CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

San Jose Hydrogen Station

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

Gavin Newsom, Governor

May 2019 | CEC-600-2019-017

California Energy Commission

Tim Brown
Patti Kohler
Primary Authors

FirstElement Fuel, Inc.
5155 California Ave., Suite 220
Irvine, CA 92617
www.firstelementfuel.com

Agreement Number: ARV-14-013

Mark Johnson
Commission Agreement Manager

Mark Wenzel
Office Manager
ADVANCED VEHICLE INFRASTRUCTURE OFFICE

Kevin Barker
Deputy Director
FUELS AND TRANSPORTATION

Drew Bohan
Executive Director

ACKNOWLEDGEMENTS

The construction of the San Jose 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 Aliantel 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, Vice Chair Janea Scott, and many others at the California Energy Commission for tremendous, sustained confidence in clean, alternative transportation.

PREFACE

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

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

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

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-13-607 to provide funding opportunities under the Clean Transportation Program for hydrogen refueling stations. In response to PON-13-607, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards on May 1, 2014. 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 2101 North First Street, San Jose (Santa Clara 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, San Jose.

Please use the following citation for this report:

Brown, Tim. (FirstElement Fuel, Inc.). 2019. *San Jose Hydrogen Station.* California Energy Commission. Publication Number: CEC-600-2019-017.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Page

EXECUTIVE SUMMARY

Hydrogen fuel cell electric vehicles (FCEV) 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 FCEV 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 FCEV to California markets are specified in the Governor's *Zero Emission Vehicle Action Plan*.

Hydrogen fuel cell electric drive technology offers tremendous potential for the light-duty passenger vehicle market and medium- and heavy-duty truck and bus markets. Fuel cell electric passenger vehicles can drive more than 300 miles on a tank of hydrogen and can be refueled in 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 sports utility vehicles, 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.

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 CEC's Clean Transportation Program. The bill directs the CEC to allocate up to $20 million per year, or up to 20 percent of each fiscal year's available funding, to develop hydrogen refueling stations "until there are at least 100 publicly available hydrogen-fueling stations in operation in California" (Health and Safety Code 43018.9[e][1]).

The site selected for this project is 2101 North First Street, San Jose (Santa Clara County). A hydrogen refueling station at this location will serve as a core station in Northern California for at least the next 10 years. FirstElement Fuel, Inc. accomplished this goal through the steps outlined below.

The CEC contributed $1,451,000 of the total $2,269,760 cost to design, engineer, permit, construct, and commission the station.

The owner at San Jose is excited to bring a clean, alternative fuel to his station. Lease terms were negotiated, and FirstElement Fuel, Inc. and the San Jose owner executed a lease on March 4, 2014.

FirstElement Fuel, Inc. developed the site configuration and design, and Black & Veatch performed the detailed engineering design. The zoning process in San Jose did not require a public hearing, and approval was granted May 6, 2015.

Permits for zoning, building, mechanical, electrical, plumbing, and fire were filed December 5, 2014 and finalized August 5, 2015. Because the San Jose station is located close to a neighboring property line, the fire authority in this jurisdiction required an additional wall to

ensure the proper protection was met. The permitting process from application to finalization took a total of 243 days.

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 Murrieta, 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 October 30, 2015 for a construction time of 77 days from operational status to open-for-retail status.

Station commissioning began on October 26, 2015 and was complete on October 30, 2015. The FirstElement Fuel, Inc. team performed all of the commissioning tasks including cleaning, purging, and pressure testing and final start-up.

CHAPTER 1: Station Design and Construction

The following summarizes the steps required to bring the San Jose hydrogen refueling station project to completion.

Site Acquisition - Construction (Fall 2013 – October 2015)

Beginning in the fall of 2013, First Element 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 designated within the CEC's PON-13-607 solicitation 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. FirstElement Fuel, Inc. executed a letter of intent with the property owner of 2101 North First Street, San Jose (Santa Clara County) on February 1, 2014. A binding 10-year lease was later executed on March 4, 2014.

FirstElement Fuel, Inc. selected Air Products equipment because of the cost, capacity, reliability, and more mature supply chain as compared to other suppliers as detailed in the FirstElement Fuel, Inc. PON-13-607 application. FirstElement Fuel, Inc. executed a contract with Air Products for the equipment on September 16, 2014 and equipment was delivered to the site on October 2, 2015.

FirstElement Fuel, Inc. and Black & Veatch surveyed the site to begin the site layout on August 12, 2014. They generated initial engineering drawings on September 25, 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 details and serves only to outline the site plan.

On October 29, 2014, Clark Survey performed a detailed engineering survey for the San Jose station site, as shown in Figure 2.

On June 8, 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.

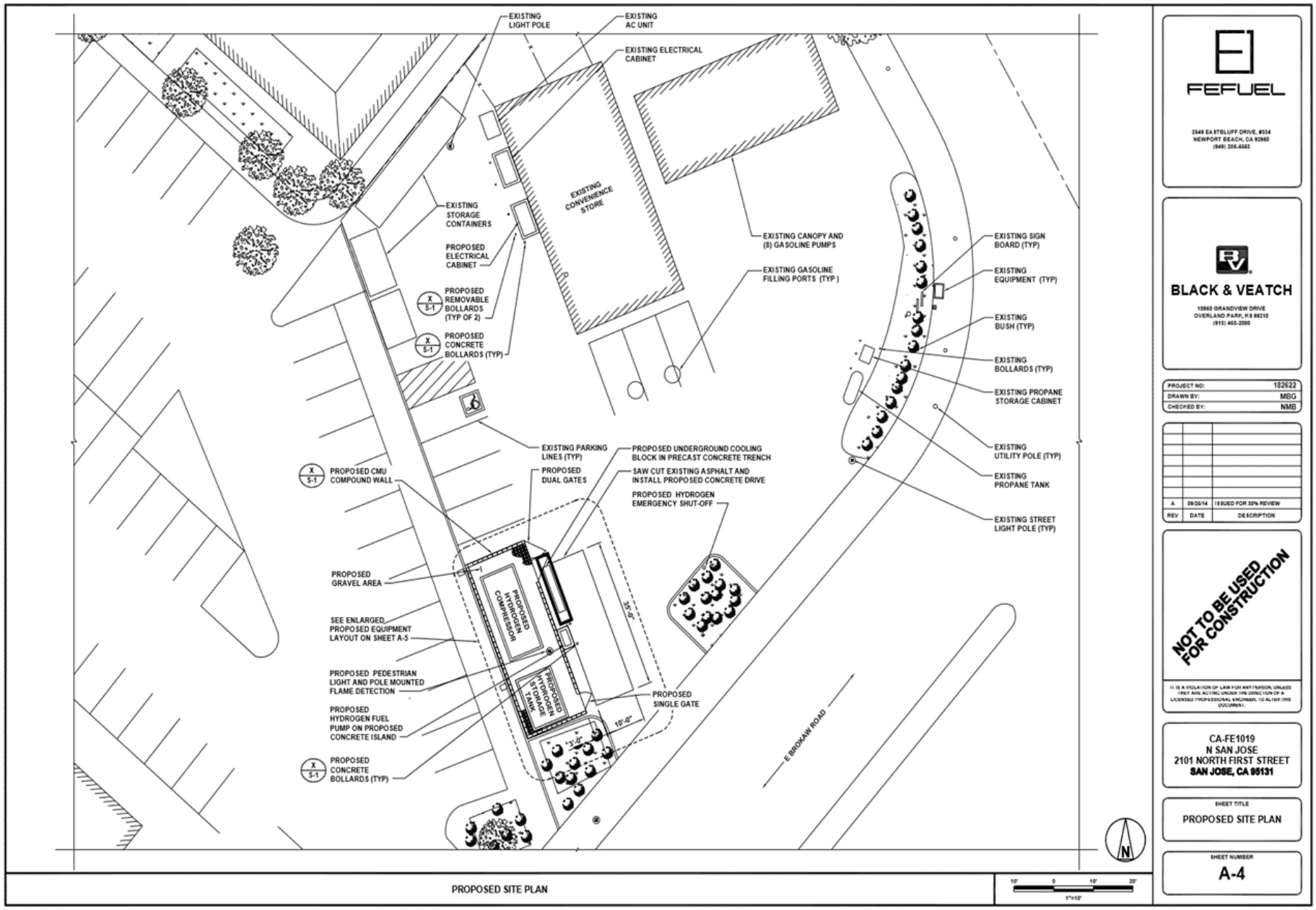
Because the site location is close to a property line, special consideration was required to obtain the fire permit. The local jurisdiction required an extra length of firewall on the equipment compound.

