Alternative FUELS IN TRUCKING

Volume 5, Number 1

Industry and Education Experts Work Together to Establish Alternative Fuel Vehicle (AFV) Technician Training Standards

As more and more AFVs find their places in the transportation industry, the need for qualified technicians to service these vehicles continues to grow. To help meet this need, transportation industry and education experts are working together to develop standards for AFV technician training, standards that will serve as a valuable tool for AFV technician training programs now and in the future.

Background

Section 411 of the Energy Policy Act of 1992 (EPAct) requires that the U.S. Department of Energy (DOE) ensure the availability of training programs for voluntary certification of alternative fuels technicians. To meet this requirement, DOE entered into a 5-year cooperative agreement with the National Automotive Technicians Education Foundation (NATEF) to develop and implement such a program.

Goals

AFV program standards will:

- Serve as a guide to schools that wish to provide alternative fuels training
- Provide a mechanism to certify and recognize programs that meet industry expectations (standards)
- Assist industry in locating quality training providers and potential future technicians.

Participants

The National Institute for Automotive Service Excellence (ASE)

The automotive industry established this nonprofit organization in 1972. ASE's mission is to improve the quality of vehicle repair and service in the United States through the voluntary testing and certification of automotive repair technicians. ASE's 40-member board of directors is made up of representatives of the automotive industry.

Bonus ***with this Issue!***

The National Renewable Energy Laboratory has prepared a case study on heavy trucks for the U.S. Department of Energy, included as a bonus with this issue of *Alternative Fuels in Trucking*. The case study, *Running Refuse Haulers on Compressed Natural Gas: The New York City Experience*, describes the results from the successful demonstration of these refuse haulers on the streets of New York City. Stay tuned for more case studies as results continue to become available.

INSIDE THIS ISSUE

Currently, there are about 370,000 ASE-certified technicians working in every segment of the automotive industry: car and truck dealerships, independent garages, fleets, service stations, and franchises. To remain certified, technicians must be retested every 5 years. Automotive service facilities display the ASE Blue Seal of Excellence logo to indicate that they hire ASE-certified technicians.

The National Automotive Technicians Education Foundation

This 501(c)(3) nonprofit organization is a separate foundation within ASE. NATEF's primary mission is to improve the quality of automotive technician training programs nationwide through voluntary certification (accreditation). NATEF is directed by a 14-member Board of Trustees appointed by the ASE Board.

How ASE Certification Works

Secondary and post-secondary institutions conduct an extensive self-evaluation of their automotive training programs against national standards, developed by industry experts through a series of workshops facilitated by NATEF. This is followed by an on-site evaluation conducted by specially trained evaluation team leaders and local technicians. Once a program has met the standards, NATEF recommends the program to ASE for certification. Programs must recertify every 5 years, and the standards are reviewed and revised by industry groups every 3 years. All 50 states endorse ASE certification of their training programs, and more than 1200 programs are currently certified to NATEF program standards for automobile repair, auto collision repair, and medium/heavy truck repair.

Developing AFV Standards

During the first 2 years of its agreement with DOE (April 1995–April 1997), NATEF is developing certification programs for compressed natural gas (CNG), liquefied natural gas (LNG), and liquefied petroleum gas (LPG) vehicle technician training. By the close of 1995, NATEF had already completed and implemented the Light-/Medium-Duty CNG/LPG Certification Program for entry-level training programs. In 1996, NATEF will complete and implement standards to certify heavy vehicle CNG, LNG, and LPG training, as well as standards to certify in-service technician training.

To develop the standards, NATEF is facilitating a series of workshops with technical experts from each segment of the industry, such as original equipment manufacturers, conversion equipment manufacturers, conversion companies and technicians, fuel suppliers, AFV educators, and end users. During each workshop, the participants identify the tasks a technician must perform on the job and the associated tools and equipment. Safety issues, instructor qualification requirements, and program hours are also identified in these workshops.

Progress to Date

The first workshop, on LNG, assembled in Los Angeles, California, on April 1–3, 1996. The NATEF program director opened the workshop by explaining its purpose and methods. Participants were also briefed on the American Trucking Association Foundation's ongoing work to develop industry-recommended practices for construction, operation, and maintenance of LNG heavy trucks because that work will contribute to the development of LNG truck program standards. NATEF is preparing the outcome of the workshop for presentation at the first combined heavy vehicle workshop, planned for August 1996.

