FUELING WITH HYDROGEN: MOVING FROM RESEARCH TO RETAIL

N. Bouwkamp[1], R. Vare[2]

1. Abstract

Easy access to fuel is a crucial element for commercializing alternative fuel vehicles. Users want access to alternative fuels to be as convenient, safe and reliable as gasoline stations are today.

California leads the world with the number of hydrogen stations and fuel cell vehicles on the road. Real-world drivers operate more than 100 FCVs in California every day, including passenger cars used for work and personal travel, and fuel cell buses that carry thousands of passengers in regular transit service. To continue progress toward a commercial market, these early customers must have a very positive experience with the vehicles, including hydrogen fueling. California is uniquely positioned to implement access solutions that improve the customer's fueling experience.

Moving from controlled research stations to retail-style hydrogen stations involves addressing both technical and non-technical topics. Examples include liability; training and user verification; information availability; customer technical requirements; interface technology improvement and ergonomics; and fuel payment.

The CaFCP, with members including station providers, vehicle manufactures, fuel cell technology companies and government agencies, is working collaboratively to address the factors vital to improving access to hydrogen fuel stations. CaFCP members take a pragmatic approach, working to identify, evaluate and implement solutions through real-world experience with FCVs and hydrogen stations.

This paper details the factors that affect fueling access, examines current real-world access challenges, and presents CaFCP's solutions to improving access and evaluating success. These findings uncover access to hydrogen fuel as a key aspect of fuel cell vehicle and hydrogen infrastructure commercialization, offering lessons learned crucial to achieve easy access to hydrogen fuel.

Keywords: Commercialization, Fuel cell vehicle, Fueling access, Hydrogen fuel, Infrastructure.

---

[1] Technology Analyst, California Fuel Cell Partnership, 3300 Industrial Blvd., Suite 1000, West Sacramento, CA 95620, (916) 375-8050

[2] Southern California Regional Coordinator, California Fuel Cell Partnership, 3300 Industrial Blvd., Suite 1000, West Sacramento, CA 95620, (909) 396-3388

2. Station Accessibility in California

As a public-private partnership, the California Fuel Cell Partnership (CaFCP) consists of 32 members representing government and industry that collaborate to make progress towards the commercialization of fuel cell vehicles in California.

Today, California is the home to 24 operational hydrogen stations with 10 more in planning stages. Early hydrogen stations were built for testing and validation programs, and designed to fuel local fleets. More than 200 fuel cell vehicles have been placed in California, and more than half are in daily operation throughout the state.

Operational Stations

1 Burbank
2 CaFCP
3 Chino
4 Chula Vista
5 Davis - UCD
6 Diamond Bar – SCAQMD
7 Irvine – Air Products
8 Irvine – Hydrogenics
9 Los Angeles - Honda
10 LAX
11 Long Beach
12 Oakland
13 Ontario
14 Oxnard – BMW
15 Riverside
16 Rosemead
17 San Francisco – PG&E
18 Santa Ana
19 Santa Clara – VTA
20 Santa Monica
21 Torrance – Honda 1
22 Torrance – Honda 2
23 Torrance – Toyota
24 Thousand Palms – SunLine

