CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Santa Barbara Hydrogen Station

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

January 2022 | CEC-600-2022-027

California Energy Commission

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ACKNOWLEDGEMENTS

The construction of the Santa Barbara hydrogen refueling station has only been possible because of the substantial efforts and funds provided by a number of stakeholders. FirstElement Fuel, Inc. graciously thanks Toyota for their vision and fortitude, Air Products and Chemicals Inc., Black & Veatch, and Aliantel 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, Commissioner Janea Scott and many others at the California Energy Commission for their tremendous, sustained confidence in clean, alternative transportation.

PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation 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 high performance hydrogen retail 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 on May 1, 2014 and the agreement was executed as ARV-14-008 on July 22, 2014.

ABSTRACT

Per the terms of funding agreement ARV-14-008 between the California Energy Commission and FirstElement Fuel, Inc., FirstElement Fuel, Inc. designed, engineered, permitted, constructed, and commissioned a hydrogen refueling station located at 150 South La Cumbre Rd., Santa Barbara, CA 93105. 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 vehicles, Santa Barbara.

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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 Zero Emission Vehicle Regulation and the Governor's Zero Emission Vehicle Mandate. 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 vehicle passenger vehicles can drive more than 300 miles on a tank of hydrogen and can be refueled in 3 to 4 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 SUVs, family passenger vans, pick-up 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 in home settings, 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 co-develop two new technologies in parallel: hydrogen refueling infrastructure and hydrogen fuel cell electric vehicles. 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 Clean Transportation 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, for the development of 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 CEC contributed $1,451,000 of the total $2,281,377 cost to design, engineer, permit, construct, and commission the station.

The site selected for this project was 150 South La Cumbre Rd., Santa Barbara, California. A hydrogen refueling station at this location will serve as a destination and early market station for at least the next 10 years. FirstElement Fuel, Inc. accomplished this goal through the steps outlined below.

The owner at Santa Barbara was excited to bring a clean, alternative fuel to his station. Lease terms were negotiated, and a lease was executed between FirstElement Fuel, Inc. and the Santa Barbara owner on December 16, 2014.

The site configuration and design were developed by FirstElement Fuel, Inc. and detailed engineering design was performed by Black & Veatch. The zoning process in Santa Barbara required three Architectural Board of Review meetings and public hearing and approval was garnered May 5, 2015.

Permits for zoning, building, mechanical, electrical, plumbing, and fire were finalized on July 29, 2015. The Santa Barbara station is well-situated with respect to fire setbacks and zoning requirements. However, the strong aesthetic values of Santa Barbara required substantial landscaping and architectural design work compared to other FirstElement Fuel, Inc. projects.

Hydrogen refueling station equipment was purchased from Air Products and Chemicals and the remainder of materials were sourced from a variety of general and specialty vendors. Aliantel from Murieta, CA 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 on August 17, 2015 and was complete on January 4, 2016.

Commissioning began on February 1, 2016 and was complete on February 25, 2016. The FirstElement Fuel, Inc. team performed the bulk of the commissioning tasks including cleaning, purging, and pressure testing with Air Products performing final start-up.

CHAPTER 1:
Station Design and Construction

Project Timeline

There were many steps required to bring the Santa Barbara hydrogen refueling station project to completion. The following synopsis highlights the most critical items, provides detail on each one, and states the timing required for each step for this particular project.

Site Acquisition (Fall 2013 – 12/16/2014)

Beginning in the Fall of 2013, FirstElement Fuel, Inc. (FE) took steps to identify and acquire appropriate sites for the station. FE worked with historic vehicle sales data, academic publications, automakers, and the CEC's Station Location Areas to select desired market locations. FE 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, FE contacted station owners and operators to negotiate lease opportunities. A Letter of Intent was executed with the property owner at 150 South La Cumbre Rd., Santa Barbara, CA 93105 on January 27, 2014. A binding 10-year lease was later executed on December 16, 2014.

Equipment Procurement (September 16, 2014 – December 9, 2015)

FE selected Air Products equipment because of the cost, capacity, reliability, and more mature supply chain as compared to other suppliers as detail in the FE program opportunity notice application. A contract was executed with Air Products for the equipment on September 16, 2014 and equipment was delivered to the site on December 9, 2015.

Site Design and Engineering (8/11/2014 – 10/19/2015)

FE and Black & Veatch conducted a preliminary site survey to begin the site layout process on August 11, 2014. Initial engineering drawings were generated on September 29, 2014. These construction drawings (CD) are referred to as "CD30s" because they represent 30 percent complete construction drawings and contain only 2 pages. Figure 1 shows the equipment compound drawing from the CD30 drawing set. As shown, the drawing lacks specific detail and serves only to outline the site plan.

On October 24, 2014, a detailed engineering survey for the Santa Barbara station site was subsequently performed by Clark Survey as shown in Figure 2.

On March 17, 2014, zoning drawings were also generated that provide an accurate but relatively high-level depiction of the project for review by planners at the jurisdiction. These drawings are signed and sealed by the professional engineer of record to ensure their accuracy and completeness. The equipment compound page of the zoning drawings is shown in Figure 3.

On April 17, 2015, draft final construction drawings (or "CD 90s") were completed that depict all of the minute detailed required for both construction and the permit review process. Final construction drawings (or "CD 100s") were completed with 60 pages that depict all of the minute detailed required for both construction and the permit review process on October 19, 2015. These drawings are similarly signed and sealed by the professional engineer of record to

ensure their accuracy and completeness. The equipment compound page of the CD100 Drawings is shown in Figure 4.

