CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Border Valley Trading, Limited

Coachella Valley Regional Liquefied Natural Gas Infrastructure

Prepared for: California Energy Commission

Prepared by: Border Valley Trading, Limited.

BORDER VALLEY TRADING

Gavin Newsom, Governor

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California Energy Commission

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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-09-006 to provide funding opportunities under the Clean Transportation Program for the Coachella Valley Regional Liquefied Natural Gas Infrastructure Project. In response to PON-09-006, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards May 17, 2010 and the agreement was executed as ARV-10-042 on July 27, 2011.

ABSTRACT

The Border Valley Trading, Limited. Coachella Valley Regional Liquefied Natural Gas Infrastructure project is a liquefied natural gas/liquefied to compressed natural gas fueling station along a critical trucking route between Phoenix, Arizona and the California Ports of Long Beach and Los Angeles. The goal of the project was to find a cost effective and scalable liquefied natural gas equipment package solution that would offer public and commercial access to alternative fueling solutions along the Interstate 10 corridor. The station provides an important connection for clean fuel within the interstate clean transportation corridor. This project has and will lead to better air quality and a reduction in the transportation industry's dependence on the import and use of carbon intensive conventional fuels, as well as fuel cost savings. The station will provide 3.23 million gallons of liquefied natural gas per year, displacing 1.82 million gallons of diesel fuel annually, resulting in a reduction of nearly 150 tons of NOx emissions and nearly three tons of particulate matter. The station's public access at a critical link point along the Interstate 10 corridor will offer the opportunity for trucking fleets to convert their high carbon diesel trucks to lower carbon liquefied natural gas trucks. The station's cost effective new horizontal tank design will allow small to medium sized trucking operations to obtain the infrastructure previously economically unreachable, on-site and in-route for converting their trucking fleets to alternative fuel usage.

Keywords: California Energy Commission, Border Valley Trading, HayDay Farms, Liquefied Natural Gas fueling, liquefied to compressed natural gas, liquefied natural gas, natural gas fueling infrastructure, natural gas trucks, heavy duty trucks, GreenFix America.

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EXECUTIVE SUMMARY

Border Valley Trading, Limited. (BVT) and HayDay Farms, Inc. are two of the largest hay exporters on the West Coast. Both companies have and continue to be committed to aggressively converting their trucking fleets to low-carbon alternative fuels, specifically liquefied natural gas (LNG) and liquefied compressed natural gas. In order to accomplish this goal, the companies needed a fueling station to link their respective locations in Brawley and Blythe California to the ports of Los Angeles and Long Beach California. They began with a smaller "phase I" 10,000 gallon fueling station along the Interstate 10 corridor. Once operational in 2012, it was apparent that a much larger public access fueling station was needed to not only service their demand, but the demands of other heavy duty trucks traveling the corridor between Phoenix, Arizona and the ports of Los Angeles and Long Beach.

BVT, with grant assistance from CEC, South Coast Air Quality Management District and Mobile Source Air Pollution Reduction Review Committee, has completed construction of phase-2 of its publicly accessible LNG and liquefied compressed natural gas fueling station in the Coachella Valley. One of the major purposes of this fueling station was to reduce carbon emissions, leading to better air quality and a reduction on the dependence on imports of carbon intensive conventional fuels in the transportation industry. Not only does the station improve air quality, it also provides a critical "half-way point" fueling link along the heavily traveled interstate 10 corridor between the California/Arizona Border and Ontario, California for LNG and liquefied compressed natural gas trucks.

As such, the fueling station is a vital piece to providing the infrastructure necessary for large heavy-duty diesel fleets to transition to clean-burning natural gas. It also provides a critical and accessible location in Palm Springs, California for fueling options along the interstate clean transportation corridor.

In addition to the goal of reducing carbon emissions, the following goals were also established:

- Support and bolster the regional refueling infrastructure strategy being developed in Southern California through the development of a new publicly-available station in a critical gap location;
- Provide for nearly 3.23 million gallons of LNG per year;
- Provide for the displacement of over 1.82 million gallons of annual diesel use with 100 percent domestically produced low-carbon LNG;
- Provide for the reduction of more than 21,700 metric tons of greenhouse gas (GHG) emissions, and nearly 150 tons of nitrogen oxide (NOx) emissions, and three tons of particulate matter per year;
- Contribute to the creation of up to 17 temporary and permanent California-based jobs;
- Promote regional growth in alternative fuel vehicle deployments and the replacement of heavy-duty diesel trucks;
- Serve as a model for other large-scale goods movement fleet operators on how to successfully implement advanced technology alternative fuel infrastructure programs in collaboration with public agencies;

- Complete these goals at a cost-effectiveness as low as $0.0884 per gallon of diesel fuel displaced and $7.82 per metric ton of GHGs reduced.

This station also brings economic improvements to the region in the way of immediate job benefits and sales tax revenues by providing economic fueling options for local fleets. This station supports criteria pollutant emission reductions in an area that is heavily impacted by emissions, geography and weather patterns. It supports businesses located in hard-hit communities by helping them save money, displacing large quantities of petroleum, and using entirely low-carbon fueling operations.