* as of February 2008

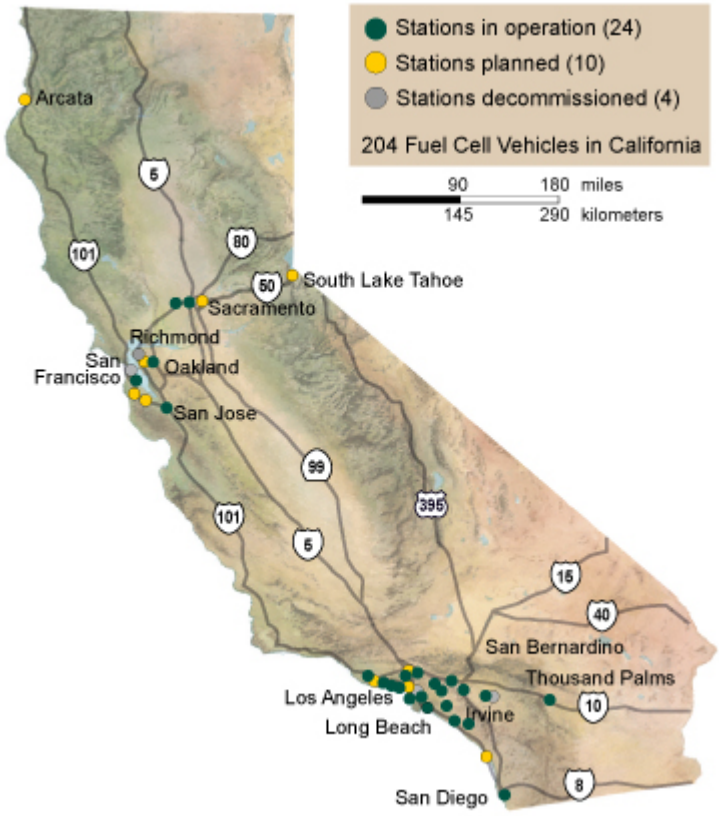


Figure 1: Stations in California

With more vehicles on the road, and as the technology comes closer to commercialization, it is important that the stations are accessible to vehicles outside the local fleet. Equally important is to make sure that customers' fueling experience is as easy and safe as filling a vehicle with gasoline.

A first step towards a level of accessibility that is more like the gasoline model is to define "public access" and identify the factors that are characteristic to retail-like business.

3. Access

No two hydrogen stations are alike. Many stations were built for specific purposes and fleets, and most stations were originally designed with restricted access. CaFCP created a Station Accessibility Matrix to recognize these different phases of hydrogen stations (see 14.1 Appendix A for a section of this matrix).

In March 2006, CaFCP staff sent a questionnaire to the operators of the 23 California stations open at that time. The questionnaire examined every aspect of station access; not just the ability to drive up to the pump, but all actions required to refuel. It covered the following subject areas:

- Liability
- Physical access
- Technology/Interface
- Safety
- Training
- Payment
- Station information

The interview questionnaire included closed- and open-ended questions, allowing for comments as well as measurable data (see 14.2 Appendix B for an example questionnaire).

From March 1 through June 30, 2006, representatives from the California Fuel Cell Partnership and the California Air Resources Board visited 20 of 23 California stations to assess station characteristics, take pictures and interview the station operators. The Washington DC Shell Hydrogen station provided a benchmark for comparison because it was (and continued to be) the only U.S. station that integrates hydrogen and gas fueling in a retail experience.

Also in 2006, a separately tasked group of CaFCP members identified liability as a crucial factor for commercialization and took on a complementary task of reviewing hydrogen fueling liability.

4. Liability

Fueling agreements help hydrogen fuel providers, fuel station owner/operators, automakers and vehicle operators to define and limit the liability that may arise from the use of hydrogen storage and dispensing equipment, use of hydrogen fuel, fuel quality and, in some cases, access to private property. At least eight California stations reported requiring individual fueling agreements before fueling vehicles that are not in the local fleet. These agreements are often a prerequisite to access a station.

While fueling agreements typically provide adequate protection to the station owner, they can be problematic for automakers and vehicle users. Each time a driver seeks approval to fuel at a new or different station, an attorney has to

review the new fueling agreement, a process that is time consuming, causes delays and does not represent commercial gasoline fueling.

Fuel quality, which appears to present one of the largest cost liability concerns, is often handled confidentially between the fuel provider and the automakers or fleet operator.

At most stations, only vehicles made by major auto manufacturers are allowed access, primarily due to liability concerns. Several stations in the South Coast Air Quality Management District Five Cities Program give priority fueling to their home fleet of Quantum Prius conversions, but also allow fueling by OEM and conversion vehicles.