The local jurisdiction initially requested FirstElement Fuel, Inc. to perform substantial additional site work, including widening sidewalks and utility upgrades estimated to cost over $150,000. Thanks to hard work by the CEC and GoBiz, FirstElement Fuel, Inc. was able to negotiate with the city of San Jose to remove these provisions.

On May 18, 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

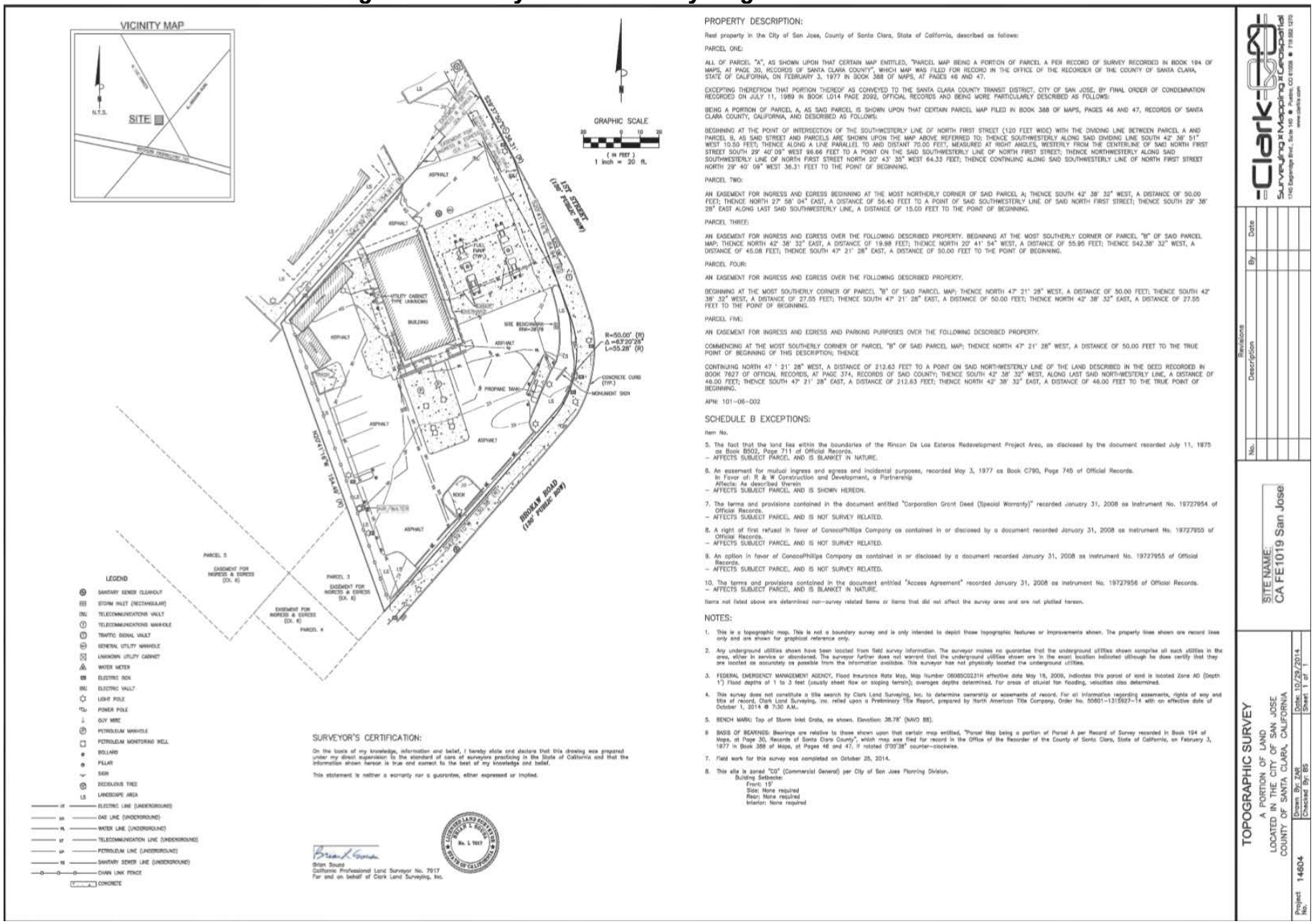
construction drawings (or “construction drawing 100s”) were completed with 60 pages that depict all the details required for both construction and the permit review on August 4, 2015. These drawings are similarly signed and sealed by the professional engineer of record to ensure accuracy and completeness. The equipment compound page of the construction drawing 100 set is shown in Figure 4.

Figure 1: Coarse Detail of Equipment Compound



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

Figure 1: Survey of San Jose Hydrogen Station Location



PROPERTY DESCRIPTION:

Real property in the City of San Jose, County of Santa Clara, State of California, described as follows:

PARCEL ONE:

ALL OF PARCEL "A", AS SHOWN UPON THAT CERTAIN MAP ENTITLED, "PARCEL MAP BEING A PORTION OF PARCEL A PER RECORD OF SURVEY RECORDED IN BOOK 194 OF MAPS, AT PAGE 30, RECORDS OF SANTA CLARA COUNTY", WHICH MAP WAS FILED FOR RECORD IN THE OFFICE OF THE RECORDER OF THE COUNTY OF SANTA CLARA, STATE OF CALIFORNIA, ON FEBRUARY 3, 1977 IN BOOK 388 OF MAPS, AT PAGES 46 AND 47.

EXCEPTING THEREFROM THAT PORTION THEREOF AS CONVEYED TO THE SANTA CLARA COUNTY TRANSIT DISTRICT, CITY OF SAN JOSE, BY FINAL ORDER OF CONDEMNATION RECORDED ON JULY 11, 1989 IN BOOK L014 PAGE 2092, OFFICIAL RECORDS AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEING A PORTION OF PARCEL A, AS SAID PARCEL IS SHOWN UPON THAT CERTAIN PARCEL MAP FILED IN BOOK 388 OF MAPS, PAGES 46 AND 47, RECORDS OF SANTA CLARA COUNTY, CALIFORNIA, AND DESCRIBED AS FOLLOWS:

BEGINNING AT THE POINT OF INTERSECTION OF THE SOUTH-WESTERLY LINE OF NORTH FIRST STREET (120 FEET WIDE) WITH THE DIVIDING LINE BETWEEN PARCEL A AND PARCEL B, AS SAID STREET AND PARCELS ARE SHOWN UPON THE MAP ABOVE REFERRED TO; THENCE SOUTHWESTERLY ALONG SAID DIVIDING LINE SOUTH 42° 38' 51" WEST 10.50 FEET; THENCE ALONG A LINE PARALLEL TO AND DISTANT 70.00 FEET, MEASURED AT RIGHT ANGLES, WESTERLY FROM THE CENTERLINE OF SAID NORTH FIRST STREET SOUTH 29° 40' 09" WEST 96.66 FEET TO A POINT ON THE SAID SOUTHWESTERLY LINE OF NORTH FIRST STREET; THENCE NORTHWESTERLY ALONG SAID SOUTHWESTERLY LINE OF NORTH FIRST STREET NORTH 20° 43' 35" WEST 64.33 FEET; THENCE CONTINUING ALONG SAID SOUTHWESTERLY LINE OF NORTH FIRST STREET NORTH 29° 40' 09" WEST 36.31 FEET TO THE POINT OF BEGINNING.

PARCEL TWO:

AN EASEMENT FOR INGRESS AND EGRESS BEGINNING AT THE MOST NORTHERLY CORNER OF SAID PARCEL A; THENCE SOUTH 42° 38' 32" WEST, A DISTANCE OF 50.00 FEET; THENCE NORTH 27° 58' 04" EAST, A DISTANCE OF 56.40 FEET TO A POINT OF SAID SOUTHWESTERLY LINE OF SAID NORTH FIRST STREET; THENCE SOUTH 29° 38' 28" EAST ALONG LAST SAID SOUTHWESTERLY LINE, A DISTANCE OF 15.00 FEET TO THE POINT OF BEGINNING.

PARCEL THREE:

AN EASEMENT FOR INGRESS AND EGRESS OVER THE FOLLOWING DESCRIBED PROPERTY. BEGINNING AT THE MOST SOUTHERLY CORNER OF PARCEL "B" OF SAID PARCEL MAP; THENCE NORTH 42° 38' 32" EAST, A DISTANCE OF 19.98 FEET; THENCE NORTH 20° 41' 54" WEST, A DISTANCE OF 55.95 FEET; THENCE S42.38' 32" WEST, A DISTANCE OF 45.08 FEET; THENCE SOUTH 47° 21' 28" EAST, A DISTANCE OF 50.00 FEET TO THE POINT OF BEGINNING.

