



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

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DOE Hydrogen Program Annual Review

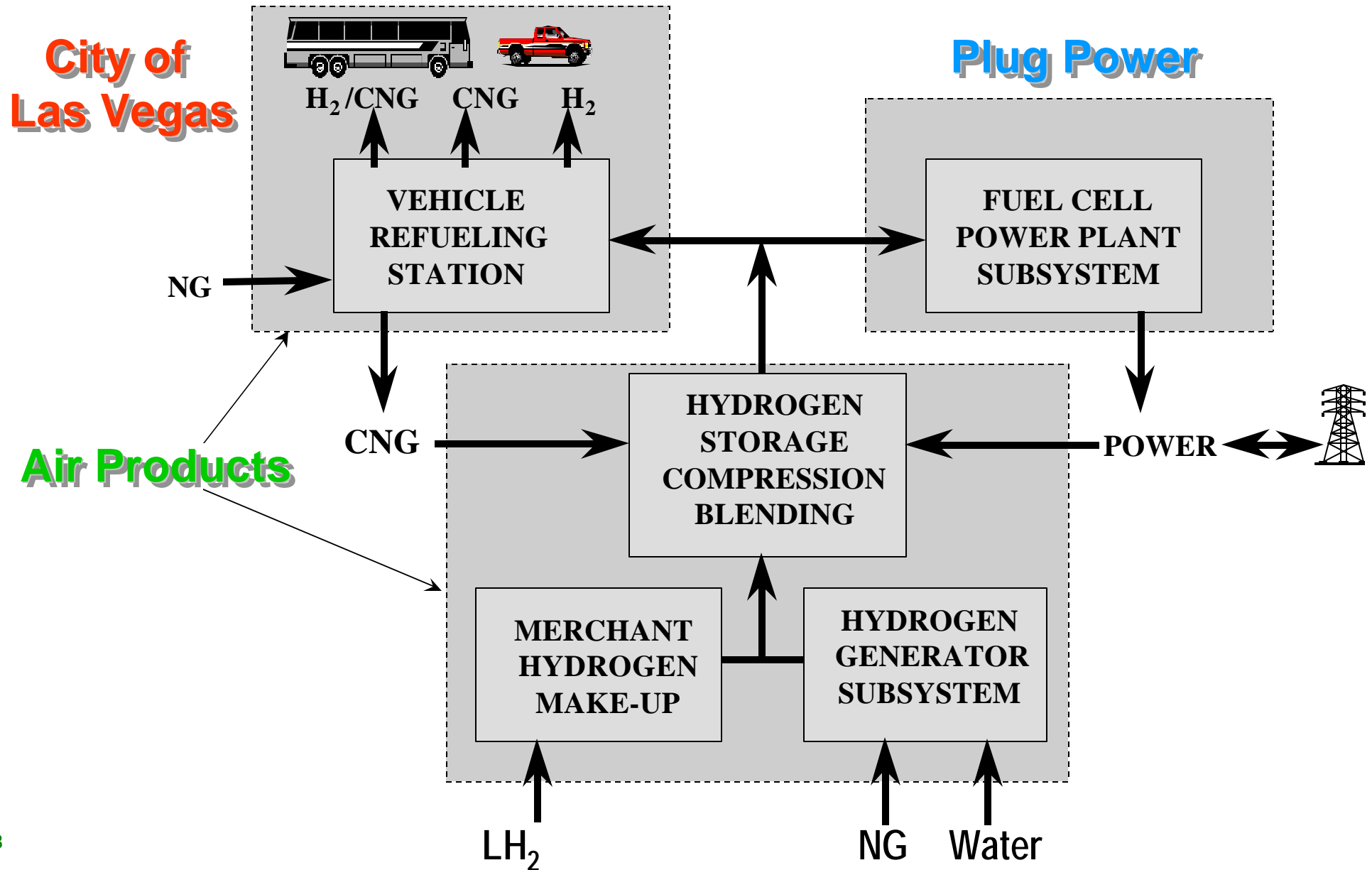
San Ramon, CA

May 9-11, 2000

Long-Term Goals/Project Objectives

- **Resolve design issues & demonstrate small, on-site H₂ production for fuel cells and H₂ fuel stations**
- **Design/construct/operate multipurpose refueling station**
 - Dispense CNG, H₂/CNG blends, and pure H₂ to 27 vehicles
 - Ultimately serve as a link in a national H₂ corridor
- **Design/construct/operate 50kW fuel cell**
- **Evaluate operability/reliability/economic feasibility, and certify integrated power generation and vehicle refueling designs**

Overall Project Scope



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)