A key aspect of the process was to architecturally design and build a new dual 11,000 gallon storage tank system to allow for 2.5 days of the fuel storage needed to accommodate the anticipated initial demand of BVT, HayDay Farms, Inc. and other companies for their combined fleets of heavy duty LNG/Liquefied Compressed Natural Gas trucks. The result of this project is an easily accessible state-of-the-art LNG/Liquefied Compressed Natural Gas full capacity fueling station that not only services BVT. and HayDay Farms, Inc., but many other companies with large trucking fleets using the Interstate 10 freeway from outlying locations to the ports of Los Angeles and Long Beach.

CHAPTER 1: Purpose and Approach

Purpose

A Critical Link

The purpose of this project is to provide a critical liquefied natural gas (LNG) fueling station link along the Interstate 10 corridor between Phoenix, Arizona and the ports of Los Angeles and Long Beach, California to allow companies using large heavy-duty trucks to convert high carbon emission vehicles to low carbon alternative fuel vehicles. This project was developed specifically in response to the federal, state and local agency demands for improved air quality and a reduction in dependence on imports of carbon intensive fossil fuels by the transportation industry.

The cleaner-burning natural gas fuel dispensed at this station is used in heavy-duty trucks that would otherwise be using diesel fuel. Transitioning from diesel to natural gas can be a low NOx and low carbon emission strategy.[1]

Emissions Reductions

The development of this station is a much needed step forward for the South Coast Air Quality Management District (SCAQMD) and the CEC to ensure emission reductions from fleets traveling within the Coachella Valley by providing the infrastructure necessary for diesel fleets to transition to cleaner-burning natural gas. With the construction of this station, a critical gap in suitable LNG infrastructure along the Interstate 10 Freeway in Palms Springs, California have been bridged. This location provides easy access for the fueling of many large heavy-duty fleets that have already transitioned to LNG.

Connecting with Interstate Clean Transportation Corridor

The station provides an important link in a growing multi-state system of heavy-duty natural gas fueling options along the interstate clean transportation corridor (ICTC), a public/private partnership created to expand alternative fuel vehicle use and refueling station access throughout the Western United States. Since its inception, the ICTC has become widely recognized for increasing the use of cleaner, low-carbon, sustainable fuels in heavy-duty natural gas vehicle operations, closing the fueling infrastructure gaps between states. The ICTC maximizes the benefit from alternative fuel stations by placing them along well-travelled corridors and making sure there is a high-volume fleet to use the stations as its base for fueling operations.

1 For example, see the CEC's funding of the Cummins-Westport Low NOx 8.9 and 12-liter natural gas engines. (https://ww2.energy.ca.gov/2019publications/CEC-500-2019-002/CEC-500-2019-002.pdf)

Improved Air Quality

The Interstate 10 corridor is one of the most congested main transport routes on the West Coast; traffic is projected to increase at least 250 percent over the next 15 years. The heavy use of this corridor and the proposed increase in use necessitates an alternative lower polluting fuel to improve the air quality in Southern California. This LNG station will contribute to the reduction of higher-polluting fuels and lead to improvement in air quality in the region.

Approach

Team

BVT began by putting together a team of individuals with collective business development skills and experience in implementing LNG fueling infrastructure projects. This included the President of BVT, Greg Braun, who has expertise in developing international trade markets and product demand for high-end hay products for the cattle feed industry throughout the world. Dale Tyson, Vice President and Co-Founder of HayDay Farms, Inc. (HDF), coordinated all trainings and fueling needs for the HDF fleet related to this station development effort. Mr. Tyson managed all day-to-day farm operations, including oversight of the on-site hay compressing facility and fleet operations team. Greenfix America (GFA), oversaw the development of this project on behalf of BVT. GFA led the project development, schedule, and budget as well as navigated all technical aspects of the station construction. GFA was assisted by Ulrich Sauebrey, P.E. who managed all site construction plans, working directly with the engineers, fuel providers and permitting officials for the Coachella Valley Regional LNG Project.

Architectural Design

The next step was drafting an architectural design for what was initially a 15,000 gallon vertical tank. Ultimately, the design was changed to a dual 11,000 gallon LNG storage tank facility to accommodate the anticipated demand of both BVT and HDF as well as other companies using LNG trucks.

Budget Preparation

Once the design was initially drafted a budget was completed that outlined the components and costs of design and construction. Ultimately, the budget was set at $2.6 million.

Grant Proposal

After the budget was set, BVT prepared and submitted grant proposals to the CEC, SCAQMD and Mobile Source Air Pollution Reduction Review Committee. These grants were successfully obtained in the amounts of $500,000, $950,000 and $150,000 respectively. The awarding of these grants allowed the company to move forward with permitting and construction of the project.

CHAPTER 2: Permitting, Construction and Commissioning

Permitting

Once the grant was awarded, the proposed project design went through the permitting phase with Palm Springs. Through this process, changes were made to the design to accommodate architectural design guidelines adjacent to one of the City's primary entries. This phase took an extensive amount of time due to the changes required.

Equipment Ordering

The equipment ordering began once the grants were awarded and continued simultaneously with the permitting process. Through this process, it was determined that the initial tall vertical tank design needed to be changed to two side by side 11,000 gallon tanks due to the significant lead time required for the upright tank and the "visual" concerns the Palm Springs permitting team had with the upright tank design.

Construction

Construction began in February of 2014. This phase included the mobilization of construction resources to begin pre-construction preparations that would not disrupt phase 1 fueling operations until absolutely necessary. It was a critical requirement to not decommission the phase 1 LNG refueler until phase 2 construction activities impacted the site in a manner in which it was unsafe or impossible to continue both fueling and construction activities.