The Washington DC Shell Hydrogen station and the South Coast Air Quality Management District (SCAQMD) stations do not require fueling agreements, but instead use a vehicle safety checklist. The checklist includes vehicle tank pressure, fill port specifications, form of hydrogen (e.g., liquid or gaseous), quantity of fuel needed, vehicle emergency response information and vehicle operator contact information. At the time of the project, only one California station did not have vehicle restrictions or require a fueling agreement.

5. Physical Access

At 14 California stations, the station operators control physical access with a gate, security guard or fueling attendant. At most stations, only a trained fueler can enter the property or the area near the station. Only five stations do not control physical access to fuel dispensing equipment. Every station requires customers to obtain some level of pre-approval before fueling and only trained fuelers with personal identification numbers (PIN) can fuel vehicles.

Four stations have unrestricted 24/7 access to the dispenser. Most other stations are accessible to trained fuelers during business hours. Station operators mentioned that they offer extended hours to trained fuelers who make prior arrangements. Two stations have specific time slots for fueling or are “by appointment only.” All station operators requested that fuelers call ahead before coming to fuel.

Temporary and non-publicly accessible fuel stations are not subject to the physical access requirements that apply to retail fuel stations, such as Business and Professions Code requirements (e.g. public restrooms) and Americans with Disabilities Act standards. None of the California hydrogen stations offer special provisions for customers with disabilities. SCAQMD uses an attendant to fuel vehicles and many station operators expressed a willingness to provide assistance for disabled customers.

From the station operators’ perspectives, hydrogen fuel dispensers are very similar to compressed natural gas (CNG) dispensers. In addition to physical

appearance, both dispenser interfaces use on-screen prompting to direct the user through the fueling procedure. The most significant differences between CNG and hydrogen versus gasoline dispensers are the restricted access and the requirement to enter a PIN and, in some cases, a proprietary access card.

6. Technology and Interface

As of February 2008, 20 of the 24 stations operating in California were permanent stations and four were mobile fuelers. Two of the mobile fuelers will eventually be replaced by permanent stations. Mobile fuelers can be more rapidly implemented at new locations and they allow jurisdictional authorities to become familiar with the basic operations of a hydrogen station before a permanent station is installed.

Six permanent stations use dispensers manufactured by Fueling Technologies International, nine use Air Products designs and two stations have Honda-developed dispensers (others did not report on the dispensers). Dispensers contain the user interface display, a controller to regulate the fueling rate, fuel metering equipment and in some cases, hydrogen leak sensors. The mobile fuelers use dispensing technology from Air Products. Roughly half of all stations use some form of tank-to-dispenser communication, which means that the vehicle fuel storage tank can communicate with the dispenser flow rate controller through a communication cable. However, not all fuel cell vehicles have communication ports. Most of the dispensers have fuel metering; although none of the metering devices are checked for accurate calibration by an official body, such as the California Division of Measurement Standards.

In general, California hydrogen station operators consider their fuel dispensing technology to be in either the “experimental” or “technology validation” phases. However, the Washington DC station operator expressed a high level of confidence regarding fuel dispensing with their station. The equipment at the Washington DC and California stations are nearly identical.

At the Washington DC station, the metering is calibrated periodically, but is not certified. Officially certified calibration must currently be within +/- 10% accuracy, although at the time of the project (2006) the team understood this was not possible given the state of development for hydrogen gas metering devices.

7. Safety

All station operators agree that safety is vital in station design, station permitting, routine fueling procedures and emergency response. State regulations, local requirements, company policies and generally accepted best practices guide the choice of specific safety measures at individual stations, but stations typically follow the same general guidelines.

