



**CALIFORNIA
ENERGY COMMISSION**



Clean Transportation Program

FINAL PROJECT REPORT

United Parcel Service Natural Gas Fueling Station

**Upgrades to the Liquefied Natural Gas Station in
Ontario, California**

Prepared for: California Energy Commission

**Prepared by: United Parcel Service and South Coast Air Quality
Management District**



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PREFACE

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

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

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

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-09-006 to provide funding opportunities under the Clean Transportation Program for projects which develop infrastructure necessary to store, distribute, and dispense electricity, E-85, Biomass-based diesel, and natural gas. 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-10-035 on February 22, 2012 in the amount of \$55,792. United Parcel Service provided \$1.4 million in matching funds.

ABSTRACT

An important barrier to natural gas vehicle deployment in California is the lack of supporting fueling infrastructure. United Parcel Service’s liquefied natural gas fueling station in Ontario is a public-private access station providing liquefied and compressed natural gas. The area is located adjacent to the Ontario International Airport in a predominantly industrial and commercial zone. Ontario is located in the Inland Empire region of Southern California and is one of the many regions comprising the South Coast Air Basin.

The Ontario station has been in service since 1997. While natural gas fueling stations exist in the Inland Empire, only a limited number of these stations provide public access to liquefied natural gas fuel. This station represents one of the first alternative fuel stations in this region and is part of the established network of alternative fuel stations in the Inland Empire. Liquefied natural gas fueling infrastructure is critical for the expanding fleet of natural gas-powered Class 8 vehicles that are involved in goods movement between the Ports of Los Angeles and Long Beach and cities and distribution centers both inside and outside of southern California.

The goal of upgrading the Ontario station was to create incentives for heavy-duty trucking fleets to adopt or expand the use of advanced natural gas technologies and enable the accelerated replacement of heavy-duty diesel trucks with low-emission natural gas in Southern California. Upgrading the Ontario natural gas fueling station project supports a region-wide transition opportunity for heavy-duty fleets interested in alternative fuels and allows for the reduction of diesel fuel use and vehicle emissions in California.

Keywords: Liquefied Natural Gas, Compressed Natural Gas, LNG, fueling infrastructure, United Parcel Service, Ontario LNG Station.

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EXECUTIVE SUMMARY

Under this grant agreement, United Parcel Service upgraded its public-private liquefied natural gas (LNG) and compressed natural gas station in the City of Ontario in Los Angeles County, California. United Parcel Service owns all equipment at the Ontario station, except for two public access compressed natural gas dispensers, which are owned by Applied LNG. Applied LNG maintains all the equipment at this site under contract with United Parcel Service. The station utilizes a 6,000-gallon LNG storage tank. LNG and compressed natural gas fuel dispensing is wholly dependent on LNG fuel delivery and storage. Other equipment used at this station includes an LNG pump, an LNG dispenser, an LNG to compressed natural gas vaporizer system, a compressed natural gas pump and four compressed natural gas dispensers.

The objectives of this project are to support the natural gas vehicle fueling requirements for the expanded United Parcel Service vehicle fleet of both LNG- and compressed natural gas - powered heavy-duty vehicles, and other natural gas-powered vehicles and fleets that operate or pass through this region of Southern California. Completion of the refurbishments at this established natural gas fueling facility will continue to provide LNG and compressed natural gas fuel in this region and continue to displace more than 700,000 diesel gallon equivalents per year of petroleum based fuels and reduce approximately 840 tons per year of greenhouse gas (GHG) emissions from the transportation sector (see Appendix A).

The original project scope was for a new and upgraded LNG station. The project was to include purchase and installation of a new 18,000-gallon LNG tank to triple this station's LNG storage capacity. United Parcel Service' original proposal was based on unreliable LNG fuel supply in combination with expected increases in fleet size, vehicle miles traveled, and fuel demand. Subsequent to grant award and contract execution, United Parcel Service realized a significant improvement in the reliability of LNG fuel delivery, reducing the immediate need for more LNG storage capacity. In recognition of the improved fuel delivery to United Parcel Service and to reduce project costs, United Parcel Service and the South Coast Air Quality Management District submitted a request to revise the project scope to a station refurbishment, thereby eliminating the costs associated with the purchase and installation of a new 18,000-gallon LNG tank.

