CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Truckee Hydrogen Station

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

Gavin Newsom, Governor

April 2019 | CEC-600-2019-013

California Energy Commission

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ACKNOWLEDGEMENTS

The construction of the Truckee 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 MIT Construction for bringing the project together; Tyson Eckerle for helping push the lease over the goal line; and, of course, Jean Baronas, Sarah Williams, Jim McKinney, Commissioner 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 ARFVTP 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-14-013 on July 22, 2014.

ABSTRACT

FirstElement Fuel, Inc. designed, engineered, permitted, constructed, and commissioned a hydrogen refueling station at 12105 Donner Pass, Truckee (Nevada 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 electric vehicle drivers.

Keywords: California Energy Commission, FirstElement Fuel, Inc., hydrogen-refueling station, hydrogen infrastructure, fuel cell electric vehicles.

Please use the following citation for this report:

Brown, Tim. (FirstElement Fuel, Inc.). 2019. *Truckee Hydrogen Station.*

California Energy Commission. Publication Number: CEC-600-2019-013.

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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 the specific actions to bring fuel cell electric vehicles to California markets 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. FCEV 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. 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 fuel cell electric vehicles. 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 19 stations. The Energy Commission contributed $1,451,000 of the total $2,181,195 cost to design, engineer, permit, construct, and commission this station.

The site selected for this project was 12105 Donner Pass, Truckee (Nevada County). A hydrogen refueling station at this location will serve as a destination and early market station in Northern California for at least the next 10 years.

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

FirstElement Fuel, Inc. developed the site configuration and design, and Black & Veatch performed the detailed engineering design. The zoning process in Truckee was administrative, and approval was granted February 28, 2015. Permits for zoning, building, mechanical, electrical, plumbing, and fire were finalized May 28, 2015.

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. MIT Engineering and Construction from Oceanside 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 in Truckee. Construction began on June 22, 2015, and was completed March 28, 2016.

Commissioning began March 31, 2016, and was completed May 1, 2016. The FirstElement Fuel, Inc. team performed the bulk of the commissioning tasks including cleaning, purging, and pressure testing, with Air Products Chemicals, Inc. performing final start-up.

CHAPTER 1:
Station Design and Construction

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

Site Acquisition - Construction (Fall 2013 – March 2016)

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 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.

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 12105 Donner Pass, Truckee, California on January 20, 2014. A binding 10-year-lease was later executed on December 23, 2014.

FirstElement Fuel, Inc. selected Air Products Chemicals Inc., (Air Products) equipment because of the cost, capacity, reliability, and more mature supply chain 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 for the equipment on September 16, 2014, and equipment was delivered to the site on February 10, 2016.

FirstElement Fuel, Inc. and Black & Veatch surveyed the site to begin the site layout August 12, 2014. They generated initial engineering drawings on October 20, 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 detail and serves only to outline the site plan.

On October 27, 2014, Clark Survey performed a detailed engineering survey for the Truckee station site, as shown in Figure 2.

On March 6, 2015, 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 accuracy and completeness. The equipment compound page of the zoning drawings is shown in

Figure 3.

On April 1, 2015, draft final construction drawings (or "Construction Drawing 90s") were completed that depict all the details required for both construction and the permit review. Final construction drawings (or "Construction Drawing 100s") were completed, with 60 pages that depict all the details required for both construction and the permit review on July 7, 2015. These drawings are similarly signed and sealed by the professional engineer of record to

ensure accuracy and completeness. The equipment compound page of the Construction Drawing 100 set is shown in

Figure 4.

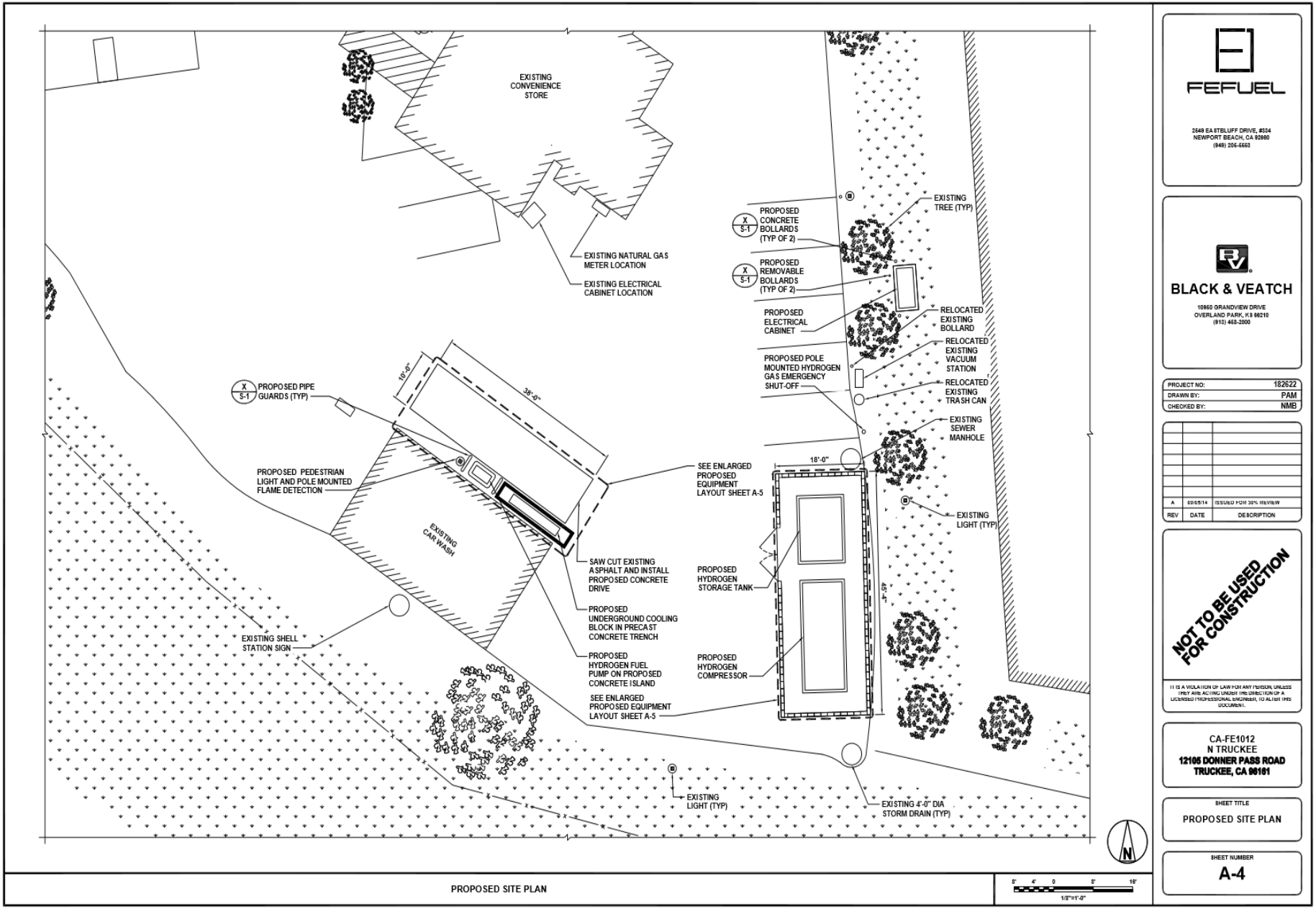
FirstElement Fuel, Inc. and Black & Veatch submitted the zoning application to the appropriate jurisdiction November 12, 2014. The local planning department must verify that the project meets the zoning requirements of the proposed location and approve any aesthetic, landscaping, or other details that are important to the community. Approval was received through an administrative process on February 28, 2015.

