CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

La Cañada Flintridge Hydrogen Station

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

Gavin Newsom, Governor

November 2019 | CEC-600-2019-047

California Energy Commission

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ACKNOWLEDGEMENTS

The construction of the La Cañada Flintridge hydrogen refueling station has been possible only because of the substantial efforts and funds provided by several 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 CEC 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 550 Foothill Blvd., La Cañada Flintridge (Los Angeles County). 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., hydrogen refueling station, hydrogen infrastructure, fuel cell electric vehicles, La Cañada Flintridge

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TABLE OF CONTENTS

Page

Acknowledgements i
Preface ii
Abstract iii
Table of Contents v
Executive Summary 1
CHAPTER 1: Station Design and Construction 3
Site Acquisition (Fall 2013-December 2015) 3
Making the Station Operational (November 16, 2015–December 9, 2015) 9
Station Declared Operational (December 10, 2015) 10
Certification (January 20, 2016) 12
Station Use (December 10, 2015-Present) 13
Station Operational Status System 13
Environmental Impacts 14
La Cañada Flintridge Station in the Network 14
Schematic Layout of the La Cañada Flintridge Station 17
Final Station Configuration and Budget 17
CHAPTER 2: Energy Analysis 20
CHAPTER 3: Future Activities 23
CHAPTER 4: Conclusions 26
GLOSSARY 27

LIST OF FIGURES

Page

Figure 1: Coarse Detail of Equipment Compound from Construction Drawing 30 Set 4
Figure 2: Survey of La Cañada Flintridge Hydrogen Station Location 5
Figure 3: Zoning Section of the Construction Drawing 30 Set 6
Figure 4: Equipment Compound from Construction Drawing 30 Set 7
Figure 5: Station Equipment Compound before Station Completion 8
Figure 6: Equipment Placement for the La Cañada Flintridge Station 9
Figure 7: Storage Tanks at Full Pressure during Commissioning 10
Figure 8: Hydrogen Fuel Quality Report on December 1, 2015 11
Figure 9: Certification Activity at La Cañada Flintridge Hydrogen Station 12
Figure 10: First Fueling at the La Cañada Flintridge Hydrogen Station 13
Figure 11: La Cañada Flintridge Hydrogen Station 15
Figure 12: Hydrogen Stations in Southern California: Open Retail and Planned 16

Figure 13: Schematic Depicting Hydrogen Station Equipment and Refueling Process 17
Figure 14: Enlarged View of Final La Cañada Flintridge Layout.....18
Figure 15: The Project Grant Funding and Match Funding 19
Figure 16: Biogas Supply Contract.....21
Figure 17: FirstElement Fuel, Inc. Response Flow Chart 24
Figure 18: Screenshot of FirstElement Fuel, Inc.'s Remote Monitoring System 25

LIST OF TABLES

Page

Table 1: Renewable Biomethane Supply Sources 20

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 CEC, FirstElement Fuel, Inc. was awarded funding for 19 stations. The CEC contributed $1,451,000 of the total $2,199,074 cost to design, engineer, permit, construct, and commission the station.

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 550 Foothill Blvd., La Cañada Flintridge (Los Angeles County). 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 La Cañada Flintridge was excited to bring a clean, alternative fuel to his station. FirstElement Fuel, Inc. and the La Cañada Flintridge owner executed a lease February 24, 2015.

FirstElement Fuel, Inc. developed the site configuration and design, and engineering firm Black & Veatch performed the detailed engineering design. The zoning process in La Cañada Flintridge required two public hearings, and approval was granted April 29, 2015. Because of the consistent look of the La Cañada Flintridge mountain community, aesthetics were an important part of the final design. Much back-and-forth with local planners and design boards led to a final station design.

Permits for zoning, building, mechanical, electrical, plumbing, and fire were filed on May 29, 2015 and finalized on August 20, 2015, for 83 days.

FirstElement Fuel, Inc. purchased hydrogen refueling station equipment from Air Products and Chemicals, Inc., and the remainder of materials came from a variety of general and specialty vendors. Vantage Company from Orange (Orange County) was selected as the contractor for

the project because of its relatively low bid, excellent safety record, good standing with Black & Veatch, and willingness to work with FirstElement Fuel, Inc. on multiple projects. Construction began September 17, 2015, and was completed December 15, 2015.

The process of making the station operational began on November 16, 2015, and was completed on December 9, 2015. The FirstElement Fuel, Inc. team performed all the commissioning tasks, including cleaning, purging, pressure testing and final startup.

CHAPTER 1:
Station Design and Construction

There were many steps required to bring the La Cañada Flintridge 33 percent renewable hydrogen refueling station project to completion. The following synopsis highlights the most critical items.

Site Acquisition (Fall 2013-December 2015)

Beginning in the fall of 2013, FirstElement Fuel, Inc. took steps to identify and acquire appropriate sites for the station. FirstElement Fuel, Inc. worked with historical vehicle sales data, academic publications, automakers, and the station location areas in PON-13-607 to select the La Cañada Flintridge location. FirstElement Fuel, Inc. executed a letter of intent with the property owner on February 5, 2014. A binding 10-year-lease was later executed on February 24, 2015.

FirstElement Fuel, Inc. then selected Air Products and Chemicals, Inc. equipment because of the cost, capacity, reliability, and more mature supply chain as compared to other suppliers as detail in the FirstElement Fuel, Inc. PON 13-607 application. FirstElement Fuel, Inc. executed a contract with Air Products and Chemicals, Inc. for the equipment September 16, 2014, and equipment was delivered to the site October 14, 2015.

