CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Fairfax Los Angeles SmartFuel® Hydrogen Station

Prepared for: California Energy Commission

Prepared by: Air Products and Chemicals, Inc.

Gavin Newsom, Governor

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California Energy Commission

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- The California Energy Commission
- The Governor's Office of Business and Economic Development (thanks to Tyson Eckerle for his efforts)
- South Coast Air Quality Management District

Air Products and Chemicals, Inc. also acknowledges the efforts of its engineering and operations teams for their ongoing commitment to safety in the deployment of this hydrogen fueling station.

PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-09-608 to fund opportunities for projects which expand the network of publicly accessible hydrogen fueling stations to serve the current population of fuel cell electric vehicle and to accommodate the planned large-scale roll-out of fuel cell electric vehicles commencing in 2015. In response to PON-09-608, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards November 17, 2010 and the agreement was executed as ARV-10-048 on December 21, 2011.

ABSTRACT

Air Products and Chemicals, Inc. designed, engineered, permitted, constructed, and made operational a hydrogen refueling station at 7751 Beverly Blvd., Los Angeles, California. The Fairfax Los Angeles SmartFuel® hydrogen station was approved for construction on March 24, 2015, and began public fueling in May of 2016. The station receives gaseous hydrogen delivered at elevated pressure from an Air Products and Chemicals, Inc. production facility in southern California. The station is comprised of compression, cooling, and a two-hose dispenser with a customer payment interface are used to refill fuel cell electric vehicles.

Keywords: California Energy Commission, Fairfax LA, Air Products and Chemicals, Inc., fuel cell vehicles, hydrogen infrastructure, SmartFuel® hydrogen refueling station

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EXECUTIVE SUMMARY

Hydrogen fuel cell electric vehicles and hydrogen refueling stations are expected to play key roles in California as the State transitions to lower-carbon and zero-emission vehicle technologies for light-duty passenger vehicles, transit buses, and truck transport fleets. Numerous government regulations and policy actions identify fuel cell electric vehicles as a vehicle technology that will be available to meet the California Air Resources Board's zero-emission vehicle regulation and the Governor's goal of 1.5 million zero-emission vehicles by 2025. More specific actions to bring fuel cell electric vehicles to California markets are specified in the Governor's Zero Emission Vehicle Action Plan.

Hydrogen fuel cell electric drive technology offers tremendous potential for the light-duty passenger vehicle market and medium- and heavy-duty truck and bus markets. Fuel cell electric passenger vehicles can drive more than 300 miles on a tank of hydrogen and can be refueled in three to four minutes the way gasoline passenger vehicles are fueled. They have zero tailpipe emissions, while the carbon footprint of these vehicles is nearly the same as plug-in electric vehicles. The technology can be readily scaled up for sport utility vehicles, family passenger vans, pickup trucks, urban package and beverage delivery trucks, and even heavy-duty trucks and buses. Most auto industry analysts and agencies view fuel cell electric drive technology as a complement to battery electric drive technologies rather than as a competing technology. Both battery and fuel cell electric vehicle technologies will be needed in California to achieve the zero-emission-vehicle deployment goals.

In contrast to battery electric and plug-in hybrid electric vehicles that can be charged at home, fuel cell electric vehicles require a new network of refueling stations that dispense pressurized hydrogen for consumer use. This has meant that the auto industry and station development industry have had to develop two new technologies in parallel: hydrogen refueling infrastructure and hydrogen fuel cell electric vehicles (FCEVs). Fuel cell electric vehicles cannot be widely marketed and sold to consumers without a minimum network of refueling stations available.

Assembly Bill 8 (AB 8, Perea, Chapter 401, Statutes of 2013) reauthorized the original Assembly Bill 118 funding program (Núñez, Chapter 750, Statutes of 2007) and created new legal requirements for the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program. The bill directs the California Energy Commission to allocate up to $20 million per year, or up to 20 percent of each fiscal year's available funding, to develop hydrogen refueling stations "until there are at least 100 publicly available hydrogen-fueling stations in operation in California" (Health and Safety Code 43018.9[e][1]).

The California Energy Commission contributed $623,709 of the total $966,442 budget to design, engineer, permit, construct, and make the Fairfax Los Angeles SmartFuel® hydrogen station operational.

The site selected for this project is 7751 Beverly Blvd., Los Angeles, California (Los Angeles County). A hydrogen refueling station at this location will serve fuel cell electric vehicles in the area. Air Products and Chemicals, Inc. accomplished this goal through the steps outlined below.