Figure 1: Relatively Coarse Detail of Equipment Compound from CD30 Drawing

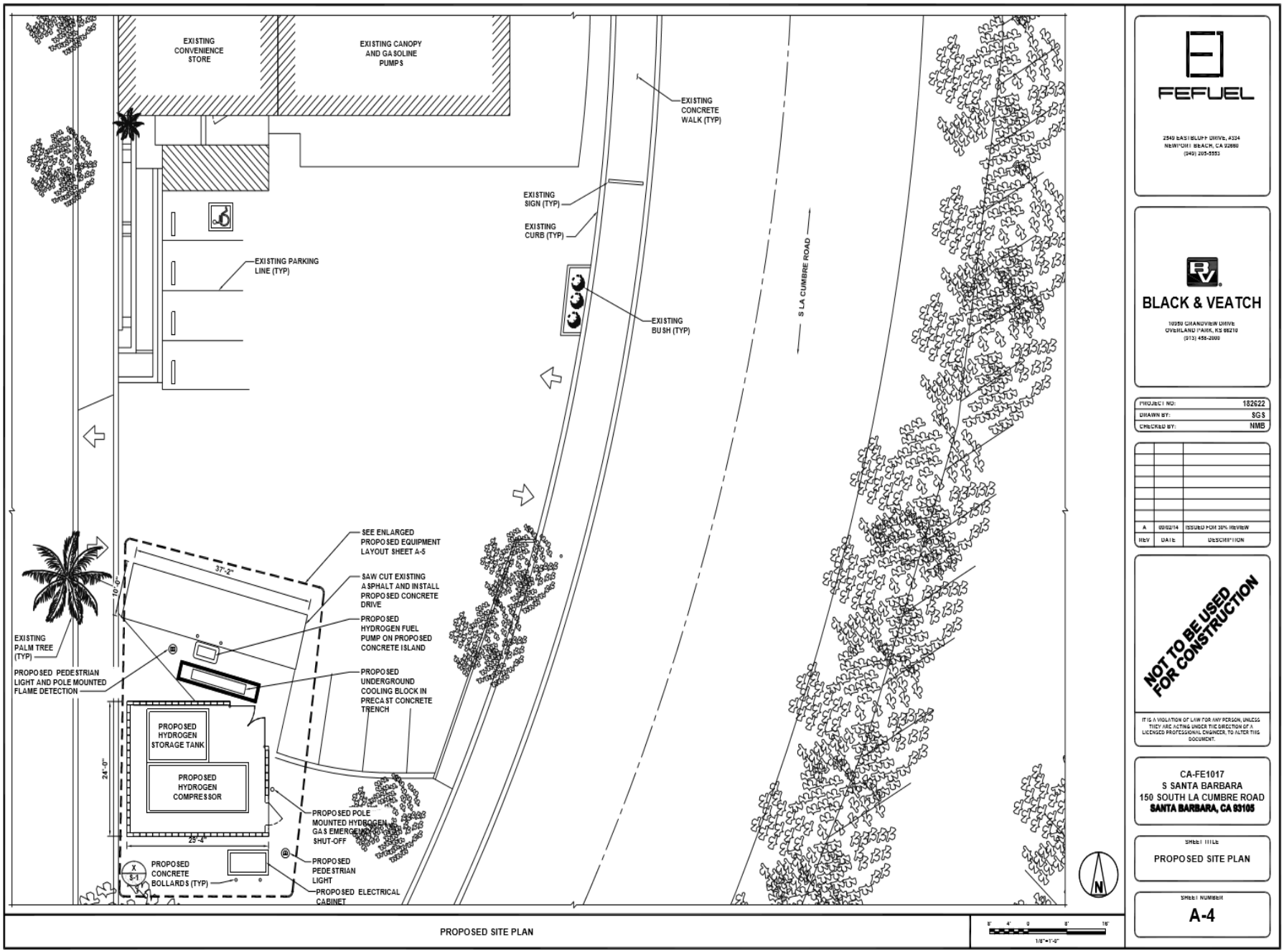


Figure 2: Survey of Santa Barbara Hydrogen Station Location

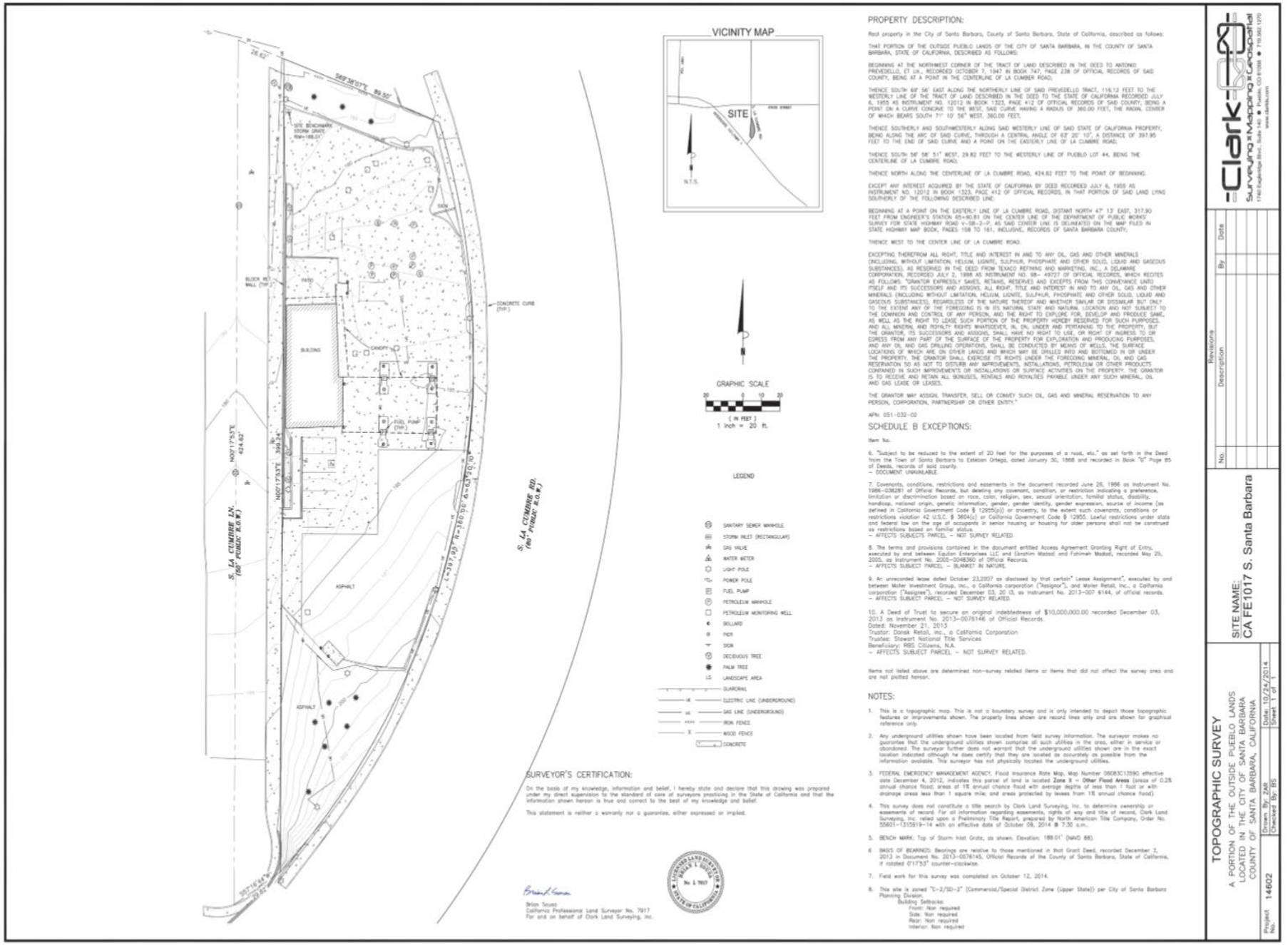


Figure 3: Detail of Equipment Compound from Zoning Drawing Set Showing More Detail and Accuracy than CD30

