CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Scaling Up the True Zero Network

Hydrogen Station – 18480 Brookhurst Street, Fountain Valley

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

Gavin Newsom, Governor

March 2024 | CEC-600-2024-031

California Energy Commission

Tim Brown
George Wu
Primary Author(s)

FirstElement Fuel, Inc.
5281 California Ave, Suite 260
Irvine, CA 92617
(949) 205-5553
Company Website (www.truezero.com)

Agreement Number: ARV-16-033

Phil Cazel
Commission Agreement Manager

Kevyn Piper
Commission Agreement Officer

Hannon Rasool
Deputy Director
FUELS AND TRANSPORTATION

Drew Bohan
Executive Director

ACKNOWLEDGEMENTS

The construction of the Fountain Valley hydrogen refueling station has only been possible because of the substantial efforts and funds provided by a number of stakeholders.

FirstElement Fuel graciously thanks Toyota for their vision and fortitude, Honda for their innovation and environmental commitment, Linde for their partnership in advancing sustainable hydrogen infrastructure, Tatsuno for their dedication to innovation and reliability, and of course, Phil Cazel, Jean Baronas, Kevyn Piper, 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. 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 solicitation Grant Funding Opportunity (GFO)-15-605, Light Duty Vehicle Hydrogen Refueling Infrastructure to provide grant funds to expand the network of publicly accessible hydrogen refueling stations that serve California's light duty fuel cell electric vehicles (FCEVs). In response to GFO-15-605, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards February 17, 2017, and the agreement was executed as ARV-16-033 on June 28, 2017.

ABSTRACT

Per the terms of funding agreement ARV-16-033 between the California Energy Commission (Energy Commission) and FirstElement Fuel, Inc. (FEF), FEF designed, engineered, permitted, constructed, and commissioned a hydrogen refueling station located at 18480 Brookhurst Street, Fountain Valley, CA 92708. FEF plans to own and operate the hydrogen refueling station until at least 2025. The station consists of an enclosed compound that houses compressing and dispensing equipment, high pressure storage tubes, two dispensers each with two fueling positions, customer payment interfaces, and canopies.

Keywords: California Energy Commission, FirstElement Fuel, Inc., hydrogen refueling station, hydrogen infrastructure, fuel cell vehicles, Fountain Valley, Brookhurst Street.

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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 (ZEV) 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 Zero Emission Vehicle Regulation and the Governor's Zero Emission Vehicle Mandate. More specific actions to bring FCEVs 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. 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. 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 ZEV deployment goals.

In contrast to battery electric and plug-in hybrid electric vehicles that can be charged in home settings, 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 co-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.

Assembly Bill (AB) 118 (Núñez, Chapter 750, Statutes of 2007), created the Clean Transportation Program. The statute authorizes the California Energy Commission (Energy Commission) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change, clean air, and alternative energy policies. AB 8 (Perea, Chapter 401, Statutes of 2013) re-authorizes the Clean Transportation Program through January 1, 2024. The Clean Transportation Program has an annual budget of approximately $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 non-road 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.

The Energy Commission issued solicitation Grant Funding Opportunity (GFO)-15-605, Light Duty Vehicle Hydrogen Refueling Infrastructure, to provide grant funds to expand the network of publicly accessible hydrogen refueling stations that serve California's light duty fuel cell electric vehicles (FCEVs). To be eligible for funding under GFO-15-605, the projects must also be consistent with the Energy Commission's Clean Transportation Program Investment Plan updated annually.

In response to GFO-15-605, FirstElement Fuel, Inc. submitted application number 9 for a number of stations, including one to be located at 18480 Brookhurst Street, Fountain Valley, CA 92708, which was proposed for funding in the Energy Commission's Notice of Proposed Awards on February 17, 2017.

The California Energy Commission contributed $1,870,000 of the total $3,308,433 cost to design, engineer, permit, construct, and commission the station.

(Note: If needed, insert a blank page so that Executive Summary begins on the right.)

CHAPTER 1:
Purpose

Hydrogen distribution and dispensing infrastructure is not readily available to meet projected commercial targets for the deployment of FCEVs. As FCEVs are deployed in greater quantities, a network of refueling stations is needed to provide coverage which takes advantage of the range of the vehicle, and provides a means to transport, store, and dispense hydrogen. The purpose of this agreement is to provide a hydrogen refueling station at 18480 Brookhurst Street, Fountain Valley, CA 92708. The station equipment stores liquid hydrogen and dispenses gaseous hydrogen.

This project will help address scientific and technical barriers to the build out of hydrogen refueling infrastructure, including addressing the limited availability of hydrogen refueling infrastructure performance data by delivering station performance data for larger capacity stations, namely those which can provide up to 310 kg of hydrogen in 12 hours, or over 800 kg in 24 hours.

Improvements to the network of hydrogen refueling stations and an expected corresponding increase in FCEVs will support the carbon reduction and air quality improvement goals of the State of California, such as the Zero Emission Vehicle (ZEV) Mandate, which calls for sufficient alternative refueling infrastructure to support up to 1 million ZEVs by 2020, reaching 1.5 million ZEVs on the road in California by 2025. Hydrogen FCEVs are expected to play a critical role in meeting the ZEV Mandate targets.