As part of its proposal to solicitation PON-09-608, Air Products and Chemicals, Inc. had proposed a site on La Cienega Blvd., but during project execution Air Products and Chemicals, Inc. determined that the gas station did not have adequate space to accommodate the hydrogen fueling equipment. Air Products and Chemicals, Inc. then identified the Beverly Blvd. location as a replacement. Air Products and Chemicals, Inc. developed a site memorandum of understanding which would enable Air Products and Chemicals, Inc. to demonstrate access to the site, to perform site design work and to develop permit application packages for siting and operating the hydrogen fueling equipment in advance of negotiating a land lease agreement. This memorandum was executed on August 14, 2013. The California Energy Commission approved the site change on November 1, 2013. Lease terms were negotiated, and Air Products and Chemicals, Inc. and the landlord executed a lease on July 29, 2015.

Air Products and Chemicals, Inc. developed the site configuration and design, and S. Gordin Structural Design and Engineering Services, Inc. performed the detailed engineering design. Initial structural and electrical design packages were completed on July 22, 2014.

Air Products and Chemicals, Inc. submitted the permit application to the Los Angeles Department of Building and Safety on July 22, 2014. The Los Angeles County Fire Department requested a separate submittal with additional information, and this was also provided on July 22, 2014. The station equipment layout was approved by the Fire Department on October 2, 2014. The station design was approved on March 24, 2015.

Air Products and Chemicals, Inc. provided the hydrogen refueling station equipment. Based upon their excellent safety record and prior experience with hydrogen station construction, Air Products selected Fueling and Service Technology, Inc. as the construction contractor on August 20, 2015. Construction began on August 24, 2015. Additional changes to the electrical design were identified by the Department of Water and Power during the construction phase. Following changes to the design, construction of the Fairfax Los Angeles SmartFuel® hydrogen station was completed on April 1, 2016.

The process of making the Fairfax Los Angeles SmartFuel® hydrogen station operational began on April 1, 2016 and was completed on May 1, 2016. Automakers performed test fills during this time. Approval of the hydrogen dispenser for retail operations by the California Department of Measurements and Standards was received on April 5, 2016. Initial use of the Fairfax Los Angeles SmartFuel® hydrogen station by retail customers occurred in early May of 2016.

The Fairfax Los Angeles SmartFuel® hydrogen station can dispense 100 kilograms per day with daily deliveries. The station has the potential to contribute to the reduction of greater than 620 metric tons of greenhouse gas emissions and greater than 36,500 gallons of gasoline consumption annually.

CHAPTER 1:
Station Design and Construction

1.1 Project Timeline

This section highlights the most critical items related to the development of the Fairfax Los Angeles hydrogen station, provides detail on each, and states the timing required for each step for this particular site.

1.1.1 Site Acquisition (January 2012 – July 29, 2015)

Following the kick-off of Grant Agreement ARV-10-048, Air Products and Chemicals, Inc. (Air Products) began working to develop a hydrogen station at 1004 S. La Cienega Blvd. in Los Angeles. This site was proposed by Air Products in response to solicitation PON-09-608. Air Products determined that the gas station did not have adequate space (as determined by the number of available parking spaces) to accommodate the hydrogen fueling equipment.

As a consequence, Air Products identified an alternate site (7751 Beverly Blvd.) which was located 2.2 miles (driving distance) from the original location. In order to demonstrate access to the new location, Air Products developed a site memorandum of understanding which would enable Air Products to perform site design work and to develop permit application packages for siting and operating the hydrogen fueling equipment in advance of negotiating a land lease agreement. This memorandum was executed on August 14, 2013. The California Energy Commission approved the site change on November 1, 2013 and amended Grant Agreement ARV-10-048 on January 10, 2014 to include this location.

A template for a property lease agreement was provided by Air Products on February 26, 2013. Negotiations were impacted by a request from the City of Los Angeles for additional documentation related to the property; these discussions took place from October of 2014 to March of 2015. The station lease was formally executed on July 29, 2015.