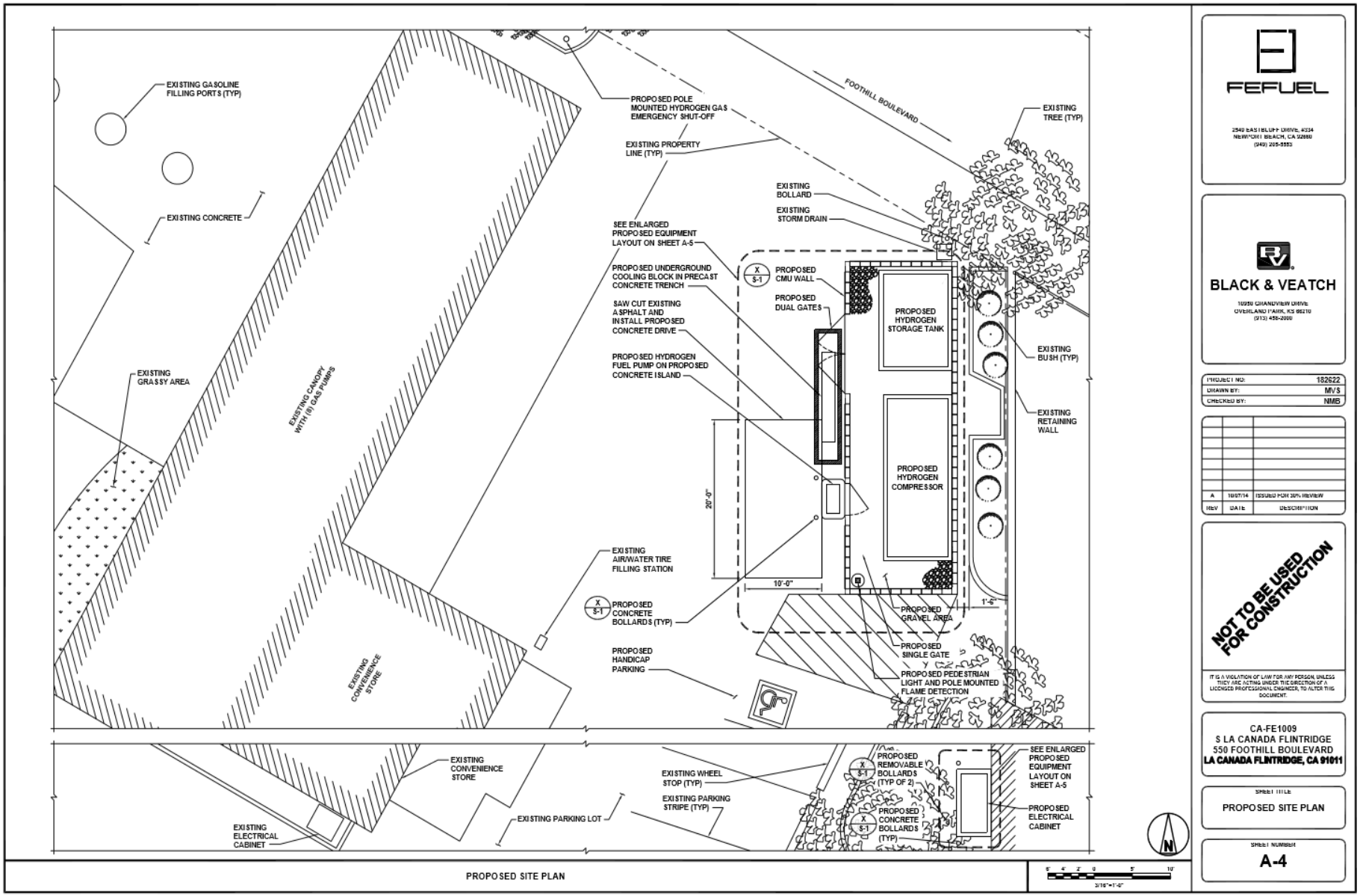
FirstElement Fuel, Inc. and Black & Veatch surveyed the La Cañada Flintridge site and began the layout August 11, 2014. They generated initial engineering drawings on November 12, 2014. These drawings are referred to as “construction drawing 30s” because they represent 30 percent complete construction 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 24, 2014, surveying firm Clark Land Surveying, Inc. performed a detailed engineering survey for the La Cañada Flintridge station site, as shown in Figure 2.

On July 31, 2015, zoning drawings were also generated that provide an accurate but relatively high-level depiction of the project (Figure 3) for review by planners at the City of La Cañada Flintridge. These drawings are signed and sealed by the professional engineer of record to ensure accuracy and completeness.

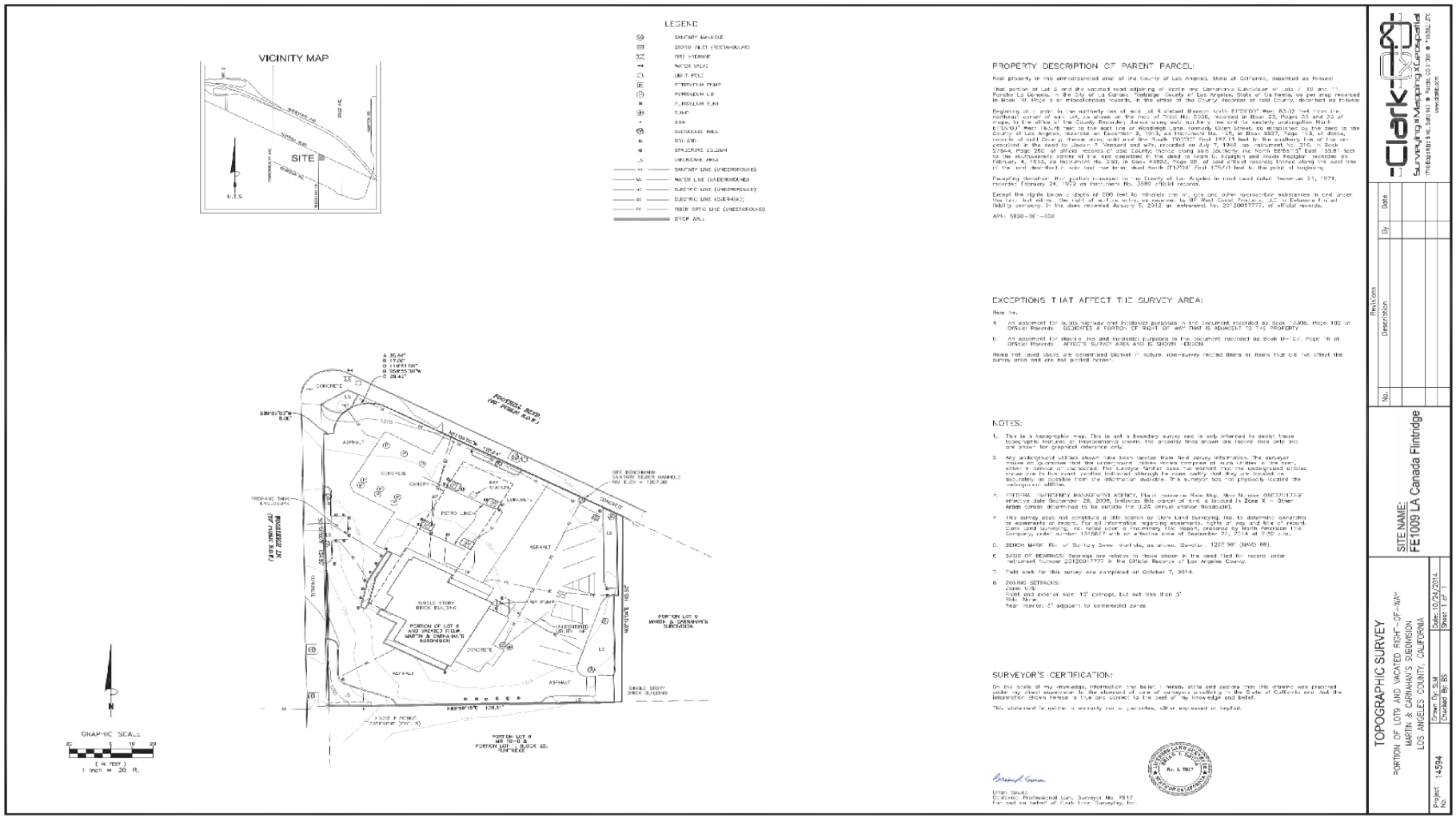
On May 14, 2015, draft final construction drawings (“construction drawing 90s”) were completed that depict all the details required for construction and the permit review. Final construction drawings (“construction drawing 100s”) were complete with all the details required for both the construction and the permit review on August 12, 2015. The equipment compound page of the construction drawing 100 set is shown in Figure 4.

