CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Playa Del Rey Hydrogen Station

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

Gavin Newsom, Governor

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California Energy Commission

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ACKNOWLEDGEMENTS

The construction of the Playa Del Rey hydrogen refueling station has been possible only because of the substantial efforts and funds provided by a number of stakeholders. FirstElement Fuel, Inc. graciously thanks Toyota for its vision and fortitude; Air Products and Chemicals, Inc., Black & Veatch, and Vantage Company for bringing the project together; Tyson Eckerle for helping push the lease over the goal line; and, of course, Jean Baronas, Phil Cazel, Jim McKinney, Vice Chair Janea Scott, and many others at the California Energy Commission for tremendous, sustained confidence in clean, alternative transportation.

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-13-607 to provide funding opportunities under the Clean Transportation Program for hydrogen refueling stations. In response to PON-13-607, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards May 1, 2014 and the agreement was executed as ARV-14-008 on July 22, 2014.

ABSTRACT

FirstElement Fuel, Inc. designed, engineered, permitted, constructed, and commissioned a hydrogen refueling station at 8126 Lincoln Blvd., Los Angeles, California. FirstElement Fuel, Inc. plans to own and operate the hydrogen refueling station until at least 2025. The station consists of a concrete reinforced block compound that encloses hydrogen storage, compression, and cooling equipment; a dispenser with two fueling hoses; a customer payment interface; a canopy; and a dedicated concrete fueling position for fuel cell vehicle drivers.

Keywords: California Energy Commission, FirstElement Fuel, Inc., fuel cell vehicles, hydrogen refueling station, hydrogen infrastructure, Playa Del Rey

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EXECUTIVE SUMMARY

Hydrogen fuel cell electric vehicles (FCEVs) 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 FCEVs as a vehicle technology that will be available to meet the California Air Resources Board's zero-emission vehicle regulation and former Governor Edmund G. Brown Jr's goal of 5 million zero-emission vehicles by 2030.

FCEVs offer 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, they have zero tailpipe emissions, and they can be refueled in three to four minutes the way gasoline passenger vehicles are fueled. However, FCEVs 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 FCEVs. FCEVs cannot be widely marketed and sold to consumers without a minimum network of refueling stations available.

In response to PON-13-607 issued by the California Energy Commission, FirstElement Fuel, Inc. was awarded funding for a total of 19 stations. The CEC contributed $1,451,000 of the total $2,297,110 cost to design, engineer, permit, construct, and commission the 100 percent renewable hydrogen refueling station located at 8126 Lincoln Blvd., Los Angeles, CA. 90045.

FirstElement Fuel, Inc. worked with historical vehicle sales data, academic publications, automakers, and the California Energy Commission's Station Location Areas to select desired market locations. FirstElement Fuel, Inc. then analyzed specific properties within the target locations to find sites that could meet the space requirements for hydrogen fueling equipment. The site selected for this project was 8126 Lincoln Blvd., Los Angeles, California. A hydrogen refueling station at this location will serve as a core station in Southern California for at least the next 10 years.

The owner at Playa Del Rey was excited to bring a clean, alternative fuel to his station. Lease terms were negotiated, and FirstElement Fuel, Inc. and the Playa Del Rey owner executed a lease on March 23, 2015.

FirstElement Fuel, Inc. developed the site configuration and design, and engineering firm Black & Veatch performed the detailed engineering design. The zoning process in Playa Del Rey was administrative and approval was granted July 23, 2015.

Permits for zoning, building, mechanical, electrical, plumbing, and fire were submitted on June 1, 2015 and finalized November 16, 2015 for a total period of 168 days. Because the Playa Del Rey station is located within the jurisdiction of the City of Los Angeles, the zoning and permitting process was burdened by the size and complexity of the City's organization. There

were no major hurdles in either planning or permitting, but the process still took significantly longer than other smaller jurisdictions.

FirstElement Fuel, Inc. purchased hydrogen refueling station equipment from Air Products and Chemicals, Inc. and the remainder of materials were sourced from a variety of general and specialty vendors. Vantage Company from Orange, California was selected as the contractor for the project because of their relatively low bid, excellent safety record, good standing with Black & Veatch, and willingness to work with FirstElement Fuel, Inc. on multiple projects. Construction began February 22, 2016, and completed June 7, 2016.

Commissioning began May 9, 2015, and was complete May 29, 2015. The FirstElement Fuel, Inc. team performed the bulk of the commissioning tasks including cleaning, purging, and pressure testing with Air Products and Chemicals, Inc. performing final start-up.

CHAPTER 1:
Station Design and Construction

There were many steps required to bring the Playa Del Rey 100 percent renewable hydrogen refueling station project to completion. The following synopsis highlights the most critical items.

Site Acquisition - Construction (Fall 2013 – June 2016)

Beginning in the fall of 2013, FirstElement Fuel, Inc. took steps to identify and acquire appropriate sites for the hydrogen refueling station. FirstElement Fuel, Inc. worked with historic vehicle sales data, academic publications, automakers, and the station location areas in PON-13-607 to select desired market locations. FirstElement Fuel, Inc. then analyzed specific properties within the target locations to find sites that could meet the space requirements for hydrogen fueling equipment.

After selecting general locations and specific sites, FirstElement Fuel, Inc. contacted station owners and operators to negotiate lease opportunities. A Letter of Intent was executed with the property owner at 8126 Lincoln Blvd., Los Angeles, California in January, 2014. A binding 10-year lease was later executed on March 23, 2015.