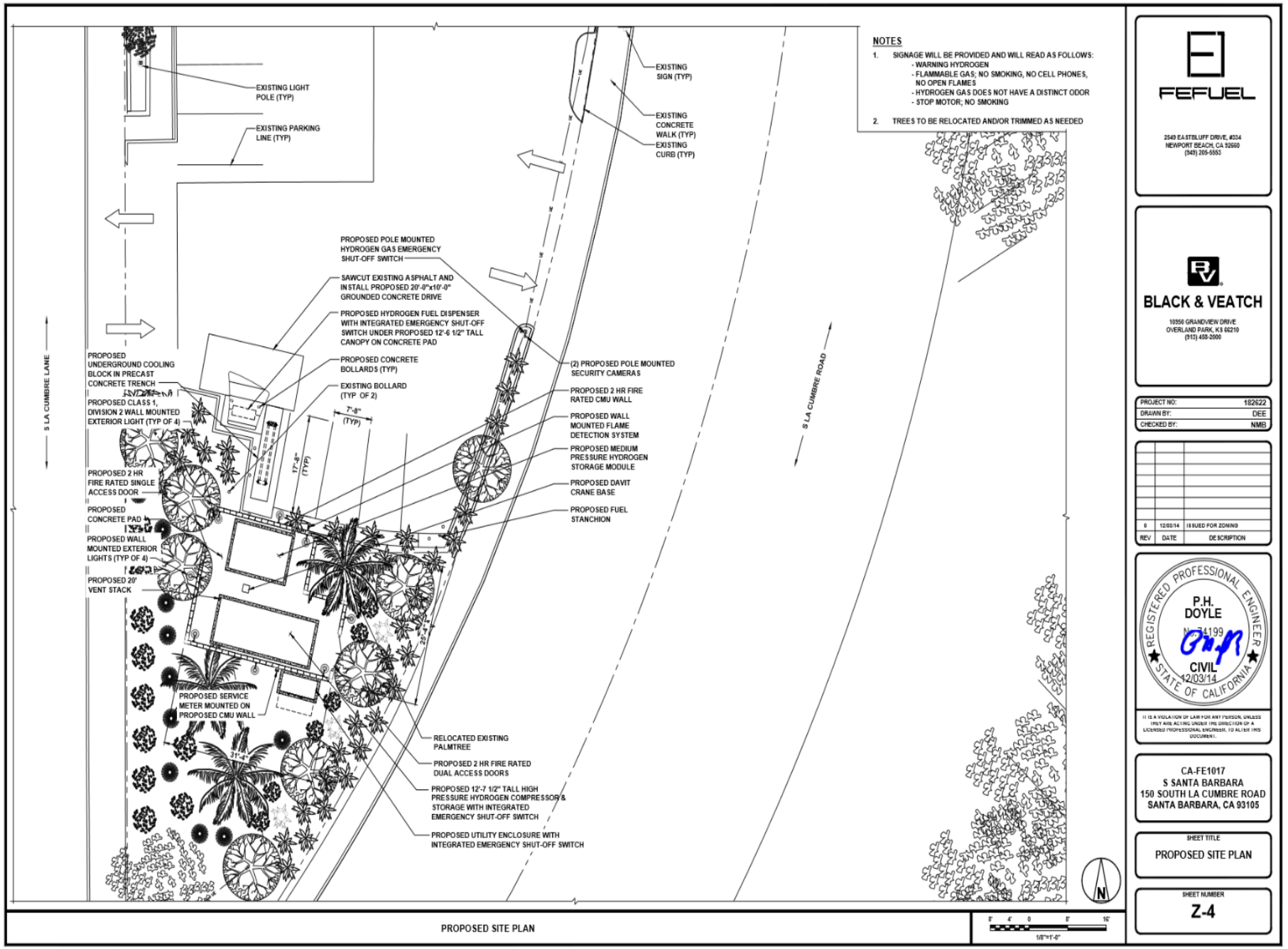
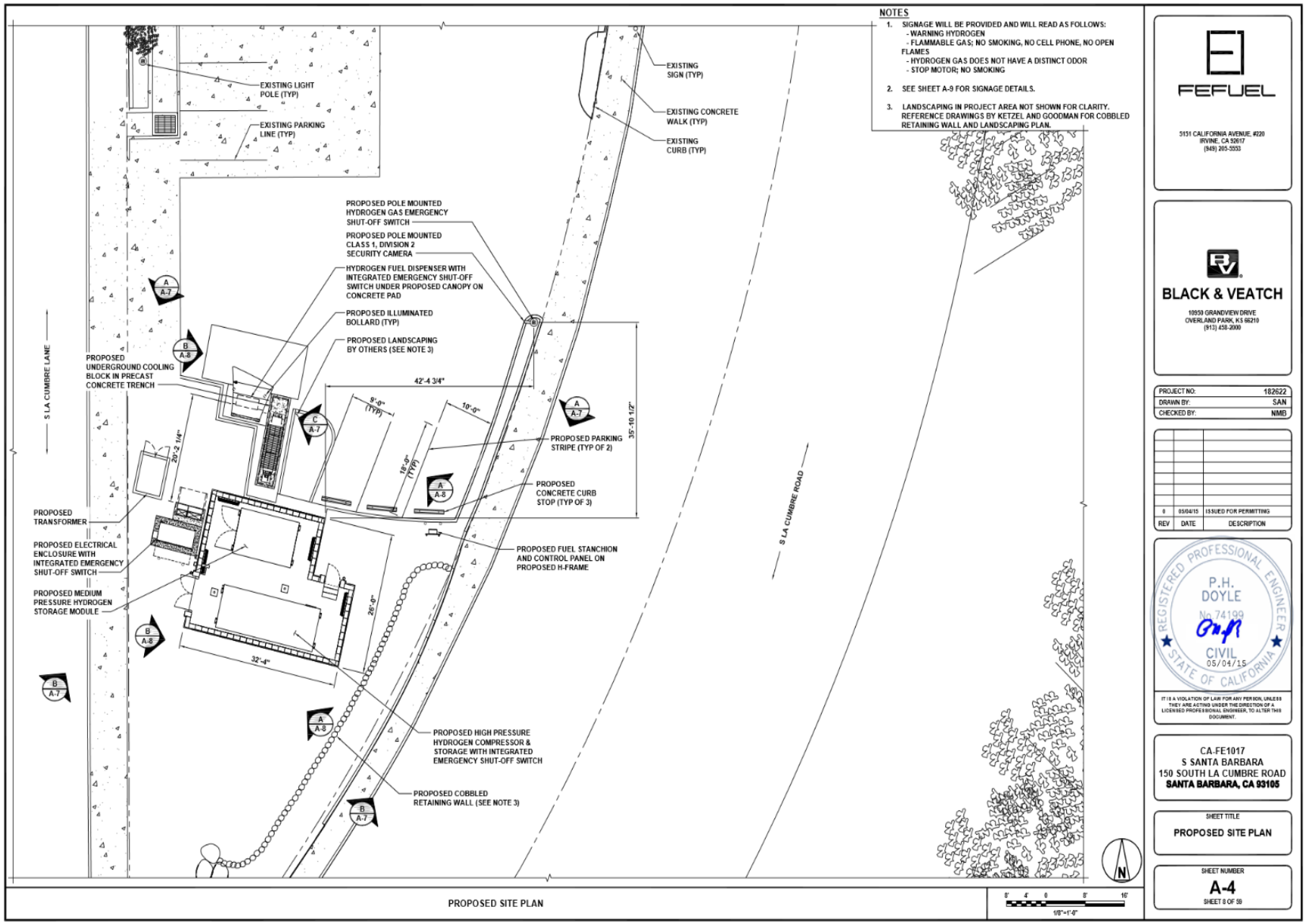


Figure 4: Detail of Equipment Compound from CD100 Drawing Set Showing Complete Detail for Permitting and Construction



Entitlement Process (12/17/2014 – 3/2/2015)

The zoning application was submitted to the appropriate jurisdiction on December 17, 2014. The local planning department must verify that the project meets the zoning requirements of the proposed location, and approve any aesthetic, landscaping or other details that are important to the community. Approval was received through public hearing process on March 2, 2015.

Permit Process (5/5/2015 – 7/29/2015)

All building permit applications were submitted on May 5, 2015 and approved on July 29, 2015.

Construction Process (7/14/2015 – 1/4/2016)

FE and Black & Veatch submitted a detailed bid package to contractors on July 14, 2015. The contract was awarded to Aliantel on July 29, 2015. The bulk of Aliantel's construction experience lies in cell towers. Cell towers are roughly similar to hydrogen stations in size, have similar foundations and block walls, and have similar electrical requirements. Aliantel provided a reasonable bid, had a desire to get involved with hydrogen projects, and had a willingness to work in northern California. Construction started August 17, 2015. Figure 5 shows the equipment compound before completion. Hydrogen storage, compression, cooling, and dispensing equipment was delivered to the site on December 9, 2015, as shown in Figure 6. Construction was completed on January 4, 2015.