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



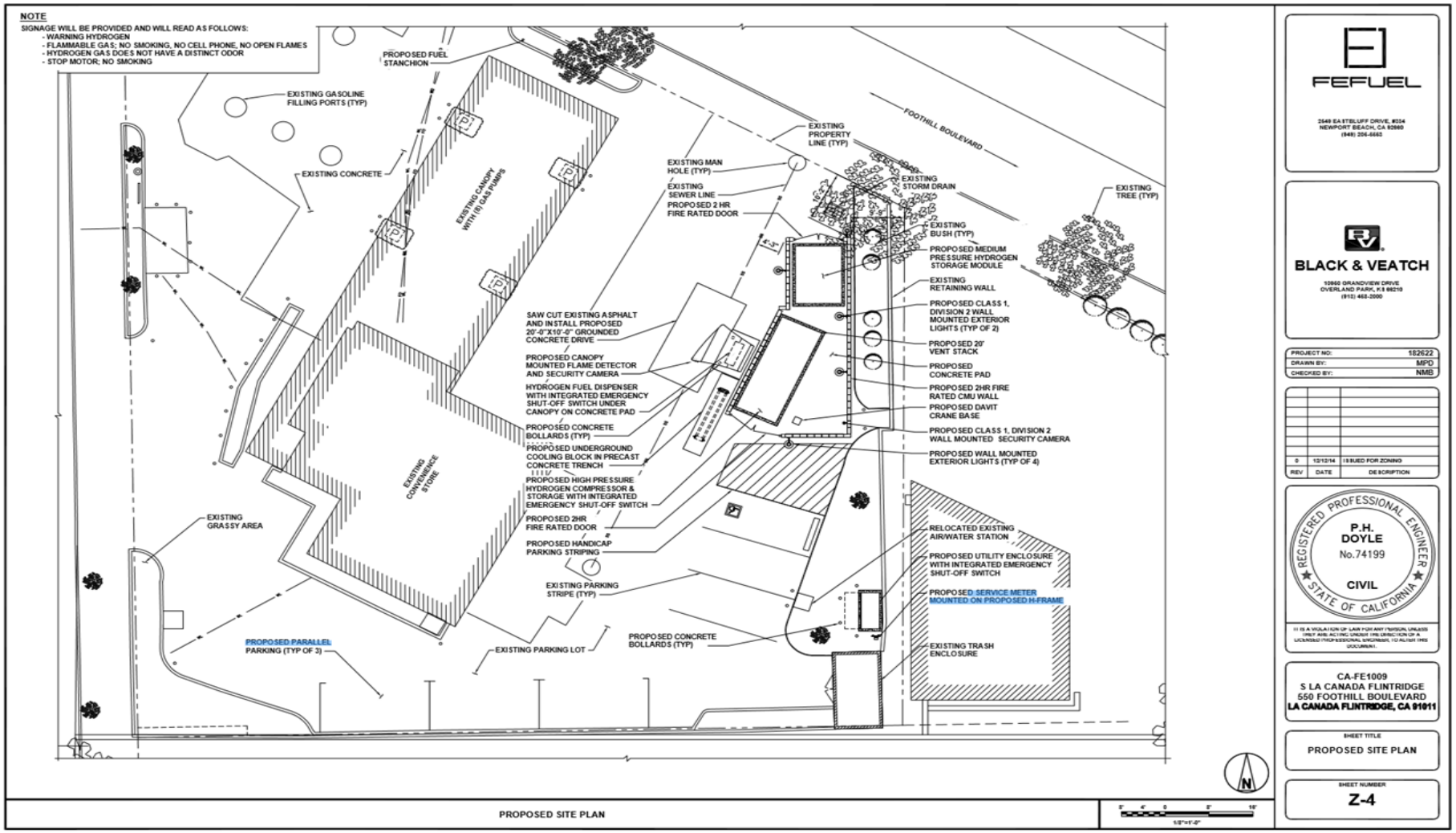
Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 2: Survey of La Cañada Flintridge Hydrogen Station Location



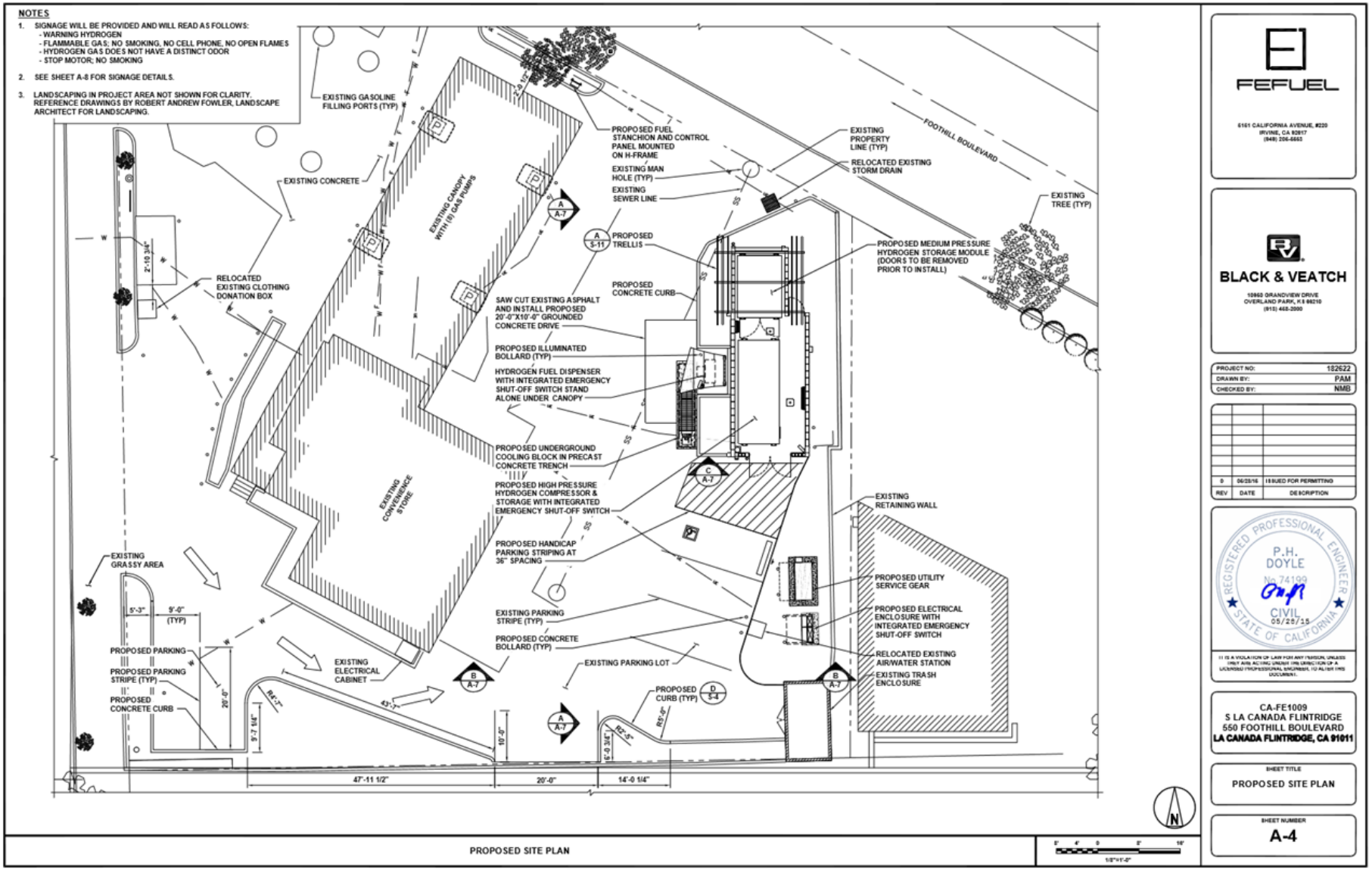
Source: FirstElement Fuel, Inc. original figure is in higher resolution.

Figure 3: Zoning Section of the Construction Drawing 30 Set



Source: FirstElement Fuel, Inc. original figure is in higher resolution.