A third and final revision was made to the project scope when it was determined that the proposed new LNG dispenser would not be able to communicate with the rest of the LNG system because United Parcel Service was unable to gain legal access to proprietary software access codes.

The ultimate refurbishment of this station maintains its current refueling capabilities, but also upgrades all private compressed natural gas dispensers, hoses, and nozzles to 3600 pounds per square inch gauge. The refurbishments included replacement of vital components such as LNG and compressed natural gas pumps, the rebuilding of these current components for spares, the repair and re-vacuuming of the existing 6,000 gallon LNG storage vessel, and assessing, and repairing all other components in both the LNG and compressed natural gas systems to bring the full station to its near original condition. The LNG dispenser replacement is not deemed critical or significant at this time, and United Parcel Service is continuing to resolve the software matter to be poised to respond to the LNG dispenser replacement matter when deemed necessary.

Emission Reductions (United Parcel Service)

Nitrogen Oxide Reductions

United Parcel Service' fleet of Class 8 LNG-powered, and Class 7 compressed natural gas - powered heavy-duty vehicles are the largest and most consistent fuel consumers at this refueling facility. As such, a baseline emission reduction assessment for this facility can be performed using the Carl Moyer Program Guidelines methodology for calculating criteria pollutant emission reductions. If it is assumed that a comparable fleet of heavy-duty diesel-powered vehicles, subject to the 1.2 gNO_x/bhp-hr standard, used an equivalent amount of diesel fuel (converting compressed natural gas to diesel gallon equivalents), the reduction in NO_x from the heavy-duty natural gas-powered vehicles would be approximately 13 tons per year.

Carbon Emission Reductions

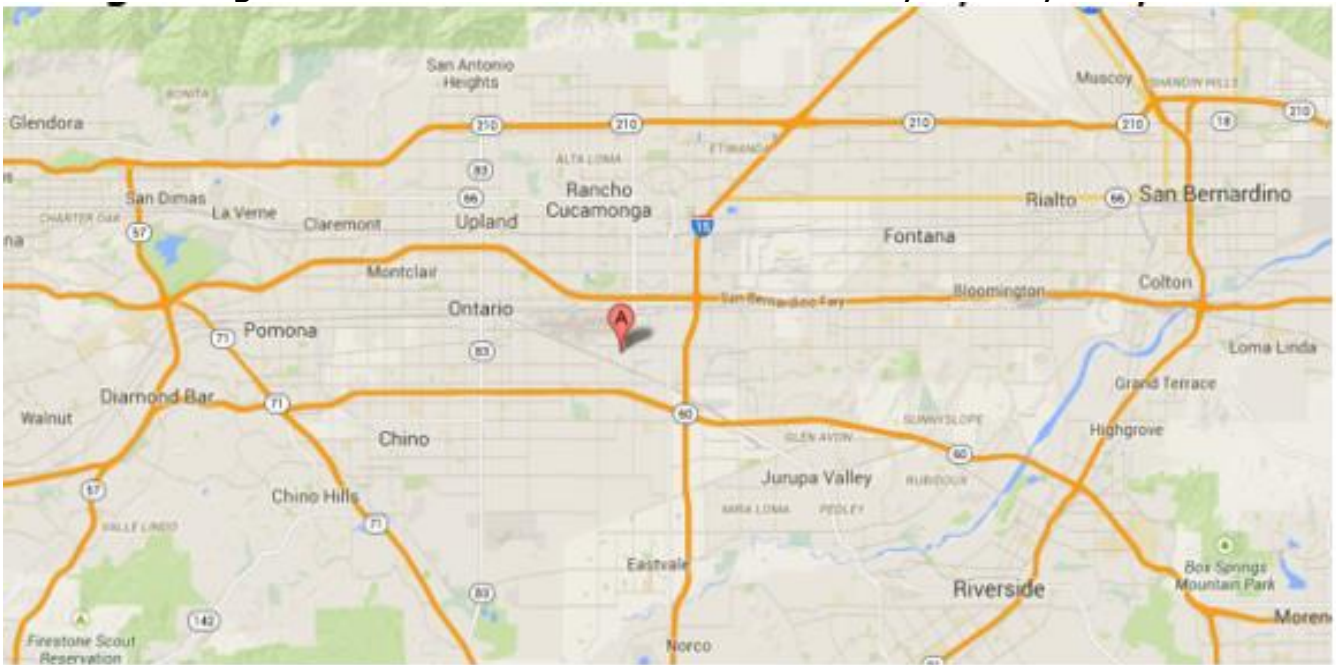
The baseline annual diesel fuel consumption for United Parcel Service' fleet of Class 8 LNG and Class 7 compressed natural gas tractors was about 750,000 gallons. This generated about 10,400 short tons of carbon dioxide (CO₂)-equivalent carbon emissions. Subtracting out the compressed natural gas emissions (4,350 CO₂ equivalent) and LNG emissions (5,225 CO₂ equivalent) yields a net benefit of about 840 short tons of CO₂ equivalent per year.