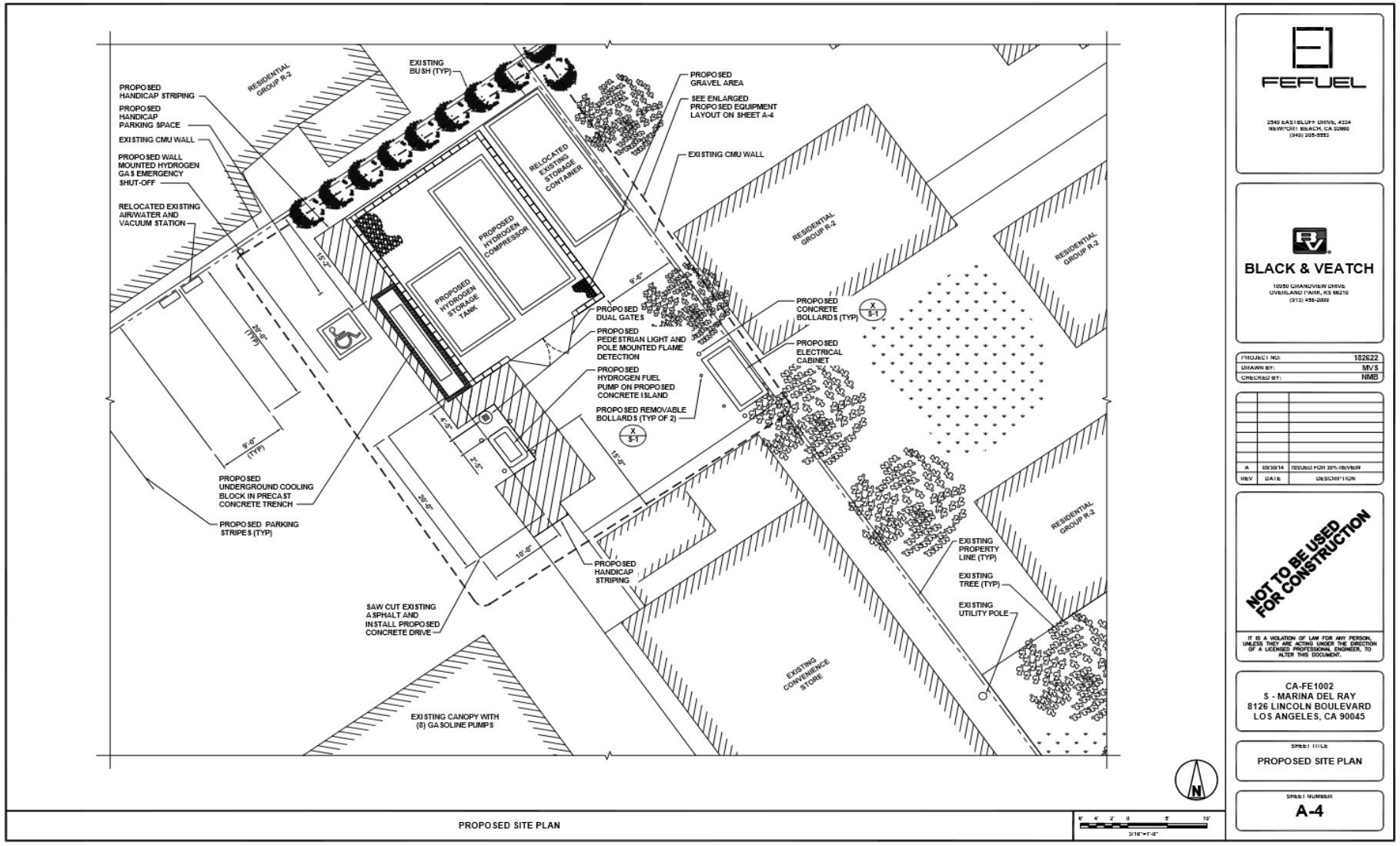
FirstElement Fuel, Inc. selected Air Products and Chemicals, Inc. equipment for the Playa Del Rey station because of the cost, capacity, reliability, and more mature supply chain as compared to other suppliers as detailed in the FirstElement Fuel, Inc. application for funding under PON-13-607. FirstElement Fuel, Inc. executed a contract with Air Products and Chemicals, Inc. for the equipment on September 16, 2014 and equipment was delivered to the site on April 12, 2016.

FirstElement Fuel, Inc. and Black & Veatch surveyed the site to begin the site layout on August 12, 2014. They generated initial engineering drawings on September 30, 2014. These drawings are referred to as “construction drawing 30s” because they represent 30 percent complete construction drawings and contain only two pages. Figure 1 shows the equipment compound drawing from the construction drawing 30 drawing set. As shown, the drawing lacks specific detail and serves only to outline the site plan.

On October 29, 2014, Clark Land Surveying, Inc. performed a detailed engineering survey for the Playa Del Rey station site, as shown in Figure 2.

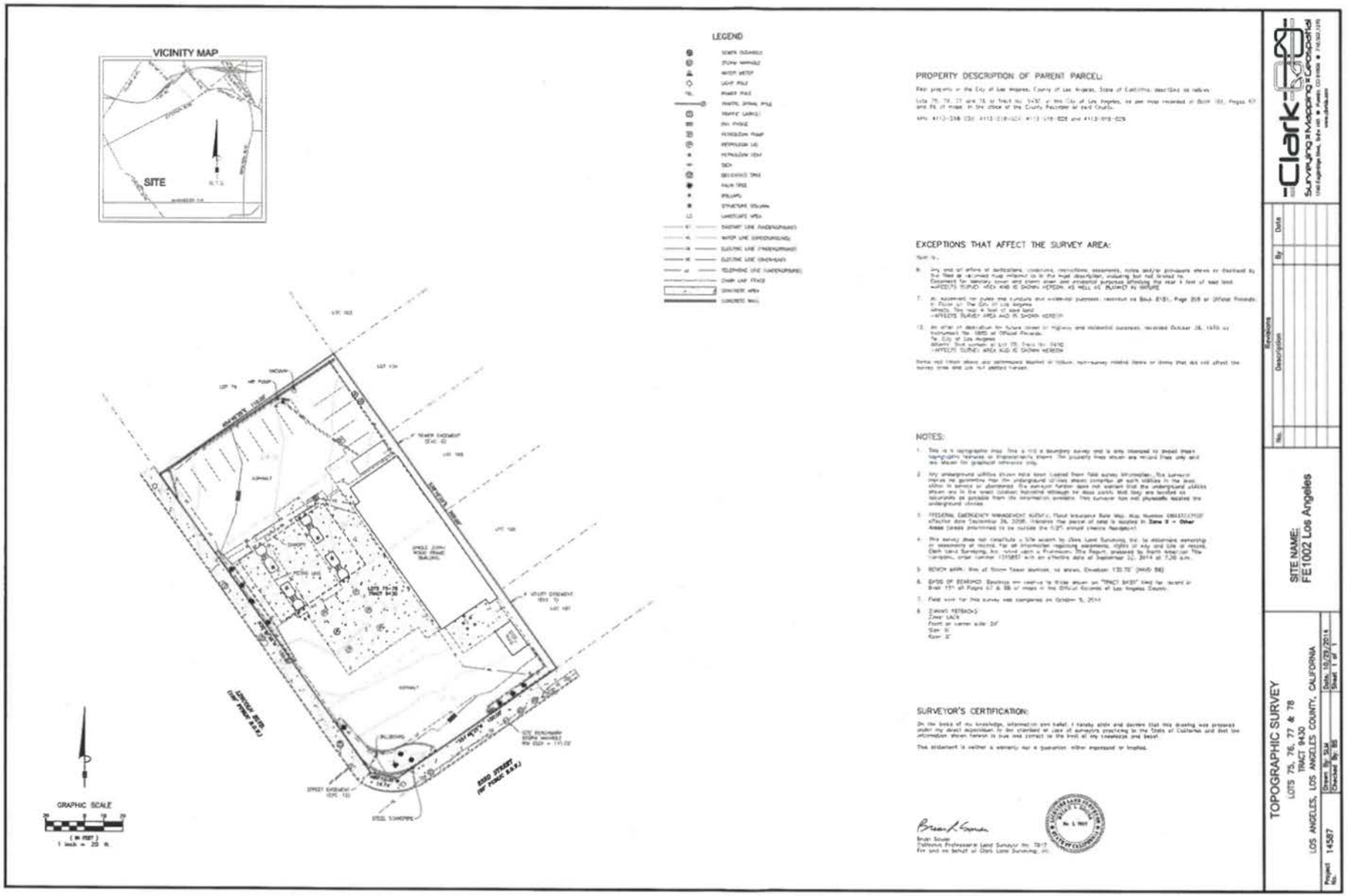
On March 27, 2015, draft final construction drawings were completed that depict all of the details required for both construction and the permit review. Final construction drawings were completed with 60 pages that depict all of the details required for both construction and the permit review process on September 17, 2015. The equipment compound page of the construction drawing 100 drawings is shown in Figure 3.