PARCEL FOUR:

AN EASEMENT FOR INGRESS AND EGRESS OVER THE FOLLOWING DESCRIBED PROPERTY.

BEGINNING AT THE MOST SOUTHERLY CORNER OF PARCEL "B" OF SAID PARCEL MAP; THENCE NORTH 47° 21' 28" WEST, A DISTANCE OF 50.00 FEET; THENCE SOUTH 42° 38' 32" WEST, A DISTANCE OF 27.55 FEET; THENCE SOUTH 47° 21' 28" EAST, A DISTANCE OF 50.00 FEET; THENCE NORTH 42° 38' 32" EAST, A DISTANCE OF 27.55 FEET TO THE POINT OF BEGINNING.

PARCEL FIVE:

AN EASEMENT FOR INGRESS AND EGRESS AND PARKING PURPOSES OVER THE FOLLOWING DESCRIBED PROPERTY.

COMMENCING AT THE MOST SOUTHERLY CORNER OF PARCEL "B" OF SAID PARCEL MAP; THENCE NORTH 47° 21' 28" WEST, A DISTANCE OF 50.00 FEET TO THE TRUE POINT OF BEGINNING OF THIS DESCRIPTION; THENCE

CONTINUING NORTH 47 ° 21' 28" WEST, A DISTANCE OF 212.63 FEET TO A POINT ON SAID NORTHWESTERLY LINE OF THE LAND DESCRIBED IN THE DEED RECORDED IN BOOK 7627 OF OFFICIAL RECORDS, AT PAGE 374, RECORDS OF SAID COUNTY; THENCE SOUTH 42° 38' 32" WEST, ALONG LAST SAID NORTHWESTERLY LINE, A DISTANCE OF 46.00 FEET; THENCE SOUTH 47° 21' 28" EAST, A DISTANCE OF 212.63 FEET; THENCE NORTH 42° 38' 32" EAST, A DISTANCE OF 46.00 FEET TO THE TRUE POINT OF BEGINNING.

APN: 101-06-002

SCHEDULE B EXCEPTIONS:

Item No.

5. The fact that the land lies within the boundaries of the Rincon De Los Esteros Redevelopment Project Area, as disclosed by the document recorded July 11, 1975 as Book B502, Page 711 of Official Records.
– AFFECTS SUBJECT PARCEL AND IS BLANKET IN NATURE.

6. An easement for mutual ingress and egress and incidental purposes, recorded May 3, 1977 as Book C790, Page 745 of Official Records.
In Favor of: R & W Construction and Development, a Partnership
Affects: As described therein
– AFFECTS SUBJECT PARCEL AND IS SHOWN HEREON.

7. The terms and provisions contained in the document entitled "Corporation Grant Deed (Special Warranty)" recorded January 31, 2008 as Instrument No. 19727954 of Official Records.
– AFFECTS SUBJECT PARCEL AND IS NOT SURVEY RELATED.

8. A right of first refusal in favor of ConocoPhillips Company as contained in or disclosed by a document recorded January 31, 2008 as Instrument No. 19727955 of Official Records.
– AFFECTS SUBJECT PARCEL AND IS NOT SURVEY RELATED.

9. An option in favor of ConocoPhillips Company as contained in or disclosed by a document recorded January 31, 2008 as Instrument No. 19727955 of Official Records.
– AFFECTS SUBJECT PARCEL AND IS NOT SURVEY RELATED.

10. The terms and provisions contained in the document entitled "Access Agreement" recorded January 31, 2008 as Instrument No. 19727956 of Official Records.
– AFFECTS SUBJECT PARCEL AND IS BLANKET IN NATURE.

Items not listed above are determined non-survey related items or items that did not affect the survey area and are not plotted hereon.

NOTES:

1. This is a topographic map. This is not a boundary survey and is only intended to depict those topographic features or improvements shown. The property lines shown are record lines only and are shown for graphical reference only.
2. Any underground utilities shown have been located from field survey information. The surveyor makes no guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned. The surveyor further does not warrant that the underground utilities shown are in the exact location indicated although he does certify that they are located as accurately as possible from the information available. This surveyor has not physically located the underground utilities.
3. FEDERAL EMERGENCY MANAGEMENT AGENCY, Flood Insurance Rate Map, Map Number 06085C0231H effective date May 18, 2009, indicates this parcel of land is located Zone AO (Depth 1') Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); averages depths determined. For areas of alluvial fan flooding, velocities also determined.
4. This survey does not constitute a title search by Clark Land Surveying, Inc. to determine ownership or easements of record. For all information regarding easements, rights of way and title of record, Clark Land Surveying, Inc. relied upon a Preliminary Title Report, prepared by North American Title Company, Order No. 55601-1315927-14 with an effective date of October 1, 2014 @ 7:30 A.M..
5. BENCH MARK: Top of Storm Inlet Grate, as shown. Elevation: 38.78' (NAVD 88).
6. BASIS OF BEARINGS: Bearings are relative to those shown upon that certain map entitled, "Parcel Map being a portion of Parcel A per Record of Survey recorded in Book 194 of Maps, at Page 30, Records of Santa Clara County", which map was filed for record in the Office of the Recorder of the County of Santa Clara, State of California, on February 3, 1977 in Book 388 of Maps, at Pages 46 and 47, it rotated 0°00'38" counter-clockwise.
7. Field work for this survey was completed on October 25, 2014.
8. This site is zoned "CG" (Commercial General) per City of San Jose Planning Division.
Building Setbacks:
Front: 15'
Side: None required
Rear: None required
Interior: None required

Clark Land Surveying & Geospatial
1140 Eagleridge Blvd., Suite 140 • Pueblo, CO 81008 • 719.582.1270
www.clarkls.com

