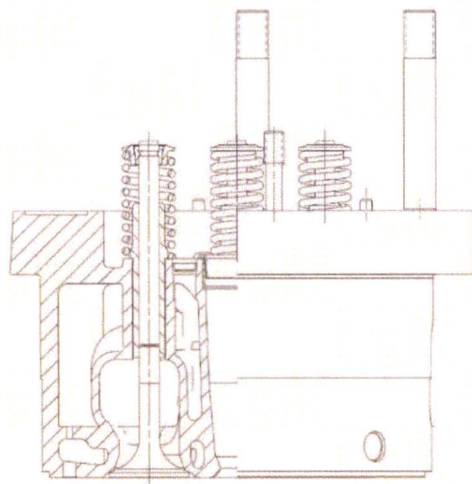
(iii) Identification of the firm supplying the basic component which fails to comply or contains a defect.

*Engine Systems Inc. (ESI)*

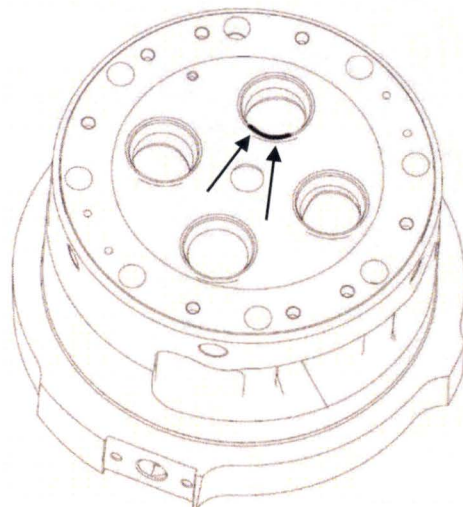
(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

*A fatigue crack was discovered in the fireface of an EMD cylinder head installed on an emergency diesel generator set. The crack initiated on the coolant side and propagated through the fireface wall to the combustion side resulting in a water leak. Fatigue failure was likely caused by a reduced fireface thickness which reduced overall rigidity of the fireface, allowing increased deformation and ultimately failure due to high tensile stress at the blend between the fireface and valve seat.*

*The cylinder head is integral to operation of an emergency diesel generator set. Each head assembly, one per engine cylinder, forms the top wall of the combustion chamber which allows the buildup of pressure for fuel ignition. Within its assembly, the head contains jacket water passages adjacent to the fireface to remove heat and regulate fireface metal temperatures. A reduced fireface thickness could result in a through wall crack that would introduce jacket water into the combustion chamber. A minimal amount of leakage would have no immediate impact on engine operation; however, over time if the crack propagated or went undetected engine damage may occur. In standby conditions, fluid in the combustion chamber is typically detected when barring the engine over prior to a normal engine start. This common practice safeguards against damage due to such an event and leakage is observed as fluid discharging from the cylinder indicator valve. During an emergency start, where engine barring does not occur, a significant amount of fluid in the combustion chamber could cause hydraulic lock. During engine operation, fluid leakage into the combustion chamber could lead to cylinder liner scuffing and progressive engine damage. Ultimately, a crack in the fireface could lead to failure of the diesel engine which would prevent the emergency diesel generator set from performing during a safety-event.*



Fireface → **Figure 1: Cylinder Head (side view)**



**Figure 2: Location of Crack (transition of fireface to valve seat)**

(v) The date on which the information of such defect or failure to comply was obtained.

January 27, 2022

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.

*Cylinder heads from D/C 18K were supplied within the power pack assemblies listed below. Note the serial number of the power pack assembly is the serial number of the cylinder head.*

Customer	Customer PO	ESI Sales Order	Part Number Ordered	Serial Number	ESI C-of-C Date
NUCLEAR POWER PLANT KRSKO+	3200432/1269	3020124	40124897 (Fork Power Pack)	18K0405	8/6/2020
				18K0454	8/6/2020
				18K0477	8/6/2020
				18K2011	8/6/2020
				18K2084	8/6/2020
				18K2112	8/6/2020
				18K2116	8/6/2020
				18K2122	8/6/2020
			40124898 (Blade Power Pack)	18K0427	8/6/2020
TENNESSEE VALLEY AUTHORITY - WATTS BAR	6311467	3020536	40124897 (Fork Power Pack)	18K0481	1/15/2021
				18K0520	1/15/2021
			40124898 (Blade Power Pack)	18K0120	1/15/2021
				18K0408	1/15/2021
				18K0448	1/15/2021
				18K0483	1/15/2021
				18K1961	1/15/2021
				18K2118	1/15/2021
	18K2121 <sup>(1)</sup>	1/15/2021			
	6311864	3020939	40124897 (Fork Power Pack)	18K0010	12/14/2021
				18K0518 <sup>(2)</sup>	12/14/2021
				18K0522 <sup>(2)</sup>	12/14/2021
			40124898 (Blade Power Pack)	18K0046 <sup>(2)</sup>	12/14/2021
				18K0440 <sup>(2)</sup>	12/14/2021
18K2085 <sup>(2)</sup>				12/14/2021	
			18K2113	12/14/2021	

Table 1: List of Customers for Cylinder Head P/N 40121485 and D/C 18K

Notes: (1) This is the head that developed the crack.

(2) These heads were returned to ESI and inspected during the Part 21 evaluation process. It was confirmed they do not exhibit the same condition as the failed head.

- (vii) The corrective action which 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.