Figure 1: Coarse Detail of Equipment Compound from Construction Drawing 30 Set



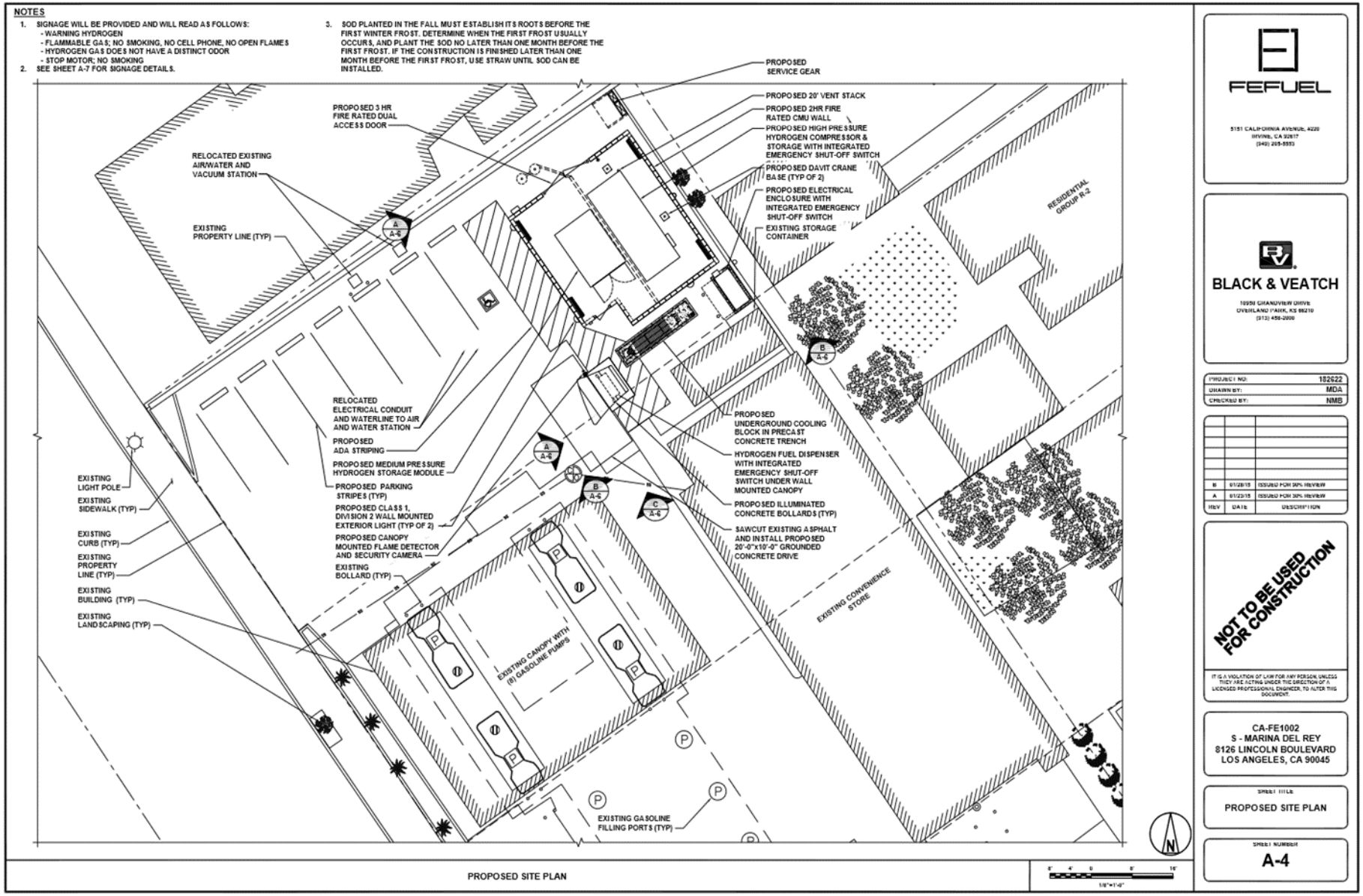
Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 2: Survey of Playa Del Rey Hydrogen Station Location



Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 3: Detail of Equipment Compound from Construction Drawing 100 Set



Source: FirstElement Fuel, Inc. Original figure is higher resolution

The zoning application was submitted to the appropriate authority having jurisdiction on June 1, 2014. The local planning department must verify that the project meets the zoning requirements of the proposed location, and approve any aesthetic, landscaping, and other details that are important to the community. Approval was received through an administrative process on July 23, 2015.

All building permit applications were submitted on June 1, 2015, and approved on November 16, 2015 for a total period of 168 days. Because the Playa Del Rey station is located within the jurisdiction of the City of Los Angeles, the zoning and permitting process took extra time because of the size and complexity of the City's organization.

FirstElement Fuel, Inc. and Black & Veatch submitted a detailed bid package to contractors on December 30, 2015. The contract was awarded to Vantage Company on January 11, 2016. The bulk of Vantage's construction experience lies in cell towers. Vantage provided a reasonable bid, had a desire to get involved with hydrogen projects, and is based in southern California. Construction began February 22, 2015.

Figure 4 shows the foundation work in progress in the equipment compound. Pier foundations were used instead of a traditional slab foundation to mitigate storm water runoff issues. Hydrogen storage, compression (Figure 5), cooling, and dispensing equipment was delivered to the site on April 12, 2016. Construction was completed on June 7, 2016.

Construction progressed quickly, in part because of the time spent throughout the project to gain a common understanding of project requirements, especially those listed in the National Fire Protection Association hydrogen technologies code

Figure 4: Rebar Installation for Pier Foundations

Source: FirstElement Fuel, Inc.

Figure 5: Crane Lifting Hydrogen Compressor Unit

Source: FirstElement Fuel, Inc.

Making the Station Operational (May 9, 2016 – May 29, 2016)

The commissioning of the Playa Del Rey hydrogen station included the cleaning and purging of lines, pressure testing, and hydrogen sampling.

Station Declared Operational (June 17, 2016)

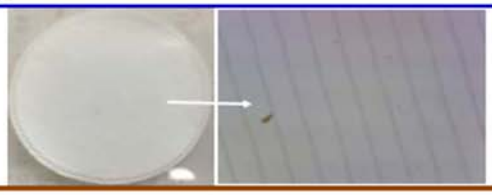
The Playa Del Rey hydrogen station met the definition of operational in PON-13-607 by completing installation of all station/dispenser components, obtaining all of the required permits from the local jurisdiction, filling the station's storage tubes with pressurized hydrogen gas, successfully passing a hydrogen quality test (Figure 6), successfully fueling one fuel cell vehicle with hydrogen, and opening to the public. FirstElement Fuel, Inc. declared the station operational on June 17, 2016.