No.	Revisions Description	By	Date

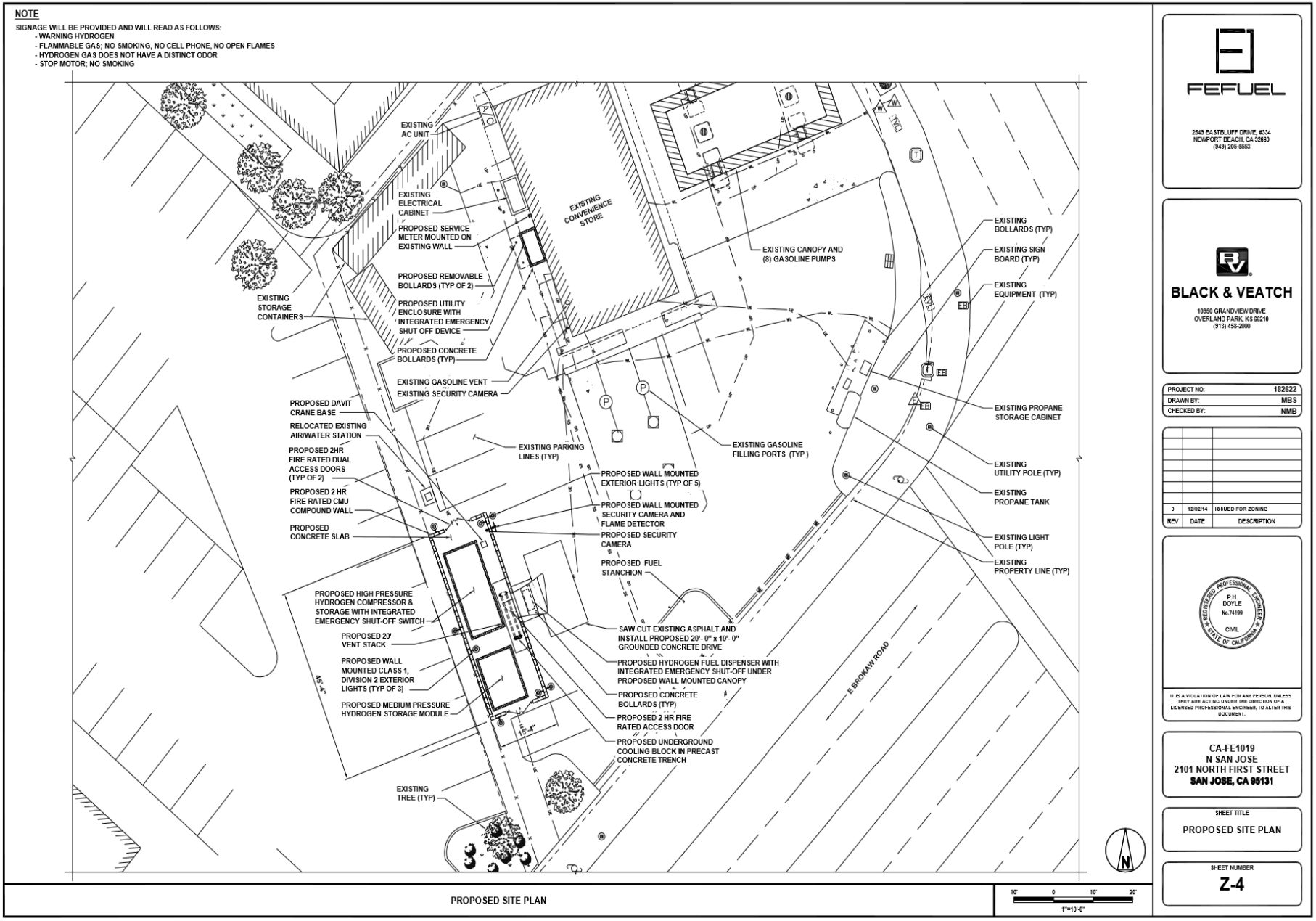
SITE NAME:
CA FE1019 San Jose

TOPOGRAPHIC SURVEY
A PORTION OF LAND
LOCATED IN THE CITY OF SAN JOSE
COUNTY OF SANTA CLARA, CALIFORNIA

Project No. 14604 | Drawn By: ZBR | Checked By: BS | Date: 10/29/2014 | Sheet 1 of 1

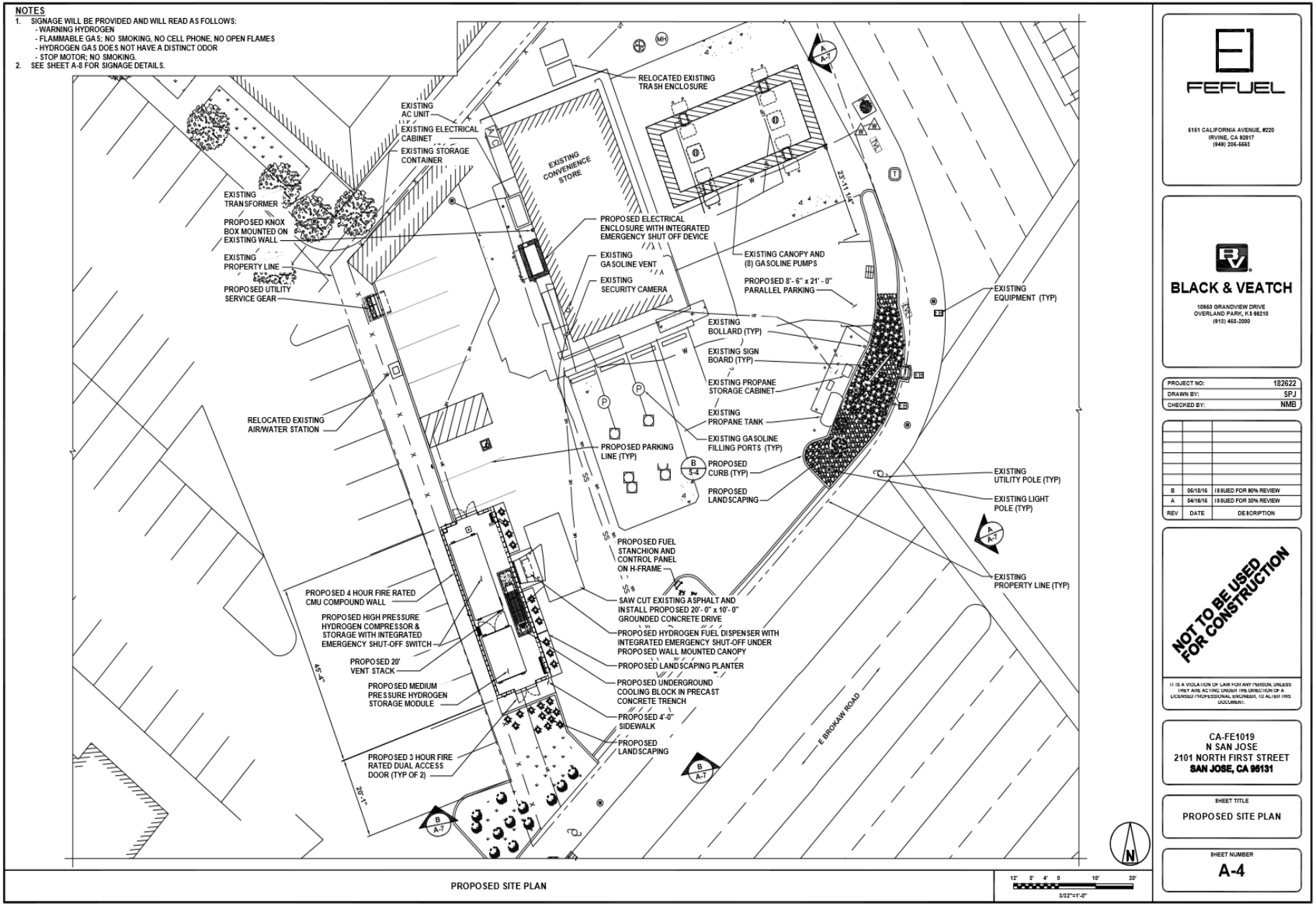
Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 2: Equipment Compound from Zoning Drawing Set



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

Figure 3: Equipment Compound from Construction Drawing 100 Set



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

FirstElement Fuel, Inc. and Black & Veatch submitted the zoning application to the authority having jurisdiction on December 5, 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 May 6, 2015.

All building permit applications were submitted on May 25, 2015, and approved on August 5, 2015.

FirstElement Fuel, Inc. and Black & Veatch submitted a bid package on July 14, 2015. The contract was awarded to Aliantel on August 13, 2015. The bulk of Aliantel's construction experience lies in constructing 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 conduit "stub-ups" before the concrete foundation was poured.

Figure 4: Station Conduit "Stub-ups"

Source: FirstElement Fuel, Inc.

Figure 6 shows hydrogen storage, compression, cooling, and dispensing equipment that was delivered to the site on October 2, 2015. Construction was completed on October 30, 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.

Figure 5: Crane Lowering Hydrogen Ground Storage Unit into Place

Source: FirstElement Fuel, Inc.

Making the Station Operational (October 26, 2015 – October 30, 2015)

The commissioning of the San Jose hydrogen station included the cleaning and purging of lines, pressure testing, and hydrogen sampling. Figure 7 shows the gas purity results.

Station Declared Operational (October 30, 2015)

The San Jose hydrogen station met the CEC's 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's storage tubes with pressurized hydrogen gas, successfully passing a hydrogen quality test (Figure 7), successfully fueled one fuel cell electric vehicle with hydrogen, and opening to the public. FirstElement Fuel, Inc. declared the station operational on October 30, 2015.

Figure 6: Hydrogen Fuel Quality Report on October 8, 2015

www.SmartChemistry.com

SAE J2719 Report

FIRST ELEMENT SAN JOSE H70 H_2

@Nozzle sampled on

	SAE J2719 Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)		Analytical Method
Water	5	0.2	**0.73**	
Total Hydrocarbons (C_1 Basis)	2	1	**0.045**	ASTM D7892
Methane		0.001	0.025	
Acetone			0.020	
Oxygen	5	1	< 1	ASTM D7649
Helium	300	10	< 10	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		5	**13**	ASTM D7649
Argon		0.5	< 1	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	**0.000081**	ASTM D7652
Hydrogen Sulfide		0.000001	0.000047	ASTM D7652
Carbonyl Sulfide		0.000001	0.000023	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		0.00001	0.000010	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	0.005	< 0.005	ASTM D5466
Ammonia	0.1	0.01	< 0.01	ASTM D5466
Total halogenates	0.05		**0.0017**	
Chlorine		0.001	< 0.001	ASTM D5466
Hydrogen Chloride		0.007	< 0.007	ASTM D5466
Hydrogen Bromide		0.007	< 0.007	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 (Particulate Concentration Calculation Sheet is listed in Table II)	1mg/Kg		**0.027 mg/kg**	ASTM D7651

Particulates Found & Size (Images of particulates found is in Table 1) — ASTM D7634

Particulate Size	# Found	Particulate Size	# Found
0.02 mm	2	0.03 mm	6
0.04 mm	7	0.05 mm	2
0.06 mm	2	0.08 mm	1
0.10 mm	2	0.11 mm	1
0.13 mm	1	0.16 mm	1
0.18 mm	1	0.23 mm	1

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)

99.99861%

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

Source: FirstElement Fuel, Inc.