Locating and exposing the existing underground electrical conduits, grounding, plumbing, required demolition, foundation preparation and concrete placement were all conducted in conjunction with LNG fleet fueling. In May of 2014 the phase 1 LNG fueling equipment was decommissioned and all phase 2 equipment components were installed on the same day. The unique modular design of the station layout and horizontal tanks allowed for all 10 components to be installed in approximately five hours; LNG Tank A, LNG Tank B, LNG pump skid, LNG heat exchanger vaporizer, LNG motor control center Panel, LNG vapor recover buffer tank, LNG wall mount dispenser panel, compressed natural gas (CNG) storage cylinder skid, CNG compressor skid and CNG motor control center panel. After all components were installed, electrical and mechanical plumbing and connection work began.

Construction Technical Specifications

The following are the equipment and construction specifications for the project:

LNG Dispensing Unit

- Purchase wall mount LNG dispensing cabinet and underwriter's laboratory listed dispenser control head
- Revise mechanical general arrangement drawing to include only one tank (Tank A)
- Purchase wall mount classified dispenser hardware

- Fabricate tank supports
- Purchase station control hardware
- Finalize station process control program
- Complete installation of the flame and combustible gas detection devices to LNG tank frames

LNG Control Cabinet

- Approve vacuum-jacketed mechanical piping general arrangement drawings for fabrication
- Review revised drawings
- Order cryogenic valves and instrumentation
- Complete wall mount LNG dispenser
- Complete LNG station electrical control cabinet and process control program
- Complete final assembly of station electrical control cabinet
- Bench test wall mount LNG dispenser with station controller program
- Pick up building department permit

Concrete Foundation

- Pickup building department permit
- Start concrete foundation work per revised structural plans
- Revise mechanical drawings and controls to accommodate the addition of Tank B
- Completed new building department submittal for addition of Tank B per approved structural plans
- Perform underground utility repairs
- Complete concrete foundation work per revised structural plans

Removal of Existing LNG Equipment

- Prepare existing LNG station equipment for removal
- Decommission existing LNG station. Remove existing LNG phase one station skid

Mechanical Construction

- Set new horizontal LNG tanks (A&B), LNG pump skid, vaporizer coil, electrical control cabinet, CNG compressor, CNG storage vessels and LNG buffer tank
- Install mechanical piping and flanges
- Start classified electrical installation
- Start electrical wiring and control terminations
- Test station controls and alarm shut downs
- Order bulk fuel delivery – cool down tank A and off load 8,800 gallons of LNG
- Test LNG pump skid operation, meter cool down function and dispensing sequence

Electrical Completion

- Completed classified electrical installation and electrical wiring and control terminations
- Test station controls and alarm shut downs again
- Completed cryogenic insulation
- Fuel testing
- Received building department sign off
- Calibrate point of service device
- Debug Programmable Logic Controller program
- Complete vapor recovery connections

Major Equipment List

11,000 Gallon LNG Storage Tanks

Once the pre-manufactured LNG storage tanks were received, they were pre-plumbed and wired for the gas and flame detection system devices, automated station control valves and process monitoring devices. All of this work was done and tested off site at the contractor's local shop.