Safety includes safety plans, detection equipment, maintenance, vehicle access, adherence to codes and standards, grounding and personal safety. Stations tend to

follow similar general safety measures. Fueling access safety, however, varies greatly from station to station in four areas: personal protection equipment requirements, number of people allowed in the fueling area, vehicle grounding and vehicle access.

All California stations require the following as part of their safety practices:

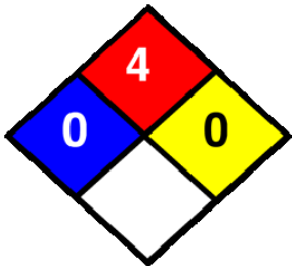
- Vehicles must meet applicable safety standards for on-road use
- Station operators must grant prior approval to vehicles, either for one-time fueling or for routine fueling
- Training fuelers on fueling procedures and hydrogen safety
- Emergency response procedures
- Emergency warning indicators
- Regular station maintenance
- Flame detectors and leak detection equipment
- Station status must be monitored on-site or remotely

Basic safety precautions for people in the dispensing area are the same as those at gasoline fuel stations: no smoking, and no use of cell phones or electronic devices. In several cases, the stations do not limit the number of people near the vehicle during fueling.

At all stations, the first emergency contact is "911," followed by on-site security, local fire and police departments, the site operator and eventually the station provider. Specific contact instructions depend on the type of emergency situation. At a few stations, the local fire officials deemed that installation of the station did not require changing the site's existing emergency plans.

Codes and Standards

Some codes and standards for hydrogen stations have already been developed, however, additional ones are still in the proposal stage. For some California stations, proposed codes were included as design and implementation parameters, allowing these stations to immediately meet these standards if they are adopted. In addition to existing and proposed codes and standards, which provide the minimum level of safety for the user, local fire departments often impose their own requirements. For example, at many stations the local fire department requires hydrogen leak sensors located near or in the dispensers.



NFPA Diamond for hydrogen

Specific safety distances around all the hydrogen dispensers at the stations visited by the team are in line with National Fire Protection Agency (NFPA) 50A/B, NFPA 52[3] and other fire code requirements. Five

[3] NFPA 50A/B are the previous industrial codes for hydrogen and natural gas, now combined in NFPA 55 and NFPA 52 which are the proposed NFPA codes for natural gas and hydrogen fueling

hydrogen station operators delineated a “safety zone” with yellow crosshatched markings. All stations have visible, readable warning signage that include emergency phone numbers and the NFPA diamond.

Vehicle Requirements
Most stations do not check the condition of an automaker (OEM) vehicle before fueling, assuming that the OEMs’ attention for safety throughout the design and engineering stages and their rigorous maintenance schedule assures the vehicles’ safety. At stations where operators outside of the local fleet are allowed to fuel, three station managers allow access only to OEM vehicles, as they are confident these vehicles comply with the official transportation safety requirements of the U.S. Department of Transportation.

With non-OEM vehicles, station operators express uncertainties about the safety of vehicle system design and engineering. SCAQMD uses a checklist to quickly determine the compatibility of non-OEM vehicles conversions and allows some non-OEM vehicles to fuel. The SunLine station operator evaluates the pressure system, tank and receptacle of non-OEM vehicles before granting fueling approval. The Burbank, Chula Vista and UC Davis stations will fuel any hydrogen vehicle that meets the station’s pre-approval criteria.

Grounding
Eighteen stations reported on their grounding practices.

- Four stations offer two types of a connection to the vehicle: a dedicated grounding cable and a communication cable.
- Three stations offer only the communications cable.
- Nine stations ground the vehicle through the fueling nozzle and hose connected to the vehicle.
- Two stations do not use dedicated grounding because research demonstrated sufficient grounding through the tires into the concrete fueling pad. One station operator is researching special conductive paint to achieve the same result on asphalt.