Figure 5: Hydrogen Station Under Construction

Figure 6: Crane Lifting Hydrogen Ground Storage Unit Off of Delivery Truck in Santa Barbara

Commissioning Process (2/1/2016 – 2/25/2016)

The commissioning of the Santa Barbara hydrogen station included the cleaning and purging of lines, pressure testing, and hydrogen sampling. Figure 7 shows labeling and routing lines during commission and Figure 8 presents the finding of the hydrogen fuel quality report.

Station Declared Operational (2/25/2016)

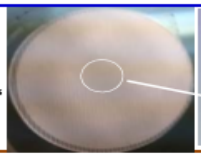
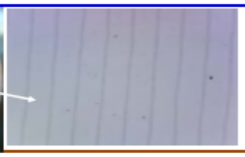
The Santa Barbara hydrogen station met the CEC's definition of operational by completing installation of all station/dispenser components, obtaining all of the required permits from the local jurisdiction, filling the station's storage tubes with pressurized hydrogen gas, successfully passing a hydrogen quality test, successfully fueled one fuel cell vehicle with hydrogen, and becoming open to the public.

Figure 7: Labeling and Routing Lines During Commissioning

Figure 8: Hydrogen Fuel Quality Report on March 1, 2015

www.SmartChemistry.com

FIRST ELEMENT FUEL — SANTA BARBARA

SAE J2719	SAE J2719 Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)	H70 H2 @Nozzle sampled on 03/01/2016 Concentration (µmol/mol)	Analytical Method
Water	5	1	2.0	
Total Hydrocarbons (C_1 Basis)	2	1	0.66	ASTM D7892
Methane			0.65	
Propane			0.0093	
Oxygen	5	1	< 1	ASTM D7649
Helium	300	10	15	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		2	< 2	ASTM D7649
Argon		0.4	0.50	ASTM D7649
Carbon Dioxide	2	0.5	< 0.5	ASTM D7649
Carbon Monoxide	0.2	0.0005	0.0026	ASTM D5466
Total Sulfur	0.004	0.000001	0.000043	ASTM D7652
Hydrogen Sulfide		0.000001	0.000014	ASTM D7652
Carbonyl Sulfide		0.000001	0.000016	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		0.00001	0.000013	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	0.005	< 0.005	ASTM D5466
Total halogenates	0.05		0.0041	
Chlorine		0.0008	< 0.0008	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	0.0041	ASTM D7892
Tetrachloro-hexafluorobutanes			0.0041	
Particulate Concentration - ASTM D7651 Particulates Found & Size - ASTM D7634 (Images of particulates is in Table I)	 		0.013 mg/kg Eight particulates with the sizes in µm are found: 171, 97, 96, 82, 67, 62, 62 & 35.	
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)			99.99820%	

Automaker Testing

Automaker testing was performed at the Santa Barbara hydrogen station to verify correct operation per SAE J2601.

Division of Measurement Standards Certification (3/10/2016)

The California Department of Food and Agriculture's Division of Measurement Standards is responsible for enforcement of California weights and measures laws and regulations and must certify any device used for metering the sale of commercial items within California.

Acting as a Registered Service Agent and working with the local County Weights and Measures Officer as a witness, FirstElement successfully put the dispenser into service as shown in Figure 9.

Figure 9: Division of Measurement Standards Certification at Santa Barbara Hydrogen Station

Customer Usage (2/25/2015 – Present)

The first public customer, shown in Figure 10, filled their Hyundai Tucson at the Santa Barbara station on February 25, 2015 and the station has been used regularly since then. The Santa Barbara station dispensed 10.2 kilograms of hydrogen in February 2016. Sales in March 2016 were 158.8 kilograms, 30.6 kilograms in April 2016, and 59.9 kilograms in May 2016.

Figure 10: Photo of First Customer Using the Santa Barbara Hydrogen Station on February 25th, 2016

Station Online Status System Activated (4/9/2016)

The California Fuel Cell Partnership Station Operational Status System provides regularly updated station status information to fuel cell vehicle drivers. FirstElement developed software in-house that provides the required updates to the Station Online Status System. The Santa Barbara hydrogen station began sending regular status updates to Station Online Status System on 4/9/2016 as shown in Figure 11.

Figure 11: Screenshot of California Fuel Cell Partnership Station Online Status System Showing Santa Barbara Hydrogen Station Status

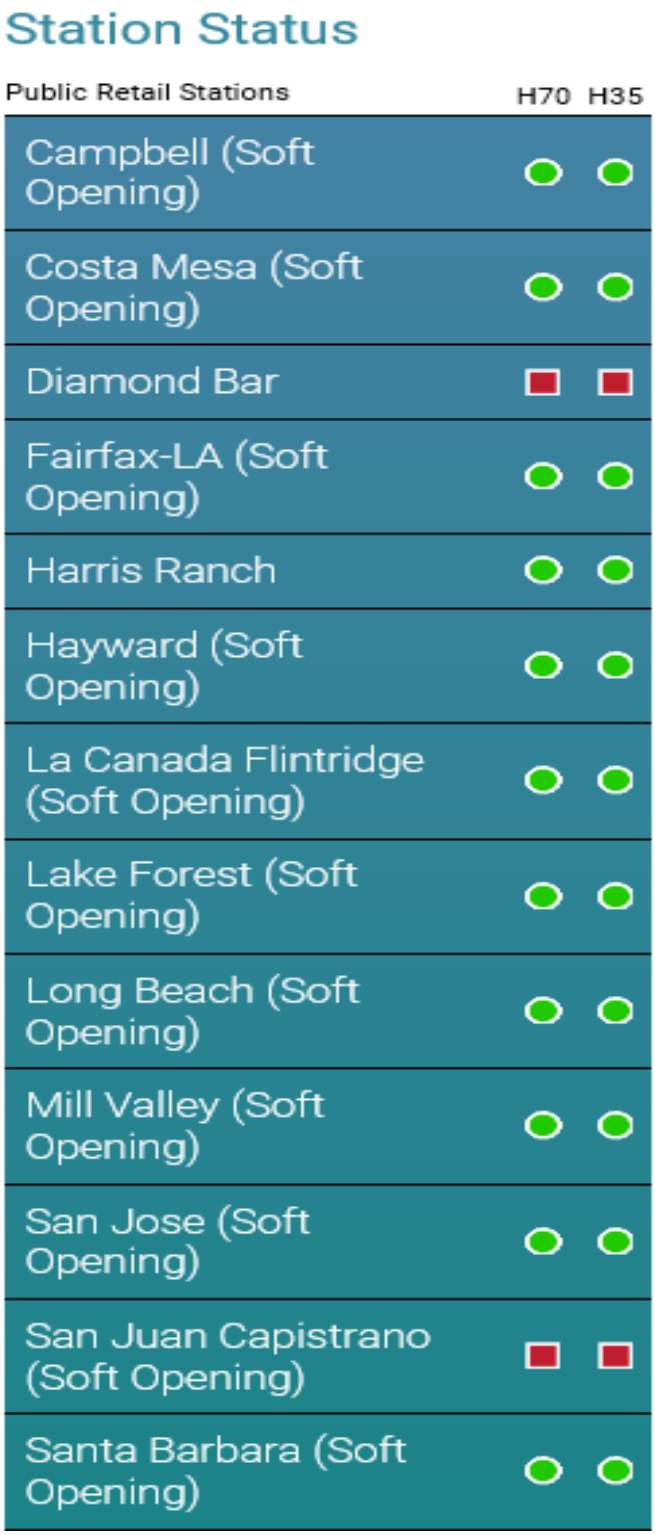


Figure 12 shows a picture of the Santa Barbara Hydrogen Station open and fully operational.