All building permit applications were submitted on April 13, 2015, and approved on May 28, 2015.

FirstElement Fuel, Inc. and Black & Veatch submitted a detailed bid package to contractors on June 1, 2015. The contract was awarded to MIT on June 9, 2015. The bulk of MIT's construction experience lies in gasoline station construction. MIT provided a reasonable bid, had a desire to get involved with hydrogen projects, and had a willingness to work in Truckee. Construction started June 22, 2015.

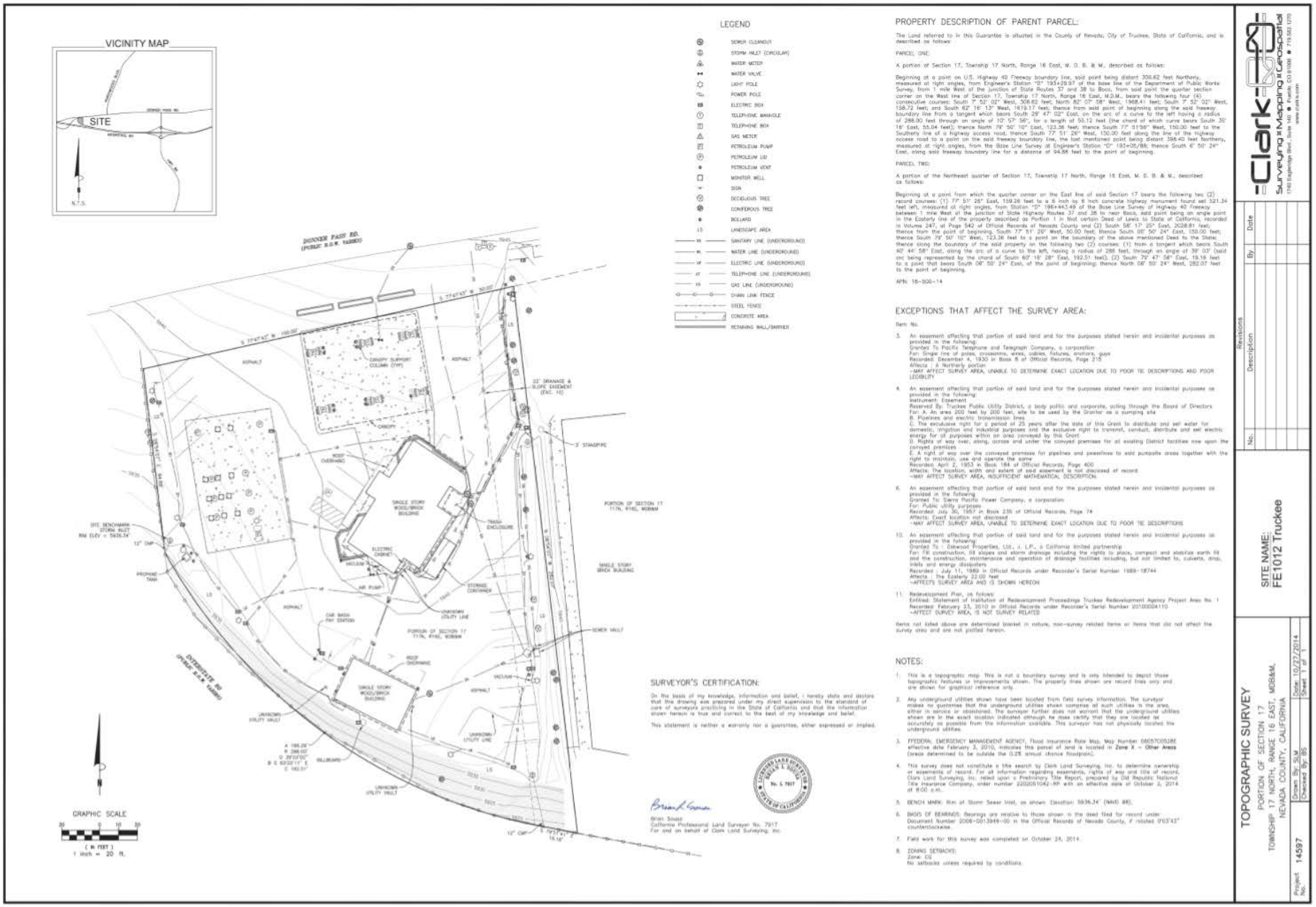
The Truckee Donner Public Utility installed the necessary utility upgrades ahead of schedule. Construction progressed smoothly, in part because of the time spent throughout the project to gain a common understanding of project requirements, especially those listed in the National Fire Protection Association hydrogen technologies code. Construction was completed on March 28, 2016.

