LAX Airport Hydrogen Fueling Station – Small Footprint H_2 Capability at the Corner Filling Station

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State Energy Programs Special Projects
Category 6.53: Power Technologies
Compression, Storage, and Dispensers

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Objectives

- Establish and implement a small footprint hydrogen fueling station design compatible with a retail fueling station facility
- Support a small fleet of hydrogen fueled vehicles, with expandability
- Modular and reproducible design

Budget

- Total funding for the project: $1.9 MM+
  - Contractors and contributors shares:
    - Praxair: $550,000
    - U.S. DOE: $499,048 (FY ‘02 – ’04)
    - SCAQMD: $351,000
    - BP: $500,000
    - Total: $1,900,048
  - DOE FY ’04 funding: $184,048

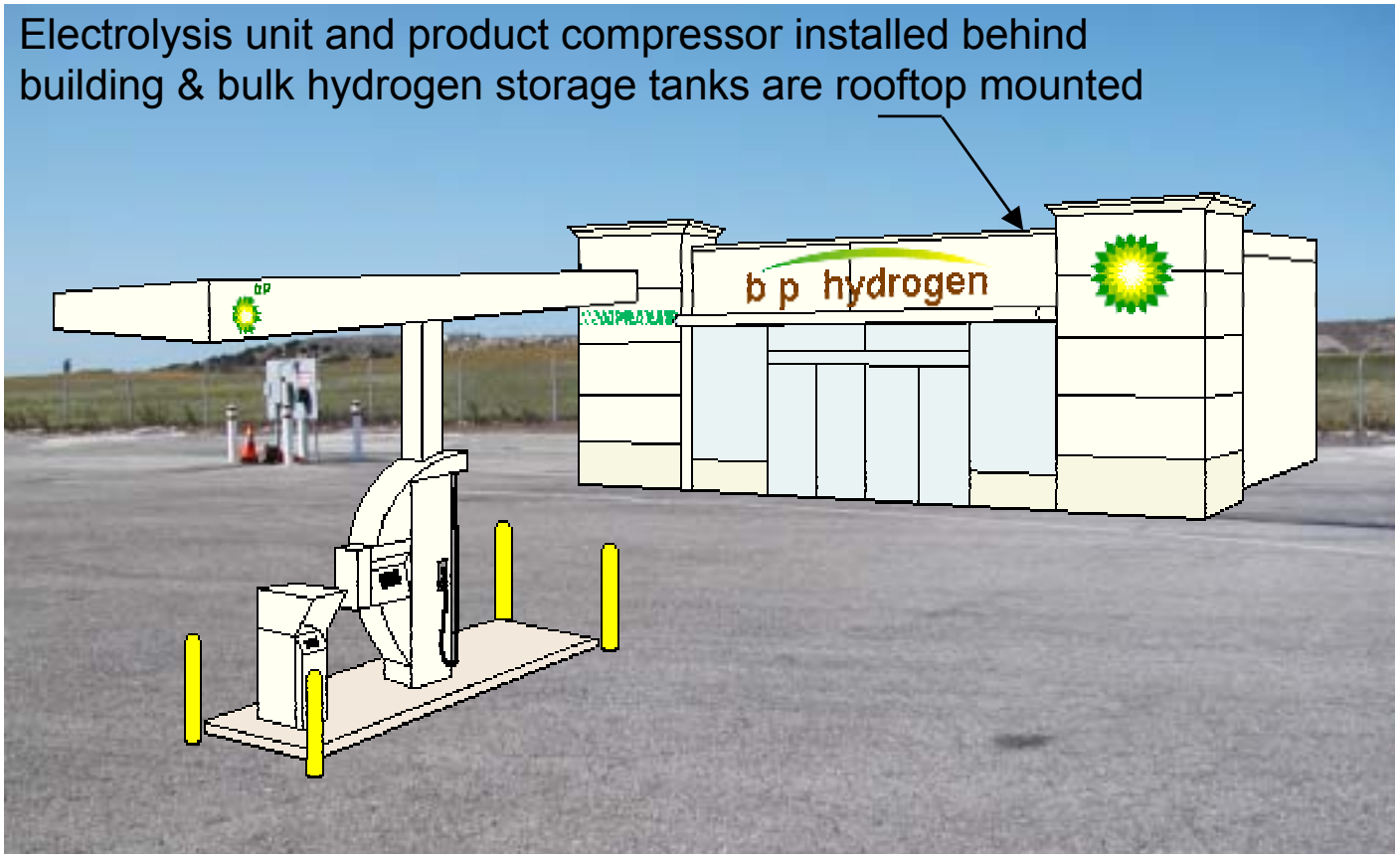
Technical Barriers & Targets

- MYPP Technology Validation section 3.5.4.2
  - **C. Hydrogen Refueling Infrastructure**
    - "Integrated facilities with footprints small enough to be deployed into established refueling infrastructures…"

➢ **To satisfy above footprint requirements, the LAX hydrogen fueling station will incorporate:**

- Roof-mounted hydrogen storage
- Low-profile H_2 equipment located behind small station building
- Traditional fueling station canopy with CAFCP compatible dispenser

Technical Barrier Approach



Technical Approach- (Cont.)