Figure 12: Santa Barbara Hydrogen Station

Environmental Impacts

Hydrogen will be stored as a compressed gas in an above ground tank concealed behind a wall at this facility. 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.

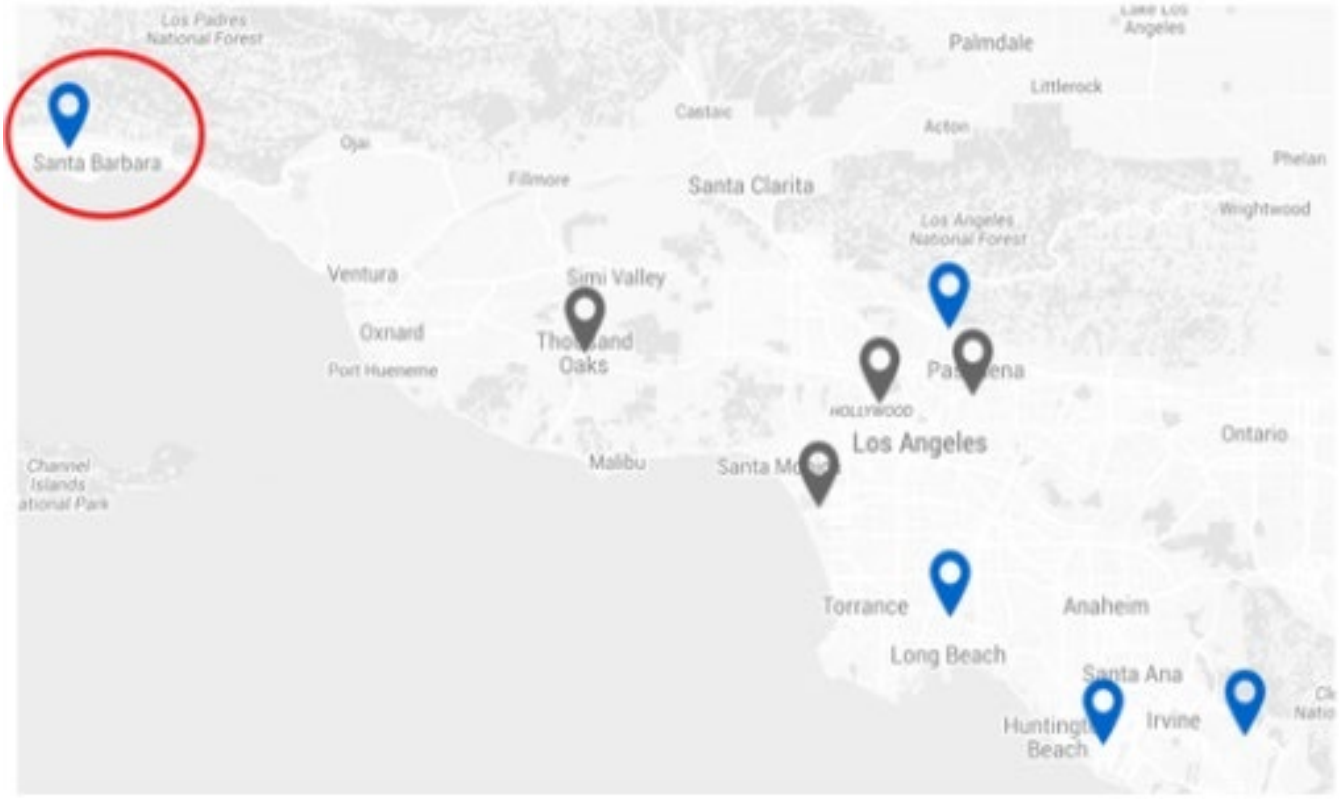
Minimal water was consumed for this project. There was additional landscaping added for the construction of the hydrogen refueling station and therefore additional irrigation water will be consumed.

The 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.

Santa Barbara Station in the Network

Figure 13 shows the location of the Santa Barbara hydrogen station at 150 South La Cumbre Road, Santa Barbara as a destination and early market station.

Figure 13: Santa Barbara Hydrogen Station Location



Schematic Layout of the Santa Barbara Station

Figure 14 depicts an overview of the Santa Barbara hydrogen station components and the steps involved in the refueling process.

Figure 14: Schematic Depicting Hydrogen Station Equipment and Refueling Process

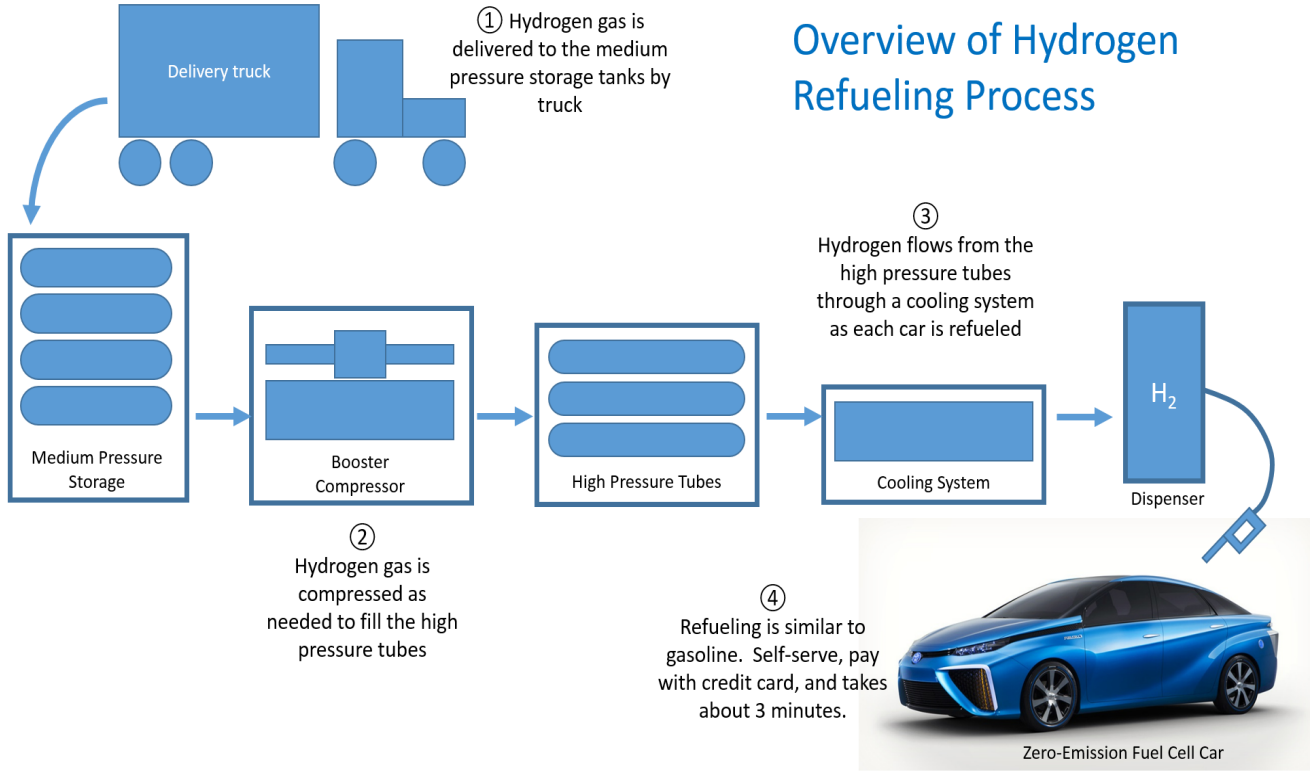


Figure 15 shows a detailed view of the final, as-built configuration of the Santa Barbara station.