Figure 6: Hydrogen Fuel Quality Report on June 14, 2016

www.SmartChemistry.com

FIRST ELEMENT FUEL — MARINA DEL REY HYDROGEN STATION

SAE J2719	SAE J2719 Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)	H70 H2 @Nozzle sampled on 06/14/2016 Concentration (µmol/mol)	Analytical Method
Water	5	0.4	< 0.4	
Total Hydrocarbons (C, Basis)	2		**2.22**	ASTM D7892
Methane			2.17	
Acetone			0.0048	
Isopropyl Alcohol			0.0042	
Propane			0.042	
Oxygen	5	1	< 1	ASTM D7649
Helium	300	10	**45**	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		1	**1.0**	ASTM D7649
Argon		0.4	**1.2**	ASTM D7649
Carbon Dioxide	2	0.5	< 0.5	ASTM D7649
Carbon Monoxide	0.2	0.0005	**0.0029**	ASTM D5466
Total Sulfur	0.004	0.000001	**0.000041**	ASTM D7652
Hydrogen Sulfide		0.000001	0.0000092	ASTM D7652
Carbonyl Sulfide		0.000001	0.000027	ASTM D7652
Methyl Mercaptan (MTM)		0.00001	< 0.00001	ASTM D7652
Ethyl Mercaptan (ETM)		0.00001	< 0.00001	ASTM D7652
Dimethyl Sulfide (DMS)		0.00001	< 0.00001	ASTM D7652
Carbon Disulfide		0.000002	0.0000049	ASTM D7652
Isopropyl Mercaptan (IPM)		0.00001	< 0.00001	ASTM D7652
Tert-Butyl Mercaptan (TBM)		0.00001	< 0.00001	ASTM D7652
n-Propyl Mercaptan		0.00001	< 0.00001	ASTM D7652
n-Butyl Mercaptan		0.00001	< 0.00001	ASTM D7652
Tetrahydrothiophene (THT)		0.00001	< 0.00001	ASTM D7652
Formaldehyde	0.01	0.001	< 0.001	ASTM D7892
Formic Acid	0.2	0.001	< 0.001	ASTM D5466
Ammonia	0.1	0.01	< 0.01	ASTM D5466
Total halogenates	0.05		**0.00036**	
Hydrogen Bromide		0.001	< 0.001	ASTM D5466
Hydrogen Chloride		0.003	< 0.003	ASTM D5466
Chlorine		0.0010	< 0.001	ASTM D5466
Organic Halides (32 compounds in red and bold listed in "Other Hydrocarbons"). Both Smart Chemistry and method limits is for each individual organic halide.		0.001	0.00036	ASTM D7892
Tetrachloro-hexafluorobutanes			0.00036	
Particulate Concentration			0.116 mg/kg	ASTM D7651
Particulates Found & Size			**There are total 4 particulates found with the sizes in micrometer: 558, 66, 57, 55.**	ASTM D7834
Hydrogen Fuel Index The hydrogen fuel index is the value obtained when the amount of aggregate impurities, as, expressed as percent (µmole/µmole), is subtracted from 100%. (Section 3.5 of SAE J2719)			**99.99505%**	



Source: FirstElement Fuel, Inc.

Automaker testing was performed at the Playa Del Rey hydrogen station to verify correct operation per *SAE J2601 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles.*

Certification (June 26, 2016)

The California Department of Food and Agriculture's Division of Measurement Standards 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. FirstElement Fuel, Inc. achieved certification by acting as the registered service agent, dispensing a measured amount of fuel, and confirming the quantity dispensed is accurately reflected by the dispenser in accordance with examination procedures (Examination Procedures Outline NO. 40-A) as witnessed by the local county weights and measures officer as shown in Figure 7.[1]

Figure 7: Division of Measurement Standards Certification

Source: FirstElement Fuel, Inc.

1 Examination Procedures for New Station (https://www.cdfa.ca.gov/dms/programs/devices/Hydrogen_Gas-Measuring_Devices_EPO-40.pdf)

Station Use (June 16, 2016 - Present)

Figure 8 shows the first vehicle filled was a Hyundai Tucson on June 16, 2016 and the station has been used regularly since then.

Figure 8: First Fueling at the Playa Del Rey Hydrogen Station

Source: FirstElement Fuel, Inc.

Station Operational Status System

The California Fuel Cell Partnership, Station Operational Status System is a website portal designed to provide hydrogen station status for motorist use.[2] This system is important to FCEV drivers during the development phase of the hydrogen refueling station network because it lets drivers know that the hydrogen station they intend to use is operational before they depart. The Playa Del Rey hydrogen station began sending automated updates (FirstElement

2 Hydrogen Station Portal (https://m.cafcp.org/)

Fuel, Inc. software) on a regular basis to Station Operational Status System on August 18, 2016.

Environmental Impacts

Hydrogen will be stored as a compressed gas in an above-ground tank concealed behind a wall at the Playa Del Rey station. In accordance with the funding agreement with the CEC, 100 percent of the hydrogen sold at the Playa Del Rey hydrogen station will be produced from renewable sources including biogas. Hydrogen is non-toxic, colorless, and odorless so hydrogen station equipment is outfitted with appropriate sensors to provide immediate notification in the case that a leak ever occurs. No solid or liquid waste will be produced at this site.

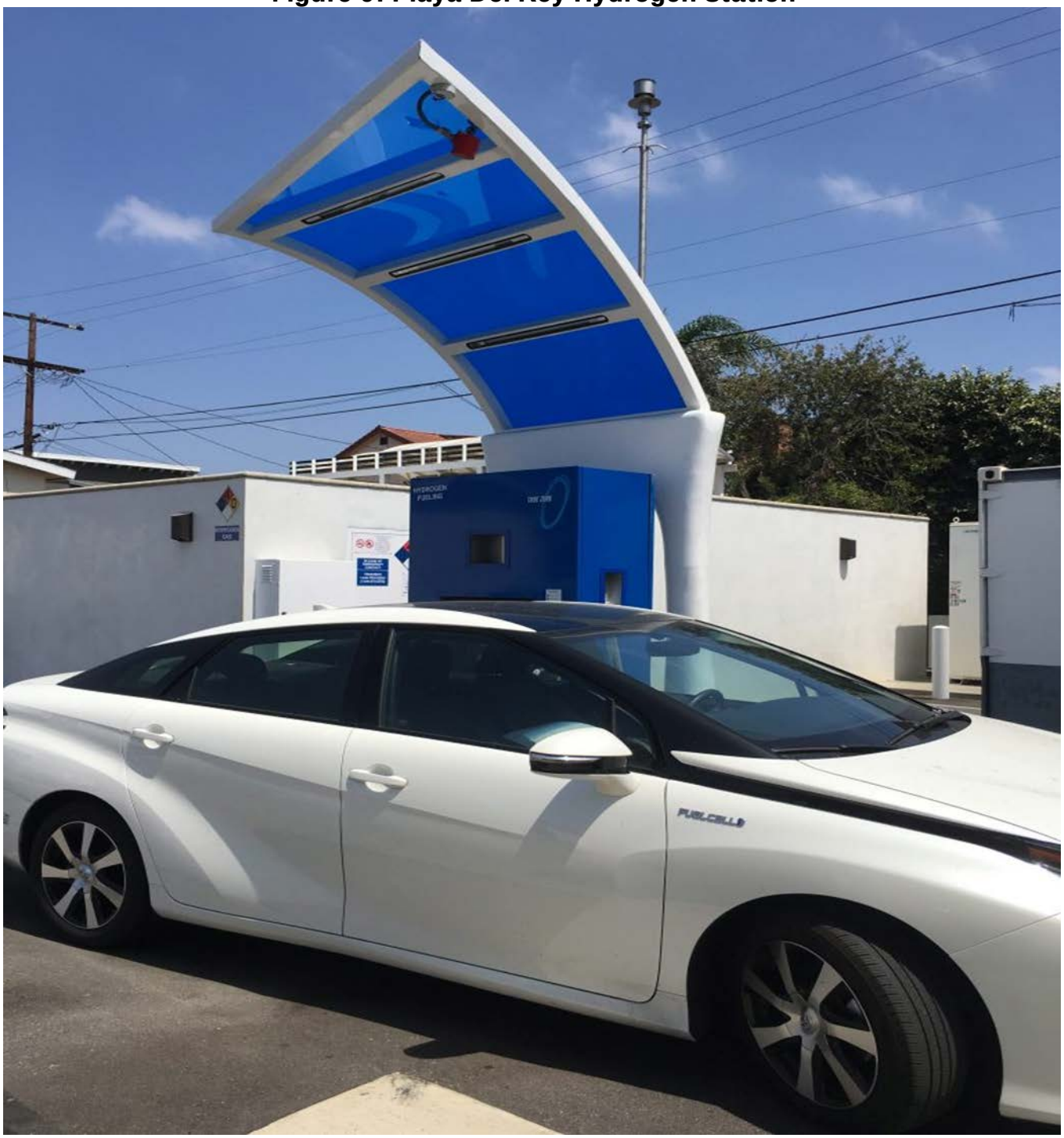
Minimal water was consumed for this project. There was no additional landscaping added for the construction of the hydrogen refueling station, and, therefore, no additional irrigation water will be consumed.