Figure 4: Equipment Compound from Construction Drawing 30 Set



Source: FirstElement Fuel, Inc. Original figure is in high resolution

FirstElement Fuel, Inc. and Black & Veatch submittedthe zoning application to the City of La Cañada Flintridge on December 16, 2014. The local planning department verified that the project would need to meet the zoning requirements of the proposed location and approve any of the aesthetic, landscaping or other details important to the community. Because of the consistent look of the La Cañada Flintridge mountain community, aesthetics were an important part of the final design. Through careful deliberation with local planners and design boards, a final station design emerged that was ultimately a natural evolution of the original design. Design approval was received through a public hearing on April 29, 2015.

All building permit applications were submitted May 29, 2015, and approved August 20, 2015, a span of 83 days.

FirstElement Fuel, Inc. and Black & Veatch submitted a detailed bid package to contractors September 2, 2015. The contract was awarded to Vantage Company on September 4, 2015. The bulk of Vantage's construction experience is in cell towers. The rationale for choosing Vantage was because cell towers are roughly similar to hydrogen stations in size, have similar foundations and block walls, and have similar electrical requirements. Vantage provided a reasonable bid, had a desire to get involved with hydrogen projects, and is based in Southern California. Construction started September 17, 2015. Figure 5 shows the equipment compound during construction.

Figure 3: Station Equipment Compound before Station Completion

Source: FirstElement Fuel, Inc.

Hydrogen storage, compression (Figure 6), cooling, and dispensing equipment was delivered to the site October 14, 2015.

Figure 4: Equipment Placement for the La Cañada Flintridge Station

Source: FirstElement Fuel, Inc.

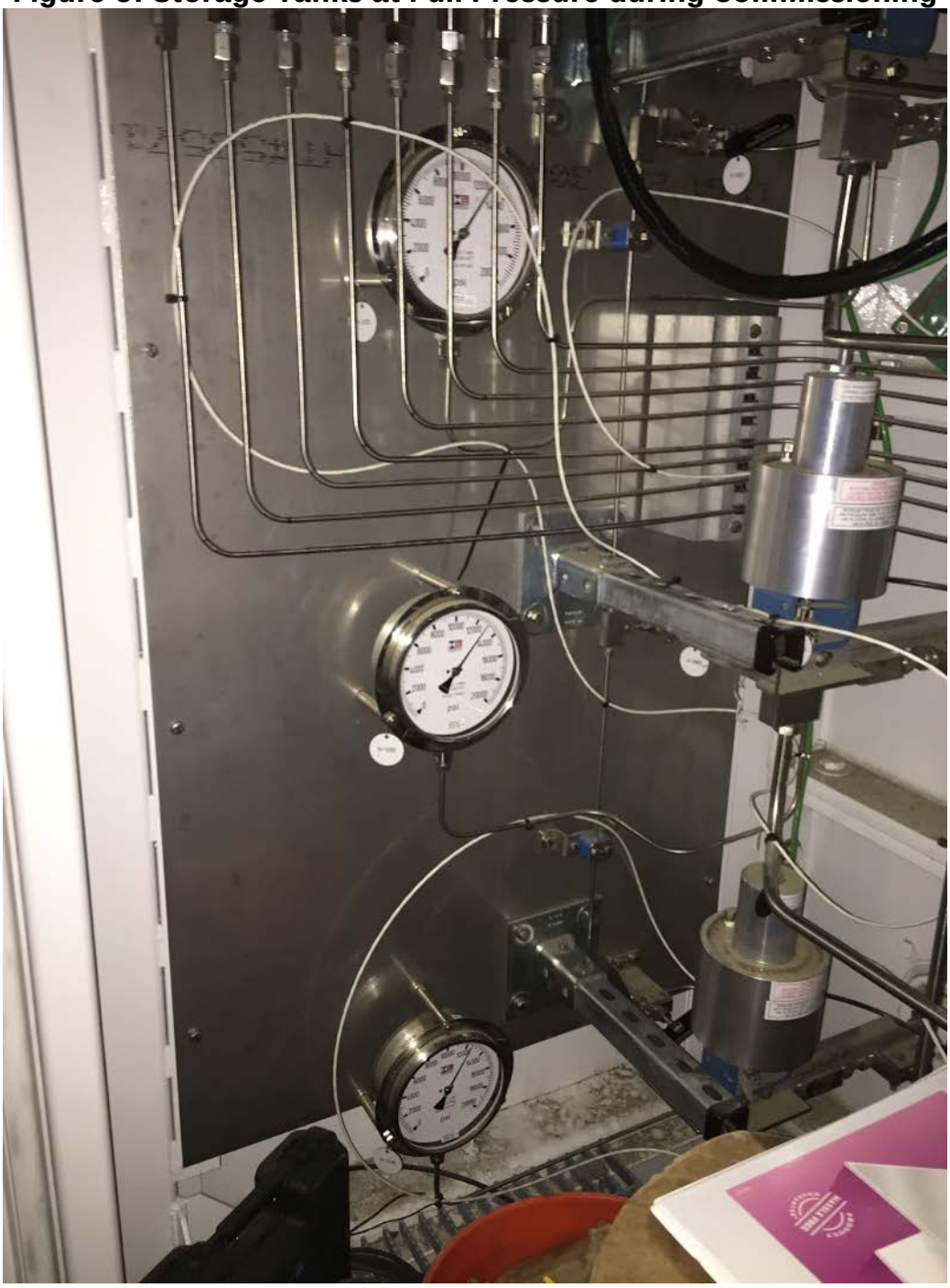
The La Cañada Flintridge hydrogen refueling station construction was completed December 15, 2015.

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.

Making the Station Operational (November 16, 2015–December 9, 2015)

The commissioning of the La Cañada Flintridge hydrogen station included the cleaning and purging of lines, pressure testing, and hydrogen sampling. Figure 7 shows pressure testing.

Figure 5: Storage Tanks at Full Pressure during Commissioning



Source: FirstElement Fuel, Inc.

Station Declared Operational (December 10, 2015)

The La Cañada Flintridge hydrogen station met the PON-13-607 definition of operational by completing installation of all station/dispenser components, obtaining all the required permits from the local jurisdiction, filling the storage tubes of the station with pressurized hydrogen gas, passing a hydrogen quality test (Figure 8), successfully fueling one FCEV with hydrogen,

and opening to the public. FirstElement Fuel, Inc. declared the station operational December 10, 2015.

Figure 6: Hydrogen Fuel Quality Report on December 1, 2015

www.SmartChemistry.com

FIRST ELEMENT
LA CANADA
FLINTRIDGE H70

SAE J2719 Report

H_2 @Nozzle

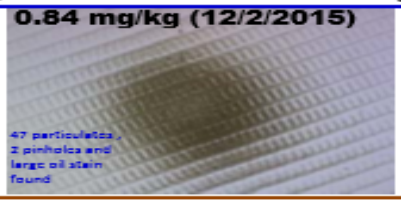
sampled on 12/01/2015

Concentration (µmol/mol)