For affected customers:

*ESI recommends an ultrasonic thickness inspection on the fireface to confirm thickness is within specified range. This requires removal of the cylinder head from the power pack assembly to access the fireface. If desired, ESI will assist with an on-site inspection and/or provide equipment to support the inspection. Alternatively, power pack assemblies may be returned to ESI for this activity.*

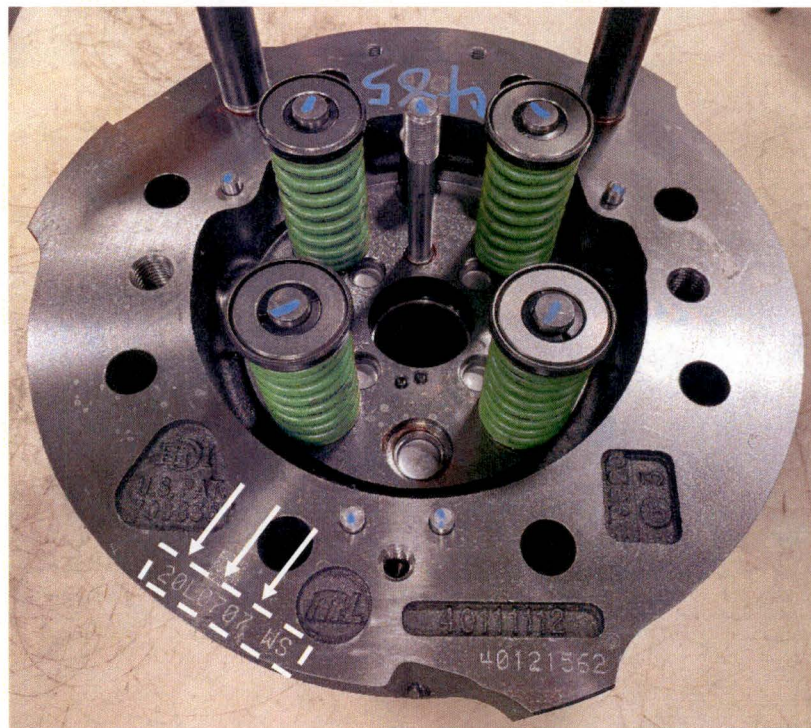
*Upon successful completion of the inspection, reassemble power pack assemblies using, at a minimum, a new head-to-liner gasket P/N 40099569 (qty 1) and new head-to-liner locknuts P/N 8060089 (qty 8).*

For ESI:

*To prevent reoccurrence, ESI has revised the dedication package to increase the number of ultrasonic thickness inspection points. An additional enhancement is the inclusion of an inspection map for guidance and clarity of the locations to be measured. The revision was implemented on March 15, 2022.*

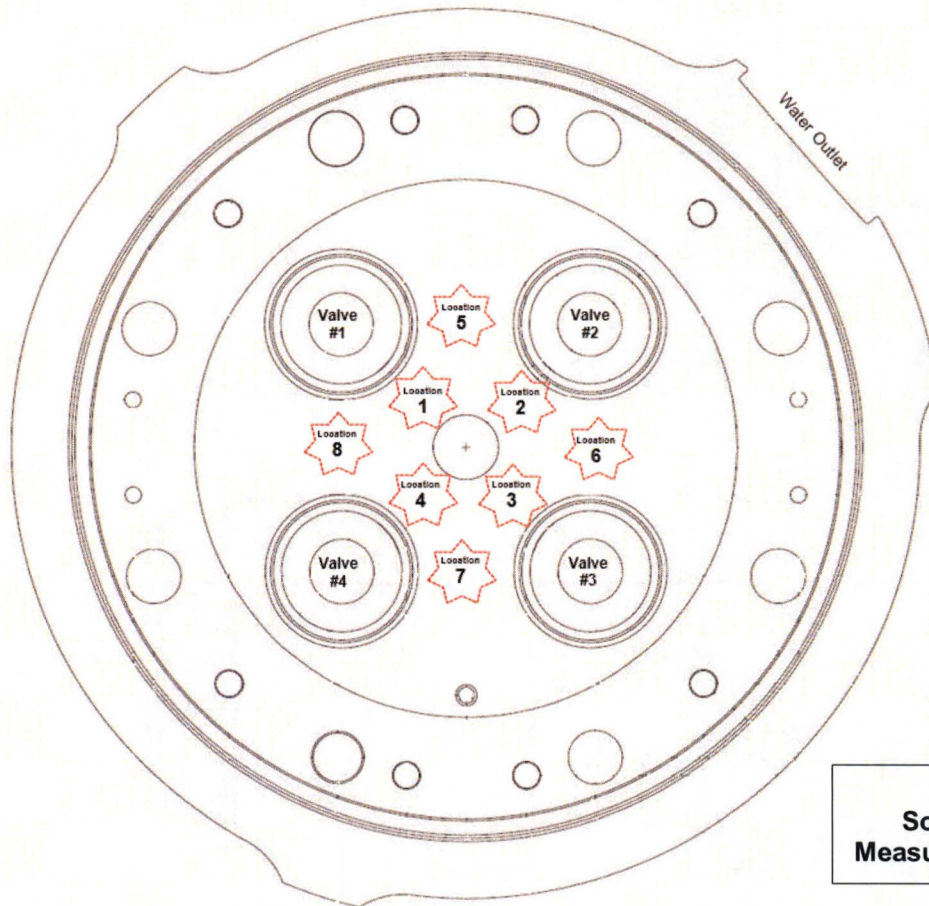
- (viii) Any advice related to the potential defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

*To ease identification of affected cylinder heads, Photo 1 below shows location of serial number stamping on the head.*



**Photo 1: Location of Serial Number Identification  
(ex. S/N 20L0707)**

To perform an ultrasonic inspection of the cylinder head fireface, the map below shows locations of interest. For best results, a 2.5 Mhz probe should be used with the ultrasonic thickness gauge. Fireface thickness at these eight (8) locations should be no less than 0.230".



**Figure 3**  
**Sonic Thickness**  
**Measurement Locations**