



Hydrogen Workshop for Fleet Operators



Module 7, “Specialty Hydrogen Vehicles”



Specialty Hydrogen Vehicle Outline

1. Freedom Fuel Cell Golf Cart
2. Hydrogenics Fuel Cell Forklift
3. Aprilia Atlantic Fuel Cell Scooter
4. HDW U33 Fuel Cell Submarine
5. BMW H2R
6. Hydrogen Shelby Cobra
7. GM Hydrogen3
 - Tokyo FedEx Demonstration
 - State of Maryland Lease
 - U.S. Postal Service Lease
8. Mercedes-Benz/Dodge Sprinter



Allis-Chalmers fuel cell tractor, 1959. A year after developing the fuel cell tractor, Allis-Chalmers produced a fuel cell forklift that could lift a 2,000-pound load off of the ground



Freedom Golf Cart

► Specifications

- Curb Weight – 760 lbs
- Fuel – Compressed Hydrogen
- Fuel Pressure – 3,000 psi
- Max Speed – 19 mph
- Time Before Refills – 3 days
- Hydrogen Consumption – 19.3 scfh

► Fuel Cell

- Type – E6 Alkaline Fuel Cell Generator
- Stacks – 2 x LC200-30
- Max Power – 1.3 hp
- Life – 2,000 hours



Astris Energy Inc



Hydrogenics Forklift

► Specifications

- Lifting Capacity – 5,000 lbs
- Fuel – Compressed Hydrogen
- Fuel Pressure – 3 psi
- Operating Time – 8 hours
- Refueling Time - <2 minutes

► Fuel Cell

- Type – PEM
- Stacks – Hydrogenics HyPM 10
- Continuous Power – 13.4 hp
- Max Efficiency – 56%



Hydrogenics Corporation



Aprilia Atlantic Scooter

► Specifications

- Driving Range – 38 miles
- Fuel – Compressed Hydrogen
- Max Speed 3.7 mph
- Fuel Pressure – 150 psi
- Operating Time – 10 hours

► Fuel Cell

- Type – PEM
- Stacks – APFCT
- Max Power – 0.3 hp



Aprilia spa



HDW U33 Submarine

► Specifications

- Submerged Capability – Weeks
- Fuel – Diesel Generator Set
- Surface Speed – 11 kn
- Dived Speed – 16 kn
- Diving Depth – 400+ meters
- Torpedo Tubes – 8 (4 capable of firing missiles)
- Produces no noise and no heat

► Fuel Cell

- Type – PEM
- Stacks – Siemens
- Max Power – 402 hp
- Net Efficiency – 70%



Hansa International Maritime Journal



BMW H2R

► Specifications

- Weight – 3,439
- Max Speed – 188 mph
- Acceleration – 0 to 62 mph in 6 seconds
- Single-seater

► Engine

- Type – 6.0L, 12-cylinder
- Max Power – 282 hp



The BMW Group



BMW H2R

► Speed records

- Flying-start kilometer: 11.9 sec, 187 mph
- Flying-start mile: 19.9 sec, 181 mph
- Standing-start 1/8 mile: 9.9 sec, 45 mph
- Standing-start 1/4 mile: 14.9 sec, 60 mph
- Standing-start 1/2 mile: 17.2 sec, 65 mph
- Standing-start mile: 36.7 sec, 98 mph
- Standing-start 10 mile: 221.0 sec, 163 mph
- Standing-start kilometer: 26.5 sec, 84 mph
- Standing-start 10 kilometer: 146.4 sec, 153 mph



The BMW Group



Hydrogen Car Company Shelby Cobra

► Specifications

- Driving Range – 80 to 100 miles
- Fuel – Compressed Hydrogen
- Max Speed – 140 mph
- Acceleration – 0 to 60 mph in 4 seconds
- ¼ mile time – 12 seconds
- Price – \$35,000 to \$80,0000