Certification (January 7, 2016)

The California Department of Food and Agriculture (CDFA), Division of Measurement Standards (DMS) is responsible for enforcing California weights and measures laws and regulations and must certify any device used for metering the sale of commercial items within California.

For the first time, FirstElement Fuel, Inc. acted as a Registered Service Agent and achieved station certification by 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]. The certification process is witnessed by the local county weights and measures officer and the DMS can perform audits as needed to assure adherence to EPO NO. 40-A. The momentous occasion was attended by a number of FirstElement Fuel, Inc. and Santa Clara county onlookers (Figure 8).

Figure 7: Certification Process at San Jose Hydrogen Station

Source: FirstElement Fuel, Inc.

Figure 9 shows the County of Santa Clara certification sticker affixed to the dispenser at the 2101 North First Street station in San Jose (Santa Clara County).

[1] Hydrogen Gas-Measuring Devices report (https://www.cdfa.ca.gov/dms/programs/devices/Hydrogen_Gas-Measuring_Devices_EPO-40.pdf)

Figure 8: Certification Seal on the H70 Dispenser

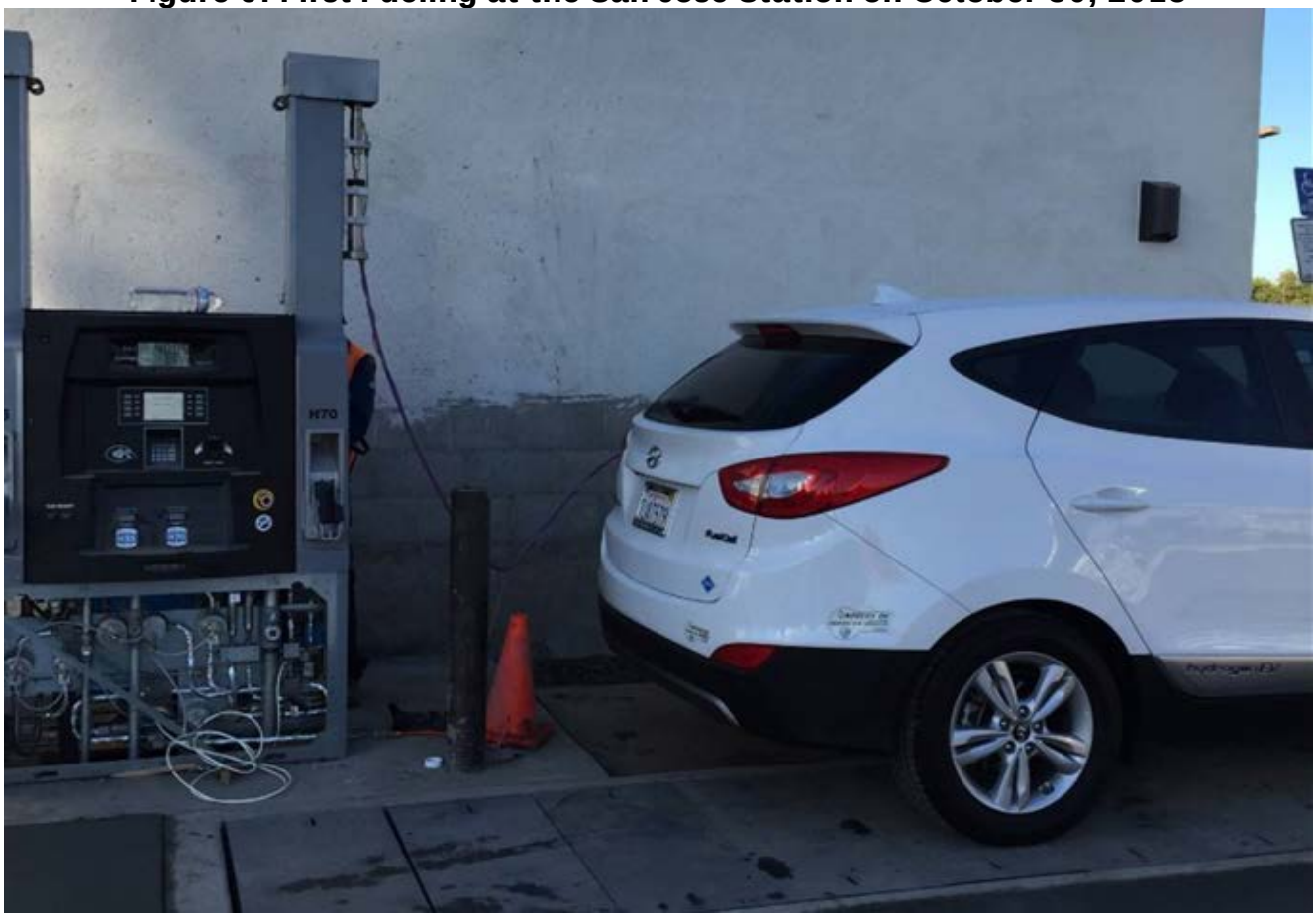
Source: FirstElement Fuel, Inc.

Station Use (October 30, 2015)

Figure 10 shows the first vehicle filled at the North First Street station, was a Hyundai Tucson on October 30, 2015. The station has been used regularly since then. Based on an average FCEV use of 0.7 kilograms per day[2], this station's 180 kilogram per day dispensing capacity is enough to support up to 260 FCEVs, although this number can vary depending on actual FCEV geographical deployment relative to other open retail station locations and FCEV driver habits.

[2] Pratt, Joseph, Danny Terlip, Chris Ainscough, Jennifer Kurtz, and Amgad Elgowainy. National Renewable Energy Laboratory and Sandia National Laboratories, 2015. H2FIRST Reference Station Design Task, Project Deliverable 2-2. (http://www.osti.gov/scitech/servlets/purl/1215215)

Figure 9: First Fueling at the San Jose Station on October 30, 2015



Source: FirstElement Fuel, Inc.

Station Operational Status System

The California Fuel Cell Partnership, Station Operational Status System (SOSS) is a website portal[3] 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 SOSS on January 15, 2016.

Environmental Impacts

The environmental impacts at the San Jose station are minimal. Hydrogen will be stored as a compressed gas in an above ground tank concealed behind a wall. In accordance with the funding agreement with the CEC, 33.3 percent of the hydrogen sold at the Playa Del Rey hydrogen station will be produced from renewable sources including biogas. Hydrogen is non-toxic, colorless, and odorless so the station equipment is outfitted with appropriate sensors to provide immediate notification in case a leak occurs. No solid or liquid waste will be produced at this site.

Minimal water was consumed for this project. There was also minimal additional landscaping, that uses water, added because of the hydrogen refueling station.

[3] SOSS Website (https://m.cafcp.org/)

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 illuminate evening fueling.