When complete, the certification program for AFVs will not simply meet the legislative requirements of EPAct, but will mirror successful existing programs for automotive technician training.

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Developing LNG Refuse Trucks

In the early 1990s, Southwest Research Institute (SwRI) developed a compressed natural gas (CNG) fuel system and installed it in tandem with a Mack E7 engine on a refuse vehicle for test purposes. The CNG fuel tanks required were less than ideal—they were large and heavy. To put their size and weight into perspective, the fuel system required on a CNG vehicle is approximately five times heavier and occupies a volume of six times that required for a given diesel fuel capacity based on energy content. Because weight, space, and vehicle range are extremely important parameters in Class 8 vehicles, CNG is at a disadvantage in heavy trucks. In addition, the fuel economy of current natural gas trucks is lower than that of a diesel truck because the engine thermal efficiency of a spark-ignited engine is inherently lower than that of a compression-ignition engine of similar power.

This experience seems to indicate that liquefied natural gas (LNG) may be a better choice for Class 8 trucks. LNG occupies a volume approximately two times that required for a given diesel fuel capacity, and the weight is approximately 1.5 times that of diesel fuel based on Btu content.

However, because LNG is a cryogenic liquid, technical and safety challenges must be addressed before LNG can be a viable Class 8 alternative fuel. To address these challenges, Mack Engine Company has set out to improve engine efficiency and develop and test a complete LNG fuel system that satisfies its design requirements. The fuel system also must comply with the American Trucking Association (ATA)

Photo courtesy of Mack Trucks/PIX 02372

The first Mack LE refuse hauler being fitted with the natural gas E7 engine

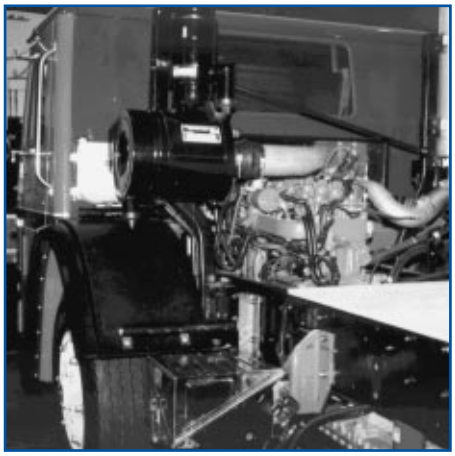

Photo courtesy of Mack Trucks/PIX 02371

Foundation's LNG Technical Subcommittee's "Recommended Practices for LNG Powered Heavy Duty Trucks." These practices are being developed with the Society of Automotive Engineers for adoption as an industry-recommended standard (see *Alternative Fuels in Trucking*, Volume 4, Number 4).

Two cryogenic tank manufacturers, CVI, Inc., and MVE, Inc., have agreed to work with Mack to develop and test a complete truck fuel system that incorporates LNG fuel tanks. Mack is working with SwRI and the Gas Research Institute to develop and evolve the next-generation natural gas Mack E7 engine to achieve a higher level of engine efficiency, especially at part-throttle loads. As part of this work, the second-generation natural gas engine and fuel system will be integrated with a Mack LE chassis to produce a prototype refuse hauler for a demonstration project with the Chambers Development Company-USA Waste.

The objectives of this work are to:

- Improve the Mack E7 natural gas engine to run more efficiently and to increase vehicle range, especially in refuse applications, while meeting 1998 emissions regulations and producing equivalent diesel power and torque
- Develop a Mack LE refuse vehicle with an E7 engine that will operate on LNG as dedicated fuel and serve as a prototype for six additional vehicles that will be operated in a more comprehensive vehicle evaluation program
- Produce a vehicle that is safe, durable, reliable, and compliant with all proposed and applicable regulations
- Design and install a vehicle fuel system capable of safely supplying adequate fuel to the engine for all operating conditions
- Include a fuel capacity volume of LNG that is no more than double that of diesel for equivalent vehicle range
- Produce a vehicle that can undergo short- and long-term servicing indoors.

