

TUG Tidbits



Newsletter of the Natural Gas Transit Users Group

March, 2006

- ◆ **“Natural Gas Buses Still Cheaper to Run than Diesel”**
 - ◆ **Scholarships Available for Natural Gas Vehicle Cylinder Inspection Training and Certification**
 - ◆ **TUG Meeting with Cylinder Training?**
 - ◆ **New NREL Reports on Alternative Fuel Buses**
 - ◆ **Zero Emissions Bus: Could a PZEB Natural Gas Hybrid ‘Fill the Bill’ at Much Lower Cost?**
 - ◆ **Meeting Presentations from 2004 and 2003 Posted on TUG Web Site**
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“Natural Gas Buses Still Cheaper to Run than Diesel”

That’s the headline of a January 8 article in the Port Huron Times Herald, discussing the price of diesel and natural gas fuel for Blue Water Transit’s buses.

The article goes on to say that “There’s good news and bad news about the ‘This Vehicle Powered by Natural Gas’ stickers on the back of Blue Water Area Transit Vehicles.”

“The good news? Natural gas burns cleaner and cheaper than diesel. The bad news? It’s the same natural gas that heats homes and has skyrocketed in cost.”

The article said Blue Water was paying \$2.10/gallon for diesel and \$1.55 for a diesel equivalent gallon of natural gas.

There may be even more “good news,” now on the price front. At the time of that article crude oil was selling for about \$57.50/bbl on the spot market. It has since gone up to about \$67 and was today selling for about \$60. But natural gas, after peaking at around \$15.50/MMBTU last December, was on the way down when the Port Huron article was written and is today selling for \$6.33 on the spot market. That

should mean that your natural gas prices are going down, while diesel may be staying level. Sure hope I see that natural gas price drop on my home gas bill this month!

Scholarships Available for Natural Gas Vehicle Cylinder Inspection Training and Certification

Scholarship funding for natural gas vehicle (NGV) cylinder inspection training and certification is available from a Clean Vehicle Education Foundation (CVEF) program underwritten by the U.S. Department of Energy (DOE).

Like a gasoline-or diesel fueled-vehicle, a natural gas vehicle's fuel system should be inspected periodically. In fact, U.S. Department of Transportation regulations require all vehicular compressed natural gas (CNG) cylinders to be labeled with a notice stating, "This container should be visually inspected after a motor vehicle accident or fire and at least every 36 months or 36,000 miles, whichever comes first, for damage or deterioration." The visual inspection looks for cuts, cracks, gouges, abrasions, discoloration, broken fibers, loose brackets, damaged gaskets or isolators, heat damage or other problems and checks that the cylinder has not reached the end of its useful life.

Inspections performed by service stations or state agencies may not include a detailed CNG cylinder visual inspection. If your fleet does not have a qualified inspector, some CNG vehicle manufacturers, local gas utilities, and cylinder manufacturers offer cylinder inspection services. If yours do not, a list of CSA-certified inspectors is available at <http://webext.csa.ca/cng/cngmain.asp#searchinspector> (CSA is the only nationally recognized organization certifying CNG cylinder inspectors in the United States and Canada).

If you would like to have a technician trained and CSA-certified as a qualified cylinder inspector, scholarships to cover the cost of training and certification testing may be available. To find out where training is available and how to apply for a scholarship, go to www.cleanvehicle.org/technology/cylinder.shtml and click on "Is Scholarship Assistance Available?" or contact Hank Seiff (703-534-6151, hseiff@cleanvehicle.org).

TUG Meeting with Cylinder Training

As the above article explains, a CVEF program underwritten by DOE reminds natural gas vehicle users of the importance of proper CNG cylinder maintenance and inspection. It also offers scholarships so that technicians can be trained and certified as cylinder inspectors.

We are considering including a cylinder inspection class and CSA certification test as part of our next TUG meeting in the fall. The three-day meeting would divide the two-day training and testing program with a day of more “normal” TUG topics, but heavy on cylinder and fuel-system related issues.

If your transit authority is interested in hosting this three-day program (and, of course, having some of your technicians trained and certified), please contact Hank Seiff at (703-534-6151, hseiff@cleanvehicle.org) to discuss possibilities. CVEF will provide the trainer, all materials, and the CSA test.

