



ENGINE SYSTEMS, INC.

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October 18, 2011

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. 10CFR21-0103, Rev. 0

Piston Assembly – Delamination of Tin Plating on Refurbished Piston Skirts

Dear Sir:

The enclosed report addresses a reportable notification on an Enterprise emergency diesel generator piston assembly.

A copy of the report has 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 252/446-1134) within 10 working days after receipt.

Yours very truly,

ENGINE SYSTEMS, INC.

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. 10CFR21-0103

Rev. 0: 10/17/11

**10CFR21 REPORTING OF DEFECTS
AND NON-COMPLIANCE**

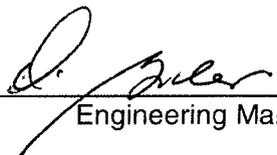
COMPONENT: Piston Assembly – Delamination of Tin Plating on Refurbished Piston Skirts

SYSTEM: Emergency Diesel Generator

CONCLUSION: Reportable in Accordance With 10CFR21

Prepared By: 
Dedication Engineering Supervisor

Date: 10/17/11

Approved By: 
Engineering Manager

Date: 10/17/11

Reviewed By: 
Quality Assurance Manager

Date: 10-17-11

| REV | DATE | PAGE | DESCRIPTION |
|-----|----------|------|----------------|
| 0 | 10/17/11 | | Initial issue. |

COMPONENT:

Enterprise piston skirts that have been re-tin plated as part of a refurbishment.

SUMMARY:

Engine Systems Inc. (ESI) began a 10CFR21 evaluation on 08/12/11 upon receipt of four piston assemblies returned from Perry Nuclear Plant. It was reported that Perry had performed a maintenance activity whereby they replaced four of their piston assemblies with four refurbished pistons provided by ESI. Following installation of the replacement pistons, it was found that large portions of the tin plating were flaking or smearing off.

The evaluation was concluded on 10/11/11 and determined the piston tin plating delamination to be a reportable defect as defined by 10CFR21. The delamination was attributed to residual oil impregnated in the ductile cast iron base material of the skirts. The piston assemblies had previously been in service on the emergency diesel generators and were later refurbished by ESI in 2007. A portion of the refurbishment activity consisted of re-tin plating the piston skirts.

