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**New Technology Research & Development Program
Grant Contract 582-5-65591-0009**

Final Deliverable Report

The preparation of this report is based on work funded in part
by the State of Texas through a Grant from the
Texas Commission on Environmental Quality.

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Task #1 Demonstration Summary for EMD Switcher Tier II Loco

Summary:

The following pictures represent an EMD 16-645E Tier II NOx engine tested at Southwest Research Institute in San Antonio, TX and rebuilt by General Electric Infrastructure Rail. Since GE does not own a switcher locomotive of this type, Southwest Research Institute installed our engine in their roots blown development locomotive platform. The standard 16-645E engine contains the following components to make a GE Tier II NOx unit: special ring pack, special liners, optimized injectors, and re-phased cam segments. AESS as described in initial scope of work was not used in this demonstration nor included on our EPA Certification. Tier II NOx was achieved without the use of this engine shut-down device.

This 16-645E Tier II NOx engine was EPA certified on December 19, 2005. Certification number GET-LOC-06-19.

Photos provided by Southwest Research Institute

Photo in Locomotive at SwRI



Photo in Locomotive at SwRI



Task #2 Fuel Optimization for EMD 16-645E Tier II Engine

Summary:

1. After running a baseline FTP test with production hardware, the static injector timing was reset to 6 ATDC and an FTP was run. The re-phased cam segments were then installed and the 6 ATDC FTP repeated. The results were as expected with a slight increase in NO_x and a decrease in HC_x and particulates. The camshaft re-phasing is needed to keep the appropriate portion of the cam profile in use during the injection event both from a performance and reliability point of view.
2. Next tests were run at 6, 9 and 12 ATDC. These consisted of FTP's. Dynamic injector timing data was collected during these tests.
3. With this data, notch-by-notch injector timing and modal NO_x values, a "timing map" was constructed that analytically would meet the goal of Tier 2 NO_x and Tier 0 all other regulated emissions for the switcher duty cycle.
4. This timing map was translated to the injector helix. New plungers were machined and built into prototype injectors. These were tested with a static injector timing of 9 ATDC confirming that the emissions goals were met.
5. The data was submitted to EPA and a certificate issued (GET-LOC-06-19).

Photo of Final Version Hardware



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

2006 Model Year Certificate of Conformity

Manufacturer: **Transportation Systems Business Operations of General Electric Company**
Certificate Number: **GET-LOC-06-19**
Effective Date: **DEC 19 2005**
Date Issued: **DEC 19 2005**

Merrylin Zaw-Mon, Director
Compliance and Innovative Strategies Division
Office of Transportation and Air Quality

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR 92, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the remanufacturing kit which has been found to conform to applicable requirements and which may be utilized with only the following locomotive engines, by engine family, more fully described in the documentation required by 40 CFR 92 and produced in the stated model year.

Locomotive Engine Family (Remanufacturing Kit): **6GETK0645MST**
Locomotive Models: (Models which appear to be duplicates are part of a different engine model/locomotive model combination.)

SD38, SD38-2, GP38, GP38-2

Locomotive Model Years: **1973 to 1985**

The rebuild kit includes:

In addition, parties who install this remanufacturing kit must also ensure that the base engine contains the following parts, more fully described in the Application for Certification for this kit:

OVERHAUL SPECIFICATIONS PROVIDE LIST
OF ALL PARTS THAT GO INTO THE ENGINE

This certificate of conformity is conditional upon compliance of said manufacturer with the provisions of 40 CFR Part 92, Subpart D. Failure to comply with these provisions may render this certificate void ab initio.

6GETK(64)MST

This certificate of conformity covers only those locomotive remanufacturing kits which conform in all material respects to the design specifications that applied to those kits more fully described in the Application for Certification required by 40 CFR 92 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR 92.

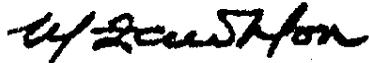
	switch	line haul	passenger
NOx FEL	8.1		
PM FEL			

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 92.215(d)(1) and 92.504 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR 92. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void ab initio for other reasons specified in 40 CFR 92.

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SD38, SD38-2, GP38, GP38-2

Locomotive Model Years: 1973 to 1985

The rebuild kit includes:

- INJECTOR
- BLOWER
- POWER ASSEMBLY
- CAMSHAFTS
- GOVERNOR
- BLOWER DRIVE GEARS

In addition, parties who install this remanufacturing kit must also ensure that the base engine contains the following parts, more fully described in the Application for Certification for this kit:

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* GENERAL ELECTRIC CONFIDENTIAL INFORMATION

6GETK064SMST

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