	SAE J2719 Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)		Analytical Method
Water	5	1	< 1	
Total Hydrocarbons (C_1 Basis)	2	1	**0.089**	ASTM D7892
Methane		0.001	0.042	
Acetone			0.015	
Ethane			0.026	
Ethanol			0.0054	
Oxygen	5	1	< 1	ASTM D7649
Helium	300	10	**49**	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		2	**2.4**	ASTM D7649
Argon		0.5	**1.2**	ASTM D7649
Carbon Dioxide	2	0.5	< 0.5	ASTM D7649
Carbon Monoxide	0.2	0.0005	**0.0011**	ASTM D5466
Total Sulfur	0.004	0.000001	**0.000014**	ASTM D7652
Hydrogen Sulfide		0.000001	0.0000020	ASTM D7652
Carbonyl Sulfide		0.000001	0.0000049	ASTM D7652
Methyl Mercaptan (MTM)		0.00001	< 0.00001	ASTM D7652
Ethyl Mercaptan (ETM)		0.00002	< 0.00002	ASTM D7652
Dimethyl Sulfide (DMS)		0.00002	< 0.00002	ASTM D7652
Carbon Disulfide		0.000005	0.0000071	ASTM D7652
Isopropyl Mercaptan (IPM)		0.00002	< 0.00002	ASTM D7652
Tert-Butyl Mercaptan (TBM)		0.00002	< 0.00002	ASTM D7652
n-Propyl Mercaptan		0.00002	< 0.00002	ASTM D7652
n-Butyl Mercaptan		0.00002	< 0.00002	ASTM D7652
Tetrahydrothiophene (THT)		0.00002	< 0.00002	ASTM D7652
Formaldehyde	0.01	0.001	< 0.001	ASTM D7892
Formic Acid	0.2	0.001	< 0.001	ASTM D5466
Ammonia	0.1	0.005	< 0.005	ASTM D5466
Total halogenates	0.05		**0.0017**	
Chlorine		0.0005	< 0.0005	ASTM D5466
Hydrogen Chloride		0.007	< 0.007	ASTM D5466
Hydrogen Bromide		0.003	< 0.003	ASTM D5466
Organic Halides (32 compounds in red and bold listed in "Other Hydrocarbons"). Smart Chemistry limit is for each individual organic halide.		0.001	0.0017	ASTM D7892
Tetrachloro-hexafluorobutanes			0.0017	

Particulate Concentration - ASTM D7651 (Particulate Concentration Calculation Sheet is listed in Table II)

Particulates Found & Size - ASTM D7634 (Images of particulates found on 12/2 & 10/2015 is are Table I and II, respectively.)



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)

99.99470%

SMART CHEMISTRY, 3401 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, jphau@smartchemistry.com

Source: FirstElement Fuel, Inc.

Automaker testing was performed at the La Cañada Flintridge hydrogen station to verify correct operation per SAE J2601 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles.

Certification (January 20, 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 of the La Cañada Flintridge station by acting as the registered service agent, dispensing a measured amount of fuel, and confirming the quantity dispensed was accurately reflected by the dispenser in accordance with examination procedures (EPO NO. 40-A).[1] The local county weights and measures officer witnessed the certification activity. Figure 9 shows the technician working on the certification.

Figure 7: Certification Activity at La Cañada Flintridge Hydrogen Station

Source: FirstElement Fuel, Inc.

1 Hydrogen Examination Procedures (https://www.cdfa.ca.gov/dms/programs/devices/Hydrogen_Gas-Measuring_Devices_EPO-40.pf)

Station Use (December 10, 2015-Present)

Figure 10 shows the first vehicle using the station, a Hyundai Tucson, on December 10, 2015. The La Cañada Flintridge station dispensed 10.2 kilograms of hydrogen in December 2015. Sales were 166.3 kilograms in January 2016, 181.7 kilograms in February 2016, and 305.2 in March 2016.

Figure 8: First Fueling at the La Cañada Flintridge 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 development of the hydrogen refueling station network because it lets drivers know that the hydrogen station they intend to use is operational before they depart.

2 California Fuel Cell Partnership (https://m.cafcp.org/)

The La Cañada Flintridge hydrogen station began sending automated updates using FirstElement Fuel, Inc. software regularly to the Station Operational Status System on January 25, 2016.

Environmental Impacts

Hydrogen will be stored as a compressed gas in an aboveground tank behind a wall at the La Cañada Flintridge station. In accordance with the funding agreement with the CEC, 33.3 percent of the hydrogen sold at the La Cañada hydrogen station will be produced from renewable sources, including biogas. Hydrogen is nontoxic, colorless, and odorless, so hydrogen station equipment is outfitted with appropriate sensors to provide immediate notification in case that a leak occurs. No solid or liquid waste will be produced at this site.

Minimal water was consumed for this project. Additional landscaping was added for the construction of the hydrogen refueling station that matches surrounding native species.

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

La Cañada Flintridge Station in the Network

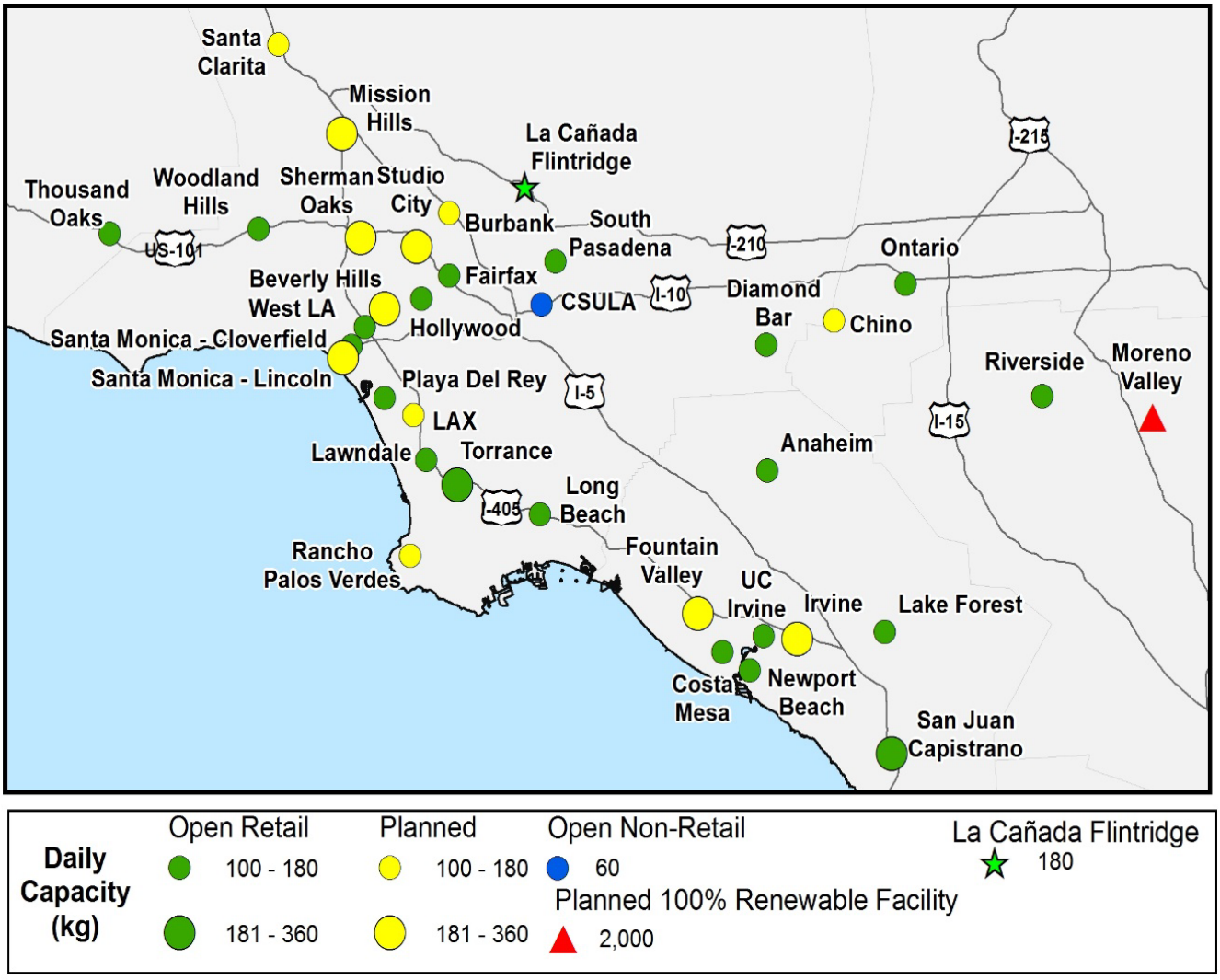
Figure 11 shows the station is open and active.