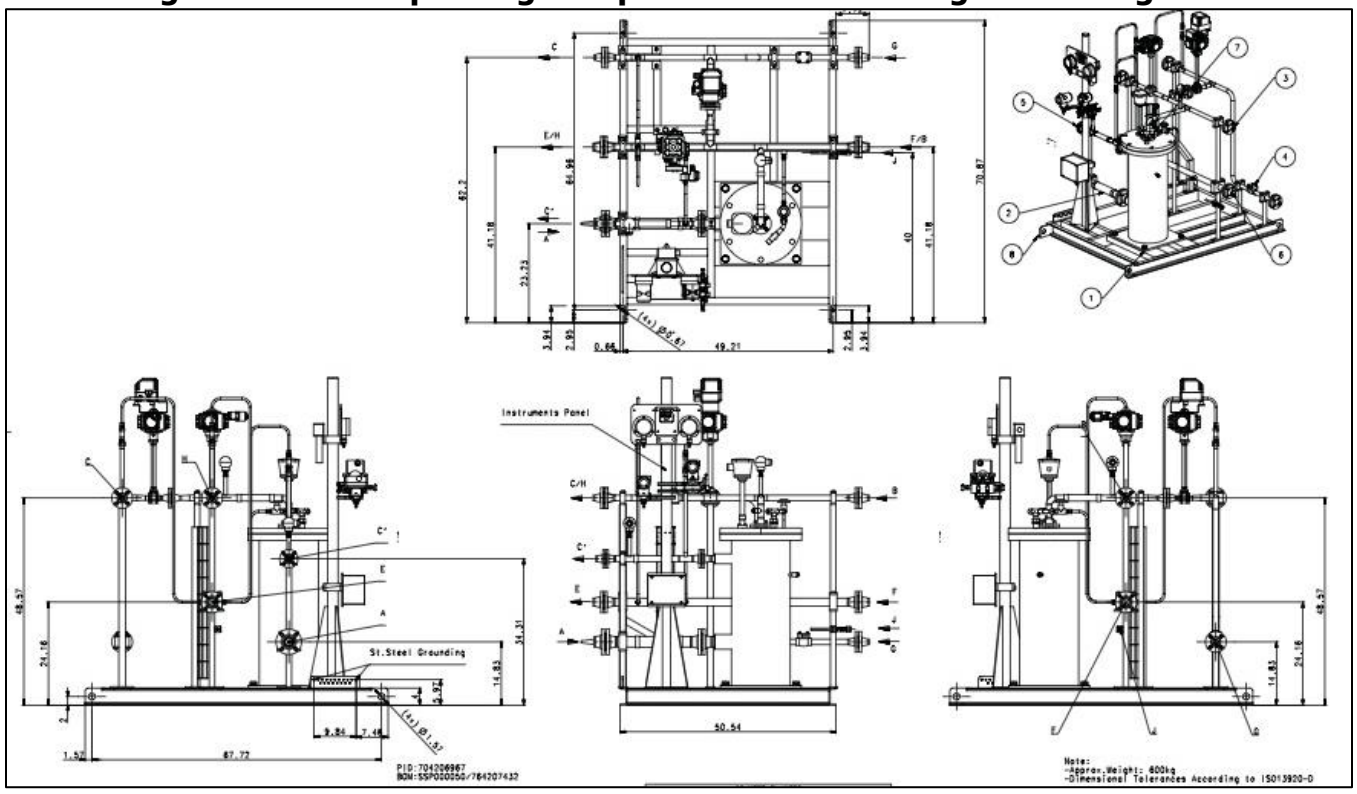
LNG Heat Exchanger

The stainless steel lined aluminum LNG heat exchanger vaporizer was manufactured by a Southern California manufacturer and stored at the contractor's local yard until needed. This unit was designed and sized to produce twice the rated capacity needed for future CNG expansion. The system also incorporated a gas warmer to capture and recover all vehicle vent gas including the LNG tank boil-off gas. With proper LNG demand, this site is intended to be free of all venting to the atmosphere.

LNG Dispensing Pump Skid

The LNG-dispensing pump skid, shown in Figure 1, was pre-fabricated off site in a unitized skid and set into place between both LNG storage tanks. The skid is connected to the LNG wall mount dispenser panel and interconnected to both LNG tanks and LNG vapor recovery system. The LNG pump dispensing process is monitored and controlled by the GFA process controller. It shuts down the dispensing process based on a low-flow fill cut off, excessive flow (broken hose) or any one of three pump alarms.

Figure 1: LNG Dispensing Pump Skid General Arrangement Diagram

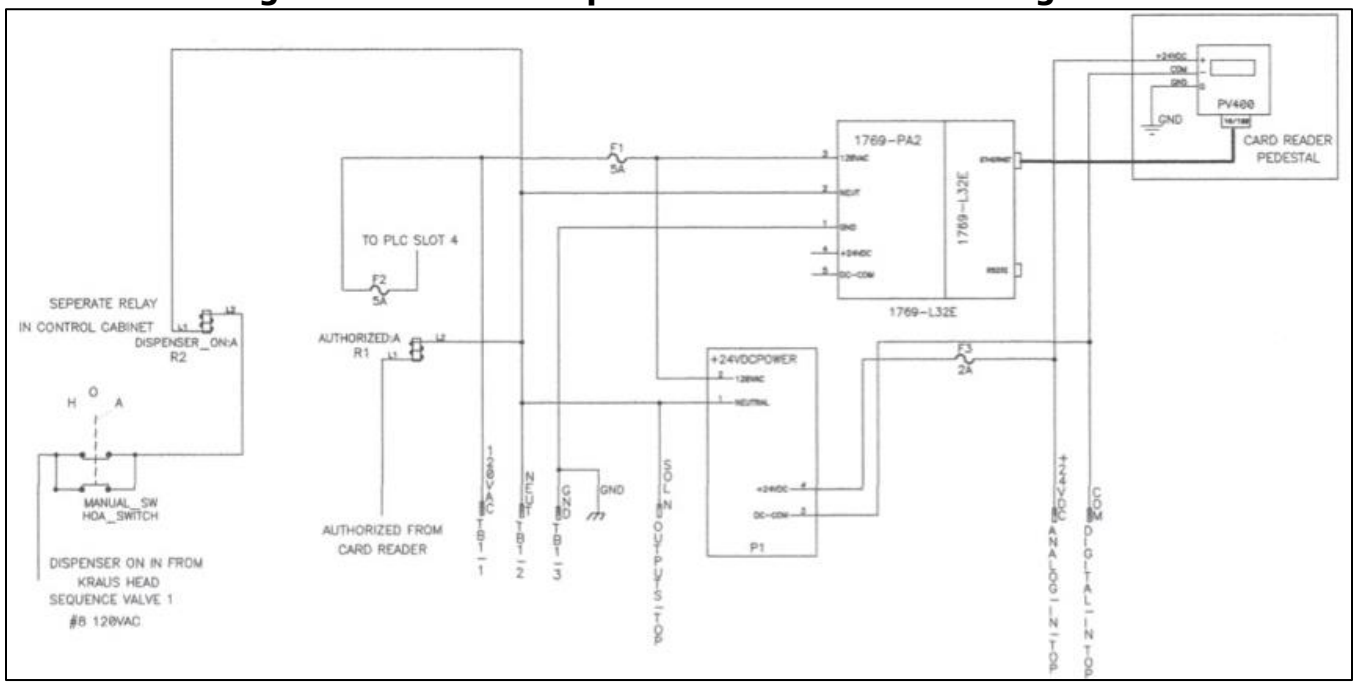


Source: Border Valley Trading, Limited.