After the first vehicle is tested extensively, plans call for six

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Alternative Fuels: Breaking Down the Barriers

Costs Improving

Not long ago, Class 8 trucks with alternative fuel engines were mostly aftermarket conversions. Engines were installed by someone other than assembly line workers, somewhere other than a truck factory. This resulted in a complicated and costly process that might cost as much as $50,000 to $70,000 more per vehicle, a fact that had deterred trucking companies from making major conversions and investments in alternative fuel vehicles. With time, however, this is changing.

The first Class 8 trucks with production-line natural gas engines became available from Volvo GM Heavy Truck Corporation this year. In January, Volvo introduced the Cummins Engine Company's natural-gas-powered L-10G engine as a factory option on its Xpeditor refuse trucks. Volvo has put about 50 of these trucks into use.

Although they cost less than earlier one-of-a-kind trucks, these trucks are still somewhat more expensive than a similar diesel truck, according to David Shrader, senior engineer and marketing specialist for Volvo. He indicated that the higher cost is more closely associated with the fuel tanks and the engine, rather than the manufacturing. Costs have run high primarily because of low volume, but as production volumes increase, costs will decrease. In addition, fuel systems are undergoing rapid development, which should bring costs down. It is unlikely, however, that liquefied natural gas (LNG) fuel tanks will ever be as cheap as their diesel counterparts.

Photo Courtesy of Cummins Engine Company, Inc.

Volvo offers a natural gas engine factory option on its Xpeditor refuse haulers

Shrader also noted that Volvo will be introducing the Cummins C8.3 natural gas engine in the Xpeditor this year, and expanding its alternative fuel demonstrations to several other natural gas engines.

ATA Looking at Safety

Uncertainties about the safety of alternative fuel vehicles have led to caution in their adoption, but the American Trucking Association Foundation, through its Alternative Fuels Task Force's LNG Subcommittee, is now leading an effort to dispel the uncertainties. Bill Peerenboom, vice president of the foundation, directed the subcommittee's efforts in performing a detailed failure modes and effects analysis (FMEA) on LNG heavy-duty trucks. This work has been supported by the U.S. Department of Energy through the National Renewable Energy Laboratory.

The FMEA attempts to discover all possible failures with a system in any given circumstance, and methods to prevent such failures. These data, along with an extensive review of codes and regulations, are being used to establish an industry-recommended practice for constructing, operating, and maintaining an LNG truck. These will be provided to the Society of Automotive Engineers for review and adoption for the trucking industry.

Manufacturing Solutions

Original equipment manufacturers have to date offered limited numbers of factory-built alternative fuel heavy trucks because it has been difficult to integrate changes into the standard engineering and manufacturing processes. Putting a natural gas engine into a chassis is not a problem on a production line, but installing the necessary LNG and compressed natural gas (CNG) fuel systems presents a challenge. Volvo has come up with a solution: the company will install the engines on the assembly line at one plant and then tow the unfinished Xpeditor refuse trucks to its vehicle modification

center next door, where the fuel systems will be installed. This process, however, is still somewhat more expensive than normal practice.

Fuel Availability to Improve

Some alternative fuels have not been readily available to trucking fleets. However, the natural gas industry has recognized the potential growth of the natural gas vehicle market, and several studies have noted this fact. A report by the Gas Research Institute calls for nearly 55,000 Class 3–8 vehicles operating on alternative fuels by 1998, a figure that is expected to jump to 151,000 by 2003. The size of this potential market is sparking more interest in fueling station installation.

Steps Toward the Alternative Fuel Future

Many alternative fuels expositions continue to be held across the country, displaying an increasing number of LNG- and CNG-powered trucks. Such events reach out not only to trucking companies but to the general public.

These steps pave the way for more and more companies to experiment with alternative fuel fleets. Such experimentation will be essential in the face of the expected alternative fuels regulations for the transportation industry.