New NREL Reports on Alternative Fuel Buses

The National Renewable Energy Laboratory (NREL) has recently published the following reports for DOE:

Emission Testing of Washington Metropolitan Area Transit Authority (WMATA) Natural Gas and Diesel Transit Buses, Authors: M. Melendez, J. Taylor, and J. Zuboy, NREL; W. S. Wayne, West Virginia University; D. Smith, DOE,
<http://www.nrel.gov/vehiclesandfuels/ngvtf/pdfs/36355.pdf>

The Executive Summary of this study reports that:

The John Deere CNG buses produced 49% lower NO_x emissions and 84% lower PM emissions compared with the MY 2004 DDC diesel buses, and 63% lower NO_x emissions and 60% lower PM emissions compared with the MY 2000 DDC diesel buses. The CWI buses produced 6.1% higher NO_x emissions and 60% lower PM emissions compared with the MY 2004 DDC diesel buses, and 23% lower NO_x emissions and equal PM emissions compared with the MY 2000 DDC diesel buses.

In addition to showing the emissions advantage of CNG buses, this project showed promising fuel economy results for the CNG buses compared with the diesel buses. The following fuel economy comparisons are made on a diesel gallon equivalent basis. The John Deere CNG buses exhibited a 9.0% fuel economy improvement compared with the MY 2004 DDC diesel buses and a 2.9% improvement compared with the MY 2000 DDC diesel buses. The CWI CNG buses exhibited a fuel economy 4.2% higher than the MY 2004 DDC diesel buses and 1.6% lower than the MY 2000 DDC diesel buses. Both CNG engines use lean burn technology.

Development and Demonstration of Hydrogen and Compressed Natural Gas (H/CNG) Blend Transit Buses, Authors: A. Del Toro, SunLine Services Group; M. Frailey, NREL; F. Lynch, Hydrogen Components Inc.; S. Munshi, Westport Innovations; S. Wayne, West Virginia University;
<http://www.nrel.gov/vehiclesandfuels/ngvtf/pdfs/38707.pdf>

The Executive Summary of this study reports that:

The results of an initial engine dynamometer laboratory assessment of the effect of hydrogen blend level on emissions and fuel economy led to the selection of 20 vol% hydrogen for use in this study. In additional laboratory testing, the H/CNG engine showed regulated pollutant reductions for oxides of nitrogen (NO_x), non-methane hydrocarbons (NMHC), and carbon monoxide (CO) of 50%, 58%, and 9% respectively with no fuel consumption penalty relative to CNG.

Over a nine month period, the CNG and H/CNG buses operated 88% and 84% of the time respectively during regularly scheduled transit service, with all buses exceeding the 24,000 mile target. Fuel economy during the in-use assessment shows the H/CNG vehicles actually used more fuel on an energy equivalent basis. In contrast to engine testing results, on average H/CNG fuel consumption was 12% higher during the in-use assessment than for CNG. In-use exhaust emission characterization supports the laboratory results for NO_x; H/CNG vehicles averaged over 55% reduction on two separate test schedules. Measurements for all other regulated pollutants were very low for both fuels because of the presence of oxidation catalysts on all the vehicles. A post service assessment of the vehicles showed no differences in engine wear between the two fuels.

This project demonstrated that with minor engine and vehicle modifications the 20/80 H/CNG blend can be used in revenue service fleets with similar operational performance as CNG. Additional optimization of the H/CNG engine calibration is necessary to attain equivalent fuel economy, or alternatively increased fuel economy at equivalent NO_x emissions.

(Editor's Note: Upcoming revisions to NGV2, the industry standard for CNG cylinders, will not permit a mixture of more than 2% hydrogen in CNG because of concerns that CNG components may not be designed for safe use of higher percentage blends. Also, emissions improvements seen on lean-burn NG engines tested in this report are not likely to be duplicated in stoichiometric NG engines offered starting in 2007.)