LNG Fuel Dispenser

The LNG wall mount dispenser was designed and constructed by GFA. It is mechanically and electrically interconnected to the station process controller, pump skid and LNG vapor recovery system. The wall mount dispenser includes a fuel display controller, cryogenic fill hose, breakaway device, static ground fault indicator, process control interface station, service air supply hose, vapor recovery connection device and a weights and measures compliant cryogenic flow meter. Figure 2 shows the LNG Fuel Dispenser and Card Reader Diagram.

Figure 2: LNG Fuel Dispenser and Card Reader Diagram



Source: Border Valley Trading, Limited.

Connecting Vacuum-Jacketed Piping

The pump skid and two horizontal LNG storage tanks are interconnected by vacuum-jacketed mechanical piping. The specific circuits requiring vacuum-jacketed piping are: Tank fill/Pump suction line; Pump sump vent line; Dispenser; and Meter cooling recirculation circuit. The vacuum-jacketed assembly is stainless steel construction with sealed flexible bellows for seismic and expansion provisions.

Automated Valves and Controls

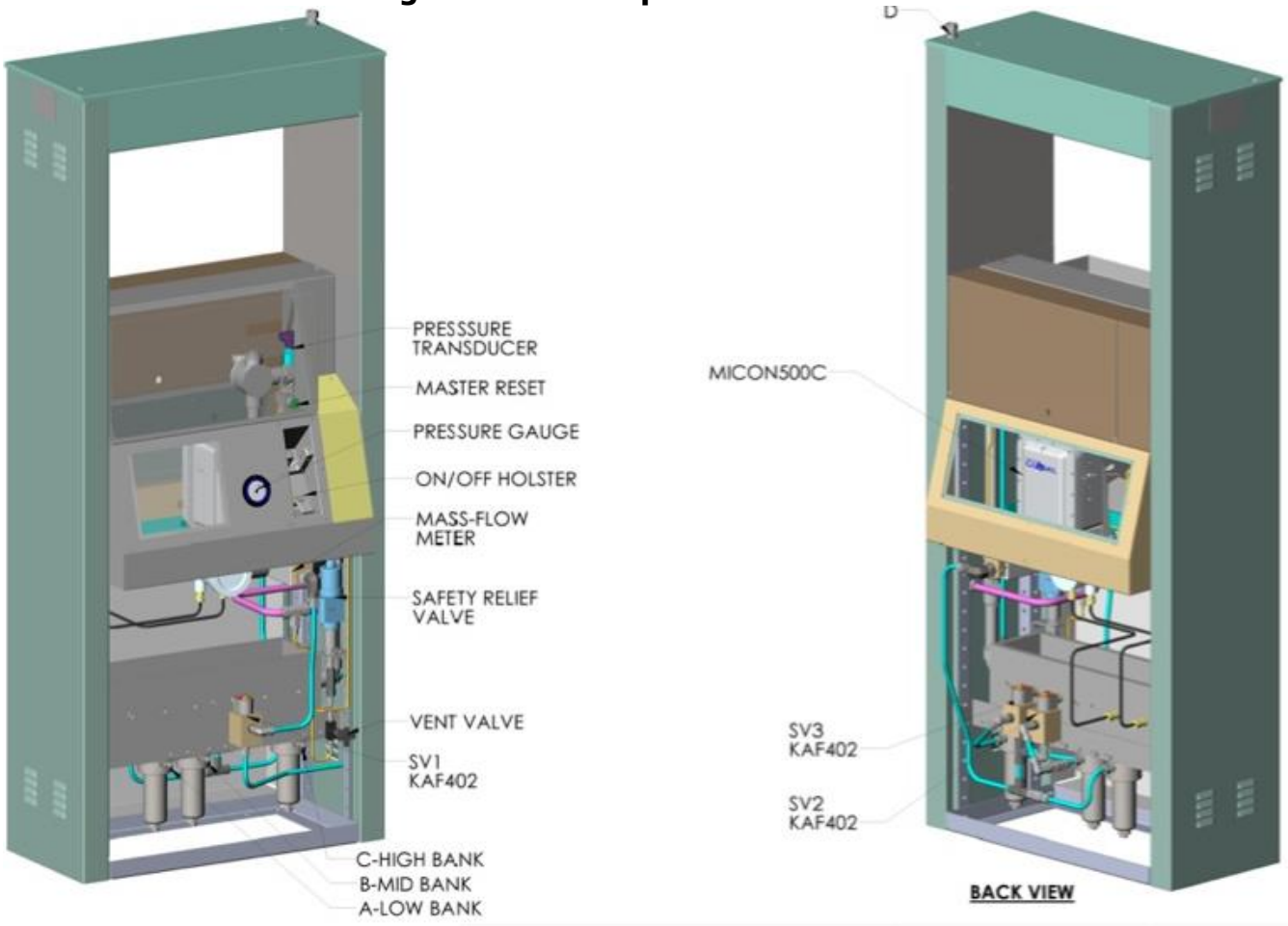
The LNG automated control vales are electro-mechanical pneumatic controlled cryogenic valves. The GFA programmable logic controller systematically controls the valve sequence during LNG filling, CNG vapor recovery, tank saturation, tank filling and emergency shut downs.