Figure 9: La Cañada Flintridge Hydrogen Station

Source: FirstElement Fuel, Inc.

Figure 12 shows the greater Los Angeles area map that indicates where the La Cañada Flintridge Station is situated in relation to other stations in the southern part of the state. This station is near the 210 freeway.

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

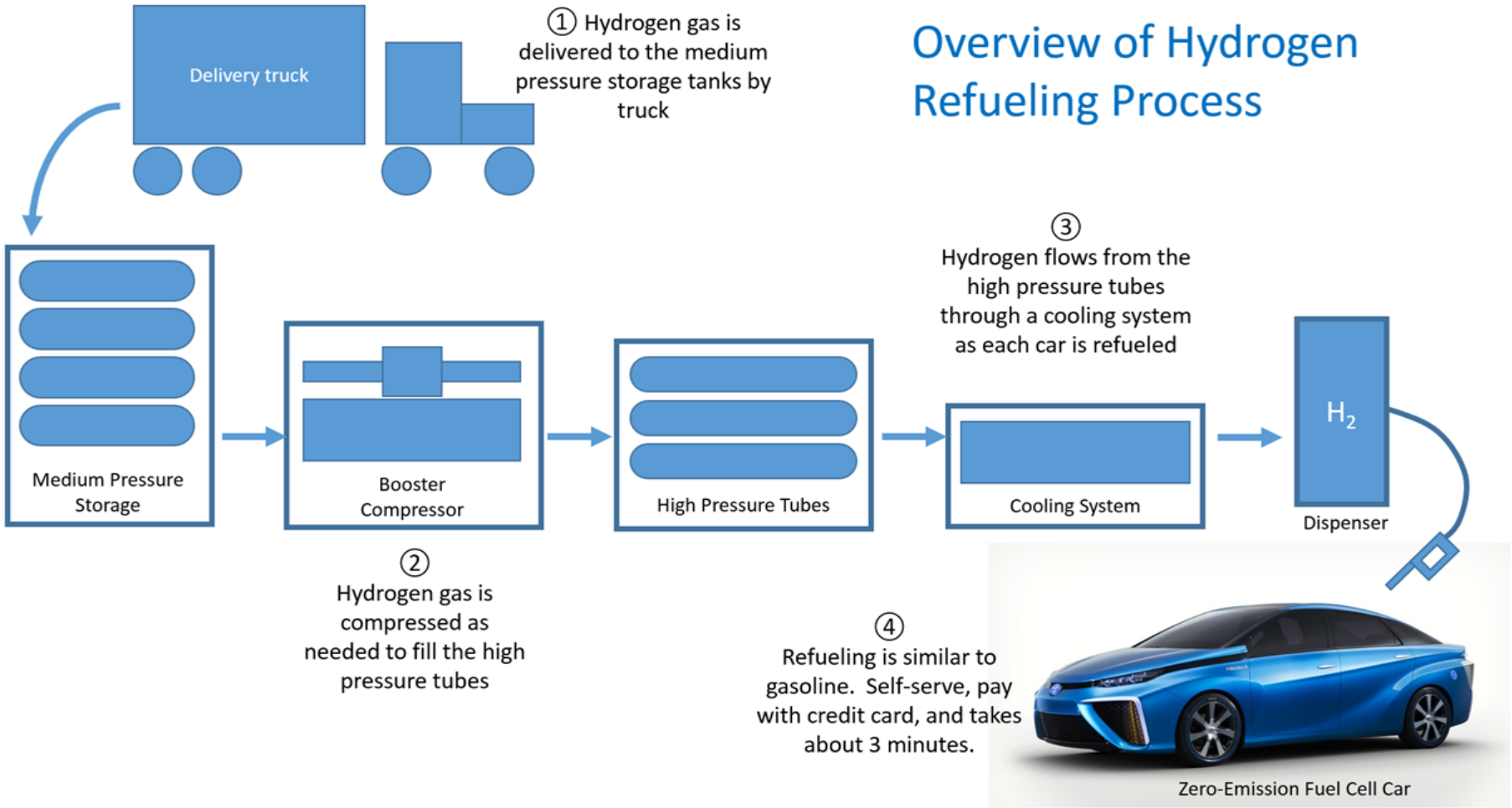


Source: CEC staff

Schematic Layout of the La Cañada Flintridge Station

Figure 13 depicts an overview of the La Cañada Flintridge hydrogen station components and the steps in the refueling process.