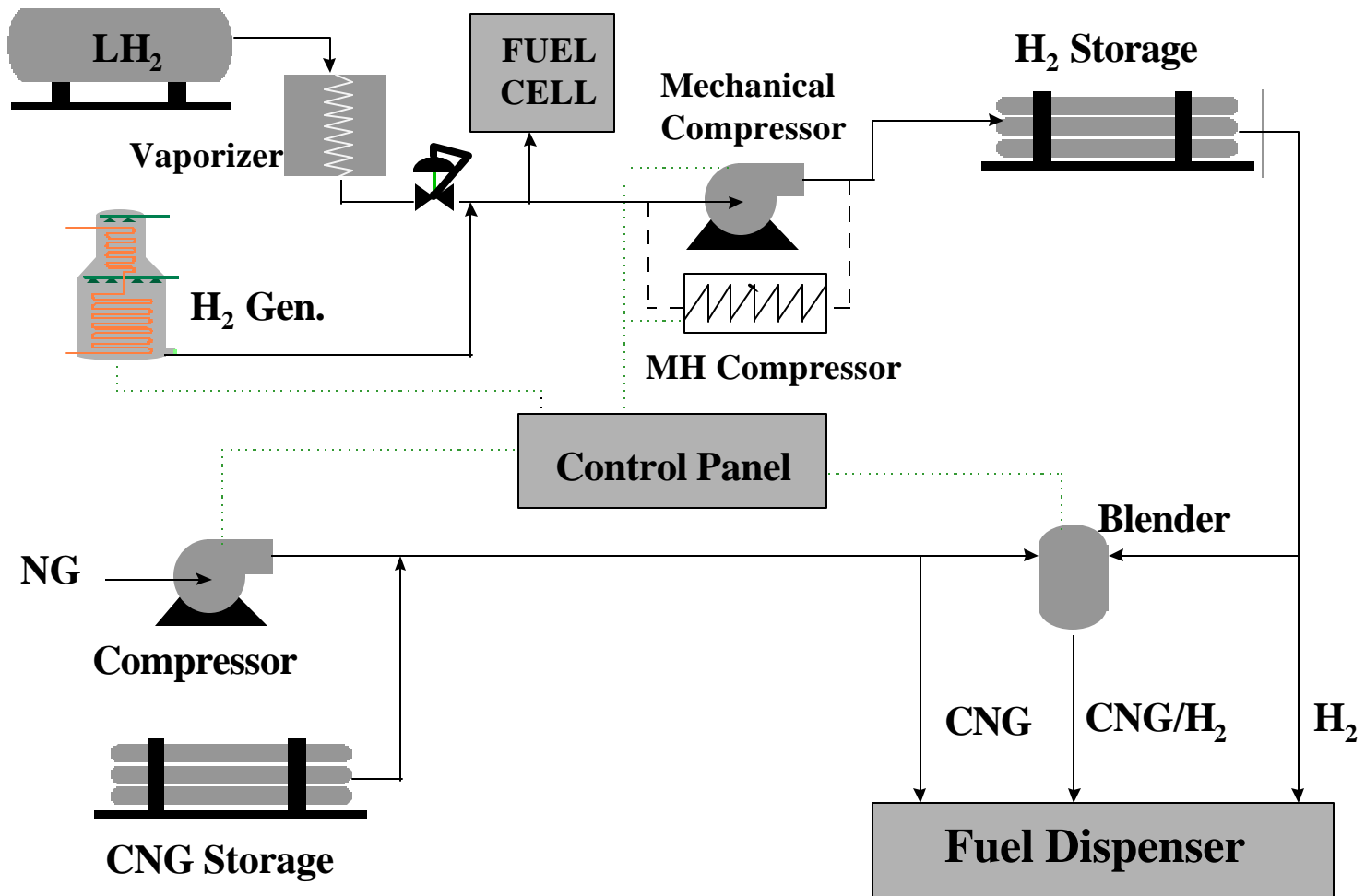
- **2.3 CLV Refueling Station**
 - Phase 1: Merchant H₂ supply
 - Phase 2 & 3 : Integration of reformers

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



Projected H₂ Demand

<u>Operations Phase</u>	<u>Hydrogen Applications</u>	<u>H₂ Demand SCFD</u>	<u>Proposed Hydrogen Supply</u>
Phase 1 Sept 2000 - Jun 2001	1 - 3 H ₂ /CNG LDVs 1 H ₂ Hybrid Elec. bus 1 H ₂ /CNG Bus - Jan 2001	1,000 - 3,000	Install LH ₂ tank and fueling equipment initially Install H ₂ generator Prototype as available
Phase 2 Jul 2001 - Dec 2001	6 - 11 H ₂ /CNG LDVs 1 H ₂ Hybrid Elec. bus 2- 6 H ₂ /CNG Buses 50kW Fuel Cell @ 25 - 50% rate	Vehicle 3,000 - 15,000 Fuel Cell 9,000 - 21,000	H ₂ Generator prototype -24,000 SCFD LH ₂ is used as backup/peak shave. Fuel Cell balances H ₂ generator production
Phase 3 Jan 2002 - Sept 2004	11 - 20 H ₂ /CNG LDVs 1 H ₂ Hybrid Elec Bus 6 H ₂ /CNG Buses 50kW Fuel Cell @ 100% rate	Vehicle 15,000 - 17,000 Fuel Cell 39,000	Install scaleup H ₂ generator, provided bus fleet buildup meets targets.

FY2000 Objectives & Rationale

- **Achieve acceptable commercial operation of prototype H₂ generator (1000 SCFH) for integration with 50 kW fuel cell and fuel station.**
- **Begin conceptual development of a commercial design for scaled-up H₂ 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.**