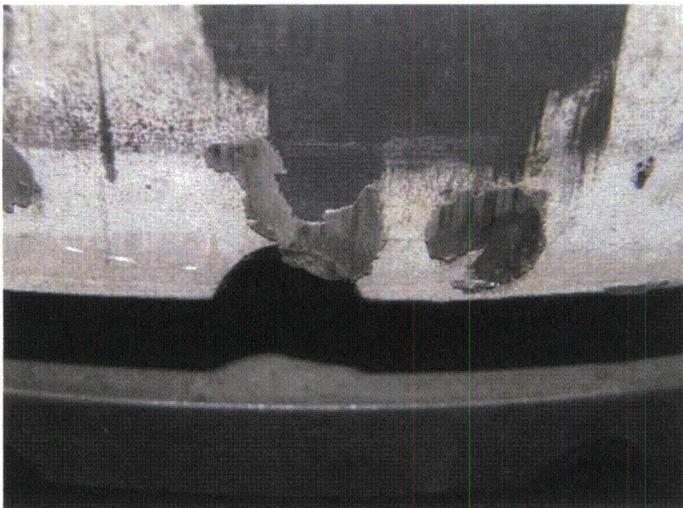
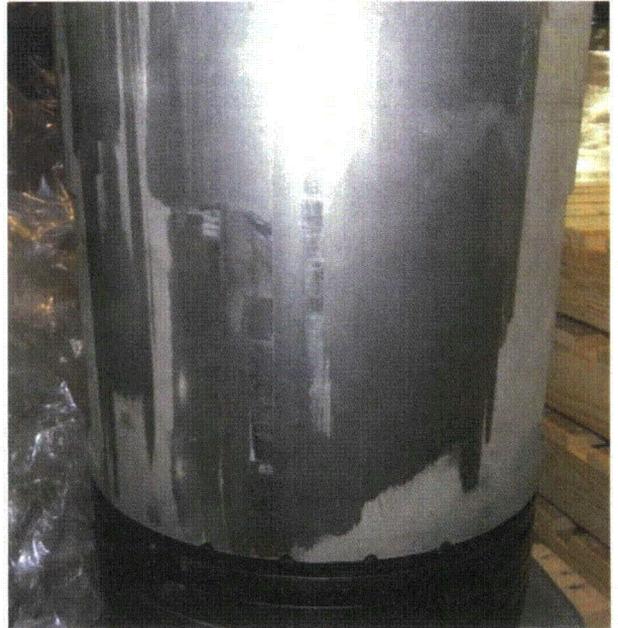
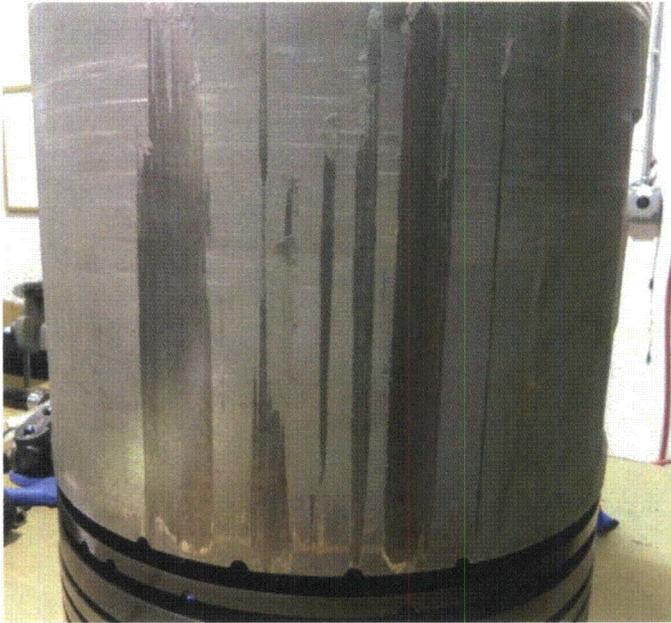
The piston assembly is an integral component of the emergency diesel engine's power assembly. It transmits the cylinder's combustion pressures to the piston pin, connecting rod, and crankshaft; thereby providing the torque to drive the generator for the supply of emergency electrical power to the safety related bus. During a loss of off-site power, the emergency diesel generators provide a source of on-site power to safely shutdown the nuclear reactor. Excessive delamination of tin plating from the piston skirt could result in failure of the engine's power assembly and therefore result in failure of the emergency diesel generator, preventing it from performing its safety related function.

DISCUSSION:

The four pistons that were installed by Perry were previously refurbished in 2007 by Engine Systems Inc. (ESI sales order 8000860). Prior to ESI's refurbishment, the pistons had been in service and were returned for standard rework. As part of a standard refurbishment, ESI performs an inspection of the piston skirt tin plating and if deemed necessary, the skirt is sent out to have the plating stripped and re-tinned. Re-tinning is performed in accordance with existing Cameron (the diesel engine OEM) procedures which have been utilized for decades.

Following consultation with Cameron and discussion with the customer, it was determined that the delamination was most likely the result of oil impregnated in the ductile cast iron base material of the skirt. The pistons had previously been in service where they were exposed to a heated, oil rich environment; meaning the engine's lubricating oil was allowed to penetrate the micropores of the cast iron. Though the piston skirts were subjected to a standard washing and caustic cleaning cycle as part of the re-plating process, further investigation finds this may not be sufficient to remove all residual oils from the base material. This remaining oil prevented the tin from fully adhering and therefore contributed to the tin plating delamination found for these four pistons.

See photos on the following page of the pistons returned to ESI:



Photos of Pistons Taken at ESI

IMPACT ON OPERABILITY:

By design, the tin plating is an engineering overlay intended to provide a soft wear coating that can withstand bearing loads and provide break-in protection. It also provides embeddability and a measure of conformability until the piston is mated to the liner. Though it is generally considered to be a sacrificial coating and not critical to operation of the engine, consideration must be made to the effects of large sections of plating delaminating from the piston and potentially transferring to other locations within the engine. During normal engine operation, over the life of the piston it is expected that scratching, streaking, and minor loss of plating may occur (see photos on page 5 for examples). While this is of little concern, the conditions noted by Perry for these four pistons do provide the following concerns:

- Excessive transfer of tin from the piston to the cylinder liner can result in a breakdown of the lubricating film on the liner wall, leading to overheating of engine parts. This can provide an ignition source for oil vapor in the crankcase, potentially causing an explosion. Excessive build-up of tin could also decrease the clearance between the piston and liner to the point where seizure may occur. Either of these scenarios would disable the engine during a safety event.
- Excessive transfer of tin to the ring grooves would reduce the clearance between the ring and its associated groove, potentially to the point where the ring would lose its ability to expand and contract to conform to the liner wall. This could progress to the point where the rings damage the liner wall and result in seizure of the piston and/or overheating of the power assembly. This would disable the engine during a safety event.
- Introduction of tin plating material into the engine lubricating oil, though less than desirable, would not be considered to negatively impact operability of the lube oil system since the lube oil strainers and filters would capture any particles prior to distribution within the engine.