Inherent Efficiency of Liquid Hydrogen

Liquid hydrogen, as used at the Fountain Valley station, has storage, transportation, and pumping efficiencies compared to gaseous hydrogen in hydrogen infrastructure scenarios. Compression of gaseous hydrogen at fueling stations up to the pressures required to fully fill FCEVs requires 3-5 kWh/kg of electricity. Because pumping a liquid is more efficient than compressing a gas, liquid pump stations use less than 1 kWh/kg to accomplish the same task. This is important because electricity at hydrogen stations is expensive and generally hard to make renewable.

Because of the extremely cold temperature of liquid hydrogen (-416°F), no additional refrigeration system is required to meet fueling protocol in the SAE J2601 standard cold fill requirements. This saves capital costs, reduces electricity consumption, and in FirstElement's (FEF) experience, improves reliability.

Delivery of liquid hydrogen is common practice in the industrial gas industry. This means that the safety, costs, and operational experience are generally well understood. Liquid hydrogen delivery trucks can easily carry 10 or more times the deliverable hydrogen as equivalently sized gaseous hydrogen trucks (see Figure 1 below). This enables multiple stops and "short,

milk runs" without constantly returning to the plant to get a new load and substantially reduces emissions and carbon associated with trucking hydrogen.

Figure 1: Liquid Hydrogen and Gaseous Hydrogen Delivery Trucks

Liquid hydrogen truck can deliver 2,400 kgs (left) compared to 120 kgs for gaseous H2 truck (right). Source: FirstElement Fuel, Inc.

Higher Capacity Results in Lower Price at the Pump

Because of the FEF dedicated hydrogen supply, volume equipment purchasing, requested CEC grant, and HRI credit value, FEF will be able to lower the hydrogen price at the pump to be competitive with gasoline.

With the Fountain Valley station capacity of 1200 kg/day:

- 3 simultaneous fueling positions to improve customer experience and reduce wait times
- Have over 808 kgs of storage to better mitigate potential supply disruptions
- Have a retail hydrogen price competitive with gasoline on a per mile basis

These quantum leaps in performance and price are made possible by moving to liquid hydrogen production, distribution, storage, and pumping. It generally takes more energy to produce liquid hydrogen, but the storage costs and densities far exceed those of gaseous hydrogen. Like most industrial processes, scale is an important factor in both cost and efficiency for hydrogen production. Because liquid hydrogen is relatively inexpensive to store and transport, a single large, efficient, optimized facility can be used to serve the entire network. This results in lower cost hydrogen supply. In addition, pumping a liquid is inherently more efficient than compressing a gas. Therefore, the pumps used in the generation of station located in Fountain Valley are considerably smaller, more efficient, have higher throughput, and lower cost than comparable compressor systems.

The advantages of liquid hydrogen production, delivery, and storage are common knowledge in the hydrogen industry. But most stations rely on gaseous hydrogen because there has historically been enough excess gaseous hydrogen from existing industry applications for the insignificant amount needed for FCEVs, and because new liquid hydrogen production requires substantial capital investment. FEF is fortunate to have developed a secure source for liquid hydrogen for the current batch of stations that will enable substantially reducing the price of this fuel.

Sustainability and Environmental Impacts

FEF notes that hydrogen and fuel cell vehicles are the most effective means to achieve sustainable transportation in the State of California. That is part of FEF's mission statement and the motivation for starting this company in the first place. FEF aims to grow the proportion of FCVs on the road as quickly as possible so that California, and the world, can fully capitalize on the environmental benefits of electric propulsion. FEF understands that, based on years of analysis and research, fuel cell vehicles can change the world in a positive way by:

- Reducing criteria pollutant emissions
- Improving urban air quality
- Reducing greenhouse gas emissions, and
- Reducing dependency on petroleum

Part of the FEF core business strategy is to simultaneously accelerate the adoption of FCEVs and to maximize the potential environmental benefits through a conscientious approach to the fuel supply chain, the operation of hydrogen station projects, and even the hydrogen development process for the hydrogen station in Fountain Valley.

CHAPTER 2:
Approach

FEF has worked hard and considers itself to have built the largest, most experienced and dedicated team for retail opening and operation of hydrogen refueling stations. FEF has successfully created the largest and most reliable hydrogen refueling network in the world and has provided OEMs the confidence to release FCEVs on a large scale into the California market. FEF stations have the best up-time performance in the state of California. Primary in the FEF culture is a focus on the customer experience and a focus on the safety and security of the FEF team and stations. To that end, FEF has developed, and continue to refine, rigorous technical and safety training procedures for the service and maintenance personnel.

Field Service Operations Technical Training

FEF Technical Training policies are intended to ensure that personnel have the right tools and experience required for the job. No employee is put in a situation where their safety is compromised. For that reason, FEF has implemented a competence tracking system where employees are graded based on their competence in a specific field of work. The four major competence categories include:

- Observer: where the personnel can only assist in a task
- Supervised: where the personnel can perform the task only if supervised
- Independent: where the personnel can perform the work unsupervised
- Trainer: where the personnel can train others on the task

For an employee to be qualified to work independently in the field, they must meet the competence criteria after working with a Trainer for a sufficient amount of time. Typical supervised training period is one to two months or more.