CHAPTER 1: Project Background and Objectives

Background and Objectives

United Parcel Service' (UPS) LNG and Compresses Natural Gas (CNG) fueling station in Ontario provides private and public access to the natural gas refueling facility at the southwest corner of the existing United Parcel Service facility site at 3140 E. Jurupa Ave. Ontario, CA 91761 (see Figure 1). The area is adjacent to the Ontario International Airport in a predominantly industrial and commercial zone. Ontario is located in the Inland Empire region of southern California and is one of the many regions that comprise the South Coast Air Basin.

Figure 1: Site Location - 1735 S. Turner Ave, Ontario, CA 91761

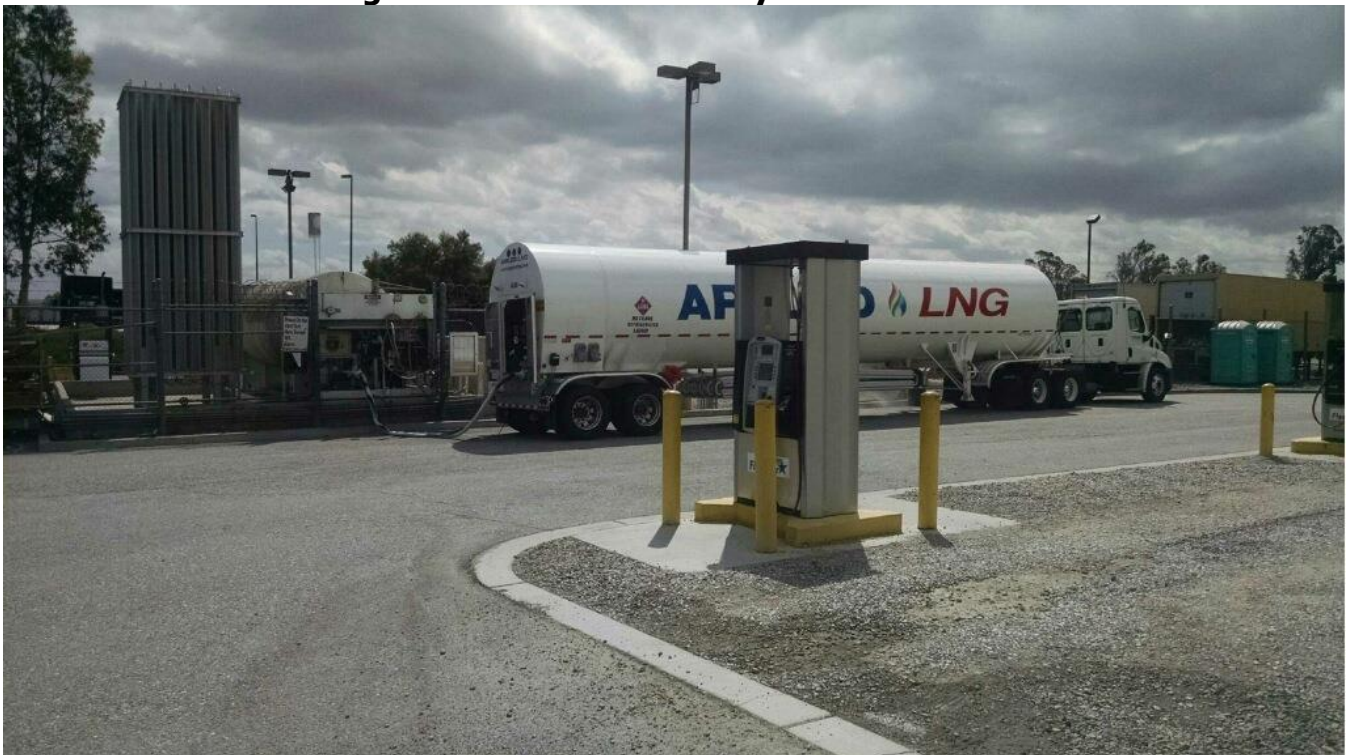


Source: Google Maps

The UPS natural gas refueling station project will overcome key barriers that have hindered the development and widespread use of natural gas as a transportation fuel. The primary barrier to natural gas vehicle deployment is the lack of supporting infrastructure. While there is existing natural gas fueling in the Inland Empire, there are limited public access natural gas fueling options, which creates a significant barrier for the adoption or expansion of natural gas vehicles by the goods movement fleets that haul cargo