CORRECTIVE ACTIONS:

The root cause analysis determined that the cause of the tin plating delamination was residual oil impregnated in the ductile cast iron material. While there are many different methods for removing imbedded oils from cast iron, ESI is not aware of any absolute methods for ensuring all oils have been removed (or at least to the point that it will not interfere with tin plating adhesion). As a result of this finding, it is ESI's recommendation that piston skirts which have been in service should no longer be re-tin plated.

ESI RECOMMENDATION FOR CUSTOMERS WITH RE-TINNED PISTONS:

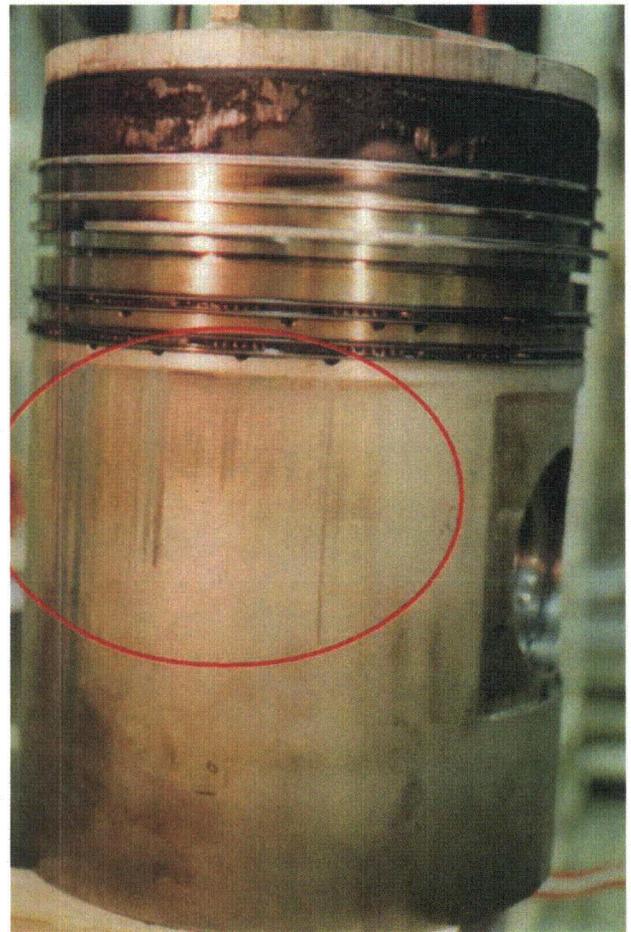
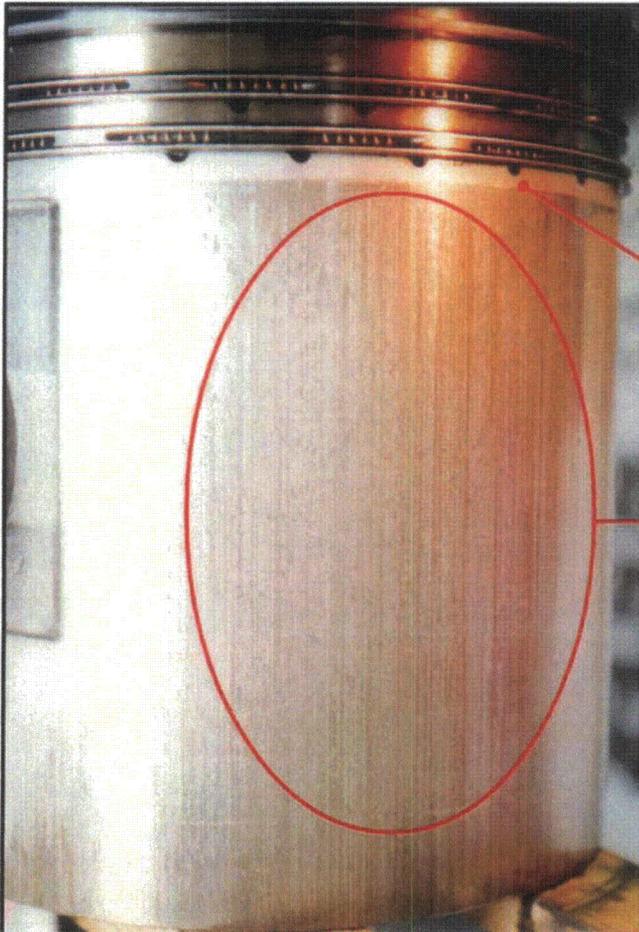
This is the first incident reported to ESI of tin plating delamination. These four pistons were all processed from the same batch and this batch consisted solely of these four pistons. While this may be an isolated incident, any customers with previously re-tinned pistons must give consideration for what to do with those pistons (see Table on following page for customers affected). ESI recommends that customers with pistons already installed should confirm that a crankcase inspection was performed following installation and that no abnormal deposits or accumulation of tin were noted. For those customers that have not yet installed their refurbished pistons, installation is not recommended unless the customer can adequately verify adhesion of the tin plating.