The station use will not cause any unsightly appearances, such as noise, glare, dust, or odor. The facility is a modern addition to an existing gasoline station. No outdoor sound amplification systems were installed; however, lighting was installed at the facility to aid in evening fueling.

Playa Del Rey Station in the Network

The station is open and active as shown in Figure 9.

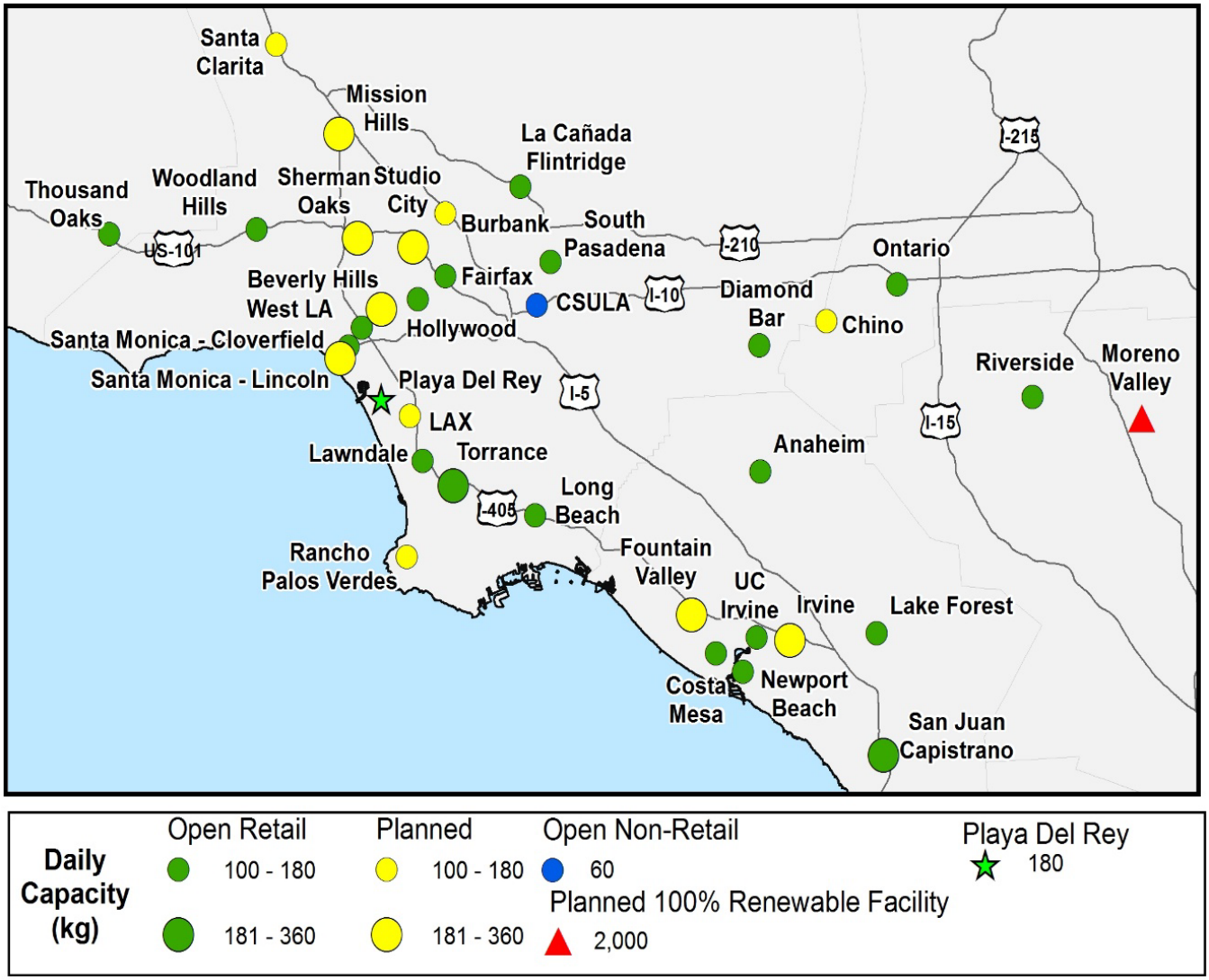
Figure 9: Playa Del Rey Hydrogen Station



Source: FirstElement Fuel, Inc.

Figure 10 shows the greater Los Angeles area map with the locations of the CTP funded stations which indicates where the Playa Del Rey station is situated in relationship to other facilities in the southern part of the state. The station services the heavy traffic that travels on California State route 1, northwest of the Los Angeles International Airport, known as LAX, and the bordering Pacific Ocean along Highway 1.