Field Service Safety Training

In addition to hands-on Station Operational Technical training, FEF personnel are constantly discussing, learning, and reviewing general safety procedures and operations.

Communication

The Field Service Team meets three times per week to discuss operational status and safety procedures. A new safety topic is introduced at every meeting and is discussed during at least three meetings. Additionally, prior to beginning every operational meeting a moment is taken to discuss a "Safety Moment".

Training Methods

The safety training program uses some or all of the following communication methods: video instruction, group discussion, homework, quick phone quizzes and when possible, practical

hands-on practice. Attendance is tracked to ensure that, at a minimum, each employee attends two of these safety sessions. At these meetings, all new policies and procedures are introduced, and the employee is told where this information resides within the company.

Special Work

When a new task is being conducted or the task does not have established procedures, pertinent employees are all trained on performing a Job Hazard Analysis prior to beginning the work.

Contractors

In some cases, where FEF requires the help of a contractor, for example in construction, refrigeration or crane operation, FEF only employs contractors who are qualified to do the work, have a similar vision for safety and have a proven track record. These records are viewed through their U.S. Occupational Safety and Health Administration Form 300A for the past three years. If there are any major injuries in the records, these are investigated to ensure that the contractor has the right culture and policies in place.

Station Operation and Maintenance

FEF has established a Preventive Maintenance Plan for the station in Fountain Valley that mandates Monthly, Quarterly, Semi-Annual and Annual scheduled maintenance activities. Each week the Team Manager reviews the preventive maintenance schedule, opens work orders for each site with the tasks to be completed by the Technicians on duty, and verifies completion of the prior week's work orders. As a routine part of the scheduling, the Team Managers arrange the planned maintenance activities to avoid cluster shutdowns of adjacent stations in the network that would otherwise create area-wide unavailability.

Far too often a robust service machine falters due to lack of communication. Therefore, simply relying on a chart of maintenance activities on a map is not sufficient. FEF goes a few steps further. The FEF Hydrogen Engineers are in constant contact with each other, literally 24 hours a day, seven days a week. The team also meets three times a week for operational meetings with Management, Schedulers and Service Technicians. FEF utilizes 21st century internal social media apps and cloud-based documentation for companywide communication at all times. The entire team knows the status of all activities at each station from any connected computer, tablet or smart phone. This heightened communication serves greatly in the coordination of planned maintenance, emergency maintenance, stress testing, press events, vacations, etc.

Additionally, FEF coordinates its planned maintenance activities at the Fountain Valley station such that all technicians are instructed to plan work such that the outage time is minimized and can return the station to working conditions with limited down time. Each technician has a personalized sign to let arriving customers at a station know that maintenance is being done, but the station is still open.

CHAPTER 3:
Activities Performed

There were many steps required to bring the Fountain Valley 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 project.

Site Acquisition

Three independent objectives must be achieved to develop a successful hydrogen station project:

1) The location must meet the needs of customers
2) The parcel must have sufficient space to safely install hydrogen fueling equipment
3) The landowner and/or business operator must be willing to participate

FEF searches for sites by first selecting specific geographic areas, then narrowing down to only those sites that have room for hydrogen, and finally, negotiating with landowners.

In early 2016, FEF took steps to identify and acquire appropriate sites for the station. FEF worked with historic vehicle sales data, academic publications, automakers, and the Energy Commission's Station Location Areas to select desired market locations. FEF 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, FEF contacted station owners and operators to negotiate lease opportunities. On July 21, 2016, a binding 10-year lease was executed with the property owner at 18480 Brookhurst Street, in the City of Fountain Valley, CA 92708.

Figure 2: View of the property from NE Corner of Ellis Avenue and Brookhurst St.

Source: FirstElement Fuel, Inc.

Equipment Procurement

The equipment packages installed at the Fountain Valley Hydrogen Refueling Station is comprised or three main components: Compressing and Dispensing Equipment manufactured by Linde, LLC; Ground Storage Unit manufactured by FIBA; and Point of Sale (Dispenser) manufactured by Tatsuno. The FEF team started the equipment procurement process early on, evaluating and visiting various component and part suppliers. As hydrogen station integrators, we assessed and help design an equipment package utilizing leaders in the industry to assemble an equipment package that vastly exceeded the minimum technical requirements required by the solicitation.

As noted in the previous chapter, FEF made the philosophical decision to upgrade the throughput and capacity of our stations, bringing our Fountain Valley station dispensing and storage capacity per day to 1,200 kgs H2/day. This decision resulted in a slight delay in the approval and engineering design process but the added benefits far outweighed the cost.

Figure 3: Installed Tatsuno Dispensers with Four Fueling Positions.

Source: FirstElement Fuel, Inc.

Figure 4: Installed Linde Unit (Compressing and Dispensing Equipment).

Source: FirstElement Fuel, Inc.

Site Design and Engineering

FEF started the site design phase on April 7, 2017, where FEF engaged internal permitting and engineering teams to proceed with design scope. After initial issues with original site location located in Huntington Beach, the project site was relocated to Fountain Valley an alternate location which FEF ran site design process in tandem.

This phase of the project was completed as of August 20, 2018 where the conceptual designs were finalized, allowing the project to proceed with entitlement approval process.