Figure 1: Coarse Detail of Equipment Compound From Construction Drawing 30



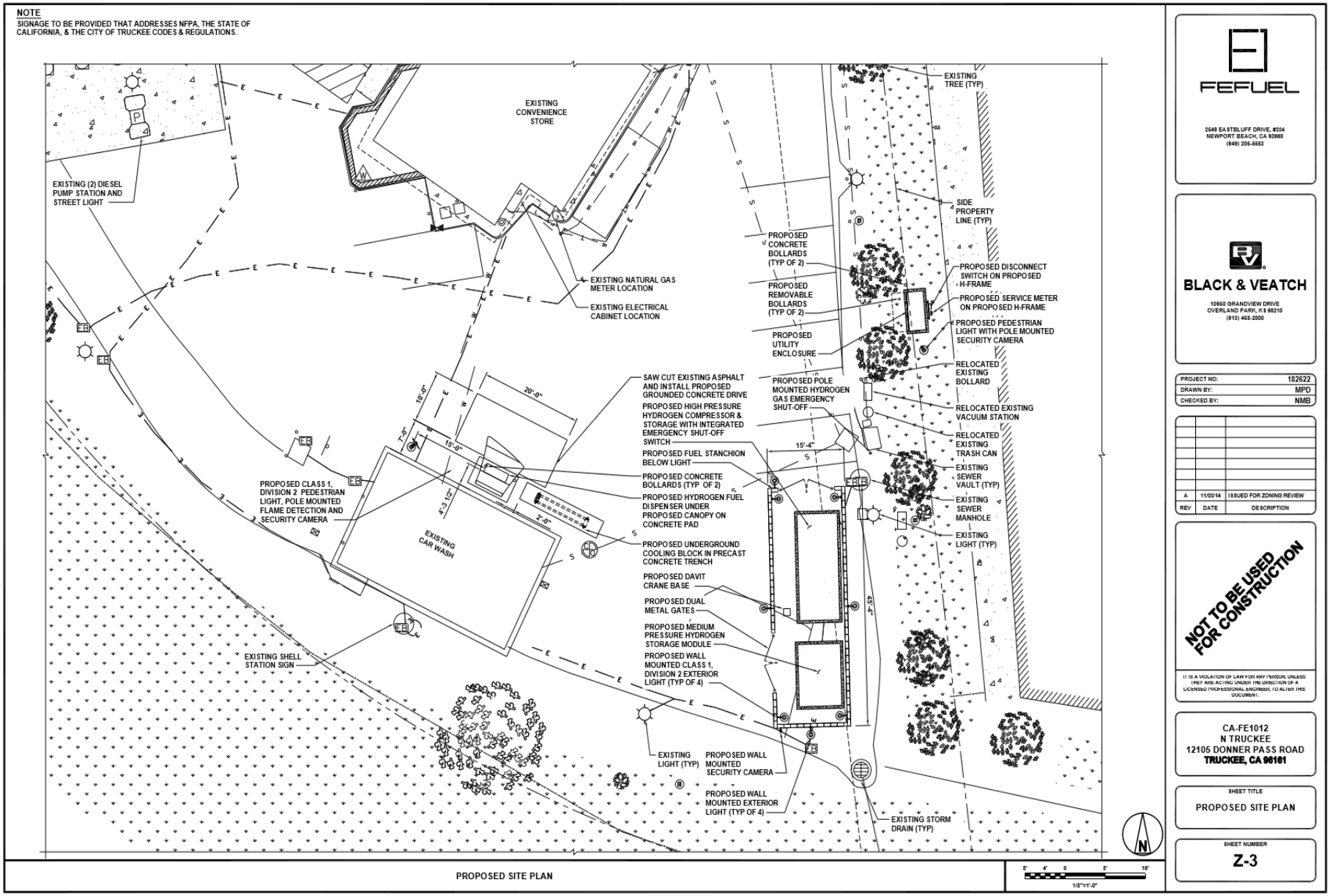
Source: FirstElement Fuel, Inc. Original figure is higher resolution

Figure 2: Survey of Truckee Hydrogen Station Location



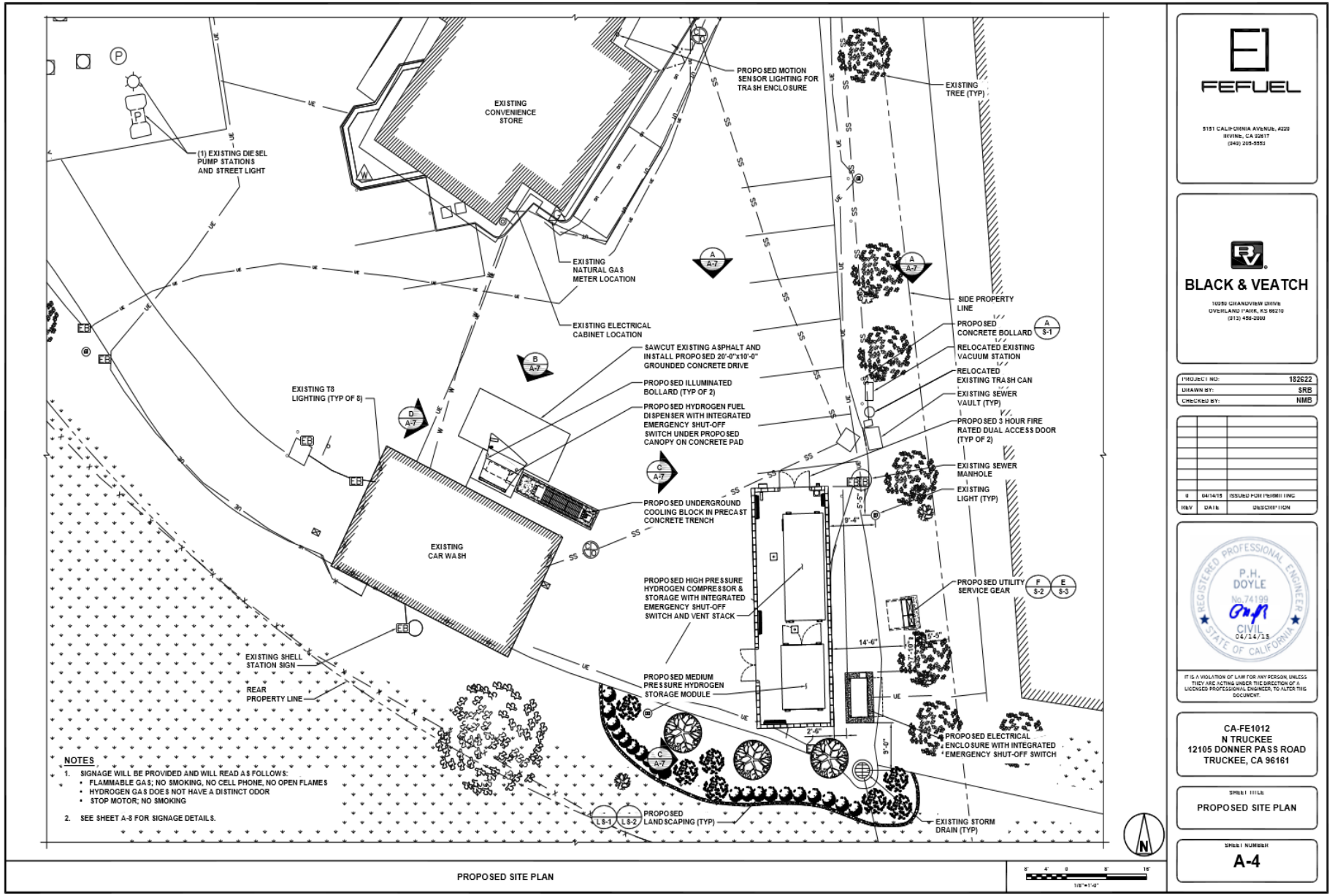
Source: FirstElement Fuel, Inc. Original figure is higher resolution

Figure 3: Equipment Compound From Construction Drawing 30 Set



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

Figure 4: Equipment Compound From Construction Drawing 100 Set



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

Figure 5 shows the equipment wiring in progress.

Figure 5: Wiring Installation in Truckee

Source: FirstElement Fuel, Inc.

Hydrogen storage, compression (Figure 6), cooling, and dispensing equipment was delivered to the site February 10, 2016, and set in place.

Figure 6: Crane Lifting Hydrogen Compressor Unit

Source: FirstElement Fuel, Inc.