LNG Dispensing Pump Skid

The prefabricated LNG pump skid is comprised of a vacuum-jacketed stainless steel sump containing a centrifugal multiple stage cryogenic pump all connected to the station process via vacuum-jacketed mechanical piping, schedule 10 stainless steel welded lines and flexible bellows where required for seismic and expansion.

Figure 3 shows the LNG dispenser with each of the above components.

Figure 3: LNG Dispenser Illustration



Source: Border Valley Trading, Limited.

CNG Storage Cylinders

The CNG storage cylinders were manufactured by CP Industries. The assembly includes three 24-inch high pressure steel cylinders, "I" beam frame assembly, pressure relief valves and manual shut-off valve connections. The details include:

- A 281 gasoline gallon equivalent CNG, or 34,880 cubic foot at 4,700 storage,
- An assembly weight of 23,660 pounds per square inch (PSI),
- A test Pressure of 8,070 psi,
- A design working pressure of 5,380 psi,
- An assembly nominal water volume of 101.1 cubic foot.

CNG Weights & Measures Certified Dispenser

The dispenser is a standard single hose CNG dispenser as manufactured by Kraus Global. It includes:

- A 3,600 psi compensated fill pressure,
- A 5,000 psi design pressure,
- A Single hose fill nozzle/vent return line and break away devices.

CNG Compressor Package

As pre-manufactured and packaged by Bauer Compressor Company. This unit is a high capacity fully enclosed water cooled CNG Compressor package. It includes:

- A discharge capacity of 150 cubic feet per minute,
- A design working pressure of 5,000 psi,
- A compensated electronic priority control.

LNG System Control Panel

The LNG System Control Panel is housed in an explosion proof classified enclosure. The system includes a GFA process control program, Allen Bradley programmable logic control platform, power supply, electrical interface between fuel display head and card reader and lock out key switch. The process control interface functions through a touchscreen located at the card reader pedestal, which allows the operator to have complete line of sight visual access to the process from outside the dispensing and storage area.

Methane and Fire Detection Equipment

The station is equipped with a National Fire Protection Association rated LNG storage and handling compliant flame and combustible gas detection system. The system devices are mounted on the horizontal LNG storage tanks and are elevated to be visible from the fuel dispenser and storage impound area.

Card Reader Systems

The card reader (card lock point of sale interface) is located outside the fuel dispensing and storage area. There are two card swipe readers. One is a slave unit for the CNG dispenser and the second is the master card swipe reader located at the LNG dispenser. Both are connected to a phone line for 24-hour data access for fuel data logging and control. This Fuel Force system is hosted by GFA.

Electrical Control Panel

The LNG System Control Panels are independent motor control center located outside the classified fuel storage and dispensing area. The motor control center hardware includes electronic motor starter and speed controllers, disconnect switches, fire alarm panel, control relays, power supply and alarm beacons. All panels are equipped with locking devices to provide for controlled security access.

Card Lock Gate Access

The site is only accessible through a card lock gate access system. This system was installed with phase 1 construction and is unaltered as approved and inspected by the local fire department authorities during that phase of construction.

Impound Area Containment

The impound area containment consists of concrete masonry as depicted on the site construction drawings. This is designed to control and contain an unscheduled release of LNG. This is a failsafe emergency design element meeting hazardous fuel and local fire code requirements.

Lighting

The site is equipped with elevated area lighting. This system was installed with phase 1 construction and is unaltered as approved and inspected by the local building department authorities during that phase of construction.

Signage

The site, LNG component fixtures and impound areas are delineated with National Fire Protection Association compliant signage as approved and inspected by the local fire department authorities. The site also is placarded with various user instruction and warning signs.

Station Commissioning

The Palm Springs Fire Department approved the station for fuel handling on March 15, 2015. Initial fuel testing met operational requirements with minor adjustments required to the meter cool down / dispensing program routine. Additional modifications were implemented to the vapor recovery routine to maintain a more desirable tank vapor pressure required to successfully fuel warm fuel vehicles. This station is required to fuel both warm and cold fueled vehicles. The site is open for fleet fueling with manned supervised fueling to safely train the fleet drivers with both fuel types. Unmanned 24-hour CNG fueling is currently servicing new commercial fleet operators.

CHAPTER 3: Results

New LNG Station Expanding Business Operations

The increased capacity at the fueling station has provided an opportunity for BVT to expand and service its base LNG fleet from 20 to 35 trucks. HDF continues to operate a base fleet of 20 LNG trucks. The expansion will also service additional fleet operators that are scheduled to start fueling mid-summer 2015. This expansion will initially include an additional 25 LNG trucks. This represents a total base fleet of 80 LNG trucks.

The additional fuel capacity storage will provide operational flexibility to add additional fleet operators as future LNG demand increases.

HDF fuel usage per year per truck is 41,470 LNG gallons. BVT and the other companies' fleets fuel usage per year per truck is 40,040 LNG gallons per year. Collectively, the LNG gallons total 2,756,000. In addition to this usage there is an estimated fuel usage growth of 18,525 LNG gallons per year per truck, representing a significant annual growth trajectory of 31 percent for LNG fuel usage.