Entitlement

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.

An entitlement package was submitted on August 20, 2018, after multiple rounds of comments and resubmissions FEF staff was notified of entitlement approval on May 7, 2019 allowing the project to proceed to building plan check.

Building Plan Check

A building permit application was submitted on July 17, 2019 and following the review by all City-required departments, the building permits were issued on February 3rd, 2020.

Figure 5: Approved Building Permit – 18480 Brookhurst Street.

Fountain Valley
Building & Safety Division
Permit Receipt

Project Number: **2019-1045**

view online at: https://fountainvalley.cts.city

Job Address:
18480 BROOKHURST ST
Tract: Lot: APN: 156-051-05

Owner:
RASM LLC
18480 BROOKHURST STREET FOUNTAIN VALLEY, CA 92708
Phone: (310) 985-0699

Applicant:
FIRSTELEMENT FUEL
3004 YALE AVE MARINA DEL REY, CA 90292
Phone: (858) 442-1207

LICENSED CONTRACTORS DECLARATION
I HEREBY CLAIM, UNDER PENALTY OF PERJURY, THE FOLLOWING STATEMENT: THAT I AM LICENSED UNDER PROVISIONS OF CHAPTER 9 COMMENCING WITH SECTION 7000 OF DIVISION 3 OF THE BUSINESS AND PROFESSIONS CODE, AND AT THIS TIME MY CONTRACTORS LICENSE IS CURRENT, ACTIVE AND IN FULL FORCE.

Contractor: (FUEL STATATIONS)
FIRST ELEMENT FUEL INC
5151 CALIFORNIA AVENUE STE 220 IRVINE, CA 92617
Phone: (949) 205-5553
Lic. #: 1025153 Class: A

CONTRACTOR TO PROVIDE ACCESS TO ROOF & ATTIC

WORKERS' COMPENSATION DECLARATION
I HEREBY CLAIM, UNDER PENALTY OF PERJURY, ONE OF THE FOLLOWING STATEMENT:
☐ I HAVE AND WILL MAINTAIN A CERTIFICATE OF CONSENT TO SELF INSURE FOR WORKERS COMPENSATION, AS PROVIDED FOR BY SECTION 3700 OF THE LABOR CODE FOR THE PERFORMANCE OF THE WORK FOR WHICH THIS PERMIT IS ISSUED.
☑ I HAVE AND WILL MAINTAIN COMPENSATION INSURANCE AS REQUIRED BY SECTION 3700 OF THE LABOR CODE FOR THE PERFORMANCE OF THE WORK WHICH THIS PERMIT IS ISSUED.

Workers' Compensation Carrier	Policy #	Exp. Date
EVEREST PREMIER INSURANCE	EN4WC00256	1/1/2021

CERTIFICATE OF WORKERS COMPENSATION EXEMPTION
(THIS SECTION NEED NOT BE COMPLETED IF WORK IS $500 OR LESS)
☐ I CERTIFY UNDER PENALTY OF PERJURY THAT IN THE PERFORMANCE OF THE WORK FOR WHICH THIS PERMIT IS ISSUED, THAT I SHALL NOT EMPLOY ANY PERSON IN A MANNER SO AS TO BECOME SUBJECT TO THE WORKERS COMPENSATION LAWS OF CALIFORNIA, AND AGREE THAT IF I SHOULD BECOME SUBJECT TO THE WORKERS COMPENSATION PROVISIONS OF SECTION 3700 OF THE LABOR CODE THAT I SHALL FORWITH COMPLY WITH THOSE PROVISIONS.

Application Date	Issued Date	Expired Date
7/17/2019	2/3/2020	8/1/2020

Permit Status: Issued **Issued By:** John

Building Use: COMMERCIAL
Type of Project: TENANT IMPROVEMENT
Improvements: ALTERATION

Work Authorized
Other

Valuation	Construction Type	Occupancy Group
$165,730		

OWNER BUILDER DECLARATION
I AM EXEMPT FROM THE CONTRACTORS LICENSE LAW FOR THE FOLLOWING REASON:
☐ I, AS OWNER OF THE PROPERTY, OR MY EMPLOYEES WITH WAGES AS THEIR SOLE COMPENSATION, WILL DO THE WORK, AND THE STRUCTURE IS NOT INTENDED FOR, OR OFFERED FOR SALE (SECTION 7044, OF THE BUSINESS AND PROFESSIONS CODE)
☐ I, AS OWNER OF THE PROPERTY AM EXCLUSIVELY CONTRACTING WITH LICENSED CONTRACTORS TO COMPLETE THE PERMITTED PROJECT UNDER THE PROVISIONS OF SECTION 7044, OF THE BUSINESS & PROFESSIONS CODE.

THIS PERMIT SHALL BECOME INVALID IF THE WORK ON THE SITE AUTHORIZED BY SUCH PERMIT IS SUSPENDED OR ABANDONED FOR A PERIOD OF 180 DAYS.

ALL WORK SHALL CONFORM TO THE 2016 CBC, CRC, CEC, CPC, CRC, CGC AND 2016 CA ENERGY CODE.