Making the Station Operational (March 31, 2016 – May 1, 2016)

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

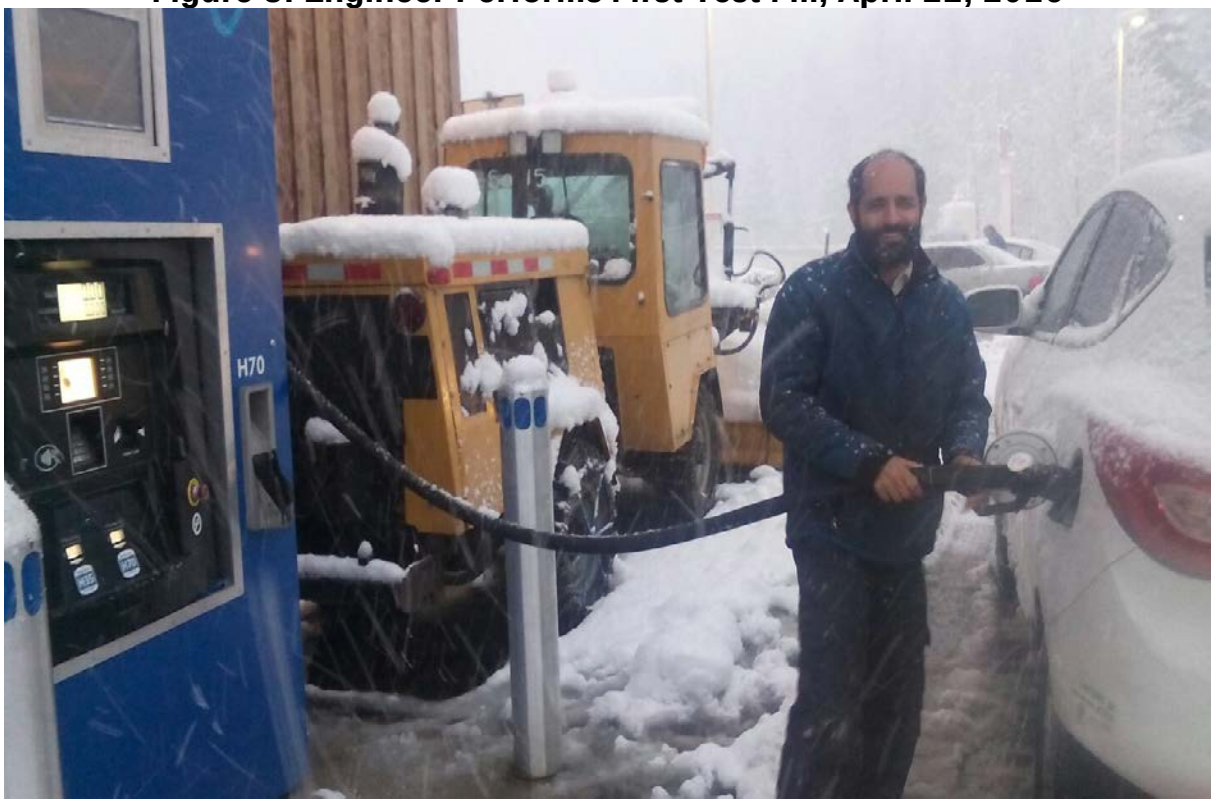
Station Declared Operational (April 22, 2016)

The Truckee hydrogen station met the definition of operational in PON-13-607 by completing installation of all station/dispenser components, obtaining all the required permits from the local jurisdiction, filling the station storage tubes with pressurized hydrogen gas (Figure 7), fueling one fuel cell electric vehicle with hydrogen (Figure 8), and successfully passing a hydrogen quality test (Figure 9). FirstElement Fuel, Inc. declared the station operational on April 22, 2016.

Figure 7: Engineer Performs Pressure Testing

Source: FirstElement Fuel, Inc.

Figure 8: Engineer Performs First Test Fill, April 22, 2016



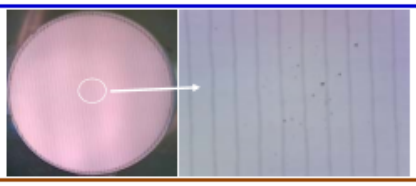
Source: FirstElement Fuel, Inc.

Figure 9: Hydrogen Fuel Quality Report on April 19, 2016

www.SmartChemistry.com

FIRST ELEMENT FUEL — TRUCKEE HYDROGEN STATION

SAE J2719	SAE J2719 Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)	H70 H2 @Nozzle sampled on 04/19/2016 Concentration (µmol/mol)	Analytical Method
Water	5	1	**1.1**	
Total Hydrocarbons (C_1 Basis)	2	1	**0.13**	ASTM D7892
Methane			0.11	
Acetone			0.0075	
Ethanol			0.0094	
Oxygen	5	1	< 1	ASTM D7649
Helium	300	10	< 10	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		2	< 2	ASTM D7649
Argon		0.4	< 0.4	ASTM D7649
Carbon Dioxide	2	0.5	< 0.5	ASTM D7649
Carbon Monoxide	0.2	0.0005	**0.0016**	ASTM D5466
Total Sulfur	0.004	0.000001	**0.000121**	ASTM D7652
Hydrogen Sulfide		0.000001	0.00011	ASTM D7652
Carbonyl Sulfide		0.000001	0.000011	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	< 0.00001	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		**0.0011**	
Hydrogen Bromide		0.003	< 0.003	ASTM D5466
Hydrogen Chloride		0.002	< 0.002	ASTM D5466
Chlorine		0.0008	< 0.0008	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	0.0011	ASTM D7892
Tetrachloro-hexafluorobutanes			0.0011	
Particulate Concentration			**0.0060 mg/kg**	ASTM D7651
Particulates Found & Size			27 Particulates found with sizes in µm: 148, 138, 114, 92, 90, 86 (2), 69 (2), 67 (2), 61, 59 (2), 54, 53, 47 (2), 46 (2), 45, 43, 42, 39, 29 (2) & 26.	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)			**99.99988%**	



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

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

Certification (May 6, 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. Figure 10 shows that 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 (EPO NO. 40-A)[1] as witnessed by the local county weights and measures officer.

Figure 10: Group Effort for Certification at Truckee Hydrogen Station

Source: FirstElement Fuel, Inc.

Station Operational Status System

The California Fuel Cell Partnership, Station Operational Status System is a website portal[2] designed to provide hydrogen station status for motorist use. 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 San Jose hydrogen station began sending automated updates (FirstElement Fuel, Inc. software) on a regular basis, to the online portal on June 17, 2016.

Environmental Impacts

Hydrogen will be stored as a compressed gas in an aboveground tank concealed behind a wall at this station. In accordance with the funding agreement with the Energy Commission, 33.3

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[1] Examination Procedure

(https://www.cdfa.ca.gov/dms/programs/devices/Hydrogen_Gas-Measuring_Devices_EPO-40.pdf)

[2] System Operation Portal (https://m.cafcp.org/)

percent of the hydrogen sold at the Playa Del Rey 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 a leak occurs. No solid or liquid waste will be produced at the Truckee station.

Minimal water was consumed for this project. There was minimal additional landscaping added for the construction of the hydrogen refueling station; therefore, little additional irrigation water will be used.

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 ease evening fueling and accessibility of the station by FCEV drivers.