San Jose Station in the Network

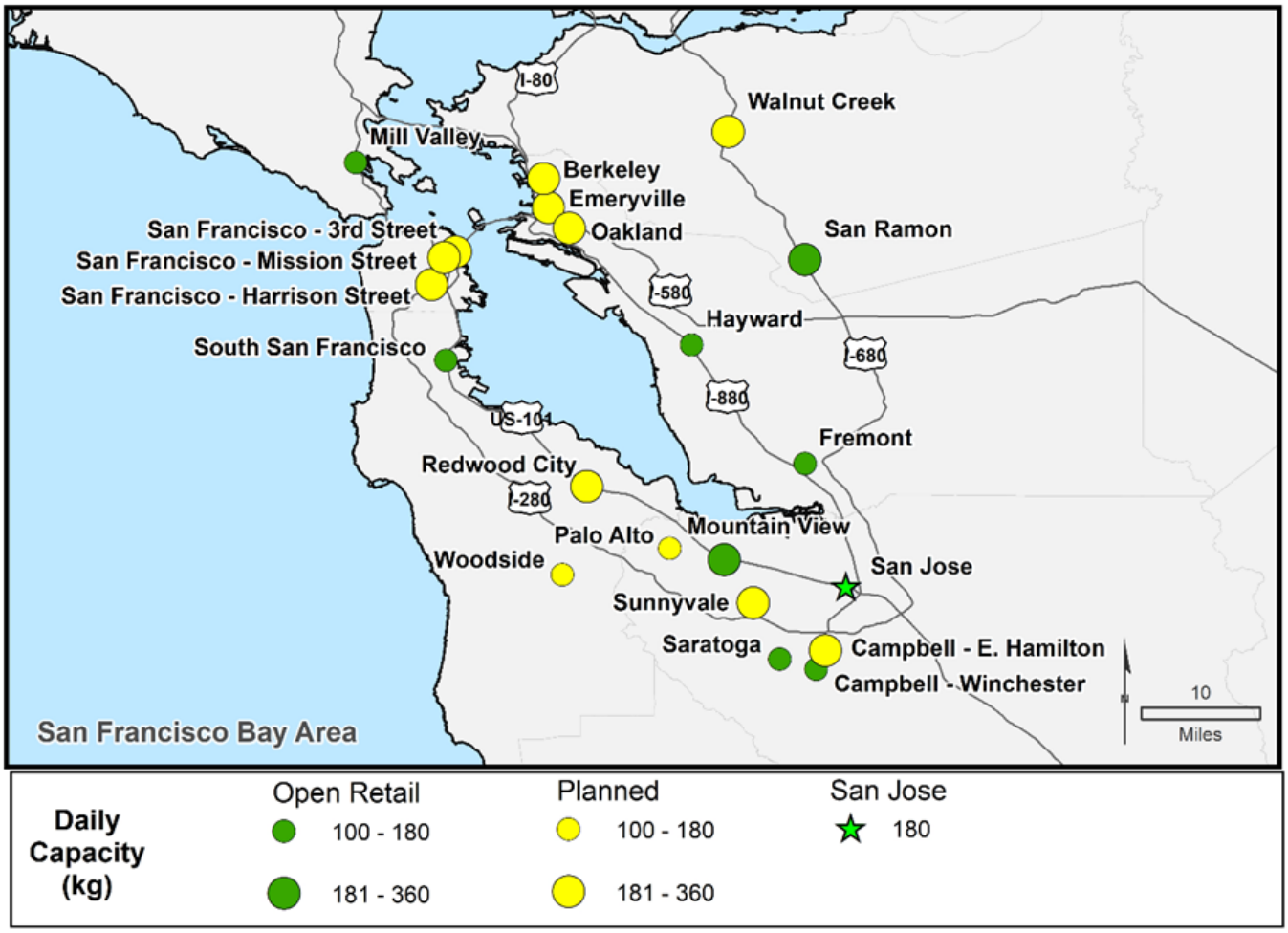
The station is open and ready for use as shown in Figure 11.

Figure 10: San Jose Hydrogen Station

Source: FirstElement Fuel, Inc.

Figure 12 shows the greater San Francisco area map which indicates where the San Jose station is situated in relationship to other facilities in the northern part of the state. The North First Street Station is close to the U.S. 101 Freeway.

Figure 11: San Francisco Area Hydrogen Stations: Open Retail and Planned

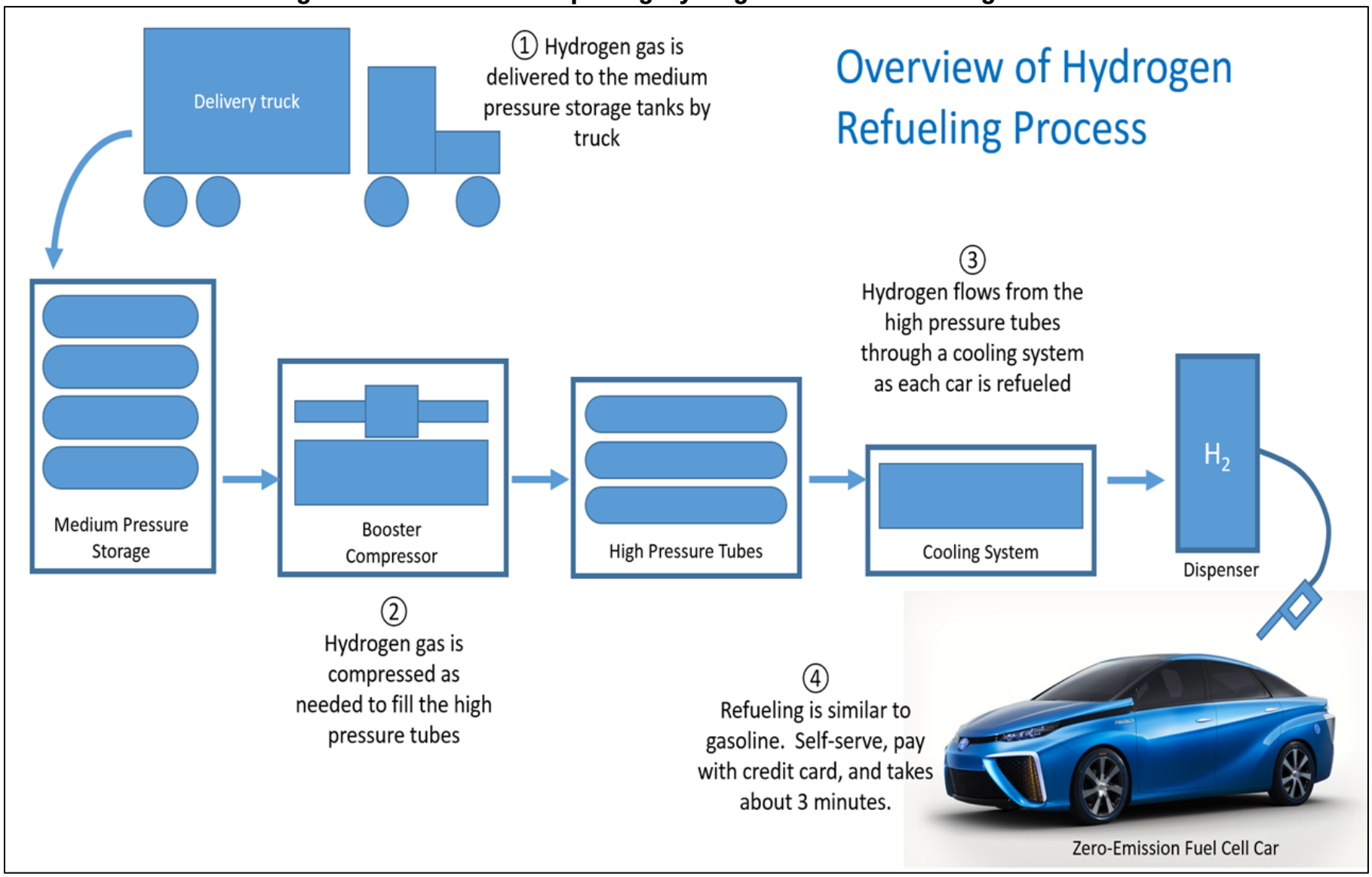


Source: FirstElement Fuel, Inc.

