H₂ Reformer, Fuel Cell Power Plant, & Vehicle Refueling System

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Long-Term Goals/Project Objectives

● Resolve design issues & demonstrate small, on-site H\textsubscript{2} production for fuel cells and H\textsubscript{2} fuel stations

● Design/construct/operate multipurpose refueling station
  – Dispense CNG, H\textsubscript{2}/CNG blends, and pure H\textsubscript{2} to 27 vehicles
  – Ultimately serve as a link in a national H\textsubscript{2} corridor

● Design/construct/operate 50kW fuel cell

● Evaluate operability/reliability/economic feasibility, and certify integrated power generation and vehicle refueling designs
Overall Project Scope

City of Las Vegas

Air Products

Plug Power

VEHICLE REFUELING STATION

H₂/CNG

CNG

H₂

NG

FUEL CELL POWER PLANT SUBSYSTEM

POWER

HYDROGEN STORAGE COMPRESSION BLENDING

MERCHANT HYDROGEN MAKE-UP

HYDROGEN GENERATOR SUBSYSTEM

LH₂

NG

Water
Project Partners

- **Plug Power Inc., Latham, NY**
  - Major owners/strategic partners: MTI Inc., DTE Energy, General Electric, SoCal Gas (Sempra)
  - Developing a 7 kW home fuel cell
  - Developing 50 kW fuel cells for vehicles and buildings under separate DOE funding

- **City of Las Vegas (CLV)**
  - Host site for the project
  - 120 CNG vehicles operated by the RTC in Las Vegas
  - Purchasing 6 new buses for conversion to CNG/H₂
Task 1 Design & Development

- 1.1 Finalize Project Plan (May 2000)
- 1.2 Reformer Design & Development
  - Preliminary Prototype Testing
  - Prep. Prototype for relocation to Las Vegas
  - Scaled-up H₂ Generator design
- 1.3 50 kW PEM Fuel Cell System
- 1.4 CLV Fueling Station/Subsystem Integration
Task 2 - Construction & Installation

2.1 Reformer Subsystem
- Phase 2 - Prototype installation
- Phase 3 - Scale-up unit installation

2.2 50 kW PEM Fuel Cell
- Off-site assembly & testing
- Installation at CLV site (July 2001)

2.3 CLV Refueling Station
- Phase 1: Merchant H₂ supply
- Phase 2 & 3: Integration of reformers
Task 3 - System/Station Operations

- 3.1 Permitting & Safety Review
- 3.2 Start-Up Testing
- 3.3 Facility O & M
  - Phase 1: 3 - 5 vehicles
  - Phase 2: 9 - 18 vehicles + 50 kW Fuel Cell
  - Phase 3: 18 - 27 vehicles

Task 4 - Project Management & Reporting
Fuel Station

- LH₂ Storage
- Fuel Dispenser
- Vaporizer
- Fuel Cell
- Mechanical Compressor
- H₂ Storage
- MH Compressor
- Control Panel
- NG Compressor
- CNG Storage
- Blender
- CNG
- CNG/H₂
- H₂
### Projected H₂ Demand

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| **Phase 1** | 1 - 3 H₂/CNG LDVs 1 H₂ Hybrid Elec. bus 1 H₂/CNG Bus - Jan 2001 | 1,000 - 3,000 | Install LH₂ tank and fueling equipment initially  
Install H₂ generator Prototype as available |
| Sept 2000 - Jun 2001 | 6 - 11 H₂/CNG LDVs 1 H₂ Hybrid Elec. bus 2- 6 H₂/CNG Buses 50kW Fuel Cell @ 25 - 50% rate | Vehicle 3,000 - 15,000  
Fuel Cell 9,000 - 21,000 | H₂ Generator prototype -24,000 SCFD  
LH₂ is used as backup/peak shave.  
Fuel Cell balances H₂ generator production |
| **Phase 2** | 11 - 20 H₂/CNG LDVs 1 H₂ Hybrid Elec Bus 6 H₂/CNG Buses 50kW Fuel Cell @ 100% rate | Vehicle 15,000 - 17,000  
Fuel Cell 39,000 | Install scaleup H₂ generator, provided bus fleet buildup meets targets. |
FY2000 Objectives & Rationale

- Achieve acceptable commercial operation of prototype H\textsubscript{2} generator (1000 SCFH) for integration with 50 kW fuel cell and fuel station.

- Begin conceptual development of a commercial design for scaled-up H\textsubscript{2} generator.
  - To realize the potential for commercial economics as vehicle usage increases.
FY2000 Objectives & Rationale (continued)

- Begin design and manufacture of a 50 kW PEM Fuel Cell Power Plant.
  - Integration with the H₂ production and compression system, and with the power needs of the site.

- Install H₂ and H₂/CNG mixed-fuel station for the City of Las Vegas.
Current Year Tasks/Progress

- **Task 1.1 - Firm Plan** - nearing completion
- **Task 1.2.1.1 - Preliminary Testing** - nearing completion
- **Task 1.3 - 50 kW Fuel Cell Design** - initiated April 2000
- **Task 1.4 - Refueling Station Design** - pending completion of Task 1.1
Status of Business Plan & Safety Review

- Business plans will follow installation and routine operation of the integrated systems
  - Partners are interested in total integrated system as well as individual components

- Safety is top priority in design, construction and operation
  - All safety and industry codes are addressed in designs
  - Reviews at each phase - design, construction, and operation
  - Follow philosophy of CTA and Ford H₂ fueling facilities
  - Air Products’ 40 years of experience in commercial H₂
Objectives for FY2001

● Achieve integrated operation and improve reliability.
  – Collect information on the reliability of the subcomponents for any corrective actions required.

● Gain operating experience on the fuel station and determine needs for improvement.

● Determine the feasibility and need for construction of the scaled-up hydrogen generator.