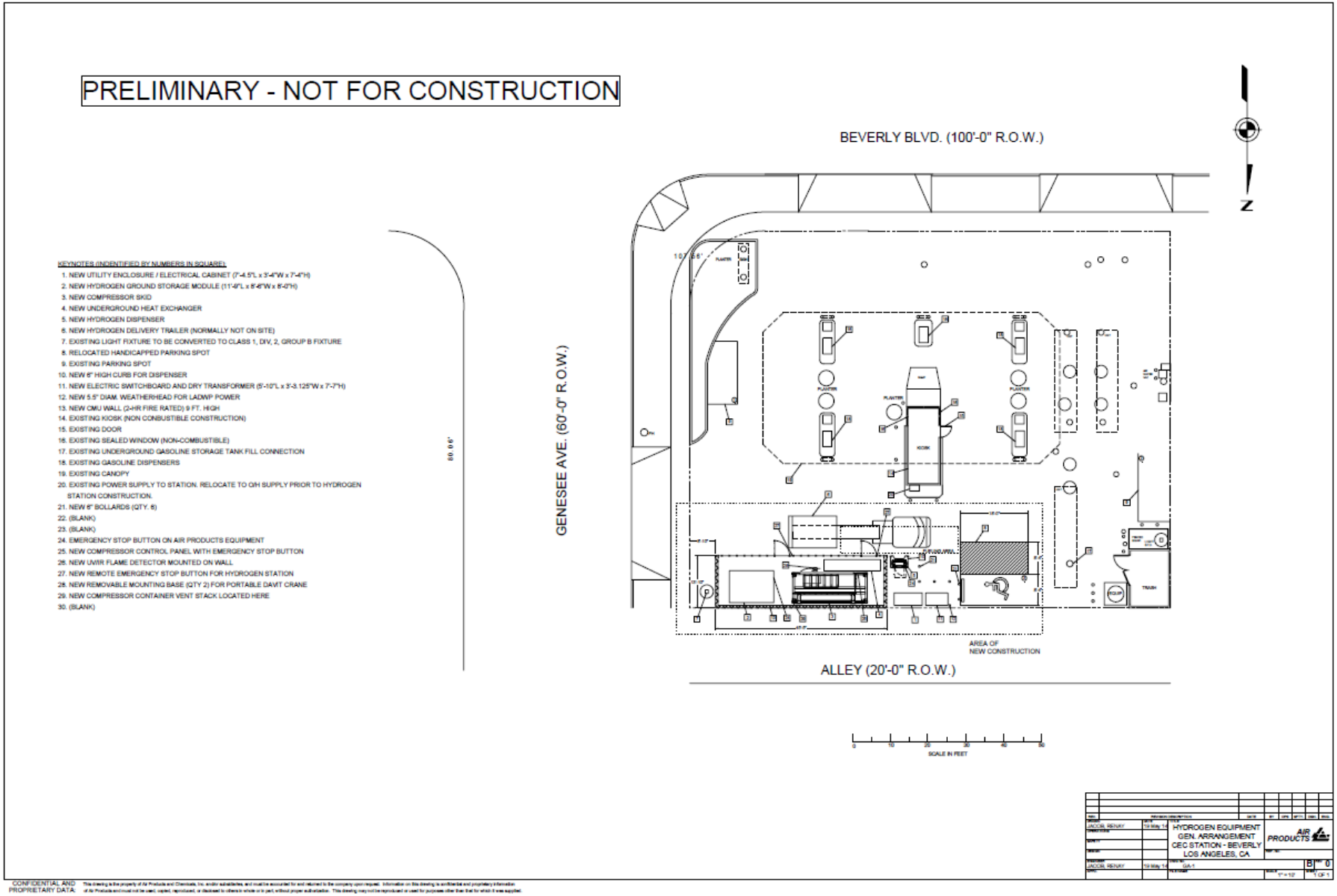
1.1.2 Site Design and Engineering (January 2014 – July 22, 2014)

Following a bid event, Air Products selected S. Gordin Structural Design and Engineering Services, Inc. to provide site design and permitting services for the Fairfax Los Angeles station. The companies executed a subcontract for design engineering services, and an initial site visit took place on February 3, 2014. A second site visit was held with a representative of the Los Angeles Department of Water and Power on February 10, 2014.

Following this meeting, options for equipment layouts were prepared by the architect for review with the gas station owner. The site plan was approved by the gas station owner on May 21, 2014, and Figure 1 provides the approved equipment arrangement drawing.

Structural and electrical designs were then initiated by S. Gordin Structural Design and Engineering Services, Inc., and initial packages were completed on July 22, 2014.

Figure 1: Fairfax Los Angeles SmartFuel® Hydrogen Station Initial Equipment Arrangement Drawing (May 21, 2014)



Source: Air Products and Chemicals, Inc. Original figure is higher resolution.

1.1.3 Equipment Procurement (January 2012 – April 2014)

Immediately after execution of the Grant Agreement, Air Products began the equipment design and procurement activities for the eight sets of SmartFuel® hydrogen station equipment that would be deployed as part of the overall project. A draft scope of work for the equipment design efforts was prepared in April of 2012. Purchase orders for long-lead items began to be issued in the summer of 2012, and the design team to fabricate a prototype of several of the key containerized components; any lessons learned from this effort could then be used in the design and fabrication of the remaining units.

The component with the longest lead time was the high-pressure storage vessels which are critical components to the hydrogen fueling process. At the time of project execution, only one vendor could provide these tubes. The first set of vessels was delivered to Air Products in June of 2013, and the remaining tubes were shipped beginning in April of 2014.

1.1.4 Entitlement Process

The City of Los Angeles did not require a zoning review of the addition of hydrogen equipment to the gas station in Fairfax Los Angeles.

1.1.5 Permit Process (July 22, 2014 – March 24, 2015)

Air Products submitted the structural and electrical plans to the Los Angeles Department of Building and Safety on July 22, 2014. The Los Angeles Fire Department requested a separate submittal with additional information, and this was also provided on July 22, 2014. Plan check comments from several departments were provided before the end of July. The electrical design was approved in early September of 2014. The equipment layout was approved by the Los Angeles Fire Department on October 2, 2014.