Figure 15: Enlarged View of Final Santa Barbara Layout

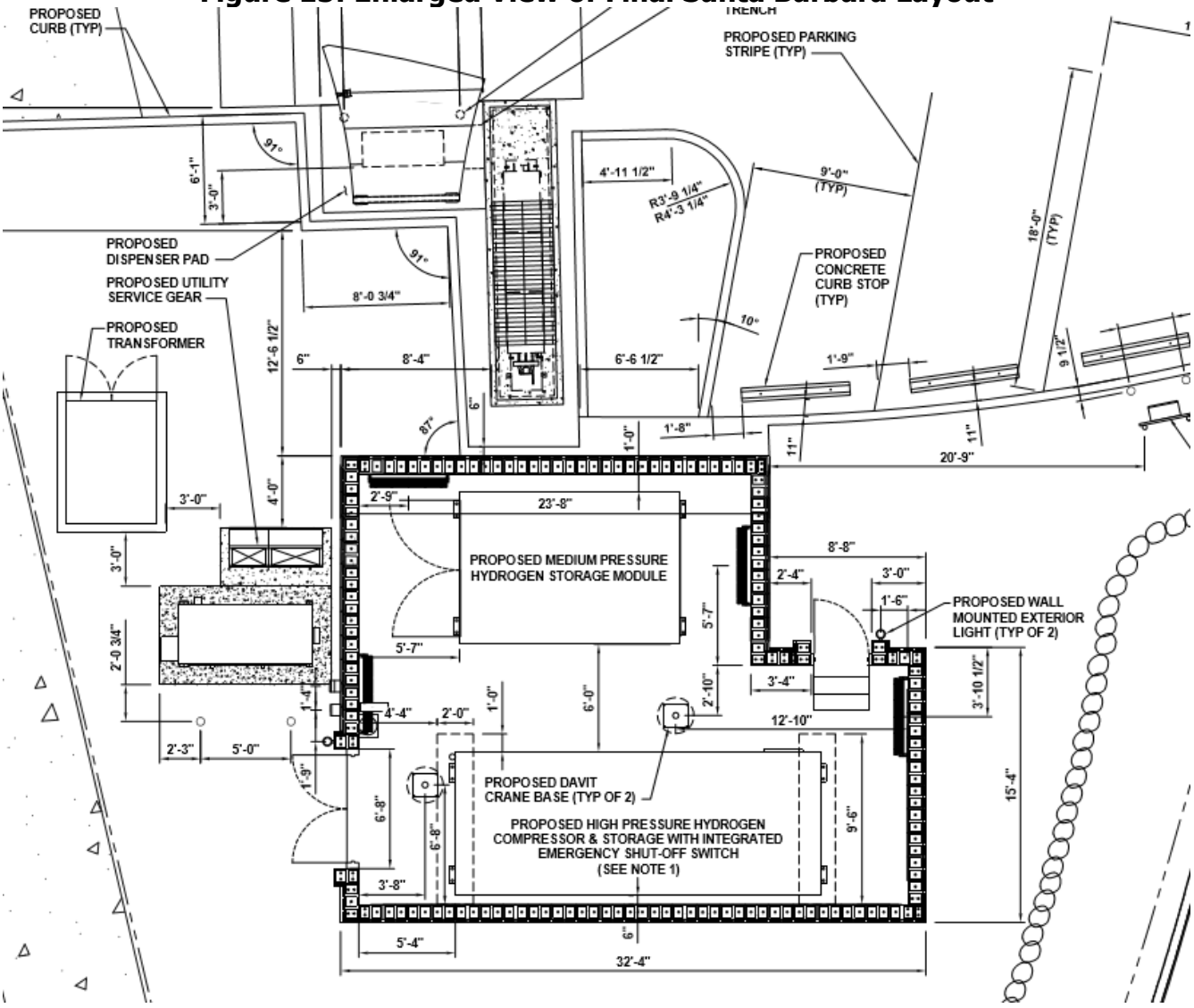


Table 1 presents a list of subcontractors and the budget for the Santa Barbara Hydrogen Station project.

Table 1: List of Subcontractors and Budget

Air Products and Chemicals, Inc., Allentown , PA	
H2 station equipment	$1,480,192.21
Black & Veatch, Overland Park, KS	
Construction	$596,767.96
Engineering	$46,957.20
Permitting	$35,987.02
Project Management	$18,197.53
Various Vendors	
Construction Materials (tubing, wire, etc.)	$15,226.12
Fixtures (doors, lights, etc.)	$66,972.46
MSI Tech, Irvine CA	
Data Collection Tool	$3,582.22
Karen Calhoun, Newport Beach, CA	
Legal services	$13,150.03
Vertical Advisors LLP, Newport Beach, CA	
Financial services	$4,345.13
Total Vendor Costs	$2,281,377.88
California Energy Commission Grant	$1,451,000.00
Remaining cash provided by FE	$830,377.88
Total CEC cost share (w/o FE internal costs)	63.6%

Source: FirstElement Fuel, Inc.

CHAPTER 2:
Data Collection and Energy Analysis

The Santa Barbara hydrogen refueling station is supplied by hydrogen generated via the Steam Methane Reformation process that converts methane and water to hydrogen and carbon dioxide, shown in Figure 16.

Figure 16: Steam Methane Reformation Process

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

Source: FirstElement Fuel, Inc.

Per California Senate Bill 1505, Environmental Standards for Hydrogen Production, at least one third of the hydrogen sold by FirstElement's state funded hydrogen refueling stations will be produced from renewable sources. Hydrogen is supplied to the hydrogen fueling stations from Air Products' hydrogen production facilities in Wilmington/Carson, CA. Renewable biogas will be procured as feedstock for the facilities, resulting in delivered hydrogen product that meets the requirements of this PON and the 33.3 percent renewable hydrogen requirements of California SB 1505, shown in Figure 17. Renewable hydrogen at 100 percent is achievable through the same supply pathway, however at a higher cost.

Air Products currently has a contract for sourcing of the renewable biogas that meets Public Resources Code Section 2574(b)(1); documentation is provided in Figure 18. Although California has a substantial amount of biogas resources, local supply cannot be injected into California pipelines because of CA Health & Safety Cost Section 25420. Air Products' 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.