Truckee Station in the Network

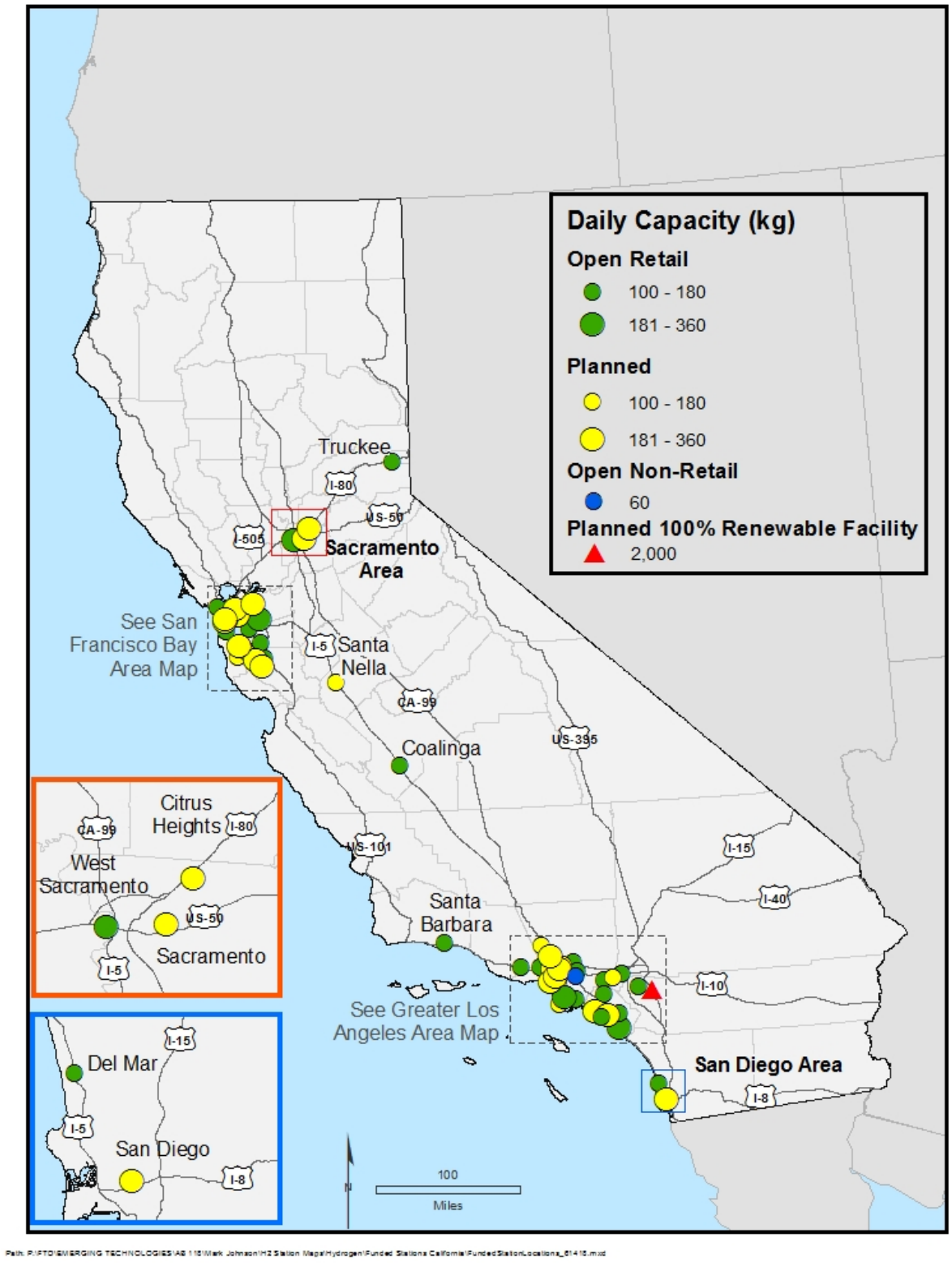
The Truckee hydrogen station is ready to open, as shown in Figure 11.

Figure 11: Truckee Hydrogen Station

Source: FirstElement Fuel, Inc.

Figure 12 shows the location of the Truckee hydrogen station located at 12105 Donner Pass, Truckee, as a destination and early market station in Northern California.