As noted earlier, the City of Los Angeles requested that Air Products provide additional documentation related to the property; these discussions took place from October of 2014 to March of 2015. The Los Angeles Department of Building and Safety then approved the station design on March 24, 2015.

1.1.6 Construction Process (August 24, 2015 – April 1, 2016)

Following a bid process, Air Products executed the construction subcontract to Fueling and Service Technology, Inc. on August 20, 2015. Fueling and Service Technology, Inc. has an excellent safety record and had prior experience in hydrogen station construction, including work performed for Air Products under this Grant Agreement ARV-10-048. Construction started on August 24, 2015, with hydrogen storage, compression, cooling, and dispensing equipment delivered to the site on October 12, 2015. Additional changes to the electrical design were identified by the Los Angeles Department of Water and Power during the construction phase. Updated electrical plans were submitted in early January of 2016 and approved by the Los Angeles Department of Building and Safety on January 29, 2016. Completion of construction, as reflected by final sign-off of the site by Los Angeles Department of Building and Safety, took place on April 1, 2016.

1.1.7 Making the Station Operational (April 1, 2016 – May 1, 2016)

Following the completion of construction, commissioning activities were undertaken by Air Products' engineering and operations staff. Initial equipment operation, hydrogen sampling, and test fills into an Air Products test tank were performed during this time.

1.1.8 Station Declared Operational (May 2, 2016)

Following completion of a series of test fills by automakers, notification that the Fairfax Los Angeles SmartFuel® station was ready for retail operation was provided by Air Products to the Governor's Office of Business and Economic Development on May 2, 2016.

1.1.9 DMS Certification (April 5, 2016)

The California Department of Food and Agriculture's Division of Measurement Standards (DMS) is responsible for enforcing California weights and measures laws and regulations and must certify any device used for metering the sale of commercial items within California. The permanent DMS approval was received for the Fairfax Los Angeles SmartFuel® hydrogen station on April 5, 2016. Figure 2 provides a photograph of the dispenser with the DMS stickers in place.

Figure 2: Fairfax Los Angeles SmartFuel® Dispenser following DMS Certification

Source: Air Products and Chemicals, Inc.

1.1.10 Customer Usage (May 2016 – Present)

The first public customer fueled at the Fairfax Los Angeles SmartFuel® station in early May of 2016, and the station has been used regularly since then. Dispensed volumes totaled 63 kilograms in May of 2016, 250 kilograms in June of 2016, and 352 kilograms in of July 2016. A photograph of a Hyundai FCEV fueling at the Fairfax Los Angeles SmartFuel® hydrogen station is provided in Figure 3.

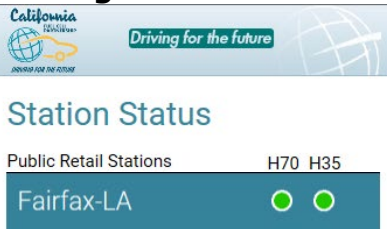
Figure 3: Fairfax Los Angeles SmartFuel® Dispenser

Source: Air Products and Chemicals, Inc.

1.1.11 Station Online Status System Activated (May 2, 2016)

The California Fuel Cell Partnership Station Online Status System provides regularly updated station status information to fuel cell vehicle drivers. Air Products has provided California Fuel Cell Partnership station status information regarding its stations since the inception of the Station Online Status System. The Fairfax Los Angeles station was added to the Station Online Status System on May 2, 2016. A screenshot of the Station Online Status System network that includes the Fairfax Los Angeles SmartFuel® hydrogen station is shown in Figure 4.

Figure 4: Screenshot of California Fuel Cell Partnership Station Online Status System Showing Fairfax Los Angeles SmartFuel® Hydrogen Station Status



Source: Air Products and Chemicals, Inc.

The station is open and active.