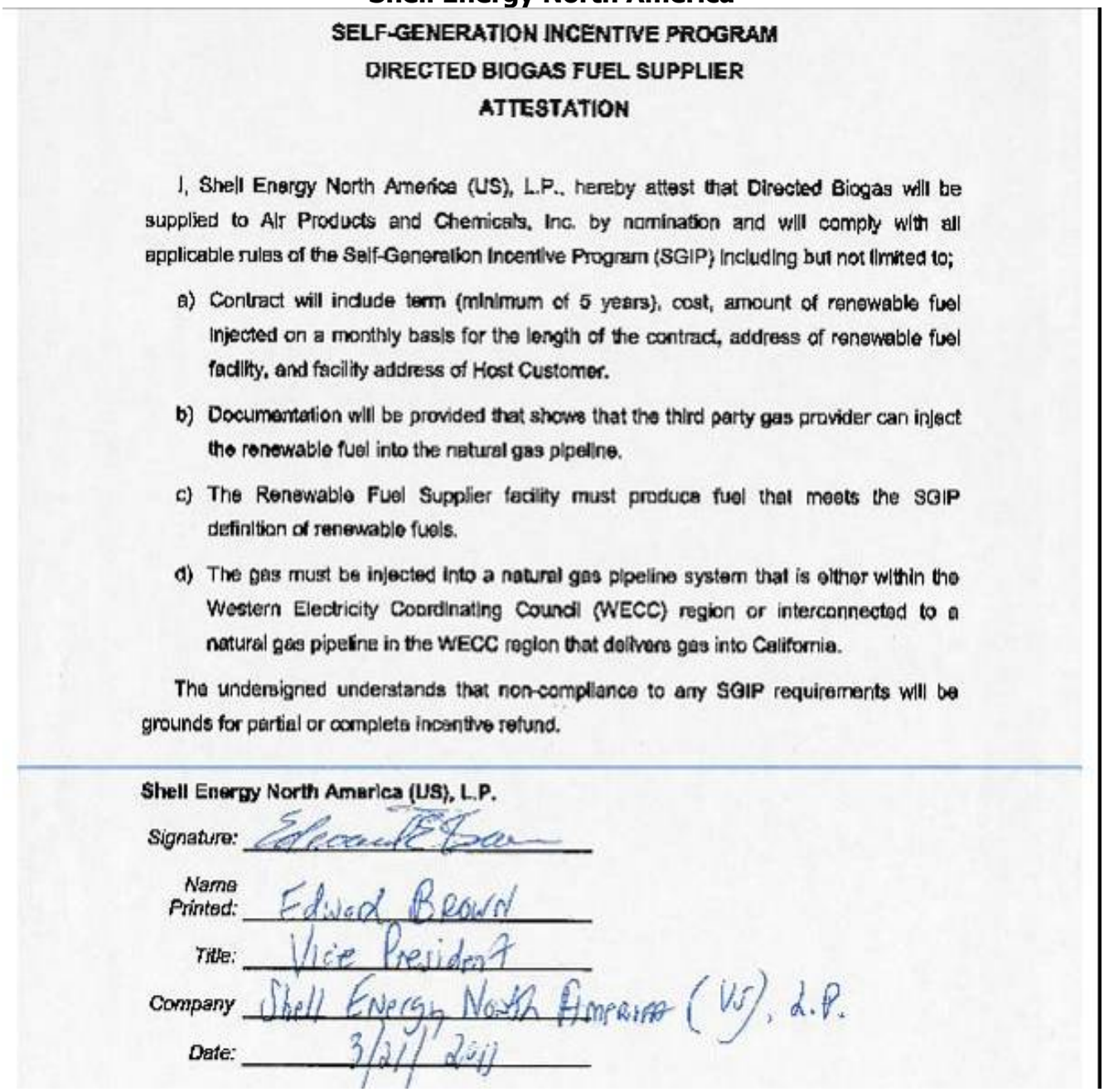
Figure 17: Biogas Sources

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: FirstElement Fuel, Inc.

Figure 18: Biogas Supply Contract Between Air Products and Chemicals, Inc. and Shell Energy North America



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 F 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 all FE stations (including Santa Barbara) by a Department of Transportation certified high-pressure delivery trailer.

The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model produced by Argonne National Laboratory was used to determine the energy sources and greenhouse gas emissions data presented in Table 2. As shown, 1/3 of the energy feedstock is renewable, nearly zero petroleum is used, and the only tailpipe emissions are water compared to the myriad pollutants emitted by combustion of gasoline. Also, the entire well-to-wheels greenhouse gas emissions are 58 percent lower than similar usage for a typical California gasoline vehicle.

Table 2: Percentage of Energy Sources and Well-to-Wheel Greenhouse Gas Emissions for FirstElement Hydrogen Compared to Average California Gasoline

Energy Sources	Fuel Cell Vehicle fueled at FirstElement station	Average California internal combustion car fueled by gasoline
Coal	1.7%	0.4%
Petroleum	0.3%	78.6%
Natural Gas	64.7%	13.9%
Renewable	33.3%	7.1%
Total Greenhouse Gases	178 grams/mile	428 grams/mile
Tailpipe Emissions	Pure Water	VOC, CO, NOx, PM10, PM2.5, SOx, CH4, N2O, and toxins

Source: FirstElement Fuel, Inc.

The Santa Barbara hydrogen station is capable of dispensing 180 kilograms/day. Assuming that fuel cell electric vehicles average 52 mile/kilograms (taken from the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model), and consumption of 180 kilograms/day for the next 10 years, the station will offset 8,384 metric tons of total greenhouse gases compared to equivalent gasoline vehicles. Also, the Santa Barbara hydrogen station will eliminate over 1.54 million gallons of gasoline, assuming the 2013 national passenger fleet average fuel economy of 21.6 miles per gallon[1].

Data on the operation of the station will be collected and reported to the CEC throughout the term of an associated operations and maintenance grant through the Clean Transportation Program. Data collected and reported will include throughput, vehicle usage, gallons of gasoline displaced, and a comparison of the project's actual performance to proposed expectations.

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

CHAPTER 3:
Statement of Future Intent

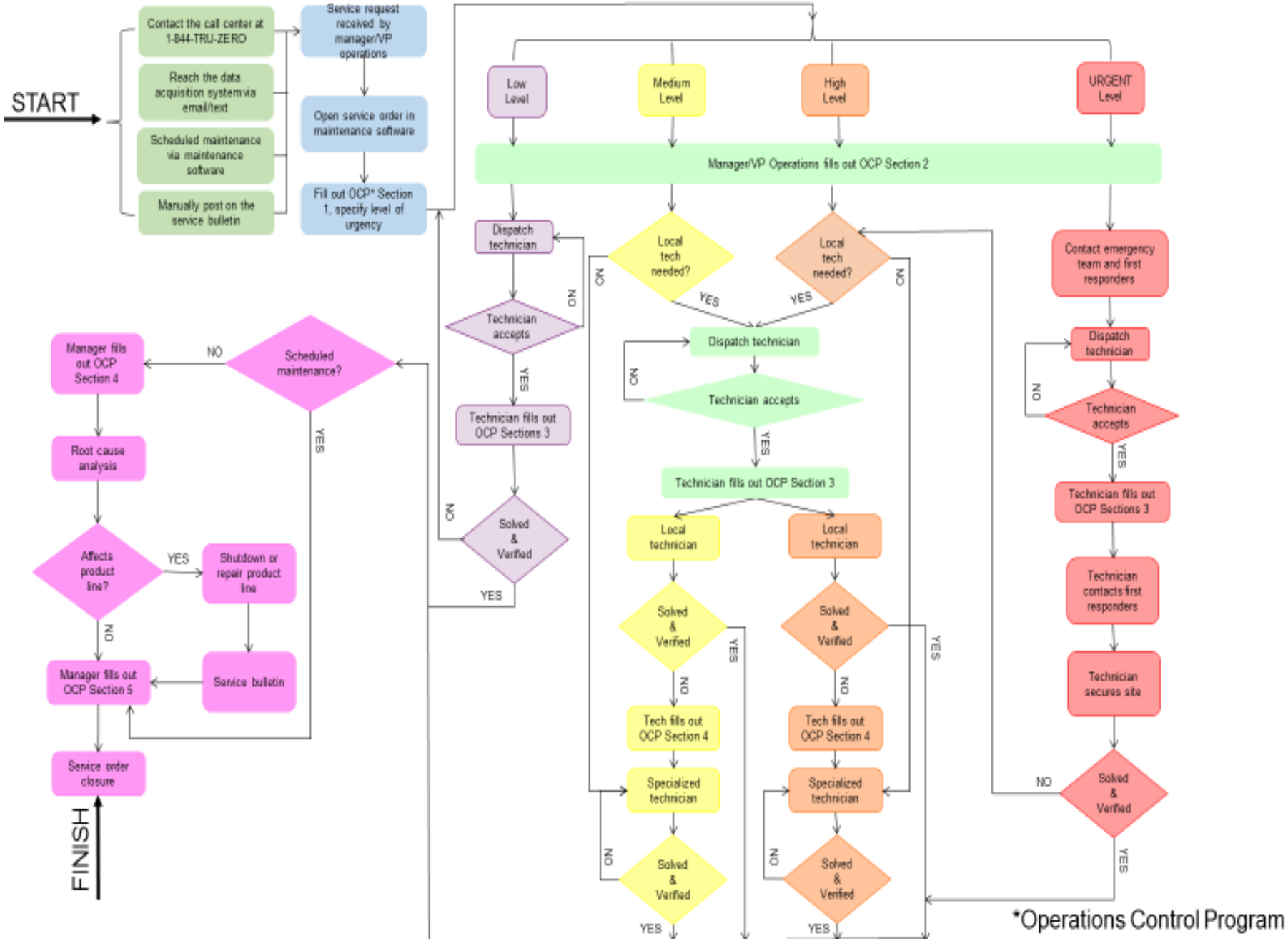
FE intends to own and operate the refueling station at 150 South La Cumbre Rd., Santa Barbara, CA for at least 10 years. FE has invested substantial capital to build the station and will require many years of operation to recoup the development costs. FE has executed an initial 10-year lease with the landowner with the possibility for extension.