Personal protective equipment (PPE)
The majority of stations in California do not require personal protective equipment (e.g. Nomex coat/jacket and safety glasses). The rationale cited by station operators for not requiring PPE includes:

- Prior experience and a good safety record with CNG fueling
- Demonstrated safety of vehicles’ fuel systems
- Built-in safety devices and processes in the fuel dispensing system and process
- Use of a third-party certified nozzle

One-third of the stations in California require PPE for persons engaged in fueling. Of these stations, some allow only the fueler in the safety zone. Other stations

allow more people in the safety zone, but require PPE for everyone. Two stations require only safety glasses.

At their Washington DC station, Shell Hydrogen bridges these by allowing multiple people in the fueling area but requiring fuelers to wear a personal hydrogen sensor. This reflects the importance of ensuring safety at this stage of hydrogen fueling development, while avoiding the image of danger that PPE creates.

8. Training

Of the stations surveyed, all except one require formal fueling training before a person or a dedicated fueling operator can fuel a vehicle. Hydrogen station training is specific for each station, and currently a driver cannot be trained at one station and fuel at another station. Customers hear much of the same basic information repeated at each station training. New-driver fueling training consists of understanding hydrogen properties and safety, fueling procedures and site-specific safety, and emergency response protocol. Two of the stations surveyed offer self-training.

Trained fuelers receive a PIN and sometimes keys or an access card. Some stations use fueling attendants so customers do not need training.

Station operators offer refresher training to on-site and new local first responders and when circumstances at a station change. Station operators also often train on-site fleet mechanics, technicians and personnel, first responders and local enforcement agencies.

9. Payment

Payment for fuel occurs at two levels: the contract between the station and the fuel provider, and payment between the fuel cell vehicle (FCV) driver and the station. Most station/fuel provider contracts include a fee based on the actual or estimated number of vehicle fuelings per year. Many operators expressed concerns with collecting payment for fuel from vehicles not part of the home fleet. Establishing a payment system is difficult, particularly for stations operated by government entities (e.g. cities, universities, transit agencies).

None of the California stations use a system similar to gasoline stations to charge or bill FCVs drivers for the fuel they use. At the time of the survey, all stations provided fuel free of charge to users outside of their own fleet. The Riverside and SunLine stations use credit cards to verify user requirements (training, PIN, pre-approval) and to create a log of people who have fueled at the stations. The credit cards are for identification purposes only, not for payment.

10. Station Information

Each station estimates the quantity of hydrogen it dispenses to its home fleet, which can include fuel cell passenger vehicles, fuel cell buses and hydrogen

internal combustion engine vehicles. The station operators, for the most part, assume that their home fleet vehicles will consume most of the fuel in the contracted time period. Only two station operators indicated having sufficient capacity to provide fuel to vehicles and buses beyond their own fleet.

The public has access to limited information about specific stations. Some FCV users have permission to contact the station operators directly.

11. Recommendations

The Washington DC Shell Hydrogen station is currently considered the most publicly accessible station in the United States and served as the benchmark for this analysis. To move toward full public accessibility, California stations should emulate the Washington DC station by:

- Not requiring fueling agreements
- Providing 24/7 physical access for the general public
- Adhering to all requirements for retail or commercial fuel stations
- Using hydrogen dispensers that do not significantly differ in use from existing gasoline dispensers
- Allowing for multiple forms of payment for fuel
- Regularly calibrating the fuel metering devices
- Reducing or eliminating PPE
- Allowing every person to self-fuel after passing training
- Making all station information available to the public

Implementing these recommendations would make hydrogen stations look and feel much like retail gasoline stations. Currently, existing stations in California may never be able to fully implement these recommendations because they were originally developed to have restricted access and limited fleet use. However, these recommendations and this report can be used as a guideline for future stations built in California and throughout the United States. In addition, some of these recommendations can, and are, being implemented to improve access to the existing infrastructure.

12. Recent Activity

Planned stations in California are already taking into account the importance of 24/7 physical access to the dispenser. For example, the planned Shell Hydrogen stations in Southern California will have unrestricted physical access. Some stations operators are also trying to make the process simpler for consumers by removing PPE in certain locations and assigning one PIN per person, rather than one PIN per person, per station.