Based on January 2015 fuel pricing of $3.67 per diesel gallon and $1.55 per LNG gallon, the cost savings is significant as summarized on the following chart (Table 1). The chart uses a fuel conversion ratio of 1.78 gallons of LNG to one gallon of diesel for energy equivalency calculations.

Table 1: LNG Use, Cost and Petroleum Displacement

LNG Gallons		**Diesel Gallons**	
1,401,400	BVT Annual Fuel LNG Use	787,300	BVT Annual Diesel Displaced
829,400	HDF Annual LNG Use	465,950	HDF Annual Diesel Displaced
1,001,000	Annual LNG Fuel Use, 25 New Vehicles	562,360	Annual Diesel Displaced, five New Vehicles
3,231,800	***TOTAL LNG Volume, one year after project completion***	***1,815,600***	***TOTAL Equivalent Diesel Fuel, one year after project completion***
LNG Costs		**Diesel Costs**	
$5,009,290	***Total Cost @ Jan 2015 Prices ($1.55 / LNG gallon)***	***$6,663,318.00***	***Total Cost @ Jan 2015 Prices ($3.67 / diesel gallon)***
$1,654,028	**Estimated Annual Fuel Cost Savings, Yr. 1**		
$2,412,512	**Estimated Annual Fuel Cost Savings, Yr. 2***		
$3,170,996	**Estimated Annual Fuel Cost Savings, Yr. 3***		

* Assumes 31 percent growth in LNG use after Year 1.

Source: Border Valley Trading, Limited.

LNG Emissions Reduction

The Coachella Valley Regional LNG Infrastructure Project has directly facilitated the reduction of NOx emissions in the region by nearly 150 tons and particulate matter emissions by nearly three tons, as shown in Table 2.

Table 2: Criteria and Particulate Matter Emission Reductions

Annual Fuel Use	**Border Valley**		**HayDay**		**Other**		**TOTAL**	
Annual Fuel Consumption (LNG gallons)	40,040	40,040	41,470	41,470	40,040	40,040	40,400	40,400
Annual Natural Gas Fuel Consumption (diesel gallon equivalent)	23,553	23,553	24,394	24,394	23,553	23,553	23,765	23,765
Criteria Pollutant Emission Reduction Calculation	**NOx**	**PM**	**NOx**	**PM**	**NOx**	**PM**	**NOx**	**PM**
Baseline Diesel Emission Factor (gallons per mile) 2003-2006	11.63	0.25	11.63	0.25	11.63	0.25	11.63	0.25
Emission Reduction Factor (g/mi) for 2010 Natural Gas	.58	.029	.58	0.029	.58	.029	.58	0.029
Projected Diesel Baseline Emissions (tons per year)	1.93	0.042	1.995	0.043	1.93	0.042	1.945	0.042
Projected Reduced Natural Gas Emissions (tons per year)	0.1	0.005	0.1	0.005	0.1	0.005	0.1	0.005
Annual Emission Reductions (tons per year)	**1.83**	**0.037**	**1.83**	**0.037**	**1.83**	**0.037**	**1.845**	**0.037**
Project Life (years)	10	10	10	10	10	10	10	10
Number of Vehicles	35	35	20	20	25	25	80	80
TOTAL ESTIMATED ANNUAL EMISSION REDUCTIONS (tons)	**64.05**	**1.295**	**36.6**	**0.74**	**45.75**	**0.925**	**147.6**	**2.96**

Source: Border Valley Trading, Limited.

Jobs Creation

The construction, commissioning and operation of the fueling station created temporary work for 10 workers during the phase of construction, testing and start-up. The station will employ two full time rotating trainers to train drivers on safe dispensing practices (these will be temporary positions), one full time station maintenance operator, and one full time equivalent administrative support/bookkeeper for operations accounting and data collection. In addition, several employees have been hired for dealer and in-house vehicle maintenance support for

the various company's fleet of LNG vehicles. In summary, the LNG fueling project created about 12 temporary jobs and up to five permanent positions.

Local truck operators will generate a projected cost savings of $7.2 million over a three-year period of time. This cost savings will allow these companies to spend a portion of those dollars on job retention and reinvestment in employment and fleet expansion and facilitate a significant competitive advantage, allowing for increased business growth and jobs creation.

Over the long term, the industries supported by this project including the construction and design, vehicle manufacturing and support, and alternative fuel production are "green jobs" that have and will help lead California further out of the recession and into a greener more energy-secure future. The jobs created have included specialty training on unique and important skill sets that will leverage for further employment and economic advancement as alternative fuel transportation technologies become more prevalent through the economy and contribute to sustainability of a green initiative.

CHAPTER 4: Observations and Conclusions

Engineering and Design Developments

A new design was implemented in this project to meet timeline objectives, cost objectives and City of Palm Springs objection to a 42-foot vertical tank. GFA pursued this new horizontal tank technology design with success. Implementing this technology into an LNG station format is a new concept to the generally accepted practices.

GFA developed, in collaboration with manufacturer's and process control engineers, a system that works with limited negative operational consequences. The horizontal, elevated "cradle" installation provides greater operational latitude and mobility versus the vertical tank installations widely used in the industry.