Figure 11: Schematic Depicting Hydrogen Station Equipment and Refueling Process

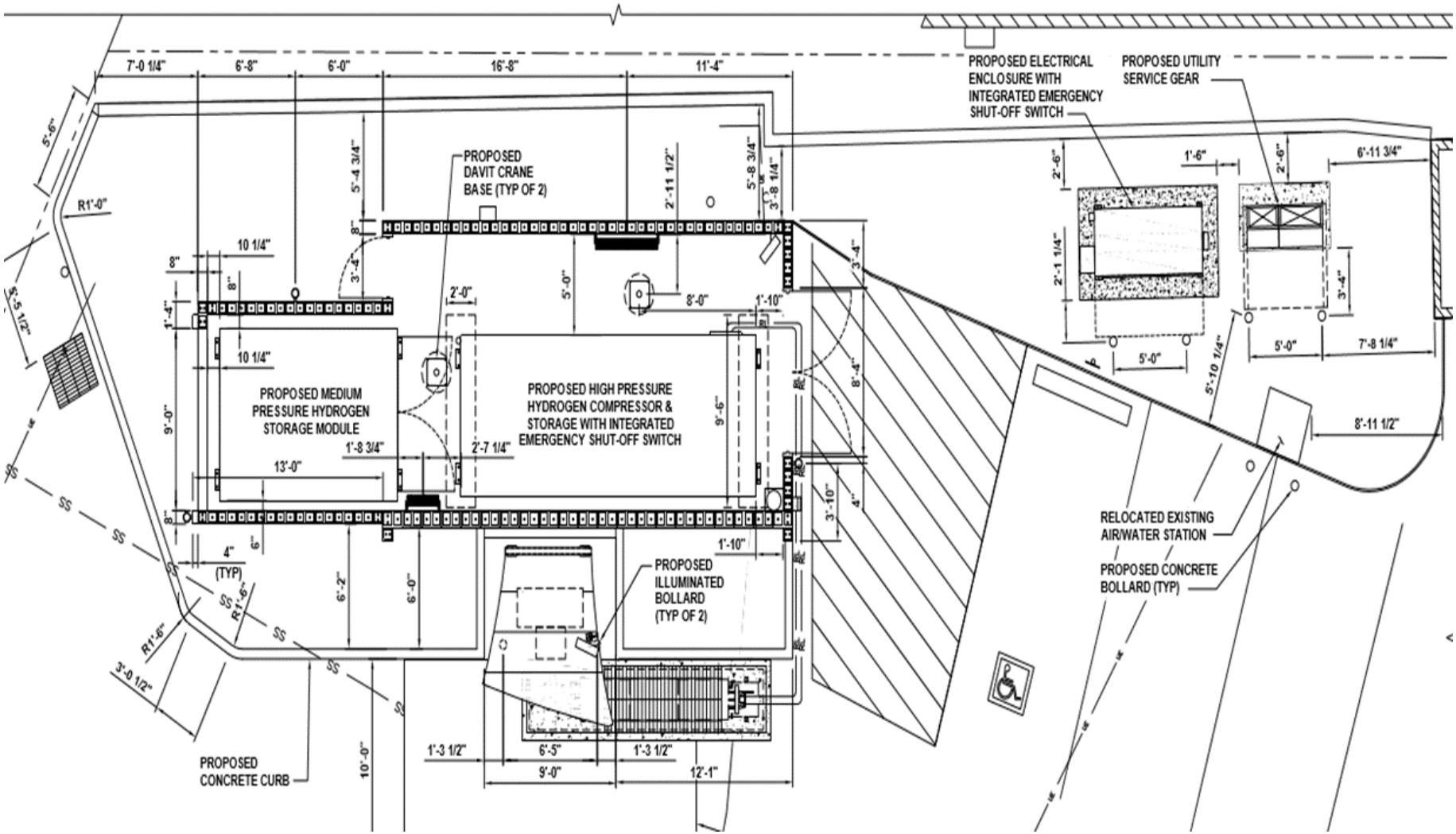


Source: FirstElement Fuel, Inc.

Final Station Configuration and Budget

Figure 14 shows a detailed view of the actual final, as-built configuration of the La Cañada Flintridge station.

Figure 12: Enlarged View of Final La Cañada Flintridge Layout



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

Figure 15 shows a detailed view of the budget to construct the La Cañada Flintridge hydrogen station.

Figure 13: The Project Grant Funding and Match Funding

Air Products and Chemicals, Inc., Allentown, PA	
H2 station equipment	$1,480,192.21
Black & Veatch, Overland Park, KS	
Construction	$463,358.02
Engineering	$56,050.95
Permitting	$64,046.86
Project Management	$18,197.53
Various Vendors	
Construction Materials (tubing, wire, etc.)	$15,931.41
Fixtures (doors, lights, etc.)	$80,220.52
MSI Tech, Irvine CA	
Data Collection Tool	$3,582.23
Karen Calhoun, Newport Beach, CA	
Legal services	$13,150.03
Vertical Advisors LLP, Newport Beach, CA	
Financial services	$4,345.13
Total Project Costs	$2,199,074.89
California Energy Commission grant	$1,451,000.00
Remaining match funding provided by FirstElement Fuel, Inc.	$748,074.89
Total California Energy Commission cost share	66.0%

Source: FirstElement Fuel, Inc.

CHAPTER 2:
Energy Analysis

The La Cañada Flintridge hydrogen refueling station is supplied by hydrogen generated via steam methane reformation that converts methane (CH_4) and water (H_2O) to hydrogen (H_2) and carbon dioxide (CO_2):

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

According to California Senate Bill 1505 (Lowenthal, Chapter 877, Statutes of 2006), Environmental Standards for Hydrogen Production, at least one-third of the hydrogen sold at the La Cañada Flintridge refueling stations must be produced from renewable sources. Hydrogen is supplied to the hydrogen refueling station from Air Products and Chemicals, Inc.'s production facilities in Wilmington/Carson (Los Angeles County), where renewable biogas will be from feedstock resulting in 33.3 percent renewable hydrogen product that meets the requirements of PON-13-607 and the 33.3 percent renewable hydrogen requirements of Senate Bill 1505. Table 1 shows the biogas sources for the La Cañada Flintridge station.

Table 1: 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. has a contract for sourcing of the renewable biogas that meets Public Resources Code Section 2574(b) (1); documentation is provided in Figure 16. Air Products and Chemicals, Inc.'s biogas supply for this project comes from outside California and is transported to California with connection to a natural gas pipeline in the Western Electricity Coordinating Council region that delivers gas into California.[3]

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

Figure 14: 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.

Hydrogen is delivered to the La Cañada Flintridge station by a California- and U.S. Department of Transportation-certified high-pressure delivery trailer.

The La Cañada Flintridge hydrogen station can dispense 180 kilograms/day. Based on average hydrogen use by FCEVs, the dispensing capacity of this station is enough to support up to 260 FCEVs, depending on driver habits. Assuming that FCEVs average 52 miles/kilogram of hydrogen according to *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 about 8,400 metric tons of total GHGs compared to equivalent gasoline vehicles. The La Cañada Flintridge hydrogen station will eliminate more than 1.54 million gallons of gasoline, assuming the 2013 national passenger fleet average fuel economy of 21.6 miles per gallon.[5]

As part of a separate grant agreement for operations and maintenance support funding through the CEC (ARV-17-028), 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.

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

5 U.S. Department of Transportation, Bureau of Transportation Statistics; Table 4-23: Average Fuel Efficiency of U.S. Light Duty Vehicles;
(http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html)

CHAPTER 3:
Future Activities

FirstElement Fuel, Inc. intends to own and operate the La Cañada Flintridge 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.

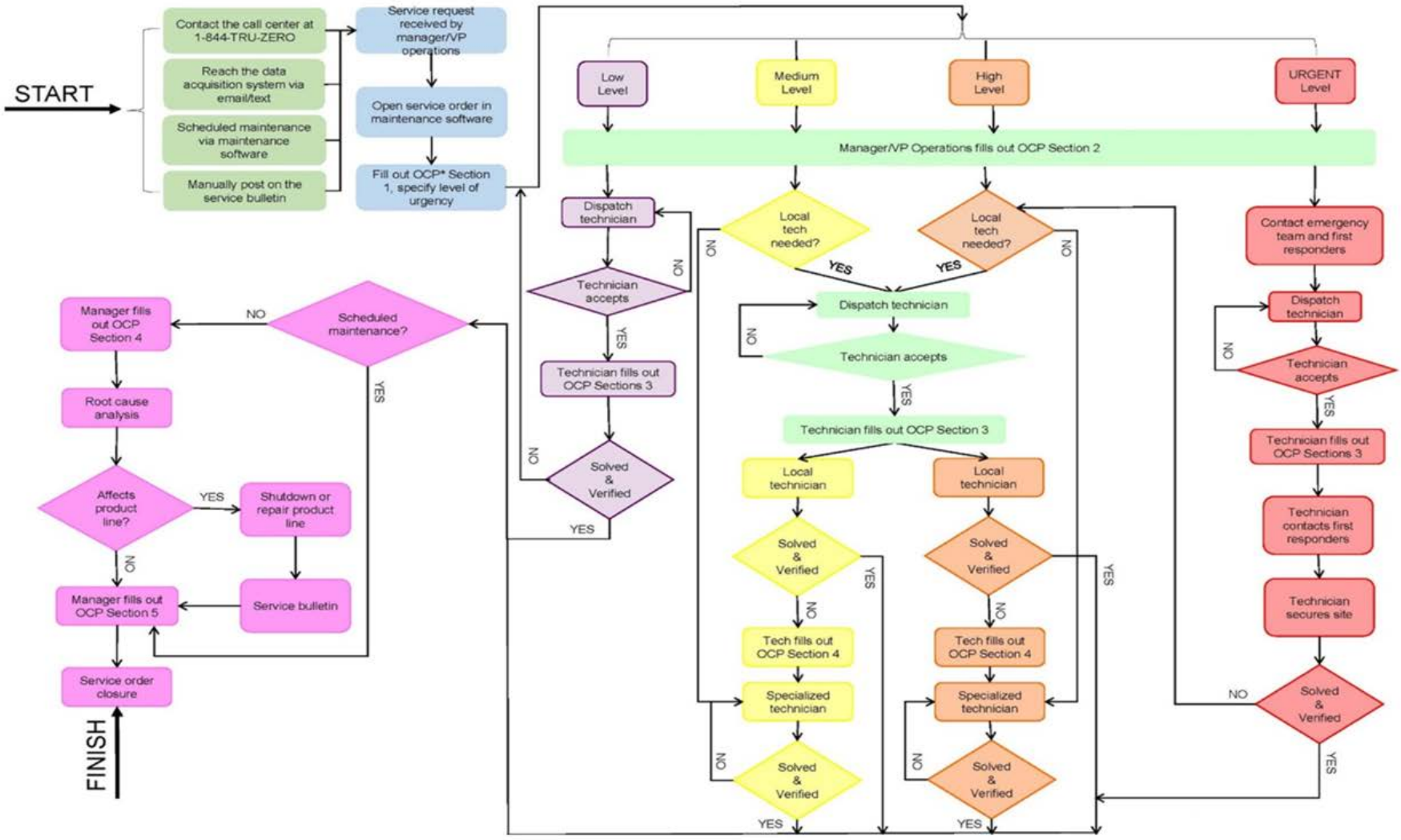
In addition, FirstElement Fuel, Inc. is building an in-house maintenance team that will have the personnel and equipment resources to maintain and repair any of its stations as quickly as possible throughout California. Figure 17 shows a flow diagram for response from the operations and maintenance team.