Most stations require that users have knowledge of hydrogen safety and refueling in these early stages. As mentioned previously, some customers are repeatedly trained on the same information. CaFCP engaged its members to create common training materials and a verification system so that customers are trained once about the fundamentals of hydrogen safety and refueling. This verification system

currently contains over 400 trained customers, and is used by station operators to verify if customers received training. The industry still strives for minimal training requirements like gasoline refueling has, but is working together to simplify the process in the interim.

To make more information available to fuel cell vehicle drivers, CaFCP created a website, www.fleet.cafcp.org, which provides detailed information about many of the hydrogen stations in California. Because every station has slightly different access methods, FCV drivers find it useful to have the information and specific access steps before heading to the station to refuel. In the future, CaFCP's fleet website will provide the operational status of hydrogen stations, eventually moving to a real-time system with hydrogen station capacity information.

To address liability concerns about fuel quality and meter calibration, CaFCP is coordinating with the California Department of Agriculture, Division of Measurement Standards. This agency regulates fuel sales in California, which will eventually include hydrogen fuel. CaFCP members are working with this agency to ensure they have current information and understanding of the state of technology as they develop regulations for hydrogen fuel quality, which are expected to be implemented by the end of April, 2008. This regulation may affect indemnification agreements for each station.

13. Conclusions

Although the accessibility of hydrogen refueling has yet to equal CNG refueling, and must advance even further to match gasoline refueling, California has made significant progress in a short time. Over the years, CaFCP members have made progress in the area of interoperability with agreements on a common interface and acceptance of 350 bar / 5000 psi as a "standard" fueling pressure. As the number of stations in California continues to grow, fueling agreements need more consistency (with a goal of not needing fueling agreements), 24/7 access to dispensers, extended hours for fueling, no PPE requirements, consistent grounding methods (or no customer-action-required grounding methods), consolidated training and PIN dissemination, easy payment methods and real-time information regarding station operational status and hydrogen availability. This is achievable. Projects already underway aim to improve access at existing stations and ensure future stations are easier to access.

This report is the first attempt to collect and organize information about the accessibility of hydrogen fuel stations in California. Much has been done, but more work is necessary before California stations will be fully publicly accessible. The Station Accessibility Matrix (14.1 Appendix A) indicates a possible phased approach as we work toward publicly accessible and user-friendly hydrogen fuel stations in California.

14. Appendices
14.1 Appendix A: Station Accessibility Matrix Example

Overview Example Station Accessibility Matrix Working Document

Phases from initial to future →

Factors	Research Station	Demonstration Station	Multi-user/fleet Station	Retail Station
Category: Technology/Safety/Interface				
Fueling Technology	Experimental	Experimental, data collection, initial statistics validation	Statistically validated, interoperable; users/customers have high confidence. Only used and maintained by trained professionals	Robust; transparent to customer; public has accident statistics comparable to conventional fuels technology
Category: Training				
User Training Level	Rigorous training for all fueling operators including hydrogen safety information.	Training for all fueling operators including hydrogen safety information.	Training for all fueling operators on dispenser handling.	No training or minimal point-of-sale training.
Etc.				

14.2 Appendix B: Station Accessibility Questionnaire (SCAQMD Answers[4])

Technology/Safety/Interface	A	B	C	D	Other
1) Is your station mobile or permanent?	Mobile		Permanent		
a. If mobile, is a permanent station planned?	Yes		No		
2) What fueling protocols do you use at your station?	Evaluating protocols	Recommended J2600			Developed protocol for metal hydride fueling
a. Who is the dispenser manufacturer?					
3) Which best describes the fuel dispensing technology is in use at your station?	Experimental	Data collection, statistics validation	Interoperable, high confidence	Robust, accident stats comparable to conventional fuels	
4) Do you require the vehicles that refuel to be certified? If so, explain.	FTI				
5) What methods for vehicle grounding do you use at this station?	Mechanical ground wired clip or Type 1 communication fill grounding connection				
6) What are the personal protective equipment (PPE) requirements?	Required	Required PPE or none, but precautions present	Determined by mutual agreement users	None	
7) Does your station adhere to the existing code requirements?	May need variation existing codes		Must adhere to all locally adopted/recognized codes	Must adhere to all nationally applicable codes	