This type of construction provides for:

- Reduced upfront installation cost;
- Reduced visual impacts on sensitive view corridors;
- Trailer mount "intermodal" installations for remote service areas including agricultural boiler and vehicle operations where a gas source is not readily available;
- Provides for lessor cost tank and pump relocations as market demand and influences dictate.

Vapor Recovery

In conjunction with the primary LNG use, CNG and vapor recovery capability has been added to the site. An important component to the site design was the addition of a vapor recovery system that not only captures and re-uses storage tank "boil-off", it also provides for truck operators to vent their tanks through the recovery system promoting 100 percent reuse of unused gas. The addition of CNG also provides a fuel source for localized and short-haul operators reducing the emissions footprint and further promoting the use of alternative, cleaner burning fuels.

Aesthetic Concerns with City of Palm Springs

The initial station proposal for the site was to utilize a vertical tank installation which is common place in the industry. However, these types of installations are both costly and are burdened with long equipment lead times for key components. In addition, the City of Palm Springs (lead agency) was initially resistant to approve a visually unattractive installation on a major thoroughfare to the City. This resistance added significant time to develop mitigation measures (added landscape and site treatments) to address the concerns of Palm Springs, which necessitated an analysis of alternate installations.

Experience suggested that a horizontal tank installation would not work. The fluid mechanics of the fuel would not provide enough head pressure at the pump impellors to provide for efficient pumping and dispensing. This led to a detailed and exhaustive analysis of the various options by GFA resulting in the horizontal tank design implemented at the Palm Springs station.

GFA had to develop a dual management dispensing program to operate the station. This was the result of equipment manufacturers and suppliers wanting to retain proprietary rights to their equipment and programming, all of which lengthened delivery times and inflated costs.

GFA developed a dual management dispensing program by removing the proprietary nature of the programming. This created the opportunity to replicate LNG storage and pumping facilities, such as the one located at Palm Springs, at a much more economically feasible budget. This made it feasible to build one, fixed base tank system for under $1 million and portable and mobile installations for under $600,000, both of which resulted in greater investment in LNG fueling infrastructure.

Since BVT's goal was to find a least cost, scalable equipment package solution that would work on a small site footprint with mobile capability, without sacrificing operational readiness. BVT found that solution in the Palm Springs station.

Conclusion

Southern California could greatly benefit from providing funds to assist in the construction of LNG stations and mobile refuelers at remote locations which link the ICTC and importers and exporters to the Long Beach and Los Angeles ports and other major metropolitan areas. This investment will support LNG conversion for not only heavy duty trucks, but machinery used at base plant-operations as well. The cost effectiveness of the small-scale technology developed in our process, combined with funding assistance, would minimize the financial risk for choosing LNG, and would greatly enhance air quality and meet emission reduction standards.

This technology is successful from the perspective of providing replicable, cost-effective access to alternative fuels. Even small companies now have the opportunity to switch to alternative fuels, which provides for a cleaner environment and a long-term cost-effective solution for renewable energy to be used in a wide variety of operations.

CHAPTER 5: Project Photos

Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, and Figure 9 show various components of the Coachella Valley LNG fueling station.

Figure 4: LNG Storage Tanks, CNG Compressor and Storage Skid

Source: Border Valley Trading, Limited.

Figure 5: LNG Pump Skid System

Source: Border Valley Trading, Limited.

Figure 6: Plumbing for LNG System

Source: Border Valley Trading, Limited.

Figure 7: LNG Wall Mount Dispenser System

Source: Border Valley Trading, Limited.

Figure 8: CNG Dispenser Panel

Source: Border Valley Trading, Limited.

Figure 9: Heavy Duty Truck Refueling with LNG

Source: Border Valley Trading, Limited.

GLOSSARY

BORDER VALLEY TRADING, LIMITED (BVT) - Exporter of alfalfa and grass hay/straw, located in Brawley, California.

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:

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

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

COMPRESSED NATURAL GAS (CNG) - Natural gas that has been compressed under high pressure, typically between 2,000 and 3,600 pounds per square inch, held in a container. The gas expands when released for use as a fuel.

GREENFIX AMERICA (GFA) - a Brawley, California based manufacturer of rolled erosion control blankets and a green solutions provider supported by a wide spectrum of products, applications and consulting.

GREENHOUSE GASES (GHG) – Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

HAYDAY FARMS, INC. (HDF) – A hay brokerage located in Blythe, California.

INTERSTATE CLEAN TRANSPORTATION CORRIDOR (ICTC) – a public/private partnership created to expand alternative fuel vehicle use and refueling station access throughout the Western United States.

LIQUIFIED NATURAL GAS (LNG) – Natural gas that has been condensed to a liquid, typically by cryogenically cooling the gas to minus 260 degrees Fahrenheit (below zero).

NITROGEN OXIDES (NOx) - Oxides of nitrogen that are a chief component of air pollution that can be produced by the burning of fossil fuels. Also called nitrogen oxides.

PARTICULATE MATTER (PM) - Unburned fuel particles that form smoke or soot and stick to lung tissue when inhaled. A chief component of exhaust emissions from heavy-duty diesel engines.

POUNDS PER SQUARE INCH (PSI) - a unit of pressure or of stress based on avoirdupois units. It is the pressure resulting from a force of one pound-force applied to an area of one square inch.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD) - the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino counties. This area of 10,743 square miles is home to over 16.8 million people– about half the population of the whole state of California.