1.2 Environmental Impacts

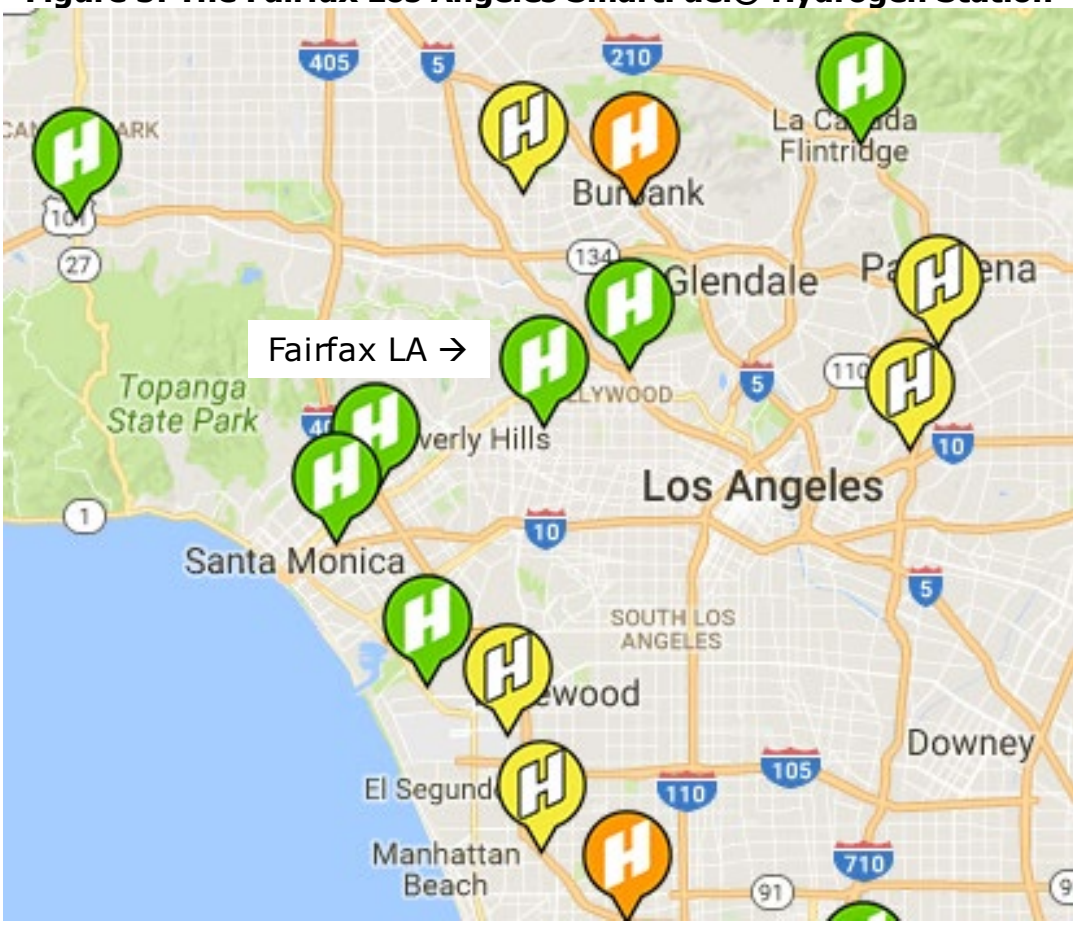
Hydrogen is stored as a compressed gas in an above-ground tank concealed behind a wall at this station. Hydrogen is nontoxic, colorless, and odorless, so hydrogen station equipment is outfitted with appropriate sensors to provide immediate notification in case a leak occurs. No solid or liquid waste will be produced at this site.

There was no additional landscaping added for the construction of the hydrogen refueling station, and, therefore, no additional irrigation water will be consumed.

1.3 Fairfax Los Angeles SmartFuel® Hydrogen Station in the Network

Figure 5 shows the location of the Fairfax Los Angeles SmartFuel® hydrogen station at 7751 Beverly Blvd. in relation to other stations in the Southern California network.