along the various transportation corridors in this region of southern California each day. The UPS Ontario station is a long established LNG and CNG refueling facility that was originally commissioned in 1997 (see Figures 2-4 for LNG/CNG station concept).

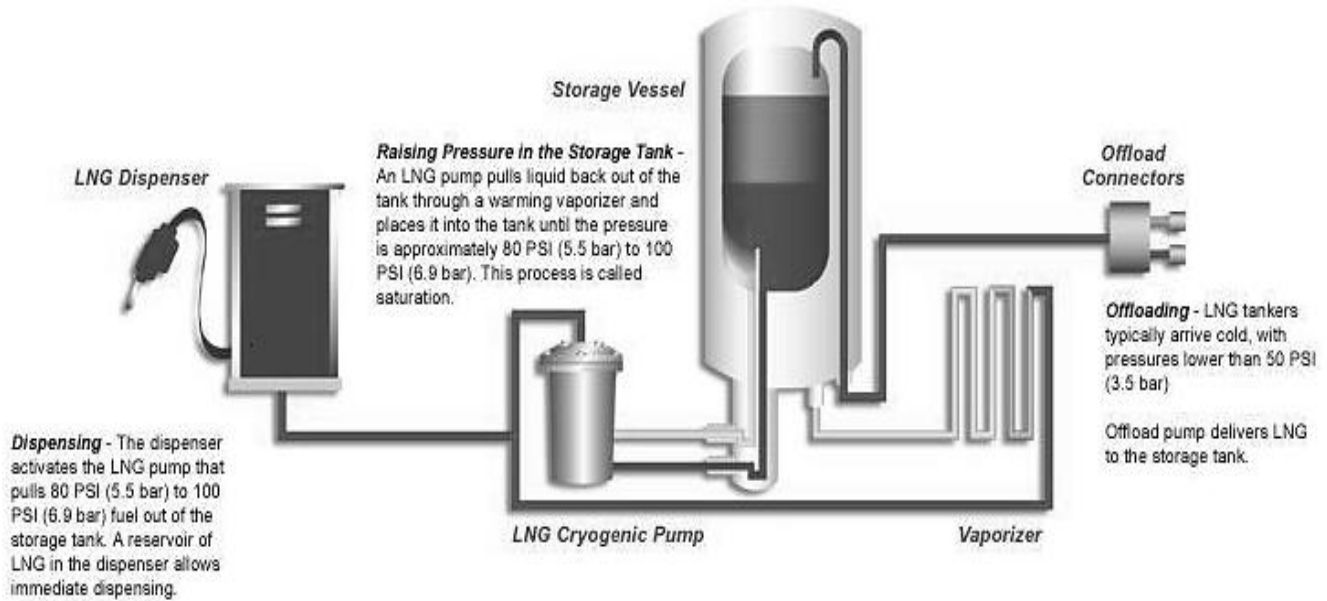
This station already provides a convenient source of natural gas fuel to other local goods movement and regional goods movement fleets that pass through the City of Ontario and needed refurbishment to maintain current refueling capabilities, as well as upgrading UPS CNG dispensers with two new, four hose 3600 pounds per square inch gauge (psig) dispensers with both high flow and standard flow nozzles. The refurbishing and upgrading of this station will continue established alternative fuel refueling infrastructure, expand 3600 psig CNG fueling demands, and maintain the web of LNG/Liquid Compressed Natural Gas (LCNG) fueling station coverage across the region and state, thereby supporting a region-wide transition opportunity for heavy-duty fleets interested in alternative fuels. Overall, refurbishing and upgrading this private/public access station-project will have a significant impact on assisting with the region's transition to an alternative fuel marketplace.