- **Electrolysis**
  - 100 psig electrolyzer output to reduce compression ratios
  - Minimized footprint while maintaining 4-sided access
- **Compression**
  - Hydraulically driven reciprocating compressor
  - Flexible operational modes (for future bus/HDV refueling)
- **Rooftop Hydrogen Storage – Small Footprint**
  - Traditional ASME coded steel construction
  - Cascaded bank configuration – 6,600 psig
- **Dispensing**
  - Fast fills of cars within 5 minutes
  - Designed compatible for future bus/HDV fueling

Technical Approach (Cont.)

- **Small Footprint Design**
  - **Bulk hydrogen receiver tubes placed on roof of a prototype convenience store to greatly reduce footprint**
  - **Originally desired composite storage, but Cal-OSHA regulations require ASME Steel Tanks**
  - **Underground storage considered, but rejected for budgetary and safety considerations**

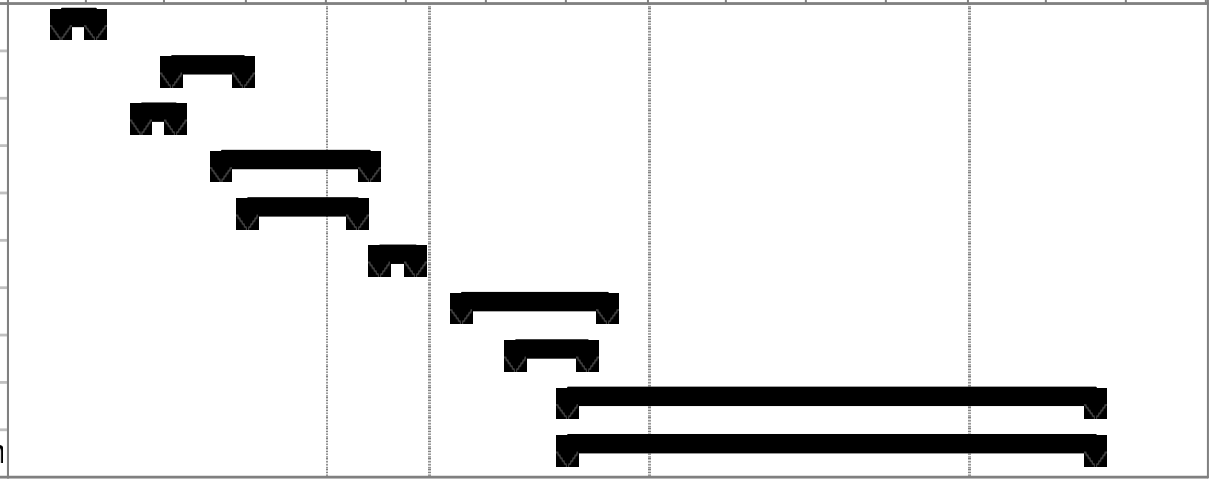
- Key Lessons Learned:
  - **Overall station footprint is not a function only of the size of the equipment, but of equipment positioning in a small area**
    - **Other considerations, e.g., safety and maintenance access, must also be considered when attempting to minimize footprint**

Project Safety

- **Safety is Top Priority at LAX Hydrogen Fueling Station:**
  - Safety Passport required for all construction workers/visitors
  - LEL detection at likely leak points (e.g., in electrolyzer, compressor, and dispenser cabinets, and under canopy
  - Audible & visible alarms activated upon H_2 leak detection or other process trip
  - Shear plate for automatic switch-off of hydrogen flow if dispenser is sheared from island
  - Vehicular collision switch (bumped dispenser shuts down)
  - PET (Plant Emergency Trip) kill switches – two in rear of building, and a dispenser trip switch on fueling island
  - PIN/Safety & station usage training required in advance of vehicle fueling authorization
  - Public station, but fueling only for 'approved' vehicles

Project Timeline

ID	Task Name
1	Site Selection & Characterization
2	System Design
3	Equipment Ordered
4	Permit Applications
5	Project Delay
6	Lease Signed
7	(Temporary) Hydrogen Available
8	Equipment Installation
9	Station to Open (Projected)
10	Technology Integration/Evaluation



Technical Accomplishments

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- **Retail Compatible Design**
  - Fine-tuning and completion of design of small footprint hydrogen based fueling infrastructure facility compatible with traditional fueling stations

- **Key Project Management Lessons Learned**
  - Real property lease (e.g., liability & indemnification) issues best solved through education of authorities, landlords, and neighbors
  - Working closely and regularly with LAFD and other Authorities with Jurisdiction (AWJs) early on in the project made permitting relatively painless