Figure 5: The Fairfax Los Angeles SmartFuel® Hydrogen Station

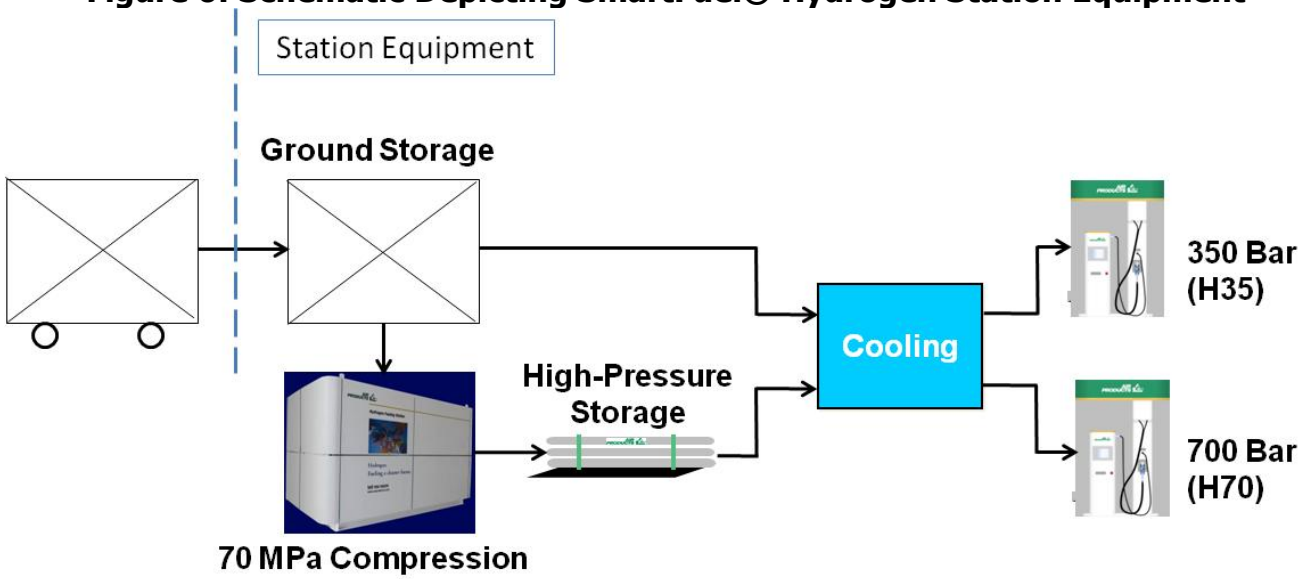


Source: Air Products and Chemicals, Inc. Map courtesy of California Fuel Cell Partnership.

1.4 Schematic Layout of the Fairfax Los Angeles SmartFuel® Hydrogen Station

As shown below, Figure 6 depicts an overview of the Fairfax Los Angeles SmartFuel® hydrogen station components. Hydrogen is produced by Air Products at a central fill system located in southern California, and the gas is delivered by a high-pressure tube trailer and pressure-transferred to a ground storage module at the station. Hydrogen is compressed as needed to fill the high-pressure storage tubes that are integral in providing a full fill to fuel cell vehicles that use the H70 nozzle. Gas is taken from storage and cooled based on the dispenser programming that meets the Society of Automotive Engineers J2601 fueling protocol; Air Products has patents which cover elements of the station operation and the dispensing process.

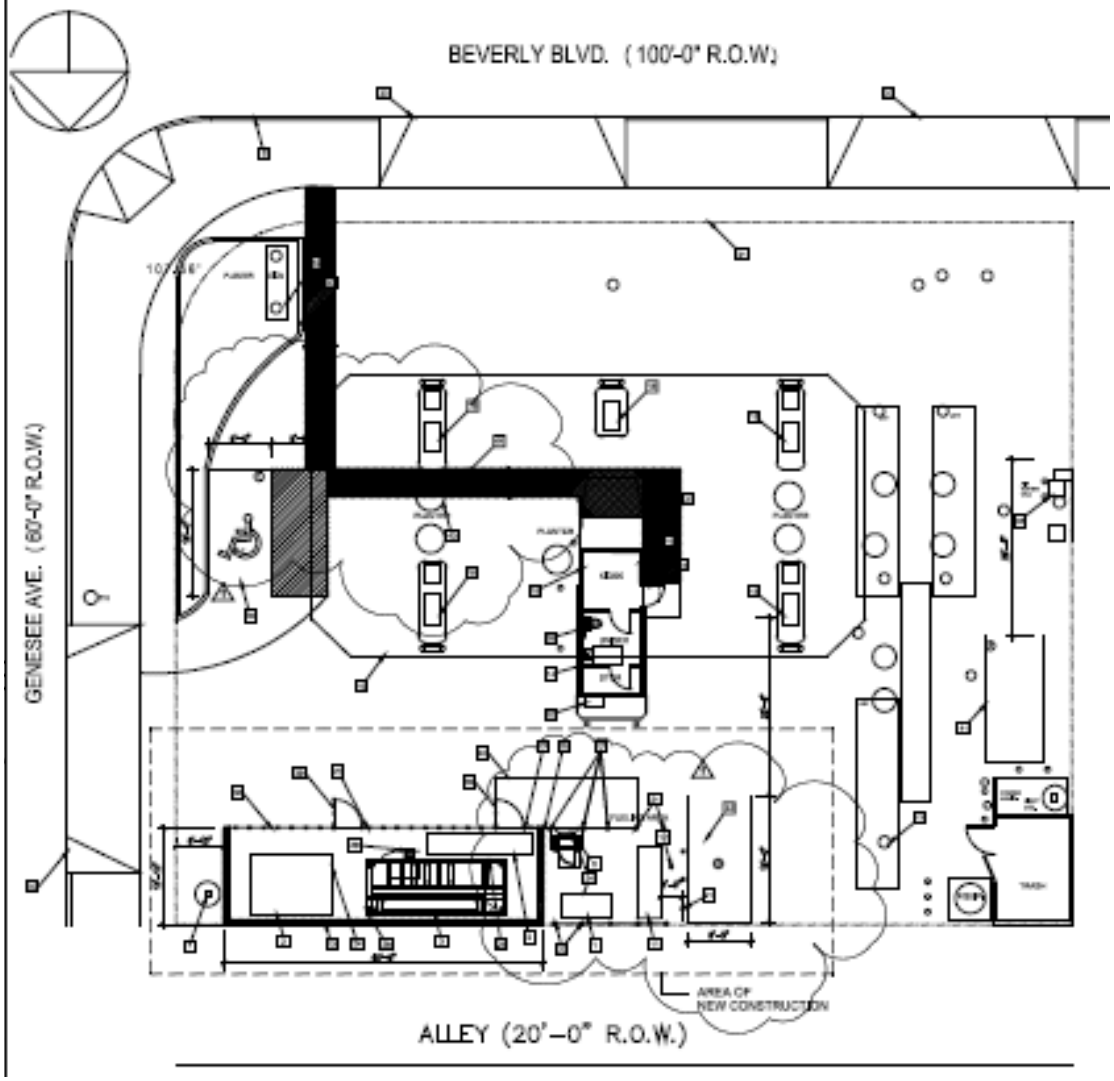
Figure 6: Schematic Depicting SmartFuel® Hydrogen Station Equipment