Figure 2: LNG Fuel Delivery to LNG Station



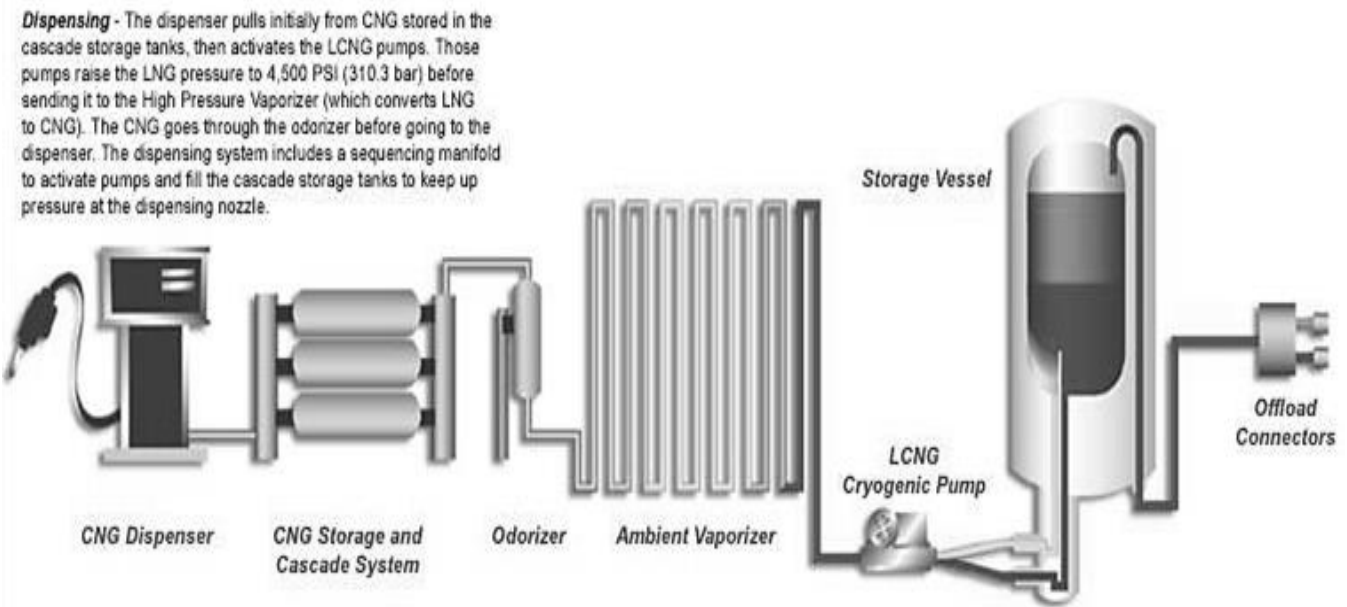
Source: GP Strategies

Figure 3: LNG Station: Delivery and Fueling Schematic



Source: Chart Industries

Figure 4: LCNG Station: Delivery and Fueling Schematic



Source: Chart Industries

All equipment at the UPS Ontario station is owned by UPS, except for two public access CNG dispensers which are owned by Applied LNG. In addition, Applied LNG maintains all the equipment at this site under contract with UPS. The station utilizes a 6,000 gallon LNG storage tank and as an LCNG station, both LNG and CNG fuel dispensing is wholly dependent on LNG fuel delivery and storage. Other equipment utilized at this station includes an LNG pump, an LNG dispenser, an LNG to CNG Vaporizer system, an LCNG pump, and four CNG dispensers. UPS has expanded its fleet of heavy-duty LNG-powered vehicles in Ontario, CA four-fold since 2010 and is displacing more than 600,000 gallons of petroleum-based fuel annually at this

location, with other users displacing about 100,000 gallons of petroleum-based fuels annually. In total, UPS' fleet of both CNG and LNG vehicles use more than 85 percent of the overall fuel dispensed at this station. UPS's LNG fleet uses about 91 percent of the LNG dispensed and about 82 percent of the CNG dispensed at this location. All other users account for the differences in usage, which is approximately 15 percent of both fuel types. (See Annual Fuel Throughput, Tables 2-7)

UPS met the goals of this project with the refurbishment of its Ontario, CA LNG/CNG station upgrades and successfully restored and upgraded an established public access LNG/CNG fueling station in the Inland Empire area near the well-travelled Interstate Freeways 10 and 60 in order to:

- Provide increased incentive for goods movement operators, municipal fleets, school districts, and water agencies to adopt or expand the use of their natural gas advanced technologies;
- Enable the accelerated replacement of heavy-duty diesel trucks with clean-burning, low-emission natural gas trucks to stimulate the U.S. manufacturing base and economy and assist in the development of a more aggressive "green" automotive industry in the United States; and