Figure 12: Truckee Hydrogen Station Location

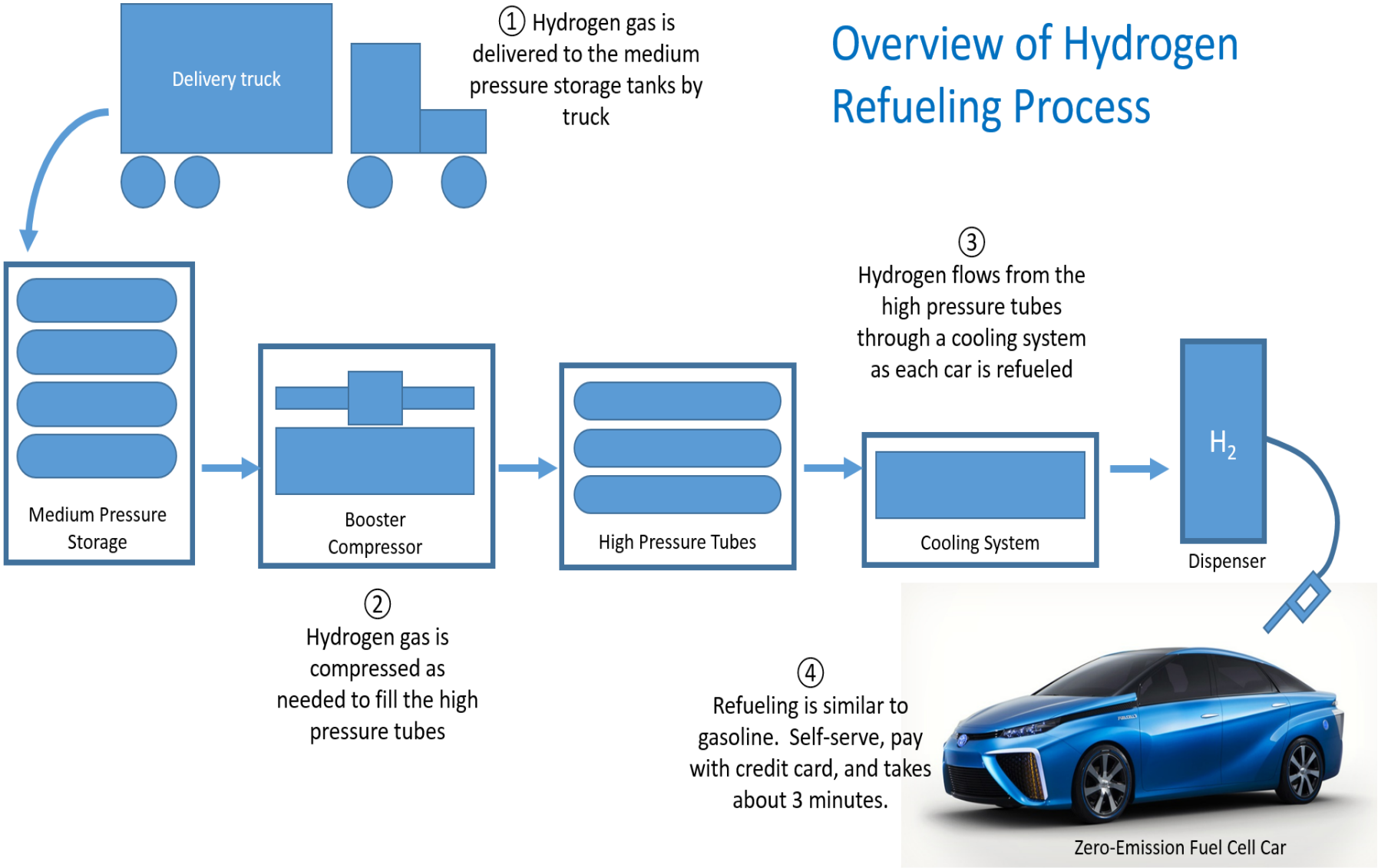


Source: California Energy Commission Staff

Schematic Layout of the Truckee Station

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

Figure 13: Diagram of the Refueling Process

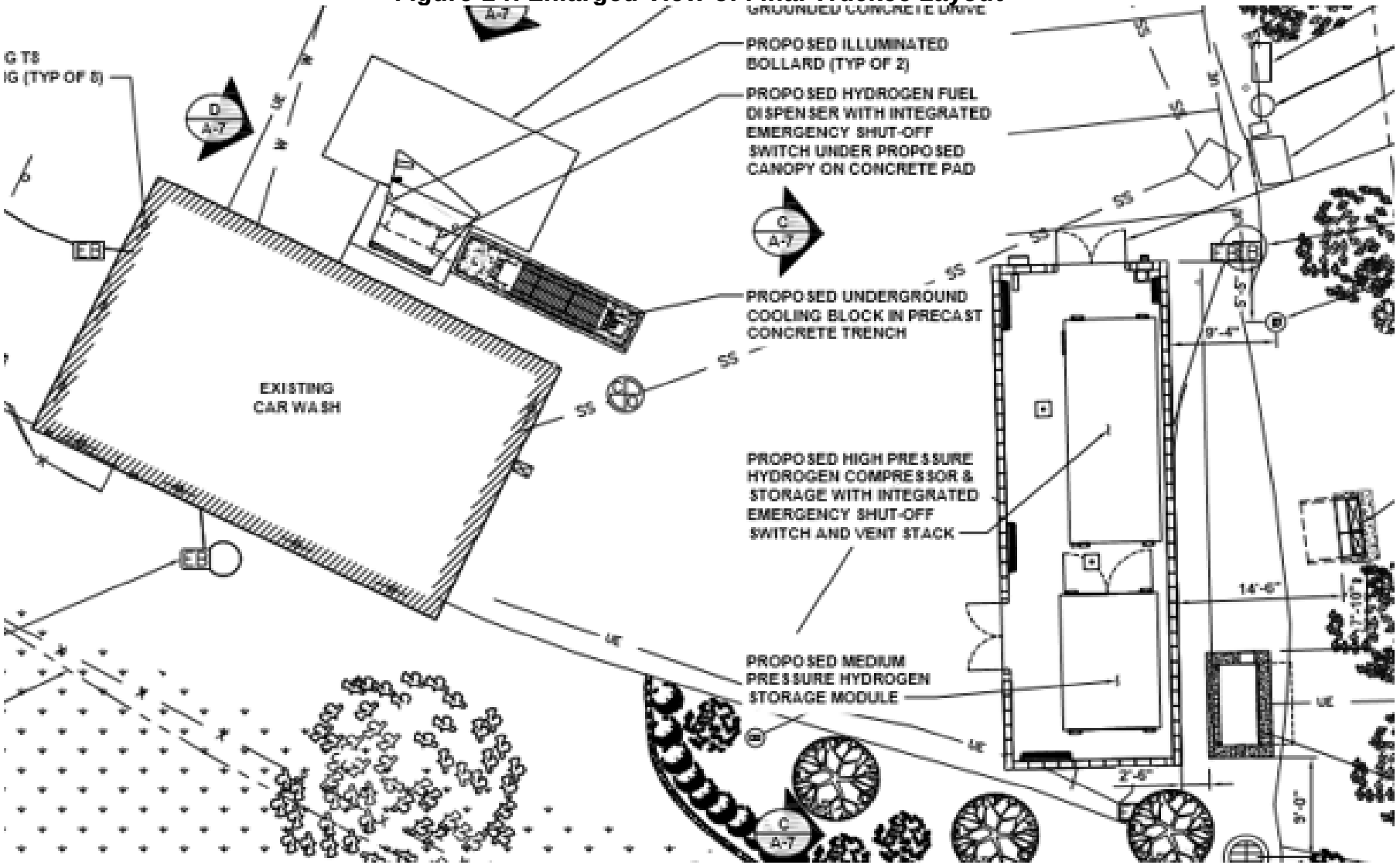


Source: FirstElement Fuel, Inc.

Final Configuration and Budget

Figure 14 shows the final, as-built configuration of the Truckee hydrogen station.

Figure 14: Enlarged View of Final Truckee Layout



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

Figure 15 shows the budget to construct the Truckee hydrogen station.

Figure 15: The Project Grant Funding and Match Funding

Air Products and Chemicals, Inc., Allentown , PA	
H2 station equipment	$1,479,873.55
Black & Veatch, Overland Park, KS	
Construction	$517,015.15
Engineering	$46,259.20
Permitting	$35,626.32
Project Management	$18,197.53
Various Vendors	
Construction Materials (tubing, wire, etc.)	$13,652.81
Fixtures (doors, lights, etc.)	$50,721.78
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	$2,181,195.06
CEC Grant	$1,451,000.00
Remaining match funding provided by FirstElement Fuel, Inc.	$730,195.06
Total CEC cost share	66.5%

Source: FirstElement Fuel, Inc.

CHAPTER 2:
Energy Analysis

The Truckee 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):

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

Per California Senate Bill (SB) 1505 (Lowenthal, Chapter 877, Statutes of 2006) and PON-13-607, which funded this project, at least one-third of the hydrogen sold by state funded hydrogen refueling stations will be produced from renewable sources. Hydrogen is supplied to the hydrogen refueling stations from Air Products' hydrogen production facilities in Wilmington/Carson (Los Angeles County). 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 Senate Bill 1505 (sources of biogas shown in Table 1). Renewable hydrogen at 100 percent is achievable through the same supply pathway, however at a higher cost.

