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New Technology Research & Development Program
Grant Contract 582-5-70807-0002

Task 4 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.

New Technology Research & Development Program
Grant Contract #582-5-70807-0002
between the
County of El Paso
and the
Texas Commission on Environmental Quality

Task 4 Deliverable:
Engineering Design and Packaging of the Hydraulic Launch Assist (HLA) System

The preparation of this report is based on work funded
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El Paso County New Technology Research and Development Grant

Task 4 Report: Engineering Design and Packaging for the Hydraulic Launch Assist System (HLA)

This report is submitted by El Paso County to the Texas Emission Reduction Program in fulfillment of the requirements of New Technology Research and Development Grant Contract #582-5-70807-0002 between the County of El Paso and the Texas Commission on Environmental Quality.

I. Introduction and Overview

El Paso County and its' primary subcontractor Ruby Mountain Inc. (RMI) have completed fabrication of the 33-passenger, low-floor, ADA-compliant project vehicle as well as the installation of the Cummins B Gas Plus natural gas engine. The compressed and liquefied (L/CNG) fueling system design and specifications have also been completed and submitted with previous reporting.

Additionally, integration of the patented Economizer Valve into the fueling system has also been completed to allow the vehicle to operate on both liquefied and compressed forms of natural gas originating at different pressures. The Economizer Valve was developed by the Idaho National Laboratory. Preliminary testing and validation of the natural gas fuel systems has also been completed.

Based on the NTRD scope of work, the following task has been completed:

Task 4: Engineering Design and Packaging for the Hydraulic Launch Assist System (HLA)

2.1. Task Statement: The PERFORMING PARTY will perform engineering design and packaging to integrate the HLA system with the LNG/CNG engine to the ADA transit bus chassis and will submit the design to TCEQ for approval prior to installation and fabrication described under Task 5 for the HLA system.

2.1.1. The PERFORMING PARTY will perform engineering design and packaging to integrate the HLA engine to the ADA transit bus chassis and the LNG and CNG engine system.

2.1.1.1. The PERFORMING PARTY will package HLA in low floor rear drive chassis.

2.1.1.2. The PERFORMING PARTY will design/detail-required parts sufficient for fabrication.

2.1.2. Schedule: The PERFORMING PARTY shall complete this task within 18 months of the signed Notice to Proceed Date as issued by TCEQ.

2.1.3. Deliverables: The PERFORMING PARTY shall submit a report on the final design for fabrication to the TCEQ upon completion of this task and prior to installation and fabrication described under Task 2.

This report and the accompanying attachments constitutes fulfillment of the aforementioned Task 4 deliverable.

II. Engineering Design & Packaging of the HLA System

The approach taken by ARBOC, Eaton and Ruby Mountain in regard to engineering design and packaging was to break the project into two distinct segments. The first segment was to develop C.A.D. drawings for the HLA system and overlay them with the C.A.D. designs for the bus. This provided the opportunity to see if there were any obvious conflicts in the bus systems, particularly the alternative fuel modifications and the proposed HLA package. Drawings were submitted from Eaton, International and Bell Power. These drawings were integrated by ARBOC to determine if there were any obvious inconsistencies. Issues such as ground and system clearances were addressed. In addition to engineering integration issues the partners attempted to anticipate potential repair issues to insure any repairs could be made with the least possible difficulty. The confidential/proprietary C.A.D. drawings used in that process are attached to this report.

The second segment of the engineering design and packaging of the HLA was to develop a full-size scale model of the HLA system and fit that model into the vehicle prior to the installation of the final HLA system. This approach allowed the partners to determine if the vehicle and the alternative fuel system as actually built and installed varied in any significant degree from the designs and three dimensional C.A.D. drawings.

Eaton provided a mock up HLA system for this segment of the effort. Over the last 4 weeks ARBOC has worked to fabricate all the necessary brackets and fittings that will allow the HLA system to be installed. Further, they have checked all tolerances and clearances to assure there are not likely areas of wear. The major problem encountered in this process was that incorrect data had been entered into the C.A.D. drawings relative to ground clearances. This mistake resulted in an HLA system that was two inches lower than anticipated and presented the potential that the vehicle could become high centered or could scrape the bottom of the HLA system when crossing certain grades.

To resolve this issue a physical inspection of the understructure of the vehicle was made to determine if the HLA pump system could be installed higher than originally contemplated. Further, the engineers and designers calculated a way to install the accumulator tanks in a more compact manner. Between these two adjustments, the needed two inches were found and the HLA scale model was successfully fit onto the chassis.

In addition to the exact positioning of the major components of the system, the real-life model of the HLA system allowed for the fabrication of hosing, clasps, and the plumbing and electrical systems. Further, all bolts and fasteners have been identified and modifications made to the chassis as required. This approach will allow for what is calculated as a truly “bolt on” installation when the final HLA system is installed.

The final benefit of a separate mock up and installation phase is that it also provided Eaton additional time to make several component modifications on the existing HLA system. These modifications are the result of “in use” data from other applications in which the HLA system has been used. Eaton is currently in discussion with their sub-contractors to affect these changes. These changes will increase the durability of the system to be installed on the bus and allow the bus to function on absolutely the latest technology.

III. Attachments

Attached to this report is the following:

ATTACHMENT A: Photos of the Mounting Brackets Designed in Packaging of the HLA System on the Project Vehicle's Undercarriage

Task 4 Deliverable:
Engineering Design and Packaging of the Hydraulic Launch Assist (HLA) System

Attachment A:
Photos of the Mounting Brackets Designed in
Packaging of the HLA System
on the Project Vehicle's Undercarriage

Caption: HLA Mounting Brackets (Angle View)

Caption: HLA Mounting Brackets (Side View)

Caption: HLA Mounting Brackets (Rear View)