I-35 Corridor Coalition Supports LNG

The Interstate 35 Corridor Coalition was formed in 1994 to gain congressional approval for a NAFTA Superhighway System designation, calling for I-35 to serve as the trade route's trunk because of its central location and ties to the Mexican PanAmerican Highway System. The proposed superhighway route runs from Mexico City north through Monterrey and Laredo to Dallas, Oklahoma City, Kansas City, and on to Minnesota and the Canadian border.

The I-35 coalition is led by Jeff Mosely, judge of Denton County, Texas, and Mercurio Martinez, Jr., judge of Webb County, Texas. The coalition convened in Austin, Texas, recently, and endorsed a resolution submitted by the Texas General Land Office to promote convenient natural gas fueling. The resolution states that the coalition "supports the development of LNG and CNG fueling facilities at regular intervals along the entire I-35 Corridor and elsewhere along the Superhighway system. Such development will enable convenient natural gas fueling for heavy-duty trucks and automobiles."

The committee resolution that resulted from the Austin meeting designated Mexico, along with Texas, Oklahoma, and Kansas, as offering an abundance of inexpensive, domestically produced natural gas. The resolution also stressed that long-haul trucks operating on liquefied natural gas (LNG) emit very few particulates and nearly less than half the NO_x of diesel trucks.

Texas Land Commissioner Gary Mauro took coalition members to the LNG and compressed natural gas (CNG) fueling stations in the Austin area, and said "Natural gas fueling—compressed natural gas and liquefied natural gas—already is practical."

I-35 corridor (LNG and CNG fueling facilities are under construction on the branches)

Midwest Ethanol Demonstration Project

by Barb Sutey, Hennepin County Bureau of Public Service

For the past few years, Hennepin County in Minneapolis, Minnesota, has been participating in the Midwest Ethanol Demonstration project to test the feasibility of using ethanol (E85) in heavy trucks in a cold-weather environment. The 3-year project is funded by the U.S. Department of Energy through the American Trucking Association Foundation. The study, which is in its final year, examines engine and vehicle performance, fuel and fuel storage, and safety and emissions.

Hennepin County has three trucks in this project—two run on ethanol and the third on diesel fuel. The trucks are International Paystar 5000 tandem-axle dump trucks with a 15-foot aluminum dump body. They are powered by Detroit Diesel Corporation (DDC) 6V92 TA DDEC engines. The trucks and the project were initially described in *Alternative Fuels in Trucking* in 1994 (Volume 2, Number 4). The trucks are mainly used for snow plowing, but also perform a variety of road maintenance duties in the spring and summer months, such as paving, hauling sand and gravel, and assisting in tree and brush removal.

Overall, the trucks have consistently performed their assigned work from the time of their inception, and they have also performed in two of the coldest winters on record. Each truck has logged more than 50,000 miles of use, typical for a 2-year service period for county trucks. Several conclusions have been drawn from this demonstration:

Engine and Vehicle Performance

- The trucks have adequate power for snow removal. They move snow with the same ease as other trucks, and certainly have enough power for the hauling applications. The trucks have had no problems operating even in extremely cold temperatures.
- Maintenance costs have been about 20% higher for the ethanol trucks, primarily because of fuel filter, fuel pump, and electrical problems with the trucks.

Warren Gretz, NREL/PIX 00243

Hennepin County E85 heavy trucks, used for snow plowing and various road maintenance duties

Warren Gretz, NREL/PIX 00246

Warren Gretz, NREL/PIX 00244

- Fuel usage is near predicted levels, meaning ethanol trucks use about twice the fuel as diesel trucks. This differential results from the lower energy content of the fuel, rather than from a deficiency in the engines.

Fuel and Fuel Storage

- Ethanol is a convenient fuel to use; it utilizes the same transport, storage, and dispensing system as diesel fuel. In fact, Hennepin County converted one of its existing underground tanks to ethanol to avoid any initial expense for the use of this fuel. Because Hennepin County is in the Midwest where ethanol production is higher, and because it has a centralized fueling operation, substantial amounts of fuel have always been available.

- The delivery response for ethanol has been the same as for any other fuel purchased, and its fuel quality has always been quite high. However, the cost of ethanol has averaged $1.22 per gallon, compared with $0.63 per gallon for diesel, excluding taxes.