Source: Air Products and Chemicals, Inc.

Figure 7 shows a detailed view of the actual final, as-built configuration of the Fairfax Los Angeles SmartFuel® hydrogen station.

Figure 7: Final Fairfax Los Angeles SmartFuel® Hydrogen Station Layout



Source: Air Products and Chemicals, Inc. Original figure is higher resolution.

1.5 List of Subcontractors and Grant Agreement Budget

Table 1 shows a list of subcontractors and the grant agreement budget for the project.

Table 1: List of Subcontractors and Grant Agreement Budget

Company / Contribution	Grant Agreement
Air Products and Chemicals, Inc., Allentown, PA / H2 Station Equipment	$721,906
Fueling and Service Technology, Inc., Buena Park, CA / Construction	$211,733
S. Gordin Structural Design & Engineering Services, Inc., Carson City, NV / Design and Permitting Services	$32,803
Total Budget:	**$966,442**
California Energy Commission Grant	$623,709
Air Products Cost Share	$342,733
Total California Energy Commission Cost Share	65%

Source: Air Products and Chemicals, Inc.

CHAPTER 2:
Data Collection and Energy Analysis

The Fairfax Los Angeles SmartFuel® hydrogen refueling station is supplied by hydrogen generated via steam methane reformation that converts methane (CH_4) and water to hydrogen (H_2) and carbon dioxide (CO_2) and along with an equilibrium amount of carbon monoxide (CO):

Steam/Methane Reforming Reaction $CH_4 + Water + Heat \Leftrightarrow CO + 3H_2$
Water-Gas Shift Reaction $CO + Water \Leftrightarrow CO2 + H_2 + Heat$

Per California Senate Bill 1505 (Lowenthal, Chapter 877, Statutes of 2006) and PON-09-608, which funded this project, at least one-third of the hydrogen dispensed will be produced from renewable energy sources.

Hydrogen is supplied to the hydrogen fueling station from Air Products' hydrogen production facilities in Wilmington / Carson, California. Renewable biogas is being procured as feedstock for the facilities, resulting in delivered hydrogen product that meets the 33 percent renewable requirements.

Air Products has a contract for sourcing the renewable biogas that meets Public Resources Code Section 2574(b)(1); documentation is provided in Figure 8. Although California has a substantial amount of biogas, local supply cannot be injected into California pipelines under California Health and Safety Cost Section 25420. Air Products' biogas supply for this project is sourced outside California and transported to California with connection to a natural gas pipeline within the Western Electricity Coordinating Council region that delivers gas into California.

Figure 8: Documentation of Biogas Sources

Exhibit A
RB Supply Sources
Shell Energy North America (US), L.P.

Supply Source	Address	Pipeline/LDC	Receipt	Delivery
Greentree Landfill	635 Toby Road Kersey, PA 15846	National Fuels Gas TETCO NGPL EPNG Socal Gas FAR	Landfill meter Nat Fuel-Bristoria Tetco-Sweet Lake 3825 EPNG Jal 3083 Topock	Bristoria NGPL-Sweet Lake EPNG Jal 3083 Topock Socal Citygate
Imperial Landfill	11 Boggs Road Imperial, PA 15126	National Fuels Gas TETCO NGPL EPNG Socal Gas FAR	Landfill meter Nat Fuel-Bristoria Tetco-Sweet Lake 3825 EPNG Jal 3083 Topock	Bristoria NGPL-Sweet Lake EPNG Jal 3083 Topock Socal Citygate

Source: Air Products and Chemicals, Inc.

Hydrogen is delivered to the Fairfax Los Angeles SmartFuel® hydrogen refueling station by a Department of Transportation-certified high-pressure delivery trailer.