Comments/Conditions/Project Description:
9/5/2019 SCOPE OF PROJECT INCREASED TO INCLUDE CANOPY OVER PUMPING STATION. INCREASED VALUATION $15,000.00
INSTALLATION OF TWO (2) DOUBLED-SIDED HYDROGEN FUEL DISPENSERS WITH SUPPORTING HYDROGEN EQUIPMENT TO AN EXISTING GASOLINE STATION

DESCRIPTION	FEE	DESCRIPTION	FEE
Building	1,952.18		
Electrical	175.65		
General Plan Maint.	193.72		
Green Building	7.00		
Microfiche Fee	178.25		
Plumbing	36.00		
SMIP	46.40		

TOTAL FEES: $2,589.20

CERTIFICATE OF COMPLIANCE AND AUTHORIZING OF ENTRY: I certify I have read this application and state that the above information is correct. I agree to comply with all federal and state laws, city ordinances, and state laws relating to building construction, and authorize a representative of the Fountain Valley to enter upon the property for which I have applied for this permit for the purpose of making inspections.

Signature of Applicant or Agent | P.D JORDAN Print Name of Applicant or Agent | 02/03/20 Date

18480 BROOKHURST ST Project #: 2019-1045

Source: FirstElement Fuel, Inc.

Site Preparation and Construction

The Fountain Valley Hydrogen Station was the first project where FEF acted as the general contractor, securing the required permits and assembling the construction team required to construct the project.

On February 6, 2020; the construction team broke ground and started work excavation and demolition work for equipment pads that serve as a base for our Linde Pump Package, the FIBA storage tubes and Tatsuno Dispenser Package. This initial scope encompassed demolition, form work, laying initial conduit connections, and trenching.

During our site mobilization we discovered gas lines not marked on any of the existing plans FEF causing a slight delay to our planned schedule. FEF's team worked with our engineers to quickly implement an alternate means of excavation, utilizing Hydrovac manufactured airoknife vaccum trucks in sensitive areas, allowing us excavate and remove soil without disturbing any underground utilities.

Figure 6: Mobilization and Breaking Ground at 18480 Brookhurst Street, Fountain Valley.

Source: FirstElement Fuel, Inc.

In Early March of 2020, the construction had been put on hold due to the lockdown order caused by the Covid-19 pandemic. FEF quickly prepared and implemented a "Covid Response" action plan allowing our team to safely continue construction onsite.

Figure 7: Progress on site during the construction phase.

Source: FirstElement Fuel, Inc.

Equipment Installation

On April 14, 2020, our Linde Equipment package was delivered to our site and subsequently installed after careful coordination with crane operators.

The figure below illustrates some of the complexity of the crane lifting.

Figure 8: Crane lifting hydrogen ground storage unit off delivery truck.

Source: FirstElement Fuel, Inc.

Energize and Mechanical Connections

Following equipment installation, FEF and subcontractors completed scope to make sure that both mechanical and electrical connections where property terminated are ready for energization.

Given issues with COVID-19 and the delay in scheduling of public utility work and inspections, our commissioning scope was started on temporary power.

On June 22, 2020 the Fountain Valley station received permanent power.

Commissioning

On April 15, 2020 FirstElement started the commissioning phase where our equipment is tested to verify that our station is ready dispense hydrogen. See Table 1 for a summary of tasks performed to commission our station.

Table 1: Commissioning Checklist.

FirstElement Fuel Inc.
Station Readiness Review
ARV-16-033 Fountain Valley

Commissioning Tasks	FE1023=-Fontain Valley 18480 Brookhurst st. 92708
Date:	
Operator:	

No.	Complete If yes check box	Tasks
1	☑ Check	Cleaning Skid
2	☑ Check	Pressure Test
3	☑ Check	Electrical Startup
4	☑ Check	Mechanical Landing
5	☑ Check	PSV Check
6	☑ Check	Calibrate Gas Detectors
7	☑ Check	Safety Function Test
8	☑ Check	Vacuum H2 Storage
9	☑ Check	Purge GH2 Storage
10	☑ Check	Vacuum LH2 Tank
11	☑ Check	Purge LH2 Tank
12	☑ Check	FillFluids
13	☑ Check	Cooldown LH2 Tank and Fill
14	☑ Check	Remove and Pump Drive
15	☑ Check	Cleaning Pump Vessel
16	☑ Check	Install Pump Insert
17	☑ Check	Install Pump Coupling
18	☑ Check	Purge pump vessel and head room
19	☑ Check	Cooldown the pump
20	☑ Check	Recalibrate Pump Level Sensor
21	☑ Check	Power on Dispenser'
22	☑ Check	Pressure Test Dispenser

Source: FirstElement Fuel, Inc.

Some of the activities in the commissioning phase included the cleaning and purging of lines, pressure testing, and hydrogen sampling. The figure below captures various moments of this process.

Figure 9: Station Commissioning by FEF Commissioning Team

Source: FirstElement Fuel, Inc.