Table 1: Renewable Biomethane Supply Sources

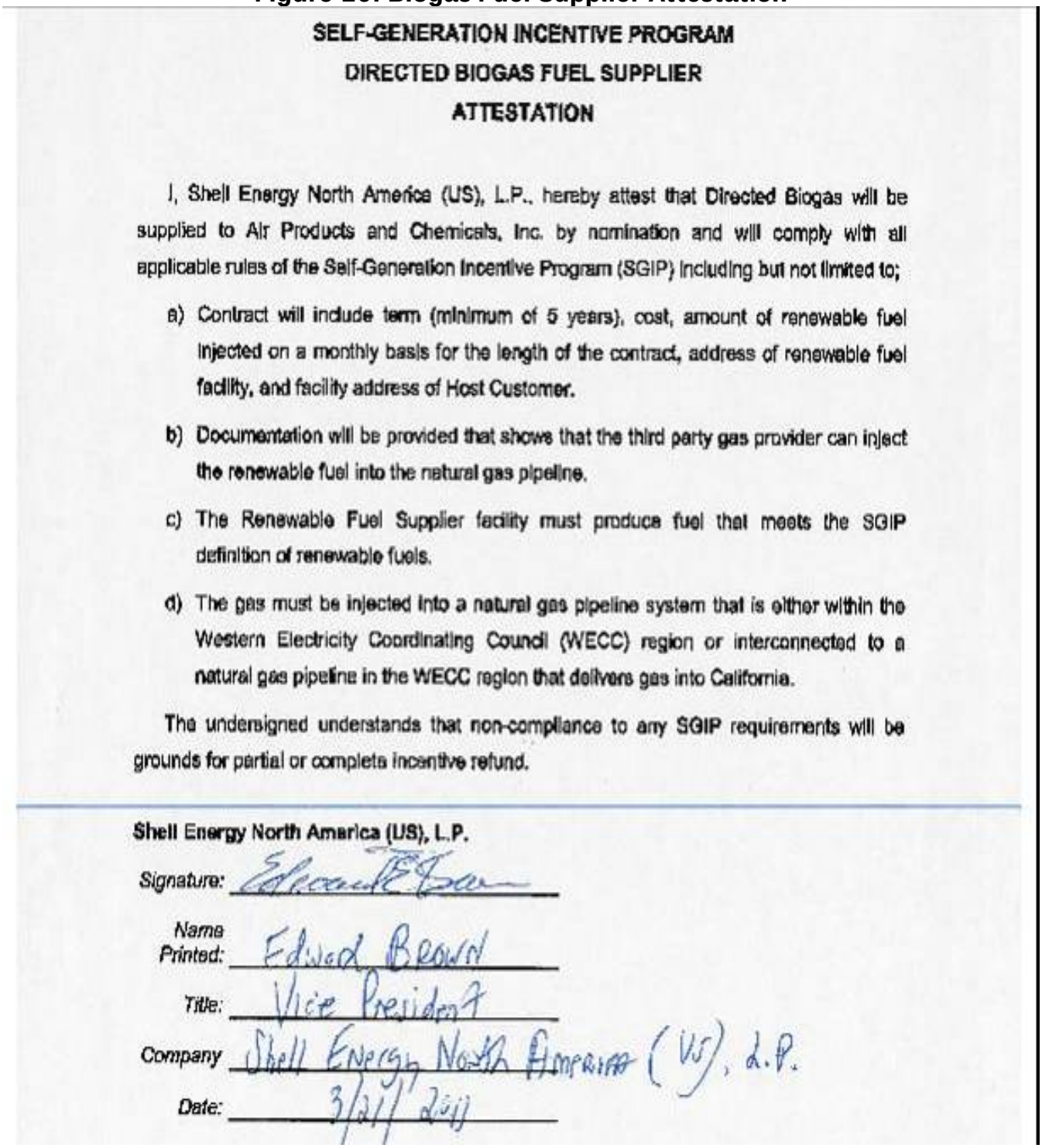
Shell Energy North America (US), L.P.

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 has a contract for sourcing of the renewable biogas that meets Public Resources Code Section 2574(b)(1); documentation is provided in Figure 16. Although California has a substantial amount of biogas, local supply cannot be injected into California pipelines under California Health & Safety Code Section 25420. Air Products' biogas supply for this project is being sourced outside 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 16: Biogas Fuel Supplier Attestation



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 Brown

Name Printed: Edward Brown

Title: Vice President

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

Date: 3/21/2011

Source: FirstElement Fuel, Inc.

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

The Truckee hydrogen station can dispense 180 Kilograms/day. Assuming that FCEVs average 52 mile/Kilograms according to *The Greenhouse Gases, Regulated Emissions, and Energy Use*

in Transportation Model[3], and consumption of 180 Kilograms/day for the next 10 years, the station will offset 8,384 metric tons of total GHGs compared to equivalent gasoline vehicles. Furthermore, the Truckee hydrogen station will replace more than 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-17-035) for operations and maintenance funding support through the Energy Commission, 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] GREET® Model (https://greet.es.anl.gov/).

CHAPTER 3:
Future Activities

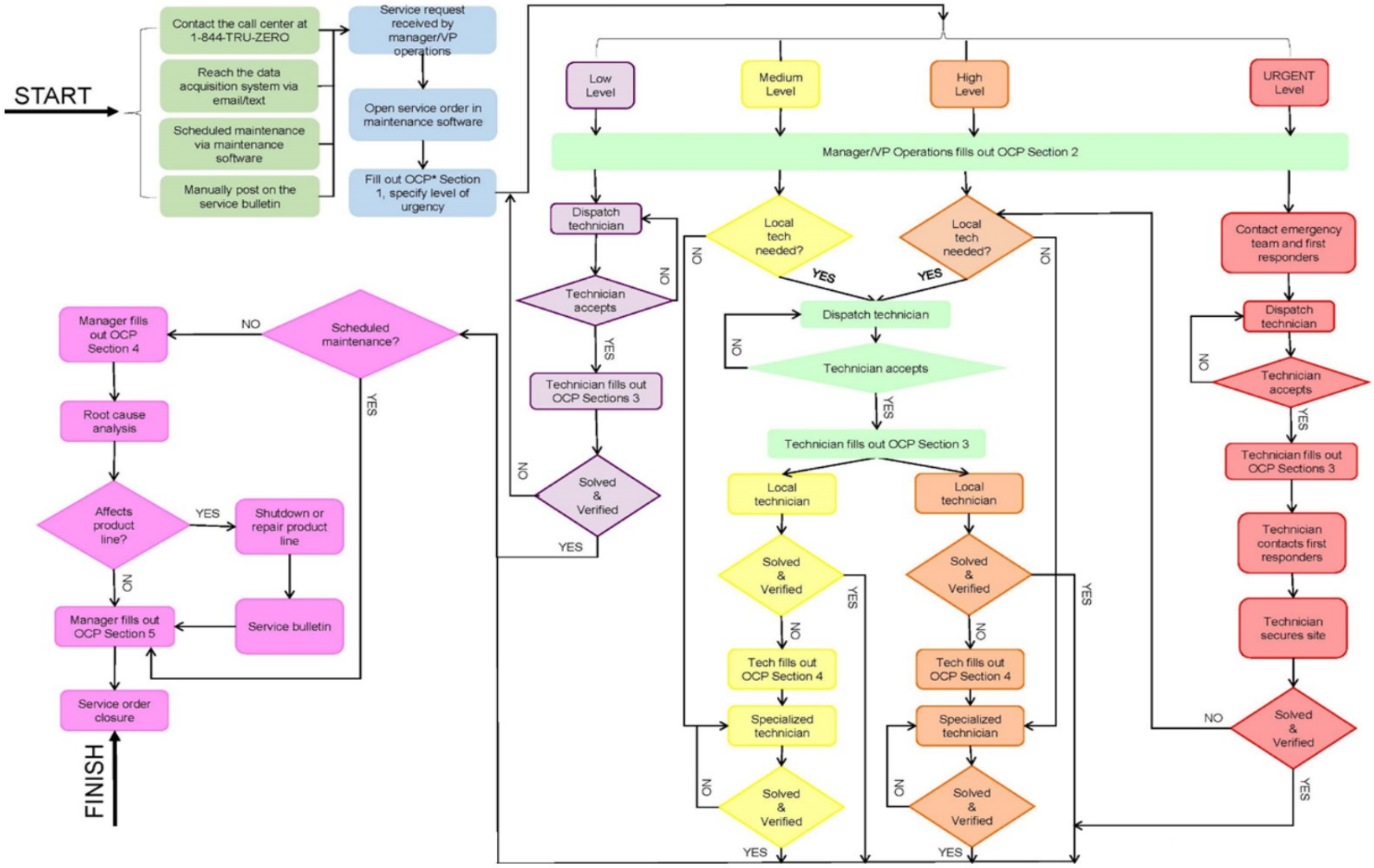
FirstElement Fuel, Inc. intends to own and operate the Truckee refueling station for at least 10 years. FirstElement Fuel, Inc. has invested substantial capital to build the station and will require many years of operation to recoup the development costs. FirstElement Fuel, Inc. has executed an initial 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 17 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 18 shows a screenshot of one page of the remote monitoring 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 a day.