Schematic Layout of the San Jose Station

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

Figure 12: Schematic Depicting Hydrogen Station Refueling Process

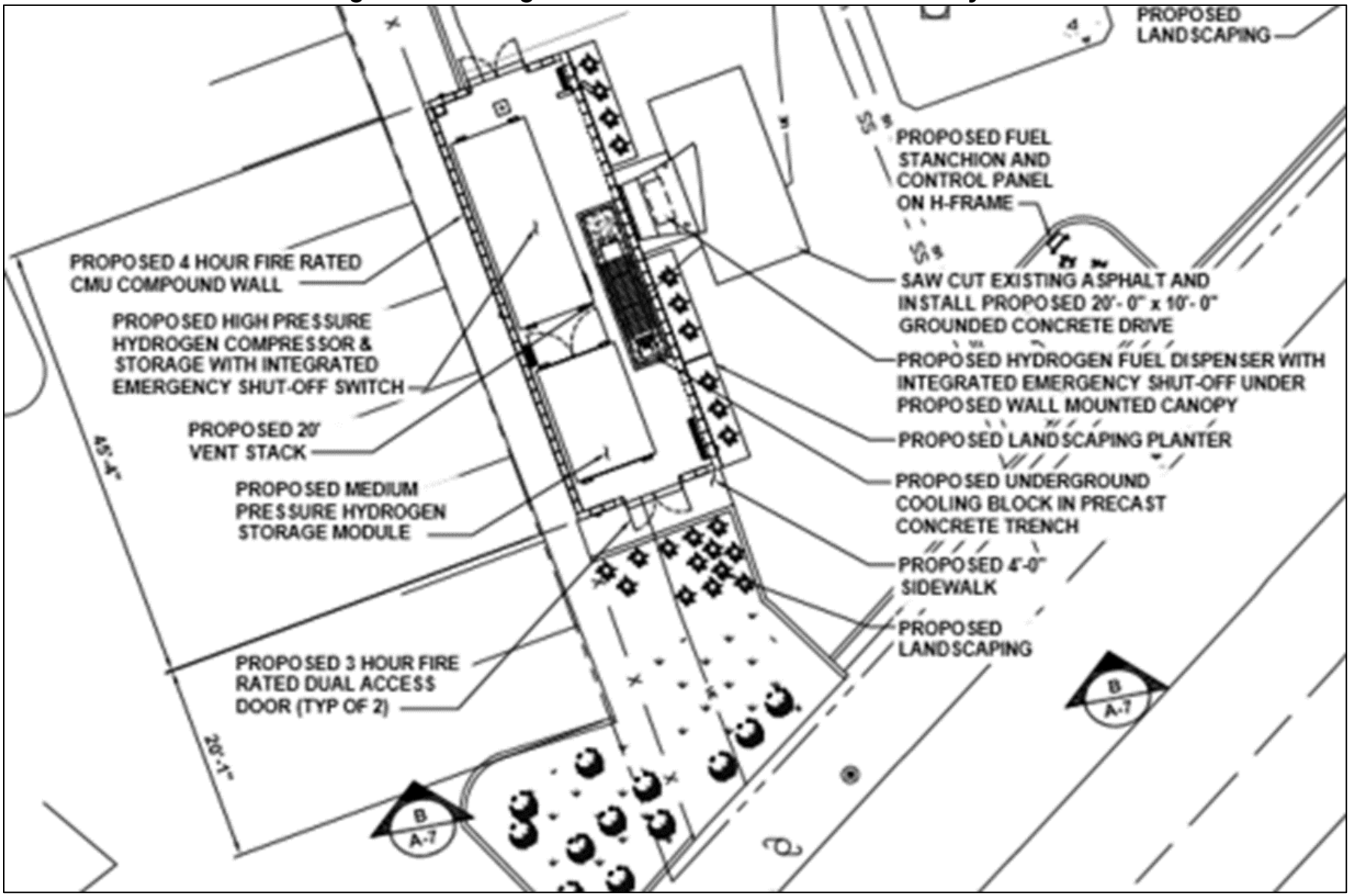


Source: FirstElement Fuel, Inc.

Final Configuration and Budget

Figure 14 shows a detailed view of the actual final, as-built configuration of the San Jose hydrogen station.

Figure 13: Enlarged View of Final San Jose Station Layout



Source: FirstElement Fuel, Inc.

Table 1 shows a detailed view of the budget to construct the San Jose hydrogen station.

Table 1: The Project Grant Funding and Match Funding

Air Products and Chemicals, Inc., Allentown , PA	
H2 station equipment	$1,479,873.56
Black & Veatch, Overland Park, KS	
Construction	$515,103.04
Engineering	$47,300.00
Permitting	$68,756.88
Project Management	$18,197.53
Various Vendors	
Construction Materials (tubing, wire, etc.)	$59,211.75
Fixtures (doors, lights, etc.)	$60,405.90
MSI Tech, Irvine CA	
Data Collection Tool	$3,416.86
Karen Calhoun, Newport Beach, CA	
Legal services	$13,150.03
Vertical Advisors LLP, Newport Beach, CA	
Financial services	$4,345.13
Total Project Costs	$2,269,760.68
CEC Grant	$1,451,000.00
Remaining match funding provided by FirstElement Fuel, Inc.	$818,760.68
Total CEC cost share	63.9%

Source: FirstElement Fuel, Inc.

CHAPTER 2: Energy Analysis

The San Jose 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 1505 (Lowenthal, Chapter 877, Statutes of 2006) and PON-13-607, which funded this project, at least one-third of the hydrogen sold by FirstElement Fuel, Inc.'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, California. 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 as shown in Table 2. Renewable hydrogen at 100 percent is achievable through the same supply pathway, however at a higher cost.

Table 2: 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 15. Although California has a substantial amount of biogas, local supply cannot be injected into California pipelines under California Health & Safety Cost 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[4] region that delivers gas into California.

[4] The Western Electricity Coordinating Council website (https://www.wecc.biz/Pages/AboutWECC.aspx)

Figure 145: 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 all FirstElement Fuel, Inc. stations (including San Jose) by a Department of Transportation-certified high-pressure delivery trailer.

The San Jose hydrogen station can dispense 180 kilograms/day. Based on average hydrogen use by FCEVs, this station's dispensing capacity is enough to support up to 260 FCEVs, depending on driver habits. Assuming FCEV average 52 miles/1 kilograms according to

Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model[5], and consumption of 180 kilograms/day for the next 10 years, the station will offset 8,300 metric tons of total Greenhouse gas compared to equivalent gasoline vehicles. Furthermore, the San Jose hydrogen station will eliminate more than 1.54 million gallons of gasoline, assuming the 2013 national passenger fleet average fuel economy of 21.6 mpg[6].

Data on the operation of the station will be collected and reported to the CEC throughout the term of the grant. Data collected and reported will include throughput, vehicle usage, gallons of gasoline displaced, and a comparison of the actual performance of the project to proposed expectations.

[5] GREET® Model (https://greet.es.anl.gov/)

[6] 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

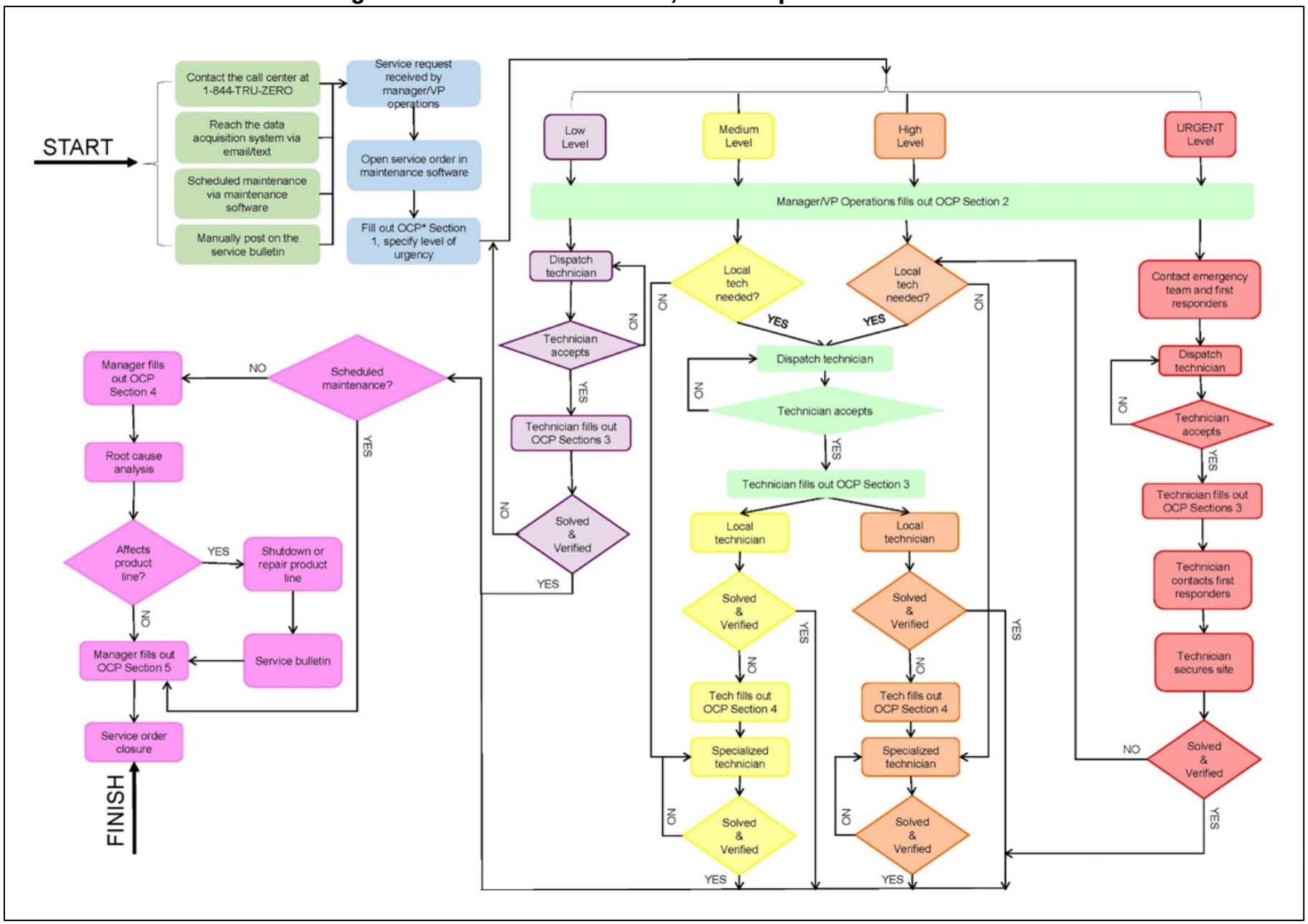
FirstElement Fuel, Inc. intends to own and operate the San Jose refueling station for at least 10 years. FirstElement Fuel, Inc. has invested substantial capital to build the station and will require many years of operation to recoup the development costs. FirstElement Fuel, Inc. has executed an initial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

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

To augment onsite personnel across the FirstElement Fuel, Inc. network, a comprehensive data collection and monitoring system has been implemented. Figure 17 shows a screenshot of one page of the data collection and 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.