HyStep and DMS Testing

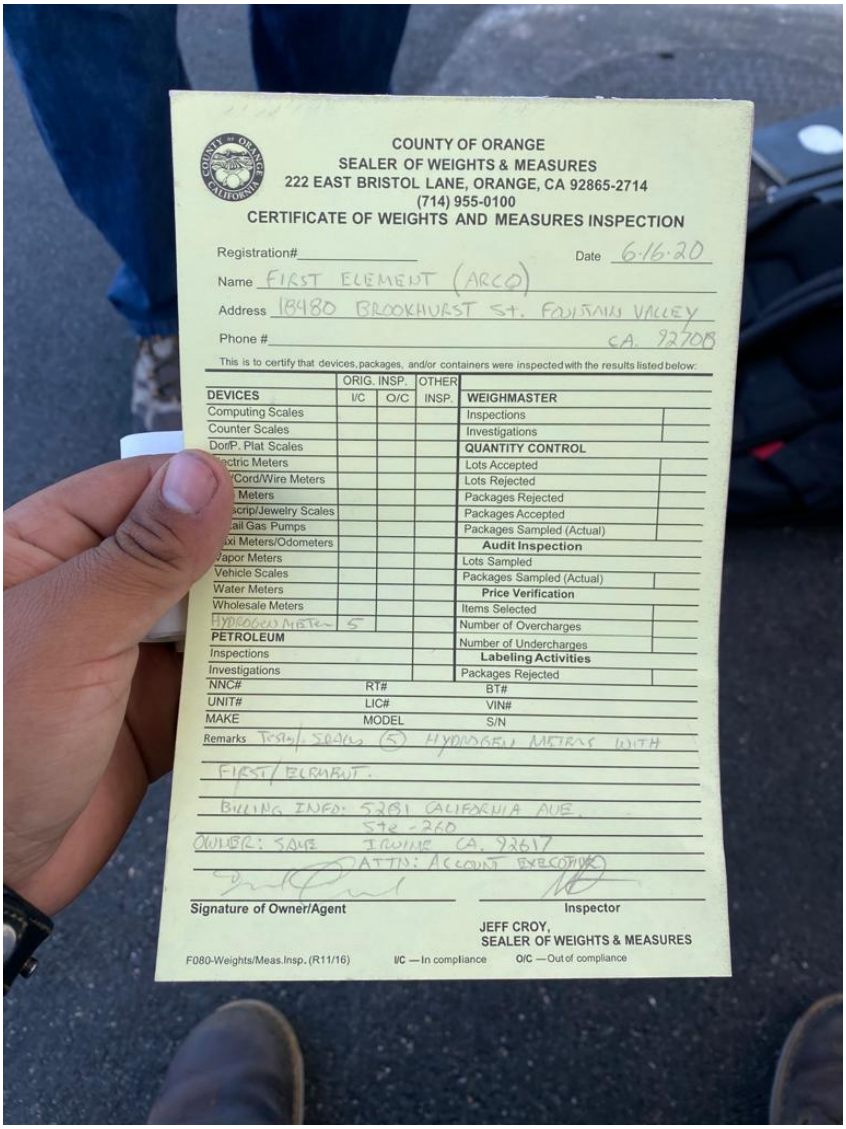
The California Department of Food and Agriculture's Division of Measurement Standards (DMS) is responsible for enforcement of California weights and measures laws and regulations and must certify any device used for metering the sale of commercial items within California.

Acting as a Registered Service Agent and working with the local County Weights and Measures Officer as a witness, FEF successfully completed our DMS Testing on June 16, 2020.

Hydrogen fueling station performance validation is accomplished through the Hydrogen Station Equipment Performance (HyStEP) testing device and was performed on June 22-25, 2020 to

validate that the station is able to meet the fueling protocol standards. The results were reviewed by our OEM manufacturers and approved for station opening on July 2, 2020.

Figure 10: DMS Certification for Fountain Valley.



COUNTY OF ORANGE
SEALER OF WEIGHTS & MEASURES
222 EAST BRISTOL LANE, ORANGE, CA 92865-2714
(714) 955-0100
CERTIFICATE OF WEIGHTS AND MEASURES INSPECTION

Registration#_____ Date 6.16.20

Name FIRST ELEMENT (ARCO)

Address 18480 BROOKHURST ST. FOUNTAIN VALLEY

Phone #_____ CA. 92708

This is to certify that devices, packages, and/or containers were inspected with the results listed below:

DEVICES	ORIG. INSP. I/C	O/C	OTHER INSP.
Computing Scales			
Counter Scales			
Dor/P. Plat Scales			
ctric Meters			
/Cord/Wire Meters			
Meters			
scrip/Jewelry Scales			
ail Gas Pumps			
ixi Meters/Odometers			
apor Meters			
Vehicle Scales			
Water Meters			
Wholesale Meters			
HYDROGEN METER	5		
PETROLEUM			
Inspections			
Investigations			

WEIGHTMASTER	
Inspections	
Investigations	
QUANTITY CONTROL	
Lots Accepted	
Lots Rejected	
Packages Rejected	
Packages Accepted	
Packages Sampled (Actual)	
Audit Inspection	
Lots Sampled	
Packages Sampled (Actual)	
Price Verification	
Items Selected	
Number of Overcharges	
Number of Undercharges	
Labeling Activities	
Packages Rejected	

NNC# RT# BT#
UNIT# LIC# VIN#
MAKE MODEL S/N

Remarks TESTED SCALES (5) HYDROGEN METERS WITH FIRST ELEMENT.
BILLING INFO: 5281 CALIFORNIA AVE. STE-260 IRVINE CA. 92617
OWNER: SAME ATTN: ACCOUNT EXECUTIVE

Signature of Owner/Agent

Inspector
JEFF CROY,
SEALER OF WEIGHTS & MEASURES

F080-Weights/Meas.Insp. (R11/16) I/C — In compliance O/C — Out of compliance

Source: FirstElement Fuel, Inc.