► Engine

- Type – Ford 427
- Displacement – 526 CID
- Max Horsepower – 300 to 400 hp





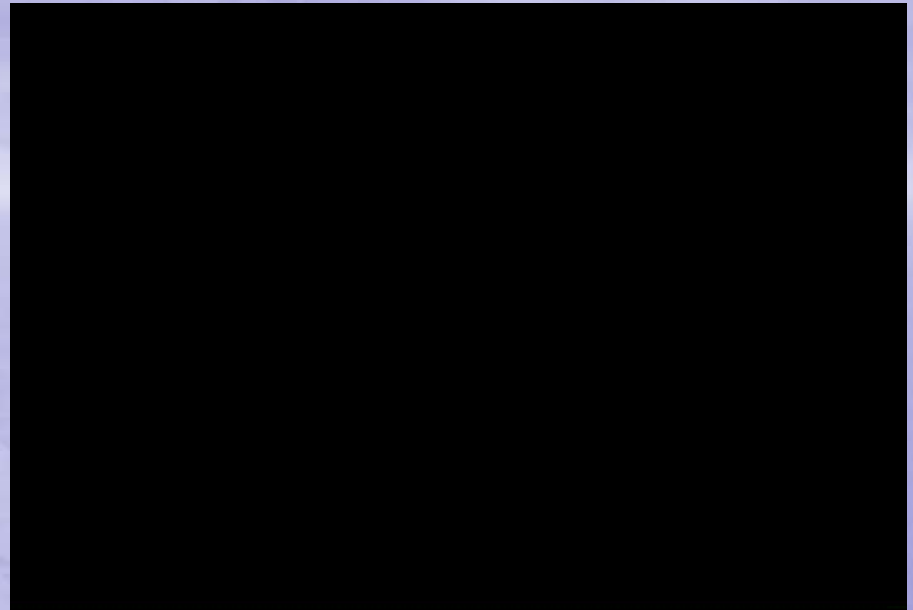
GM Hydrogen3

► Specifications

- Driving Range – 250 miles
- Fuel – Liquid Hydrogen
- Fuel Temperature – -253C
- Fuel Economy – 67 mpg city
- Acceleration – 0 to 60 mph in 16 seconds
- Cost - \$2,000,000

► Fuel Cell

- Type – PEM
- Stacks – GM
- Max Power – 126 hp
- Efficiency – 40%





Fuel Cell Marathon Across Europe

- ▶ Set world record for fuel cell technology with a 6,059-mile, 38-day run through 14 European countries
- ▶ Nearly doubled previous record held by DaimlerChrysler in 2002
- ▶ Vehicle performed without an unscheduled stop for repair
- ▶ Subjected to high speeds, steep mountains and extreme temperature variations
- ▶ Replacement of the mechanical parking mechanism (twice), replacement of 5 temperature sensors and software update were the only repairs necessary

*GM Hydrogen3 arrives in
Cabo de Roca near Lisbon*





Tokyo FedEx Fuel Cell Demonstration

- ▶ Joint one year testing program between FedEx and GM beginning in June 2003
- ▶ Delivered packaged for FedEx in high-impact financial and governmental areas of Tokyo
- ▶ FedEx drivers were trained to operate vehicles
- ▶ Vehicle was exposed to demanding driving cycles, repeated start-up and shut-down cycles, intensive stop-and-go, extra idle and weather extremes



“General Motor’s Hydrogen3, Fuel-Cell Power in the Real World”, December 2002



Tokyo FedEx Fuel Cell Demonstration

- ▶ FedEx picked up and delivered more than 10,000 packages during the program
- ▶ Vehicle was driven more than 5,000 km and an additional 10,000 km as part of the Japan Hydrogen and Fuel Cell Demonstration Project
- ▶ Vehicle had to be pulled from service for maintenance and repairs but FedEx never missed a delivery



“General Motor’s Hydrogen3, Fuel-Cell Power in the Real World”, December 2002



State of Maryland Lease

- ▶ One year evaluation to determine whether it is a successful means to reduce reliance on conventional fuels
- ▶ Used by the Maryland Department of Human Resources in Prince George's County (closest refueling station is Ft. Belvoir in Northern Virginia)
- ▶ GM engineer accompanied vehicle's driver over the one year operation



Maryland Governor Robert Ehrlich, Jr.



Palmieri, Peter, "Maryland Leases State's First Hydrogen Vehicle", September 2004



U.S. Postal Service Lease

- ▶ Leased one vehicle and added it to mail delivery in Washington, D.C.
- ▶ Assigned to the postal delivery route in the Ft. Belvoir, Virginia vicinity
- ▶ First commercial application of a fuel cell vehicle in the U.S.



General Motors Corporation



Mercedes-Benz/Dodge Sprinter

► Specifications

- Curb Weight – 4,300 lbs
- Fuel – Compressed Hydrogen
- Fuel Pressure – 5,000 psi
- Max Speed – 75 mph
- Driving Range – 93 miles
- Cargo Capacity – 2,000 lbs

► Fuel Cell

- Type – PEM
- Stacks – Ballard Mark 902
- Max Power – 114 hp



The Mercedes-Benz Owner's Community



Mercedes-Benz/Dodge Sprinter

▶ Hermes Delivery Service

- Cooperative venture with Hamburg-based Hermes Delivery Service
- In the first year of the two-year test phase, the Sprinter ran over 16,000 km in service

The Mercedes-Benz Owner's Community



▶ UPS Collaborative

- Collaborative project beginning in October 2003 in Stuttgart, Germany
- Scheduled to test in a 12-24 month trial
- Will cover 45 miles per day making deliveries from a central UPS depot

United Parcel Service of America, Inc





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ALLIANCE TECHNICAL SERVICES, Inc.