[4] Highlighted answers are the actual chosen answers of the South Coast Air Quality Management District station operator.

a. If possible, provide a list of applicable codes.	For permitting, adapted draft NFPA 52 from natural gas with line item changes to address H2			
8) Do you check on customer vehicle maintenance/vehicle condition?	Responsibility OEM	Responsibility OEM or joint with owner	Responsibility owner. OEM warranty	We check our own vehicles
9) Describe the general safety methods used at this station.	Mechanical ground, auto stop (3 locations), warning light			
a. What problem detection equipment is used (i.e., monitors, leak sensors)?	H2 leak sensors at dispensing and production			
b. Onsite or remote monitoring?	Onsite	Remote, except for metal hydride dispensing		
10) Is there a safety area at the dispenser? Are there restrictions to the number of people in that area?	Cross-hatched area, 1 person	Cross-hatched area, multiple people ok	Fueling area, no smoking + cell ph, unrestricted number of people	No
a. What are the distances?	Nothing marked			
b. Do you have an emergency protocol?	Yes	No		
c. Who has provided an example?	Initially CaFCP, then Stuart/Hydrogenics station specific information			
d. Who is your first emergency contact?	Building Maintenance Manager			
11) Describe the methods for communication between vehicle and dispenser.	Non-communication or Type 1 communication fill			
12) Describe the warning/precautionary signage you have at this station.	See pictures			
13) Do you have fuel metering? Is it calibrated and are there periodic inspections?	No restrictions (no metering)	Regulations may apply if fuel is sold	Dispensers meet all applicable metering codes	Metering data collected, fuel not sold

14) What types of nozzles are in use?	Weh TK-15/metal hydride different nozzle				
Physical access	**A**	**B**	**C**	**D**	**Other**
15) What provisions have been made for customers with disabilities?	May be determined by station provider	May be determined by station provider. Coordination with vehicle users	Payment for fuel may require adherence ADA	Full adherence to codes	Attended fueling
16) How do you control station access for customers?	Through proprietary system (PIN/card) or station attendant	Through mutually agreed upon system (PIN, card) or station attendant	Anyone trained with PIN/card or station attendant	Anyone can access station	
a. What are your access hours?	Tuesday – Friday 7am-5:30pm call 24 hrs ahead to ensure fuel availability, can arrange fuel anytime by appointment				
17) How accessible is the site?	Controlled access area	Dispensers in gated area, only accessible at certain hours	Dispensers in public area and operable during limited range of hours	Dispensers in public area and operable during all hours	People can still access site when by feet
18) Who does the fueling?	Dedicated and trained fueling operator		Determined by mutual agreement	Vehicle user	
19) How is the user-to-machine interface compared to a self serve gasoline fueling experience?	Attended				
Training	**A**	**B**	**C**	**D**	**Other**
20) What is the level of operator training?	Rigorous training for operators incl. H2 safety info	Training for operators incl. H2 safety info	Training on dispenser handling	No training	
21) What training method is being used?	Develop site + operation specific training	Train the trainer or on-site training	Train the trainer or self-training	Self-training	
22) What are special target groups for training related to the station?	ER locals & city officials, AQMD staff, vehicles providers				
a. Training updates/refreshers?	As needed				
Liability	**A**	**B**	**C**	**D**	**Other**