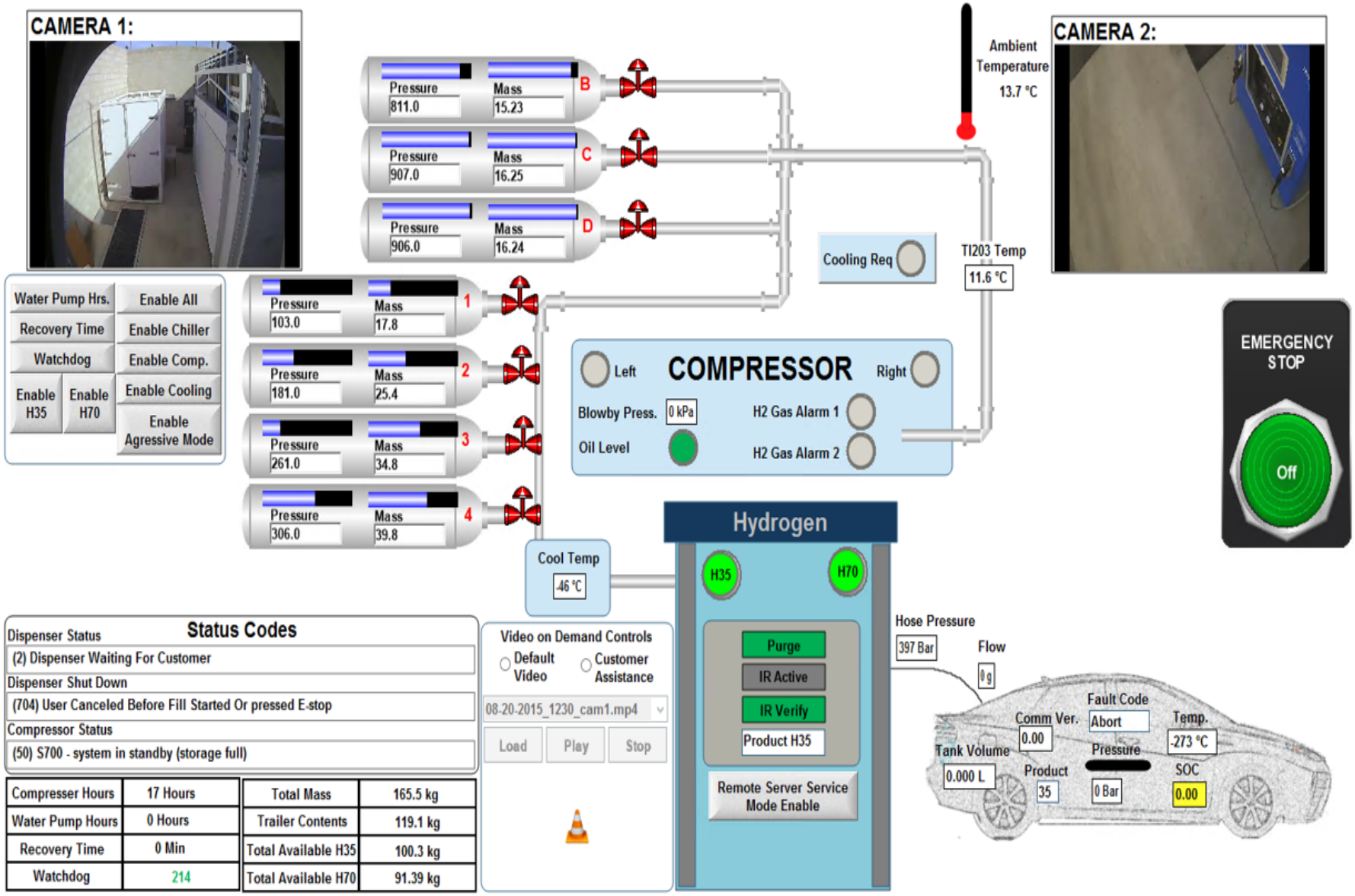
In addition to remote monitoring, FE has implemented rigorous computerized maintenance management systems and enterprise asset management systems to schedule and track maintenance, repairs, and inventory. The work orders will be generated, completed, and logged for all maintenance and repair activities in the computerized maintenance management systems and enterprise asset management systems. This will help maximize station up-time and enable tracking of key performance indicators.

Figure 17: FirstElement Fuel, Inc. Response Flow Chart



Source: FirstElement Fuel, Inc.

Figure 18: Screenshot of Remote Monitoring System



Source: FirstElement Fuel, Inc.

CHAPTER 4: Conclusions

The following considers findings from the 33.3 percent renewable hydrogen Truckee hydrogen refueling station project.

The relatively small, independent jurisdiction in Truckee (Nevada County) was a pleasure to work with and welcomed green, hydrogen development with open arms.

Unlike any other project completed to date, the Truckee Donner Public Utility installed the necessary utility upgrades ahead of schedule.

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 CEC's five major areas of responsibilities are:

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

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

CARBON DIOXIDE (CO_2)—A colorless, odorless, nonpoisonous 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. CO_2 is the greenhouse gas whose concentration is being most affected directly by human activities. CO_2 also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

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 GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_x), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).