Safety

- Ethanol poses no hazardous risk to drivers or the community, and requires no special handling. Also, since the project began, the trucks have remained accident and incident free.

Emissions

- All of the demonstration trucks meet U.S. Environmental Protection Agency standards for diesel emissions, as certified by DDC. In addition, West Virginia University has twice conducted emissions tests on the trucks, and the results were the same both times. The ethanol engines have lower particulate matter and oxides of nitrogen emissions than diesel engines, but higher carbon monoxide and hydrocarbon emissions.

Hennepin County will continue to observe these trucks in real-world applications, and document engine and vehicle performance. The demonstration project will conclude in the fall of 1996.

Detroit Diesel Developing Propane Engine

by Gina Scherffius, Texas Railroad Commission

The first U.S. original equipment manufacturer (OEM) heavy-duty propane engine for many years, called the Detroit Diesel Corporation (DDC) Series 50P, will go to field trials in 1996. The engine has the potential to make propane the nation's foremost alternative fuel for medium and heavy trucks, as well as other applications in the 250 to 275 horsepower (hp) class.

A consortium of more than two dozen organizations began engine development in 1994. The consortium, made up of participants interested in introducing a heavy-duty propane engine into the marketplace, has contributed more than $4 million to fund the project.

Sponsors include demonstration sites (Corpus Christi Regional Transportation Authority, Corpus Christi, Texas, and the Hertz Corporation, Denver, Colorado), propane industry sponsors (Propane Vehicle Council, National Propane Gas Association), and government agencies (Texas Railroad Commission, U.S. Department of Energy through the National Renewable Energy Laboratory). Sponsor participation ranges from in-kind services to funding for tank installation and engine maintenance. All sponsors are also influential in project direction. The Adept Group of Los Angeles manages the program.

The diesel version of the 8.5-liter unit produces anywhere from 150 to 300 hp and 1000 foot pounds (ft-lb) of torque. The new propane version, targeted toward Class 8 trucks, transit buses, and generator sets, will produce 250 to 275 hp and 890 ft-lb of torque at 1200 rpm.

After 18 months of development, field-testing will begin this fall. Transit buses and trucks in both Corpus Christi and in Nova Scotia will be equipped with the Series 50P engine. After several months of real-world applications in medium and heavy trucks, DDC will formally decide on commercial production of the Series 50P.

Along with publicizing the engine's characteristics and availability through trade publications and other media, project partners are planning an event at the International Transit Expo 1996, which will be held in October in California. Events are also planned for each of the engine demonstration sites.

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The aim of **Alternative Fuels in Trucking** is to inform fleet owners and operators, equipment suppliers, government officials, and other interested parties about important developments in the use of alternative fuels in heavy-duty trucks. Suggestions and comments are welcome and may be directed to the National Alternative Fuels Hotline at 1-800-423-1DOE. Views expressed by guest authors are their own, and not those of ATAF, DOE, or NREL.

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additional LNG and seven diesel vehicles to be placed in service to yield more comprehensive data. This planned fleet will operate from Chambers-USA Waste's Washington, Pennsylvania, facility, which has a state-of-the-art LNG refueling system. The refueling facility was designed and installed by CVI. Additionally, Chambers-USA Waste has outfitted its Washington site with a new maintenance facility designed specifically to support its natural gas trucks. This integration is the first of its kind in the trucking industry.

A consortium was formed to contribute supplemental funds for the fueling facility, to build six additional LNG vehicles, and to collect pertinent data. Consortium members are: Mack Trucks, Inc.; Columbia Gas of Ohio, Inc.; Consolidated Natural Gas Service Company; Equitable Gas Company; ATA Foundation; Chambers-USA Waste Company, Inc.; the U.S. Department of Energy through the National Renewable Energy Laboratory; and the Pennsylvania Department of Environmental Protection.

How to Reach Us

- The AFDC World Wide Web address is **http://www.afdc.doe.gov**
- The *Alternative Fuels in Trucking* newsletter is available on the WWW at **http://www.afdc.doe.gov/1/trknews** It is available on-line 2 or 3 weeks before the newsletter is mailed.
- To speak to a human being, call the National Alternative Fuels Hotline at **(800) 423-1DOE**.

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