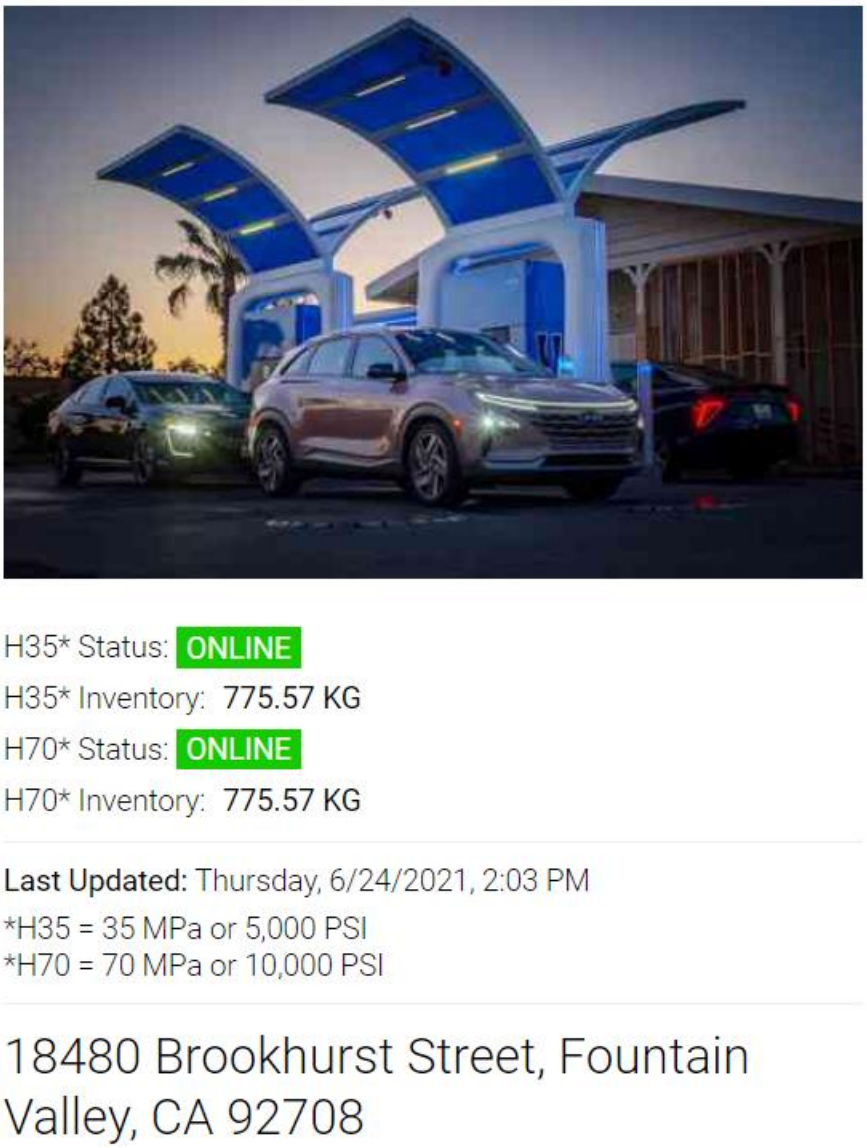
Operational and Open Retail

The California Fuel Cell Partnership (CaFCP) Station Operational Status System (SOSS) provides regularly updated station status information to fuel cell vehicle drivers. FEF developed software in-house that provides the required updates to the SOSS system. The Fountain Valley hydrogen station began sending regular status updates to SOSS on July 3, 2020.

The Fountain Valley station met requirements for open retail status on July 3, 2020.

Pending final sign-off by City Inspectors for punch list items, the station operated under a temporary certificate of occupancy until September 8, 2020 where it transitioned to full operational status.

Figure 11: Station Operation Status System – Fountain Valley.



Source: California Fuel Cell Partnership station map.

CHAPTER 4:
Results

Fountain Valley Hydrogen Station Open

The Fountain Valley Hydrogen station is the first dual dispenser liquid hydrogen station that FEF has opened which has a rated capacity of 1,200 kilograms per day. This larger capacity plays a pivotal role in the infrastructure needs of today serving the greater number of FCEV on the road today. Additionally, four fueling positions that allow three cars to fill simultaneously this station, FirstElement is able improve the customer experience and reduce that amount of time waiting for an open pump.

Figure 12: Completed Fountain Valley Hydrogen Station.

Source: FirstElement Fuel, Inc.

Data Collection and Energy Analysis

Since our first fill that occurred on July 3, 2020; that station has dispensed over 24,000 kgs in its first year of usage and recorded just under 16,800 fills. The table below summaries our data collection during this first year.

Table 2: Data Collection During First Year.