For an analysis on greenhouse gas emissions, the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation model for gaseous hydrogen has been appended with

calculations to deliver compressed hydrogen gas with 33.3 percent renewable energy content from a large central hydrogen production facility to a cluster of fuel cell stations in Southern California. For the hydrogen supply pathway and hydrogen fueling station, the lifecycle emission of hydrogen energy supply is estimated at 75.2 grams of carbon dioxide equivalent per megajoule on a full well-to-wheels basis. The California Air Resources Board's Low Carbon Fuel Standard lifecycle emissions estimate for a similar pathway for compressed hydrogen from central reforming of natural gas (Low Carbon Fuel Standard Pathway HYGN005) is 88.3 grams CO2 equivalent / megajoule. In factoring in an Energy Efficiency Ratio of 2.5 for FCEV's established under California Low Carbon Fuel Standard the resulting emissions performance for FCEVs is 148 grams CO2 equivalent / mile. In comparison to a Low Carbon Fuel Standard light-duty gasoline vehicle baseline, the hydrogen supply pathway results in a 62 percent reduction in wheel-to-wheel greenhouse emissions relative to California gasoline.

Relating to the Fairfax Los Angeles SmartFuel® hydrogen refueling station, this level of relative greenhouse gas reduction to the Low Carbon Fuel Standard 2016 baseline for gasoline vehicles each FCEV deployed in the market will reduce greenhouse gas emissions by 4.3 metric tons per year. The station has the potential to contribute to the reduction of greater than 620 metric tons of greenhouse gas emissions and greater than 36,500 gallons of gasoline consumption annually. The long-term greenhouse gas and petroleum reduction that could be realized by widespread adoption of FCEVs in the marketplace is enormous.

CHAPTER 3:
Statement of Future Intent

Air Products has executed an initial three-year lease with the landowner through July 31, 2018, with an option for a three-year extension.

Data on the operation of the station will be collected and reported to the California Energy Commission throughout the term of operations and maintenance under Grant Agreement ARV-15-026.

As part of its ongoing support to hydrogen fueling stations in California, Air Products has a fully staffed operations department which can address station maintenance and emergency situations. Air Products utilizes a 24-hour Equipment Support Team to monitor for alarms from the hydrogen station (in addition to any local alarms at the point of use). Air Products employs technicians in the Los Angeles Basin area that are trained in the specialized requirements for hydrogen fueling stations.

CHAPTER 4:
Findings, Conclusions, and Recommendations

The following is a list of important findings from the Fairfax Los Angeles SmartFuel® hydrogen station project:

- In order to shorten the time needed to permit a hydrogen fueling station, both the applicant and the various agencies responsible for review and approval must provide timely and complete responses to correspondence between the parties.
- The hydrogen station equipment at Fairfax Los Angeles has common components to other stations supplied by Air Products. This helps to increase the efficiency of the project management process.

GLOSSARY

AIR PRODUCTS AND CHEMICALS INCORPORATED (APCI or Air Products)—Provides industrial gases and related equipment to dozens of industries, including refining, chemical, metals, electronics, manufacturing, and food and beverage. Air Products is also the world's leading supplier of liquefied natural gas process technology and equipment.

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The CEC's five major areas of responsibilities are:

- Forecasting future statewide energy needs.
- Licensing power plants sufficient to meet those needs.
- Promoting energy conservation and efficiency measures.
- Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
- Planning for and directing state response to energy emergencies.

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

CARBON DIOXIDE EQUIVALENT (CO2e)—A metric used to compare emissions of various greenhouse gases. It is the mass of carbon dioxide that would produce the same estimated radiative forcing as a given mass of another greenhouse gas. Carbon dioxide equivalents are computed by multiplying the mass of the gas emitted by its global warming potential.

CARBON MONOXIDE (CO)—A colorless, odorless, highly poisonous gas made up of carbon and oxygen molecules formed by the incomplete combustion of carbon or carbonaceous material, including gasoline. It is a major air pollutant on the basis of weight.

DIVISION OF MEASUREMENT STANDARDS (DMS)—Enforcement of California weights and measures laws and regulations is the responsibility of the Division of Measurement Standards (DMS). The Division's activities are designed to:

- Ensure the accuracy of commercial weighing and measuring devices.
- Verify the quantity of both bulk and packaged commodities.
- Enforce the quality, advertising and labeling standards for most petroleum products.

The Division works closely with county sealers of weights and measures who, under the supervision and direction of the Secretary of Food and Agriculture, carry out the vast majority of weights and measures enforcement activities at the local level.[1]

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[1] California Department of Food and Agriculture Division of Measurement Standards

(https://www.cdfa.ca.gov/dms/)

FUEL CELL ELECTRIC VEHICLE (FCEV)—A zero-emission vehicle that runs on compressed hydrogen fed into a fuel cell "stack" that produces electricity to power the vehicle.

HYDROGEN (H_2)—A colorless, odorless, highly flammable gas, the chemical element of atomic number 1.

METHANE (CH_4)—A light hydrocarbon that is the main component of natural gas and marsh gas. It is the product of the anaerobic decomposition of organic matter and enteric fermentation in animals and is one of the greenhouse gases.