Figure 10: Hydrogen Stations in Southern California: Open Retail and Planned

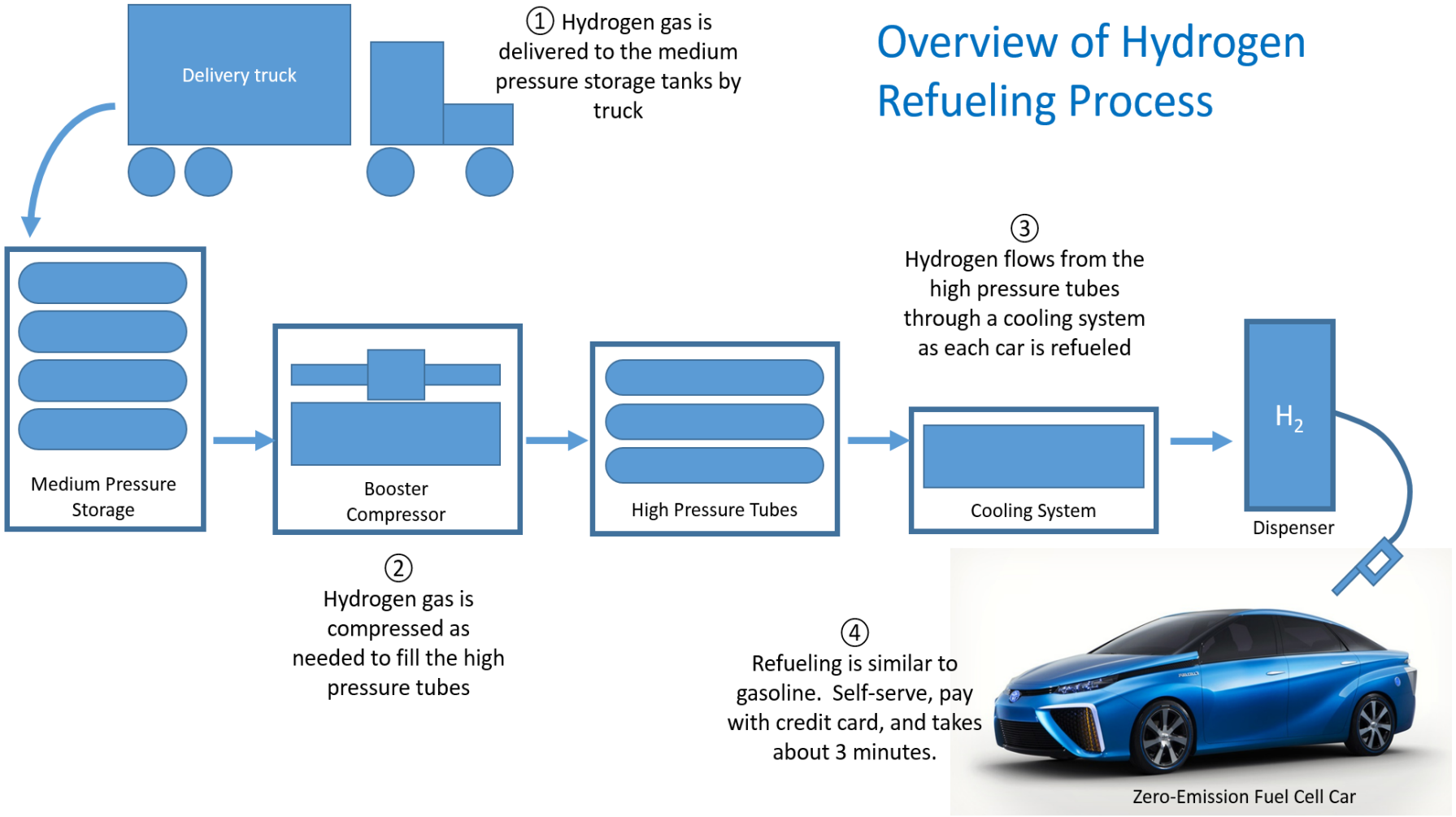


Source: CEC Staff

Schematic Layout of the Playa Del Rey Station

Figure 11 depicts an overview of the Playa Del Rey hydrogen station components and the steps involved in the refueling process.

Figure 11: Schematic Depicting Hydrogen Station Equipment and Refueling Process

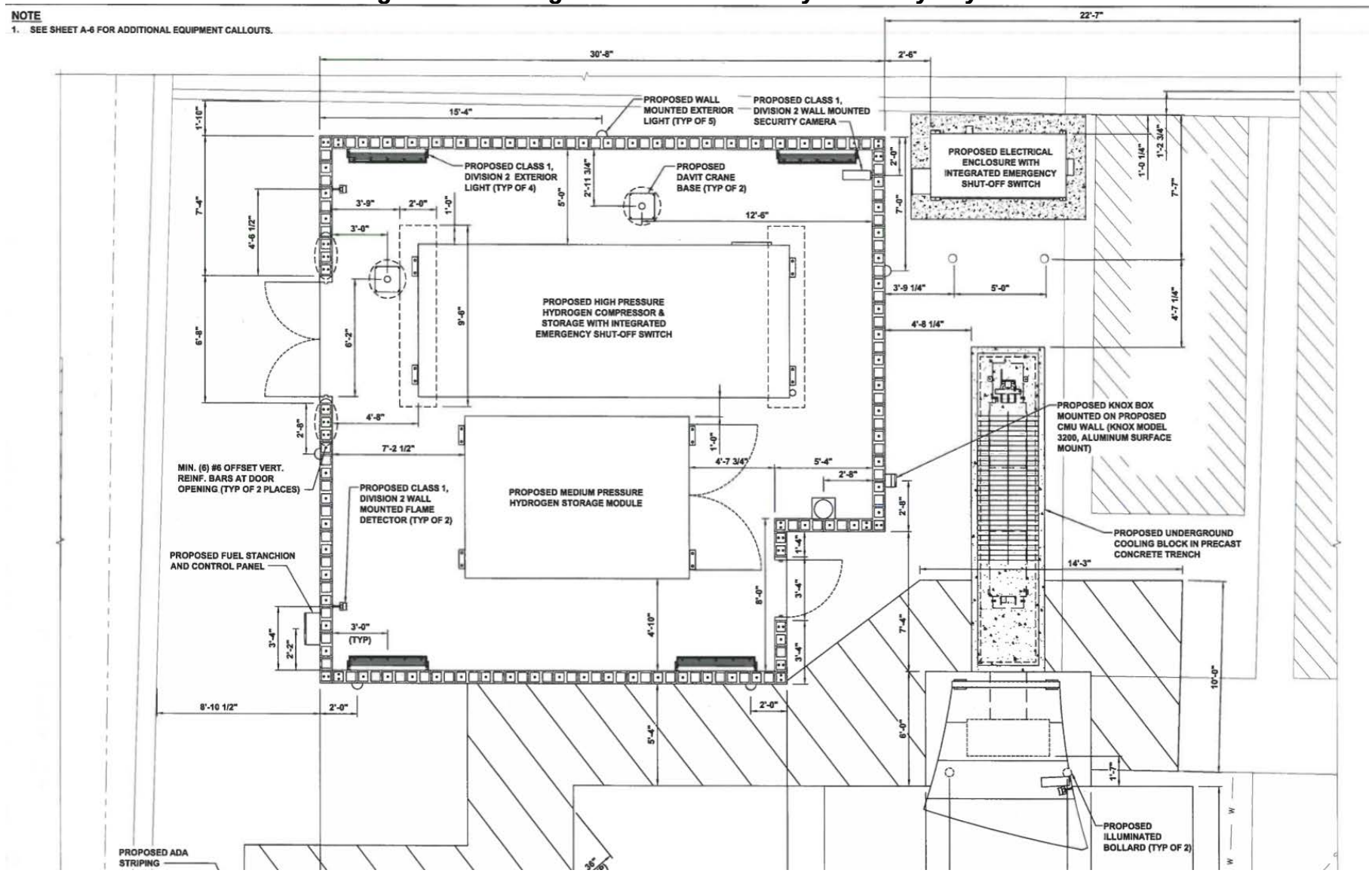


Source: FirstElement Fuel, Inc.

Final Configuration and Budget

Figure 12 shows a detailed view of the final, as-built configuration of the Playa Del Rey station.

Figure 12: Enlarged View of Final Playa Del Rey Layout



Source: FirstElement Fuel, Inc. Original figure is higher resolution

Figure 13 shows the budget to construct the Hayward hydrogen station.

Figure 13: The Project Grant Funding and Match Funding

Air Products and Chemicals, Inc., Allentown , PA	
H2 station equipment	$1,483,691.18
Black & Veatch, Overland Park, KS	
Construction	$542,708.64
Engineering	$69,054.77
Permitting	$24,929.62
Project Management	$20,910.62
Various Vendors	
Construction Materials (tubing, wire, etc.)	$56,896.29
Fixtures (doors, lights, etc.)	$79,070.67
MSI Tech, Irvine CA	
Data Collection Tool	$2,353.56
Karen Calhoun, Newport Beach, CA	
Legal services	$13,150.03
Vertical Advisors LLP, Newport Beach, CA	
Financial services	$4,345.13
Total Project Costs	$2,297,110.51
California Energy Commission Grant	$1,451,000.00
Remaining match funding provided by FirstElement Fuel, Inc.	$846,110.51
Total Energy Commission cost share	63.2%

Source: FirstElement Fuel, Inc.

