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January 10, 2017

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. 10CFR21-0115, Rev. 0

EMD Fuel Injector
P/N 40084720

Dear Sir:

The enclosed report addresses a reportable notification on an EMD fuel injector, P/N 40084720, for Entergy Operations, Inc. – Arkansas Nuclear One.

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

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 252/446-1134) within 10 working days after receipt.

Yours very truly,

ENGINE SYSTEMS, INC.

Susan Woolard

Susan Woolard
Document Control

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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Report No. 10CFR21-0115
Rev. 0: 01/06/17

10CFR21 REPORTING OF DEFECTS AND NON-COMPLIANCE

COMPONENT: EMD Fuel Injector
P/N 40084720

SYSTEM: Emergency Diesel Generator

CONCLUSION: Reportable in Accordance With 10CFR21

Prepared By: _____ Date: 1/6/17
Engineering Manager

Reviewed By: _____ Date: 1-6-17
Quality Assurance Manager

REV	DATE	PAGE	DESCRIPTION
0	01/06/17		Initial issue.

Component:

EMD Fuel Injector, P/N 40084720.

Summary:

Engine Systems Inc. (ESI) began a 10CFR21 evaluation on November 12, 2016 following the seizure of a fuel injector at Entergy Operations Inc. - Arkansas Nuclear One (ANO). ANO had completed installation of new fuel injectors on both of their EMD emergency diesel generator sets. During post-maintenance surveillance testing the fuel injector installed in the #7 cylinder of unit K4A seized (injector S/N 16C2 3186). During an attempt to shut down the unit, operators were unable to reduce the engine's load because of the seized injector/fuel rack.

The seized fuel injector was then returned to ESI for failure analysis where it was received on November 16th. The failure investigation determined that foreign material within the injector was the cause of the seizure. The report (8002768-FA) was completed on December 8, 2016 and submitted to the customer for review.

Impact on Operability:

A seized fuel injector would affect the load carrying capability of the diesel engine. Due to the fuel rack configuration utilized by ANO, an injector seizure also prohibits control of diesel engine. Many utilities use spring loaded injector linkages which allow the engine to continue to operate in the event of a frozen injector rack. In those cases, the remaining injectors are controlled by the engine's governor and credit may be taken that sufficient output is available from the remaining cylinders to carry the safety-related load. In the case of ANO, their emergency diesel generator set contains a solid injector linkage design. Seizure of one fuel injector locks the common fuel layshaft and prevents it from rotating thereby preventing the engine's governor from controlling fuel delivered to the engine. Operation in this condition would prevent the emergency diesel generator from adequately controlling and/or carrying its design safety related loads.

Root cause evaluation:

The root cause of the failure was determined to be foreign material which likely entered the fuel injector during manufacture/assembly. Once the injector was installed on the engine, it was during engine surveillance (run) testing that this foreign material migrated into the plunger and bushing assembly. This decreased the running clearance between the components which ultimately lead to seizure.

Evaluation of previous shipments:

The date code imbedded within the serial number (16C) indicates the injector was manufactured in March 2016. The only customer to whom ESI has supplied injectors with date code "16C" is ANO. A total qty 34 injectors were supplied in May 2016 of which qty 32 have a 16C date code (the other two were 15G). To date, only the one injector with serial number 16C2 3186 has failed. Given the amount of run time accumulated on the installed injectors during surveillance testing, any other injectors which may have contained foreign material would be expected to result in a similar seizure. Furthermore, aside from the qty 32 injectors supplied to ANO, ESI has qty 51 injectors in stock with the same 16C date code. All of the injectors were inspected by removing the supply and return filter elements and visually examining the filters and the cavity directly beneath the filters. For all 51 injectors, no evidence of foreign material was found. Therefore, based on the review performed by ESI this issue is determined to be an isolated incident. It is the position of ESI that:

- At most, this issue applies to injectors of date code 16C. The next closest date code injectors supplied by ESI are 15G (July 2015) and 16H (August 2016). Given these are five or more months apart from date code 16C (March 2016), they are considered sufficiently independent from this issue.
- For injectors with date code 16C that have been installed on an engine and have accumulated an appreciable amount of run time (meaning the engine was brought up to rated load and fluid temperatures/pressures have stabilized), then the injector is not susceptible to seizure from this type of foreign material.
- For all remaining injectors from date code 16C that have not been successfully installed on an engine, they are considered suspect and should be returned to ESI.

Affected Customers:

Entergy Operations Inc.- Arkansas Nuclear One is the only customer to whom ESI has supplied suspect fuel injectors. A listing of the serial numbers is provided in the table below:

ESI Sales Order	Customer	Customer P.O.	Part Number	Qty	Serial Numbers		ESI C-of-C Date
3015200	Arkansas Nuclear One	10470233	40084720	32	16C2 3148	16C2 3192	05/16/16
					16C2 3154	16C2 3193	
					16C2 3157	16C2 3194	
					16C2 3158	16C2 3196	
					16C2 3160	16C2 3197	
					16C2 3162	16C2 3200	
					16C2 3168	16C2 3202	
					16C2 3172	16C2 3203	
					16C2 3183	16C2 3204	
					16C2 3184	16C2 3205	
					16C2 3186	16C2 3207	
					16C2 3187	16C2 3209	
					16C2 3188	16C2 3210	
					16C2 3189	16C2 3211	
					16C2 3190	16C2 3214	
					16C2 3191	16C2 3233	

Corrective Action:

- Fuel injectors installed on engine:

  No action is required. Successful completion of on-engine testing indicates the injector is not susceptible to failure due to foreign material.

- Fuel injectors in inventory (not-installed) on engine:

  All fuel injectors in inventory with a 16C date code are considered suspect and should be returned to ESI for evaluation and additional testing.

- To prevent recurrence of this issue, ESI will implement an extended run time test as part of fuel injector functional testing requirements. This extended run time test will supplement the standard calibration testing performed on each injector and will provide additional assurance of internal cleanliness.
  - Completion of the extended run time test stand is expected within 90 days. In all cases, it will be complete prior to any future EMD fuel injector shipments.