CUSTOMERS AFFECTED:

Re-tinned piston skirts were supplied separately or as a part of a complete piston assembly as listed below:

| Description | Part Number | Serial Number | ESI Job Number | Certificate of Conformance Date | Customer |
|--|--------------|-----------------------|----------------|---------------------------------|----------------------|
| Piston Assembly Repair and Return (consists of skirt, crown, and hardware) | 1A-7116 | 87L | 8000404 | 6/20/2007 | Entergy - River Bend |
| | 1A-7116 | J15/505K ¹ | 8000860 | 8/27/2007 | First Energy - Perry |
| | 1A-7116 | J53/537K ¹ | 8000860 | 8/27/2007 | First Energy - Perry |
| | 1A-7116 | K10/582K ¹ | 8000860 | 8/27/2007 | First Energy - Perry |
| | 1A-7116 | J47/537K ¹ | 8000860 | 8/27/2007 | First Energy - Perry |
| | 1A-7116 | K4/570K | 8000920 | 12/17/2007 | Entergy - River Bend |
| | 1A-7116 | K18/591K | 8000920 | 12/17/2007 | Entergy - River Bend |
| | 1A-7116 | J73/553K | 8000920 | 12/17/2007 | Entergy - River Bend |
| | 1A-7116 | K5/570K | 8000920 | 12/17/2007 | Entergy - River Bend |
| | 1A-7116 | K44/602K | 8000920 | 12/17/2007 | Entergy - River Bend |
| | 1A-7116 | K18/591K | 8001329 | 8/18/2010 | Entergy - River Bend |
| | 1A-7116 | J73/553K | 8001329 | 8/18/2010 | Entergy - River Bend |
| Piston Skirt Repair and Return (skirt only) | 03-341-04-AE | 793K | 90794 | 2/6/2003 | TXU - Comanche Peak |
| | 03-341-04-AE | 775K | 101277 | 2/6/2003 | TXU - Comanche Peak |
| | 03-341-04-AE | K38 | 102261 | 2/7/2003 | Duke - Catawba |
| | 03-341-04-AE | J81 | 102261 | 2/7/2003 | Duke - Catawba |
| | 03-341-04-AE | O37 | 102261 | 2/7/2003 | Duke - Catawba |
| | 03-341-04-AE | 602K | 8000225 | 10/17/2006 | Duke - Catawba |
| | 03-341-04-AE | 596K | 8000225 | 10/17/2006 | Duke - Catawba |
| | 03-341-04-AE | K13/582K | 8000907 | 12/3/2007 | Duke - Catawba |
| | 03-341-04-AE | K39/596K | 8000907 | 12/3/2007 | Duke - Catawba |
| | 03-341-04-AE | K16/582K | 8000907 | 12/3/2007 | Duke - Catawba |
| | 03-341-04-AE | 557K | 8000907 | 2/8/2008 | Duke - Catawba |
| | 03-341-04-AE | K34/596K | 8000907 | 2/8/2008 | Duke - Catawba |

Note (1): These are the four pistons returned by Perry that are the subject of this report.



Examples of Acceptable Tin S