23) How does your organization deal with the liability at this station?	Self insured	User agreements required	User agreements or blanket agreement when necessary		
24) What are the insurance requirements?					
25) Do you have an example of a legal agreement for fueling at this station that can be shared?	None required at AQMD, we have one fuel AQMD vehicles at UCI				
Payment	**A**	**B**	**C**	**D**	**Other**
26) What payment method is being used?	Contract, MOU, fleet card	Fleet card		All methods incl. credit cards	N/A
General/Miscellaneous	**A**	**B**	**C**	**D**	**Other**
27) What is the average throughput at this station per day?	Sized to station provider requirements	Sized to fleet user needs	Sized for variety of vehicles within regional area	Sized for all vehicle users within region incl. commuters	
28) Is access provided to non-fleet vehicles? If so, describe conditions.	Yes, please call ahead to ensure H2 availability, unknown vehicles considered case-by-case basis, encourage reciprocal fueling for AQMD vehicles				
29) What information about the station is available to the users and where is it available?	Limited available public info	Basic station info for public	Complete station info, specs, data available to users, some to public	All info available to public, incl. location + contact info	On plaque at station, in funding request on AQMD website on CaFCP website
30) What is the experience of your organizations with the use of CNG and how is this experience being used for hydrogen fueling?	Extensive area over 10 years. Over 150 CNG vehicles currently in AQMD fleet of 275 vehicles. CNG dispensing on site Pinnacle station accepts Visa/Mastercard with Self-training at the CNG dispensers. Use of Visa/Mastercard involved a 20 year effort with LA County and Bank of America to establish a non-profit "enterprise fund"				
a. How do you perform training for CNG fueling?	Self-training screens at dispenser the first time you use Visa/Mastercard.				
31) What is the well-to-tank efficiency of the station?	____%__ You can use the DOE H2A model for this purpose (available on the DOE website at: http://www.hydrogen.energy.gov/h2a_production.html)				

CaH2Net Questionnaire

• What number of vehicles fuel currently at your station?	4 AQMD + others FC cars _5 AQMD + others__H2 ICE cars _FC buses __ H2 ICE buses

Hydrogen Production and Distribution

1. If your hydrogen is produced off site, who is your hydrogen provider? N/A

2. How is the hydrogen delivered to this station?
   A. Pipeline B. Heavy duty diesel truck C. Other_____

3. If your hydrogen is delivered by a motor vehicle, what is the approximate distance (one-way) that it is transported?
   A. 10 miles B. 20 miles C. 30 miles D. Other, ____ miles

4. If your hydrogen is produced on site, what technology is used?
   A. SMR B. Electrolysis C. Fuel Cell D. Other _____

Renewable Energy

1. Who is your electrical utility? SCE

2. Does your station use any renewable energy, in the production or delivery of hydrogen?
   A. Yes B. No C. Other _____
3. If yes, what type of renewable energy is used in the production or delivery of hydrogen?
   A. RPS grid B. Hydro above grid C. Wind above grid D. Biomass E. Waste to hydrogen F. Photovoltaic
   G. Other_____

4. If yes, approximately what percentage of your dispensed hydrogen is made from renewable energy?
   A. 5% B. 10% C. 15% D. 20% E. Other 100kW rated PV can offset 100kW max design hydrogen generation through our building grid__

On-site Emissions

1. What are your on-site air pollutant emissions at this station?
   A. HC ____ppm NOx ____ ppm PM ____ppm Toxics _____ppm Other ___ppm B. None, except on incident KOH upset which forms potassium carbonate C. Unknown

2. If you do not know what your emissions are, are you willing to have them measured?
   A. Yes B. No C. Depends on scheduling, test plan approval

3. What plans do you have, if any, to meet the 30% renewable goal stated in the California Hydrogen Highway blueprint plan?
   on average, we may already meet it

4. Are you interested in becoming a member of the CaH2Net?
   A. Yes, first station recognized in Southern CA B. No