Arizona Public Service

Alternative Fuel Pilot Plant & Hydrogen Internal Combustion Engine Vehicle Testing

The INL manages the light-duty vehicle testing activities of the U.S. Department of Energy's Advanced Vehicle Testing Activity (AVTA). As part of this activity, INL and AVTA teamed with Electric Transportation Applications and Arizona Public Service (APS) to develop the Alternative Fuel Pilot Plant that produces and dispenses hydrogen on site. The hydrogen is produced through electrolysis by operating a PEM fuel cell in reverse. The Pilot Plant also compresses natural gas on site and fuels internal combustion engine test vehicles that operate on 100% hydrogen, and blends of 15 to 50% hydrogen and compressed natural gas.

Alternative Fuel Pilot Plant

The Arizona Public Service Alternative Fuel Pilot Plant is a model alternative fuel refueling system, dispensing hydrogen, compressed natural gas (CNG), and hydrogen/CNG blends (HCNG). The plant is used daily to fuel vehicles operated in Arizona Public Service's fleet.

Hydrogen Subsystem

The plant's hydrogen system consists of production, compression, storage, and dispensing. The hydrogen produced is suitable for use in fuel cell-powered vehicles, for which the minimum hydrogen purity goal is 99.999%. Hydrogen is produced using an electrolysis process that separates water into hydrogen and oxygen.

At present, the hydrogen is compressed and stored at a maximum operating working pressure of 6,100 psi. The facility has over 17,000 scf of high-pressure hydrogen storage capacity and 9,000 scf of low-pressure hydrogen storage capacity. The dispenser can fuel vehicles at pressures up to 5,000 psi.



Alternative Fuel Pilot Plant and fueling island (above) and hydrogen low-pressure and two high-pressure storage tanks with PEM electrolyzer (inset at left).

Compressed Natural Gas Subsystem

In addition to producing hydrogen, the plant also compresses natural gas for use as a motor fuel. CNG vehicles typically have 3,600-psi storage tanks. However, to fill a vehicle's onboard tanks, storage pressures must be higher. The APS system compresses natural gas to pressures up to 5,000 psi using a three-stage cascade pressure arrangement.

Hydrogen and Hydrogen/CNG (HCNG) Internal Combustion Engine Vehicle Testing

The U.S. Department of Energy's Advanced Vehicle Testing Activity (AVTA) is evaluating hydrogen and

Continued on back

Science

INL Idaho National Laboratory

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Facts about Arizona Public Service's Alternative Fuel Pilot Plant

- Location – Downtown Phoenix, Arizona
- Objectives:
  - Evaluate the safety and reliability of operating internal combustion engine (ICE) vehicles on hydrogen and blended HCNG fuels
  - Quantify ICE hydrogen and HCNG vehicle costs, performance and emissions
  - Ascertain the safety issues for a hydrogen production operation in a commercial setting
  - Develop a working model of a refueling system for ICE and fuel cell vehicles, and evaluate the vehicle fueling infrastructure and vehicle-to-infrastructure interface
- Hydrogen Generator – PEM fuel cell, 57 kW, 300 scfh hydrogen output
- Hydrogen Compressor – Oil free, three stage, diaphragm compressor, 99.9997% purity
- Hydrogen Dispenser – Dispenses hydrogen up to 5,000 psi
- HCNG and CNG Dispenser – Dispenses HCNG and CNG up to 3,600 psi
- CNG Boot Compressor – 300 scfm @ 60 psi
- CNG Main Compressor – 350 scfm @ 4500 psi
- High Pressure CNG Storage – 50,000 scf @ 4,000 psi
- Fuel Dispenser – Pure hydrogen or CNG and HCNG blended fuels, with metering and electronic billing interface

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HCNG internal combustion engine vehicles in closed-track and laboratory environments (baseline performance testing), as well as in real-world applications – including fleet testing and accelerated reliability testing (accumulating life-cycle vehicle mileage and operational knowledge within 1 to 1.5 years). Emissions testing has also been conducted on several vehicles.

In addition to reducing the use of petroleum, using hydrogen and HCNG as a fuel in internal combustion engine vehicles provides air emissions benefits. Testing hydrogen internal combustion engine vehicles also supports development of the hydrogen infrastructure needed for fuel cell vehicles.

The AVTA, along with its testing partners APS and Electric Transportation Applications, is operating several 100% hydrogen internal combustion engine vehicles – with Ford and Mercedes Benz engines – as well as a dozen internal combustion engine vehicles (including Daimler Chrysler, Ford and General Motors vehicles) that operate on 15 to 50% HCNG blends. Various fuel blends have also been tested in a Ford F-150 to allow the comparison of performance and emissions impacts.



Additional information about Arizona Public Service's Alternative Fuel Pilot Plant and these advanced alternate-fueled internal combustion engine test vehicles can be found at: http://avt.inel.gov/hydrogen.html



For more information

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INL is a U.S. Department of Energy national laboratory operated by Battelle Energy Alliance