New York City Transit Hybrid and CNG Transit Buses: Interim Evaluation Results, Authors: K. Chandler, Battelle; E. Eberts, NREL:
http://www.eere.energy.gov/vehiclesandfuels/avta/pdfs/heavy/nyct_interim_report_final.pdf

The Executive Summary of this study reports that:

The CNG buses' average fuel economy was 25% lower than (their) diesel baseline buses.... The hybrid buses' average fuel economy was 45% higher than (their) diesel baseline buses....(However) the diesel baseline buses for the hybrid bus evaluation have diesel engines without exhaust gas circulation (EGR). The addition of EGR for

emissions control would tend to lower the diesel baseline fuel economy. The eight-month evaluation period does not include summer months, which could have reduced the hybrid bus fuel economy advantage from air conditioning loading and the ability to collect regenerative braking energy into the batteries. The summer-month fuel economy information will be provided in the final results report on this evaluation....

...The CNG buses' average total maintenance cost was 8% higher than the hybrid buses during the evaluation period....

The CNG buses had a rate around 5,000 MBRC (miles between road calls) compared (to its)... diesel baseline group, which had around 2,000 MBRC. The hybrid buses had a rate around 7,000 MBRC, and (its)... diesel baseline group had around 5,000 MBRC.

(Editor's Note: Emissions comparisons do not appear to be reported in this study.)

Ten Years of Compressed Natural Gas (CNG) Operations at SunLine Transit Agency, Author: K. Chandler, Battelle: <http://www.nrel.gov/vehiclesandfuels/ngvtf/pdfs/39180.pdf>

SunLine became the nation's first fleet to change to 100% CNG bus operations when it switched over its entire fleet in May 1994. Today they have a fleet of 47 buses (all CNG). The oldest is a 1985 Gillig with a Detroit Diesel S50G engine. The newest are seven 1995 Thomas buses with Cummins B5.9G engines. SunLine also operates 34 1994 Orion Vs with Cummins L10-240G engines and seven 1994 ElDorado's with Hercules 5.6L engines. Over the past five years SunLine's buses have averaged 3.1 mpg on CNG. Fuel cost has averaged \$0.34/mile. Maintenance cost is \$0.36/mile. The buses have averaged 11,000 miles between road calls.

The study states that SunLine has been successful with CNG by showing "... pioneering leadership at a very early stage of natural gas vehicle development by converting its entire fleet. SunLine has been operating some of the least sophisticated CNG buses in the transit industry and has become very successful through persistent dedication and extensive training of maintenance personnel."

You can find more publications about natural gas vehicle research, development, and deployment efforts on the NGVTF Web Site at <http://www.nrel.gov/vehiclesandfuels/ngvtf/publications.html>.

Zero Emissions Bus: Could a PZEB Natural Gas Hybrid 'Fill the Bill' at Much Lower Cost?

At the CARB Zero Emissions Bus Workshop in January, Sam Altshuler of Pacific Gas and Electronic asked whether a natural gas hybrid bus could meet California's needs for a PZEB (Partial Zero Emissions Bus). With fuel cell technology not evolving as fast or as cheaply as originally hoped and with diesel NO_x emission require-

ments for urban buses in California being relaxed from 0.2 gm to 1.2 gm/bhp natural gas hybrid buses might well provide the answer.

Natural gas heavy-duty bus engines will meet the 0.2 gm NO_x standard in 2007. Using those engines in a hybrid bus would provide environmental benefits approaching those of hydrogen fuel cell buses. At the same time, the upfront costs of such a bus would be less than 20% and the life cycle costs would be about 30% of a fuel cell bus. Mr. Altschuler is presently doing analysis work on the concept of a plug-in natural gas hybrid bus and expects its life cycle costs and emissions to be even more favorable.

For a copy of Sam Altschuler's presentation, contact Hank Seiff (703-534-6151, hseiff@cleanvehicle.org).

Meeting Presentations from 2004 and 2003 Posted on TUG Web Site

You can now download November 2004 and April 2003 TUG meeting presentations from the TUG-Members Only Site at <http://www.nrel.gov/extranet/vehiclesandfuels/tug/>. Contact Hank Seiff (703-534-6151, hseiff@cleanvehicle.org) if you need the member login and password to access the site.

Please send all questions, comments, requests for information, etc. to Hank Seiff at 703-534-6151 or hseiff@cleanvehicle.org. Photo courtesy of AFV International.