To augment onsite personnel across the FirstElement Fuel, Inc. network, the project team implemented a comprehensive data collection and monitoring system.

Figure 18 shows a screenshot of one page of the system. FirstElement Fuel, Inc. maintenance personnel can access a breadth of real-time performance and sensor data, live video feeds, and historical usage data and can control some features of the station remotely, 24 hours a day.

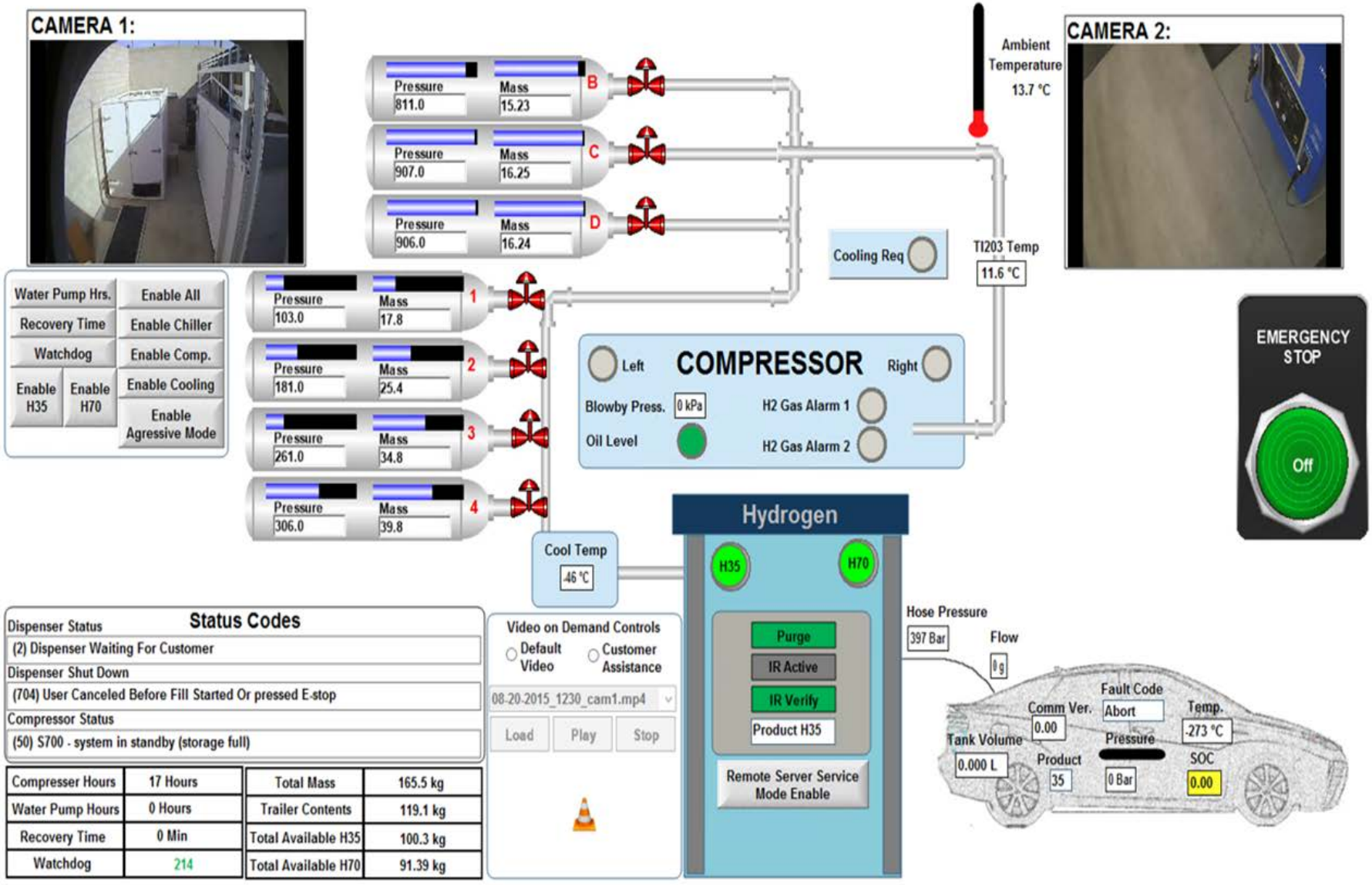
In addition to remote monitoring, FirstElement Fuel, Inc. has implemented rigorous computerized maintenance management systems and enterprise asset management systems to schedule and track maintenance, repairs, and inventory. Work orders will be generated, completed, and logged for all maintenance and repairs. This will help maximize station uptime and enable tracking of key performance indicators.

Figure 15: FirstElement Fuel, Inc. Response Flow Chart



Source: FirstElement Fuel, Inc.

Figure 18: Screenshot of FirstElement Fuel, Inc.'s Remote Monitoring System



Source: FirstElement Fuel, Inc.

CHAPTER 4:
Conclusions

The following considers findings from the 33.3 percent renewable hydrogen La Cañada Flintridge hydrogen refueling station project.

Because of the consistent look of the La Cañada Flintridge mountain community, aesthetics were important for final design. Much back-and-forth with local planners and design boards led to a final, station design that was ultimately better than the design that FirstElement Fuel, Inc. proposed. The extra effort in zoning process in some jurisdictions generally results in a better project.

Though projects can sometimes be challenged by resistance from local community members for several reasons, several long-standing community groups in La Cañada Flintridge were enthusiastically supportive of new, clean technology.

The National Fire Protection Association hydrogen technologies code is critical for technical projects of this nature. The code clearly defines fire guidelines that enable local jurisdictions and contractors to construct hydrogen facilities uniformly 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--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 (also known as the ALTERNATIVE AND RENEWABLE FUELS AND VEHICLE TECHNOLOGY PROGRAM)—Created by Assembly Bill 118 (Núñez, 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 developing engine technologies, expand transit and transportation infrastructures, 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 infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

HYDROGEN (H2)—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 and enteric fermentation in animals and is one of the greenhouse gases.