Month	KGs Dispensed	Count of Fills	Avg Kgs Dispensed
July-20	1,836.04	825.00	2.23
August-20	2,083.88	1,052.00	1.98
September-20	1,922.94	941.00	2.04
October-20	3,012.24	1,298.00	2.32
November-20	3,169.96	2,160.00	1.47
December-20	742.91	604.00	1.23
January-21	2,682.43	2,114.00	1.27
February-21	1,233.04	990.00	1.25
March-21	148.63	186.00	0.80
April-21	2,832.89	1,693.00	1.67
May-21	3,014.14	3,680.00	0.82
June-21	1,777.91	1,244.00	1.43
Total	**24,457.02**	**16,787.00**	**1.54**

Source: FirstElement Fuel, Inc.

The Fountain Valley hydrogen refueling station is supplied by hydrogen generated via the Steam Methane Reformation (SMR) process that converts methane (CH4) and water (H2O) to hydrogen (H2) and carbon dioxide (CO2):

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

Per California Senate Bill 1505 (Lowenthal, Chapter 877, Statutes of 2006), Environmental Standards for Hydrogen Production, at least one-third of the hydrogen sold by FirstElement Fuel, Inc.'s state funded hydrogen refueling stations will be produced from renewable sources.

During our first year of operation, FEF has been able to procure environmental attributes necessary to achieve 100% renewable hydrogen for the hydrogen dispensed at the Fountain Valley hydrogen refueling station. These attributes have been procured directly by FEF through a third party in order to increase our renewable supply.

Hydrogen is supplied to the hydrogen fueling stations from Air Products' hydrogen production facilities in Wilmington, CA.

Subcontractors and Budgets

A detailed view of the budget to construct the Fountain Valley hydrogen station has been summarized in Table 3 below.

Table 3: Agreement Budget – Fountain Valley.

Category	Agreement Reimbursable Budget	Agreement Match Budget	Total Project Budget
Compressing and Bulk Storage Equipment	$ 1,452,986	$ 168,015	**$ 1,621,001**
Ground Storage	$ 154,314	$ 100,403	**$ 254,717**
Dispenser	$ 262,700	$ 236,500	**$ 499,200**
Equipment	*$ 1,870,000*	*$ 504,917*	***$ 2,374,917***
Materials/Misc.	*$ -*	*$ 230,486*	***$ 230,486***
I&D Consulting PM	$ -	$ 39,075	**$ 39,075**
SGE Consulting Engineers	$ -	$ 100,317	**$ 100,317**
I&D Consulting Permitting	$ -	$ 21,484	**$ 21,484**
Site Construction	$ -	$ 520,404	**$ 520,404**
Fire Permit Consulting	$ -	$ 21,750	**$ 21,750**
Subcontractors	*$ -*	*$ 703,030*	***$ 703,030***
Indirect Costs	*$ -*	*$ -*	***$ -***
Total	**$ 1,870,000**	**$ 1,438,433**	**$ 3,308,433**

Source: FirstElement Fuel, Inc.

Statement of Future Intent

FEF intends to own and operate the refueling station at 18480 Brookhurst Street, Fountain Valley, CA 92708 for at least 10 years. FEF has invested substantial capital to build the station and will require many years of operation to recoup the development costs. FEF has executed an initial 10-year lease with the landowner with the possibility for extension.

In addition, FEF has built an in-house maintenance team that has the personnel, equipment, and resources to maintain and repair our stations as quickly as possible throughout California.

To augment onsite personnel across the FEF network, a comprehensive data collection and monitoring system has been implemented. FEF 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, FEF has implemented rigorous Computerized Maintenance Management Systems (CMMS) and Enterprise Asset Management systems (EAM) 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.

Findings, Conclusions and Recommendations

The following is a list of important findings from the Fountain Valley hydrogen station project:

- Because the Fountain Valley station represents one of our first stations constructed that incorporates our next generation of stations that features our largest to date capacity of liquid hydrogen storage; substantial learnings were made in the design,

permitting, and construction phases that were carried forward in our future station builds.

GLOSSARY

BATTERY ELECTRIC VEHICLE (BEV) – Also known as an "All-electric" vehicle (AEV), BEVs utilize energy that is stored in rechargeable battery packs. BEVs sustain their power through the batteries and therefore must be plugged into an external electricity source in order to recharge.

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.

CALIFORNIA FUEL CELL PARTNERSHIP (CaFCP) -- The California Fuel Cell Partnership is an industry/government collaboration aimed at expanding the market for fuel cell electric vehicles powered by hydrogen to help create a cleaner, more energy-diverse future with no-compromises to zero emission vehicles.

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 nonenergy production processes such as cement production. Atmospheric concentrations of CO2 have been increasing at a rate of about 0.5 percent per year and are now about 30 percent above preindustrial levels. (EPA)

DIVISION OF MEASUREMENT STANDARDS (DMS) – a Division of the California Department of Food and Agriculture who's responsibilities include Enforcement of California weights and measures laws and regulations. The Division's activities are designed to:[1]

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1 https://www.cdfa.ca.gov/dms/

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

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.

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. Chemical formula is CH4.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) - SAE International, formerly the Society of Automotive Engineers, is a U.S.-based, globally active professional association and standards organization for engineering professionals in various industries.

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.