CHAPTER 2:
Energy Analysis

The Playa Del Rey hydrogen refueling station is supplied by hydrogen generated via the Steam Methane Reformation process that converts methane (CH_4) and water (H_2O) to hydrogen (H_2) and carbon dioxide (CO_2):

$$CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$$

Per FirstElement Fuel, Inc.'s funding agreement with the CEC, 100 percent of the hydrogen sold at the Playa Del Rey hydrogen station will be produced from renewable sources. Hydrogen is supplied to the hydrogen fueling stations from Air Products and Chemicals, Inc.'s hydrogen production facilities in Wilmington/Carson, CA. Renewable biogas will be procured as feedstock for the facility, resulting in delivered hydrogen product that is 100 percent renewable (sources of biogas shown in figure 14).

Figure 14: Renewable Biomethane 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: FirstElement Fuel, Inc.

Air Products and Chemicals, Inc. currently has a contract for sourcing of the renewable biogas that meets Public Resources Code Section 2574(b)(1); documentation is provided in figure 15.

Figure 15: Biogas Supply Contract

SELF-GENERATION INCENTIVE PROGRAM

DIRECTED BIOGAS FUEL SUPPLIER

ATTESTATION

I, Shell Energy North America (US), L.P., hereby attest that Directed Biogas will be supplied to Air Products and Chemicals, Inc. by nomination and will comply with all applicable rules of the Self-Generation Incentive Program (SGIP) including but not limited to;

a) Contract will include term (minimum of 5 years), cost, amount of renewable fuel injected on a monthly basis for the length of the contract, address of renewable fuel facility, and facility address of Host Customer.

b) Documentation will be provided that shows that the third party gas provider can inject the renewable fuel into the natural gas pipeline.

c) The Renewable Fuel Supplier facility must produce fuel that meets the SGIP definition of renewable fuels.

d) The gas must be injected into a natural gas pipeline system that is either within the Western Electricity Coordinating Council (WECC) region or interconnected to a natural gas pipeline in the WECC region that delivers gas into California.

The undersigned understands that non-compliance to any SGIP requirements will be grounds for partial or complete incentive refund.

Shell Energy North America (US), L.P.

Signature: Edward E Beard

Name Printed: Edward Beard

Title: Vice President

Company Shell Energy North America (US), L.P.

Date: 3/21/2011

Source: FirstElement Fuel, Inc.

Although California has a substantial amount of biogas resources, local supply cannot be injected into California pipelines because of California Health and Safety Code Section 25420. Air Products and Chemicals, Inc.'s biogas supply for this project is being sourced outside of

California and transported to California with connection to a natural gas pipeline in the Western Electricity Coordinating Council region that delivers gas into California[3].

Hydrogen is delivered to all FirstElement Fuel, Inc. stations (including Playa Del Rey) by a Department of Transportation-certified high-pressure delivery trailer.

The Playa Del Rey hydrogen station is capable of dispensing 180 kilograms of hydrogen each day. Based on average hydrogen use by FCEVs, this station's dispensing capacity is enough to support up to 260 FCEVs, depending on driver habits. Assuming that FCEVs average 52 miles/1 kilograms of hydrogen C *the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model*,[4] and consumption of 180 kilograms/day for the next 10 years, the station will offset 12,025 metric tons of total greenhouse gas compared to equivalent gasoline vehicles.

Furthermore, the Playa Del Rey hydrogen station will eliminate over 1.54 million gallons of gasoline, assuming the 2013 national passenger fleet average fuel economy of 21.6 mpg.

As part of a separate grant agreement (ARV-17-031) for operations and maintenance funding through the CEC, data on the operation of the station will be collected and reported quarterly for three years (March 1, 2018 to February 28, 2021). Data collected and reported will include the fuel log, dispensing, compression, storage and delivery, maintenance, and other monthly operating costs such as rent, electricity, property tax, and license and permit fees.

3 The Western Electricity Coordinating Council promotes bulk electric system reliability in the Western Interconnection. (https://www.wecc.biz/Pages/AboutWECC.aspx)

4 GREET® Model (https://greet.es.anl.gov/)

CHAPTER 3:
Future Activities

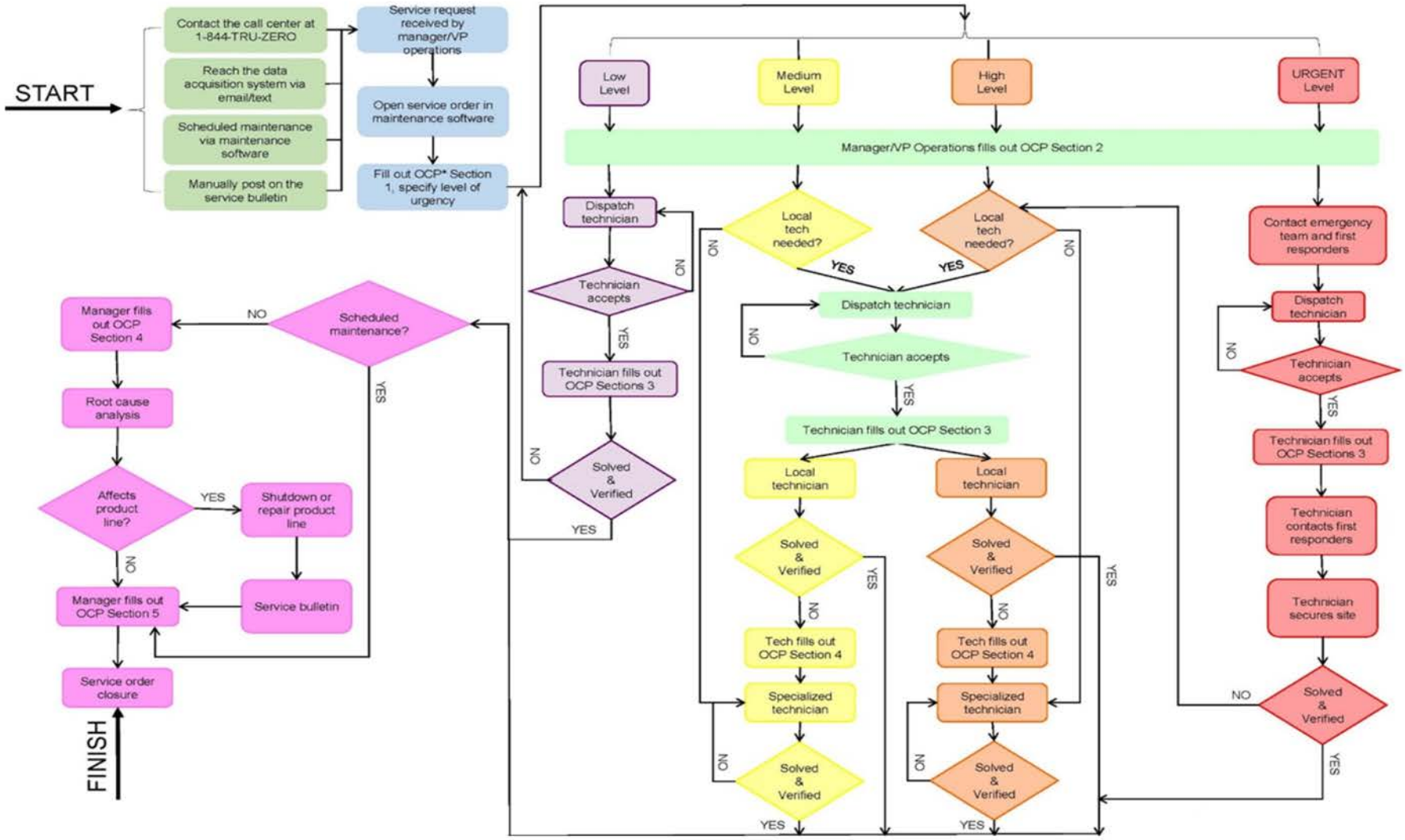
FirstElement Fuel, Inc. intends to own and operate the Playa Del Rey refueling station for at least 10 years. FirstElement Fuel, Inc. has invested substantial capital to build the station and will require many years of operation to recoup the development costs. FirstElement Fuel, Inc. has executed an initial 10-year lease with the landowner with the possibility for extension.