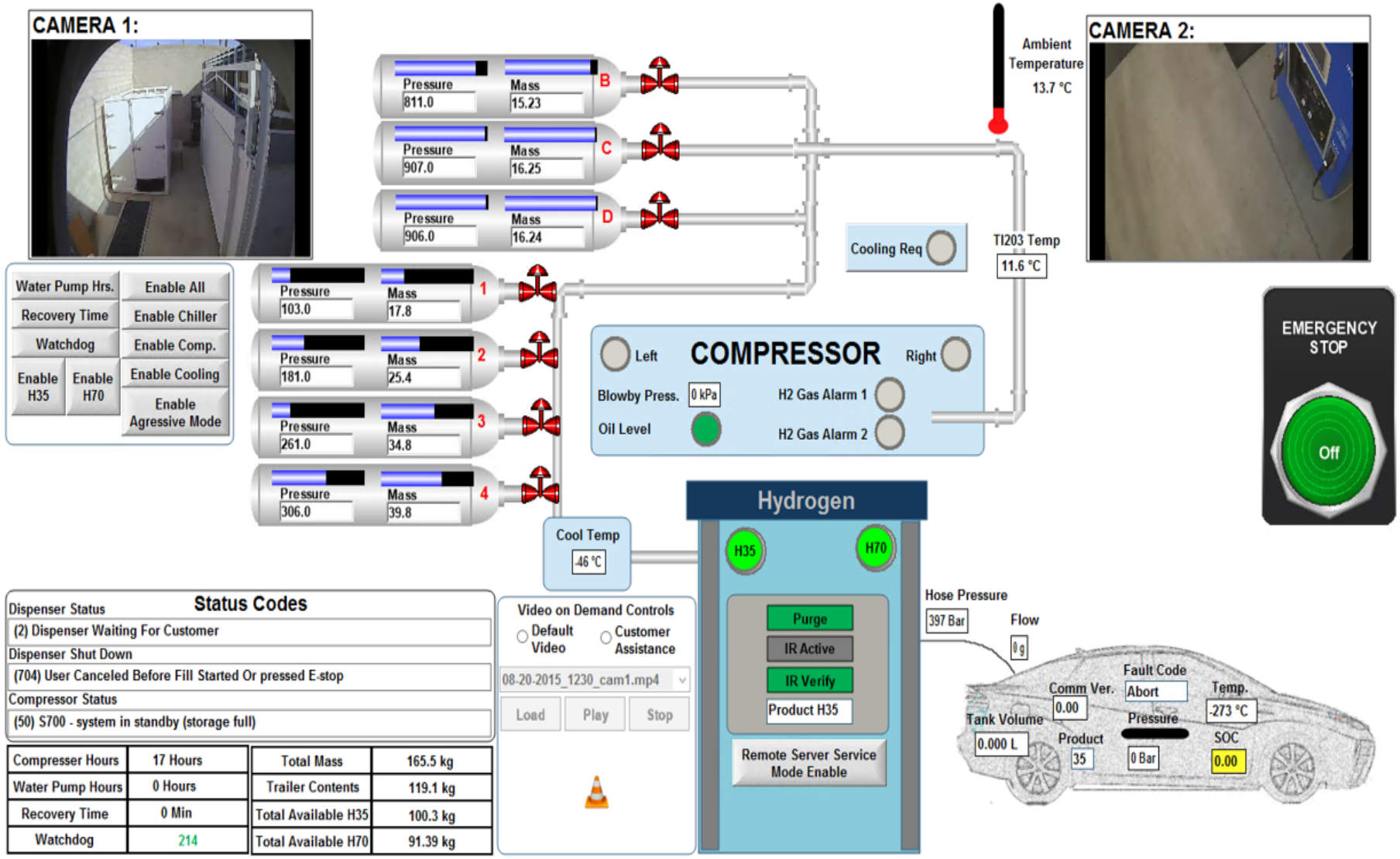
In addition to remote monitoring, FirstElement Fuel, Inc. has implemented a rigorous Computerized Maintenance Management Systems and an Enterprise Asset Management systems to schedule and track maintenance, repairs, and inventory. Work orders will be generated, completed, and logged for all maintenance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

Figure 156: FirstElement Fuel, Inc. Response Flow Chart



Source: FirstElement Fuel, Inc.

Figure 167: 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 San Jose hydrogen refueling station project.

Because the site location was close to a property line, special consideration was required to obtain the fire permit. The local jurisdiction required an extra length of firewall on the equipment compound.

The local jurisdiction initially requested FirstElement Fuel, Inc. to perform substantial additional site work, including widening sidewalks and utility upgrades estimated to cost over $150,000. Thanks to hard work by the CEC and GoBiz, FirstElement Fuel, Inc. was able to negotiate with the city of San Jose to remove these provisions.

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 DEPARTMENT OF FOOD AND AGRICULTURE (CDFA)—A cabinet-level agency in the California government responsible for the regulation of food, protecting agriculture from from pests, promoting California's agricultural industry, and enforcing standards for most petroleum products.[7]

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

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.

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

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

The Division works closely with county sealers of weights and measures who, under the supervision and direction of the Secretary of Food and Agriculture, carry out the vast majority of weights and measures enforcement activities at the local level. Ensuring fair competition for industry and accurate value comparison for consumers are the primary functions of the county/state programs.[8]

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). The major source of CO2 emissions is fossil fuel combustion. CO2 emissions are also a product of forest clearing, biomass burning, and non-energy production processes such as cement production. Atmospheric concentrations of CO2 have been increasing at a rate of about 0.5% per year and are now about 30% above preindustrial levels.

---

[7] California Department of Food and Agriculture (https://www.cdfa.ca.gov/CDFA-Mission.html)

[8] California Department of Food and Agriculture, Division of Measurement Standards Website (https://www.cdfa.ca.gov/dms/)

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

GREENHOUSE GASES, REGULATED EMISSIONS, AND ENERGY USE IN TRANSPORTATION (GREET®)—A full lifecycle model sponsored by the Argonne National Laboratory (U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy). GREET® fully evaluates energy and emission impacts of advanced and new transportation fuels, the fuel cycle from well to wheel, and the vehicle cycle through material recovery and vehicle disposal. It allows researchers and analysts to evaluate various vehicle and fuel combinations on a full fuel-cycle/vehicle-cycle basis.

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, enteric fermentation in animals and is one of the greenhouse gases.

STATION ONLINE STATUS SYSTEM (SOSS)—Online station status chart operated by the Fuel Cell Partnership. SOSS shows real time information for each hydrogen station in California, including whether open or not and fuel availability.[9]

WATER (H2O)—A colorless, transparent, odorless, tasteless liquid compound of hydrogen and oxygen. The liquid form of steam and ice. Fresh water at atmospheric pressure is used as a standard for describing the relative density of liquids, the standard for liquid capacity, and the standard for fluid flow. The melting and boiling points of water are the basis for the Celsius temperature system. Water is the only byproduct of the combination of hydrogen and oxygen and is produced during the burning of any hydrocarbon. Water is the only substance that expands on freezing as well as by heating and has a maximum density at 4°C.

[9] California Fuel Cell Partnership website: Station Status (https://m.cafcp.org/?_ga=2.140456246.447070378.1582917173-1278165517.1582917173)