In addition, FE 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 19 shows a flow diagram for response from the Operations and Maintenance team.

To augment onsite personnel across the FE network, a comprehensive data collection and monitoring system has been implemented. Figure 20 shows a screenshot of one page of the system. FE 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 a day.

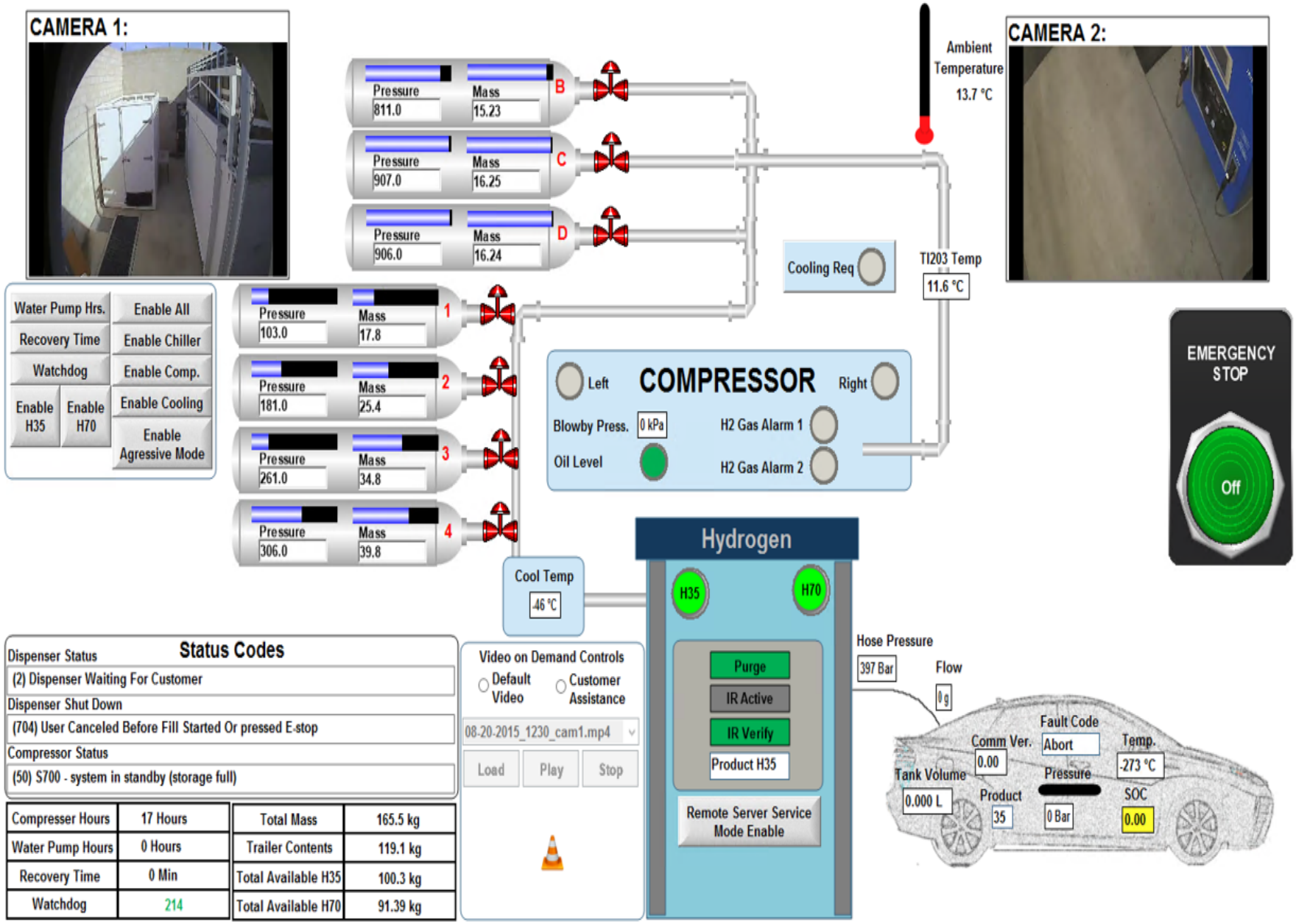
In addition to remote monitoring, FE has implemented rigorous Computerized Maintenance Management Systems and Enterprise Asset Management systems to schedule and track maintenance, repairs, and inventory. Work orders will be generated, completed, and logged for all maintenance and repair activities.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

Figure 19: FirstElement, Inc. Operations and Maintenance Control Plan



Source: FirstElement Fuel, In

Figure 20: Screenshot of FirstElement, Inc.'s Remote Monitoring System



Source: FirstElement Fuel, Inc

CHAPTER 4:
Findings, Conclusions, and Recommendations

The following is a list of important findings from the Santa Barbara hydrogen station project:

- The Santa Barbara station is well-situated with respect to fire setbacks and zoning requirements. However, the strong aesthetic values of Santa Barbara required substantial landscaping and architectural design work compared to other FE projects.
- Based on feedback from early customers, they are excited to have a station in Santa Barbara to extend the effective range of their fuel cell electric vehicles. However, the growth of a dedicated consumer base in Santa Barbara may be slow.
- National Fire Protection Agency 2: Hydrogen Technologies Code is a critical tool for working with permit agencies. The code clearly defines fire safety guidelines that enable local jurisdictions and builders to reach common ground, while also ensuring safety via the rigorous National Fire Protection Agency code writing process. The key is for both station builders and station permit agencies to fully understand, and appreciate, the content of National Fire Protection Agency 2.

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 CEC's five major areas of responsibilities are:

1. Forecasting future statewide energy needs.
2. Licensing power plants sufficient to meet those needs.
3. Promoting energy conservation and efficiency measures.
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
5. 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.

Construction Drawing (CD)–Construction drawings form part of the overall documentation that is used for tender, for the contract between the employer and contractor, and for the construction itself. The construction drawing provides a graphic representation of how the building will be built.[2]

FirstElement Fuel, Inc. (FE)– A California-based company established in 2013 to provide safe, reliable, retail hydrogen to customers of fuel cell electric vehicles. The company is the developer, owner and operator of the True Zero brand of retail hydrogen stations, which currently represents the largest retail hydrogen station network in the world.

2 What is a Construction Drawing is available at https://www.firstinarchitecture.co.uk/what-is-a-construction-drawing/