In addition, FirstElement Fuel, Inc. is building an in-house maintenance team that will have the personnel and equipment resources to maintain and repair any of our stations as quickly as possible throughout California. Figure 16 shows a flow diagram for response from the Operations and Maintenance team.

To augment onsite personnel across the FirstElement Fuel, Inc. network, a comprehensive data collection and monitoring system has been implemented. Figure 17 shows a screenshot of one page of the system. FirstElement Fuel, Inc. maintenance personal can access a breadth of real-time performance and sensor data, live video feeds, and historic usage data, and can control some features of the station remotely, 24 hours per day.

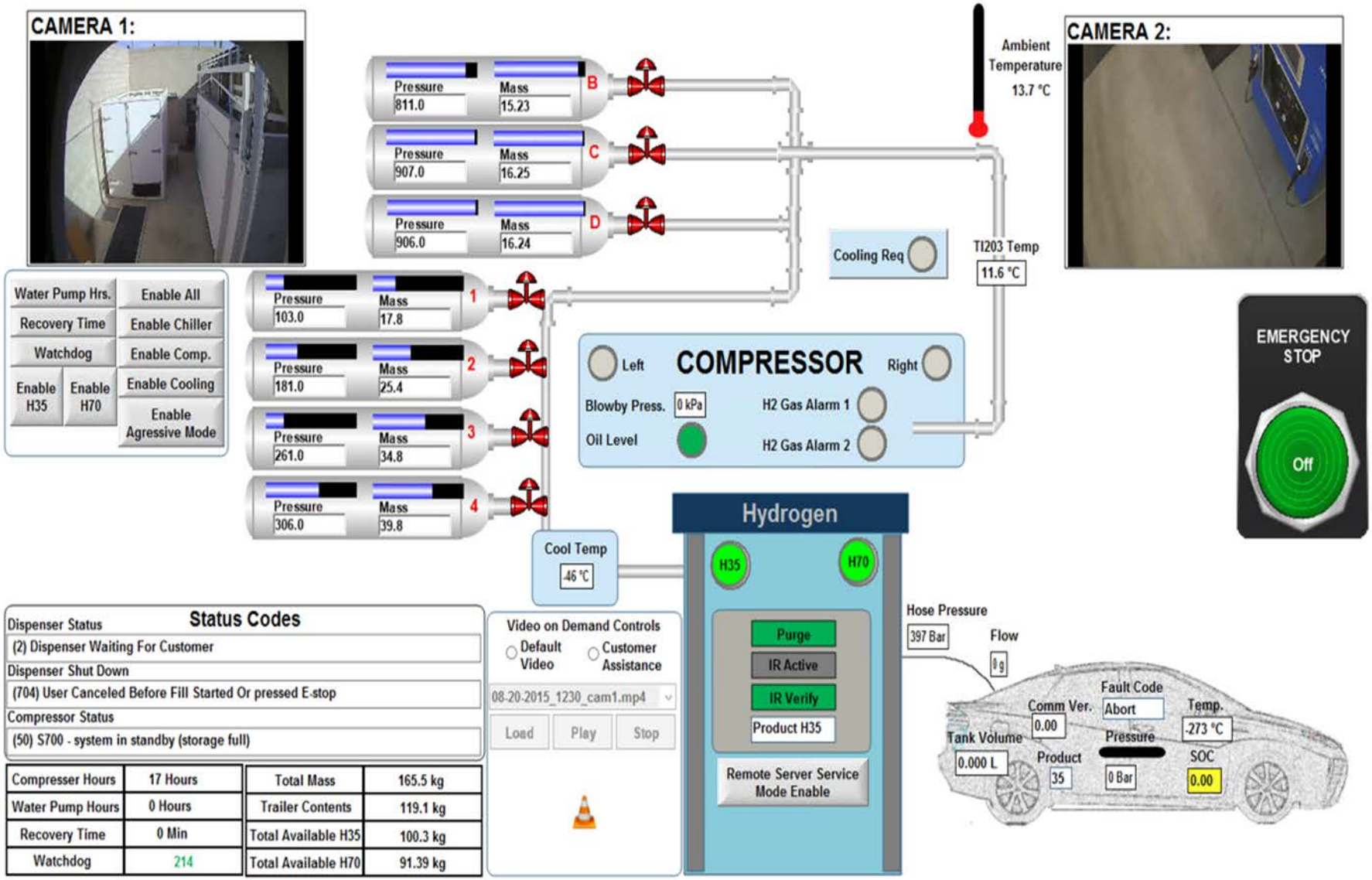
In addition to remote monitoring, FirstElement Fuel, Inc. has implemented rigorous Computerized Maintenance Management Systems and Enterprise Asset Management systems to schedule and track maintenance, repairs, and inventory. Work orders will be generated, completed, and logged for all maintenance and repair activities. This will help to maximize station up-time and enable tracking of key performance indicators.

Figure 16: FirstElement Fuel, Inc. Response Flow Chart



Source: FirstElement Fuel, Inc.

Figure 17: Screenshot of FirstElement Fuel, Inc.'s Remote Monitoring System



Source: FirstElement Fuel, Inc.

CHAPTER 4:
Conclusions

The following considers findings from the 100 percent renewable hydrogen Playa Del Rey hydrogen refueling station project.

Because the Playa Del Rey station is located within the jurisdiction of the City of Los Angeles, the zoning and permitting process was burdened by the size and complexity of the City's organization. There were no major hurdles in either planning or permitting, but the process still took significantly longer than in other, smaller, jurisdictions.

Pier foundations were used instead of a traditional slab foundation to mitigate storm water runoff issues. The design change incurred extra engineering costs, but saved substantial time in permitting.

National Fire Protection Association hydrogen technologies code is a critical tool for technical projects of this nature. The code clearly defines fire guidelines that enable local jurisdictions and contractors to uniformly construct hydrogen facilities and ensure safety. The key is for both station builders and station permit agencies to fully understand and appreciate the content of National Fire Protection Association hydrogen technologies code.

GLOSSARY

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 Energy Commission'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.

CARBON DIOXIDE (CO2) - A colorless, odorless, non-poisonous gas that is a normal part of the air. Carbon dioxide is exhaled by humans and animals and is absorbed by green growing things and by the sea. CO2 is the greenhouse gas whose concentration is being most affected directly by human activities. CO2 also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

CLEAN TRANSPORTATION PROGRAM (formerly known as the ALTERNATIVE AND RENEWABLE FUELS AND VEHICLE TECHNOLOGY PROGRAM) - Created by Assembly Bill 118 (Nunez, Chapter 750, Statutes of 2007), the program with an annual budget of about $100 million supports projects that develop and improve alternative and renewable low-carbon fuels, improve alternative and renewable fuels for existing and develop engine technologies, expand transit and transportation infrastructures, and establish workforce training programs, conduct public education and promotion, and create technology centers, among other tasks.

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.

GREENHOUSE GASES (GHG) – Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

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

METHANE (CH4) - 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, enteric fermentation in animals and is one of the greenhouse gases.