Future Work and Project Goals

- **Support a small fleet of hydrogen fueled vehicles under real world driving conditions**
  - California Fuel Cell Partnership Goal to introduce up to 60 HFCVs by 2003
  - Compatibility with other fueling stations
  - Educational/community outreach programs
- **Real world station performance to be monitored**
  - Safety
  - Performance
  - Maintenance
  - Operation
  - Cost of Delivered Hydrogen
- **Supplemental tube trailer hydrogen to be eventually introduced, pending LAX approval, if demand exceeds on-site production**

Interactions and Collaborations

- **Program Participants**
  - Praxair - program leader/general contractor
  - BP – Key Partner – station permitting and small footprint station design
- **Public Program Contributors**
  - South Coast Air Quality Management District
  - US Department of Energy (DOE)/CEC
  - Los Angeles International Airport (LAX / City of LA)
    - Alternative fueled vehicle fleet operator
- **Station Users**
  - OEMs that will be refueling their vehicles at LAX, and/or placing fleet hydrogen powered vehicles in locations proximal to the LAX H_2 Station

Responses to Previous Year Reviewers' Comments

- **Q1: Relevance to overall DOE objectives**
  - Small H_2 stations are needed
  - Good demonstration platform for electrolysis with higher pressure H_2 output than other CA stations
  - Lessons learned on permitting – meet with and inform AWJs early & often
  - Metrics & cost for delivered hydrogen will be monitored
- **Q2: Approach to performing the R & D**
  - Footprint considerations critical to commercialization
  - Economics of H_2 - $/mi. equivalent to gasoline?
  - Utilization of ASME storage

Responses to Previous Year Reviewers' Comments (cont.)

- **Q3: Technical accomplishments and progress toward project and DOE goals**
  - Noted last year that we had good progress and an ambitious schedule…
  - Project will assist LAX and local fleet operators by making fuel available for H_2 vehicles
- **Q4: Technology transfer/collaborations with industry, universities, and other laboratories**
  - BP not only advisor, but key partner in design/project
  - Educating LAFD permitting officials and other AWJs

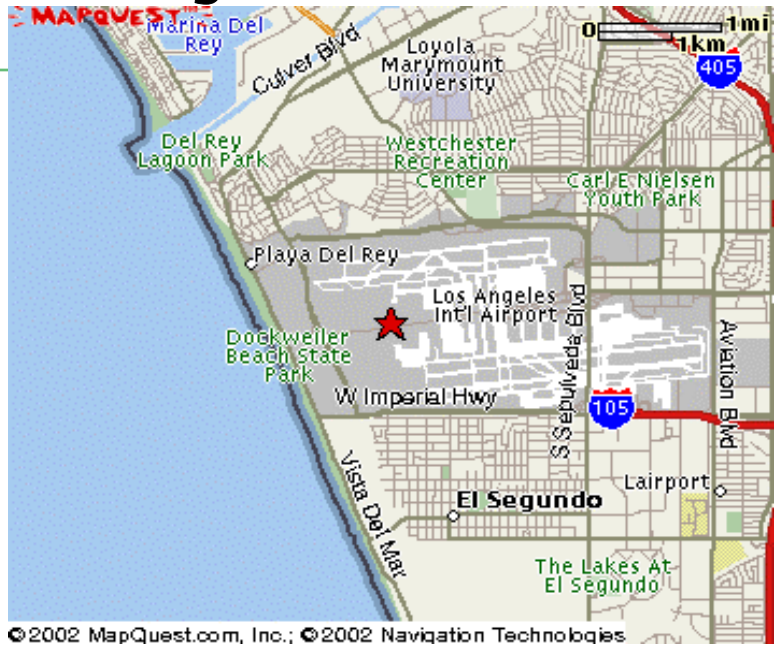
Responses to Previous Year Reviewers' Comments (cont.)

- **Q5: Approach to and relevance of proposed future research**
  - Cornerstone southern California station in CA's recently announced Hydrogen Highways program
  - Continued operation after 2 years? Will hope to continue operations for many years to come, with possible expansion as H_2 fuel demand builds. Dependent on funding
  - After station is in operation, will compare costs to similar small-scale distributed generation technologies (e.g., SMR)
- **Specific recommendation from last year:**
  - Find auto manufacturer that will lease fuel cell cars at the airport… Effort is presently under negotiation

Future Plans

- Systems Integration of Electrolysis Unit, Compressor, Rooftop Mounted Bulk Hydrogen Storage, & High Pressure Hydrogen Dispensing to Enable Safe, & User Friendly 5,000 psig Hydrogen Refueling for Hydrogen Powered Vehicles in a Public Setting
- Build Station in a Safe and Timely Manner once Final Permitting and Airport Construction Approval Has Been Obtained
- Coordinate West Los Angeles Light Duty Fleet Hydrogen Vehicle Placement that Will Utilize the LAX Hydrogen Fueling Station
- Develop Relationships with Key Heavier Duty (e.g., bus, truck, and airfield operations) Vehicles
- Consider Use of “Green Electricity” in On-Site Hydrogen Production

Station Location & Representative Early User - Questions?



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