- Further infuse the Southern California regional natural gas refueling infrastructure with locally produced, low carbon LNG fuel.

CHAPTER 2:

Scope of Work

Scope of Work

UPS's scope of work under South Coast Air Quality Management District (SCAQMD) Contract No.15438 (funded by CEC under ARV-10-054) included the installation, operation, and reporting of this upgraded LNG/CNG refueling station.

The original UPS project scope was identified as a New/Upgrade LNG station. The project was to include purchase and installation of a new 18,000-gallon LNG tank to triple this station's LNG storage capacity. The proposal was based on expected increases in fleet size, vehicle miles traveled, fuel demand, and an unreliable LNG fuel supply. UPS has expanded its fleet of heavy-duty LNG-powered vehicles four-fold (from 11 to 43 heavy-duty vehicles) since 2010 and is displacing more than 600,000 diesel gallon equivalents of fuel annually at this facility alone, with other users displacing another 100,000 diesel gallon equivalents (DGE) annually of petroleum-based fuels. UPS refueling accounts for almost 85 percent of overall fuel used; 91 percent of the LNG and 82 percent of the CNG dispensed at this station.

Subsequent to grant award and contract execution, UPS realized significant improvements in the reliability of fuel delivery, reducing the need for a new larger LNG tank. UPS and the SCAQMD requested a revision to reduce both funding and scope of the project from a new expansion to a station refurbishment project. The refurbishment would maintain current refueling capabilities as well as upgrade existing 3000 psig CNG dispensers and hoses with two new, four hose 3600 psig dispensers with both high flow and standard flow nozzles. The refurbishment would repair and re-vacuum the existing 6,000 gallon LNG storage vessel, replace and repair both the CNG and LNG pumps, and replace the LNG dispenser.

A third and final revision was made to the project scope when both GP Strategies (General Contractor) and UPS realized they could not gain access to the LNG system software due to property rights established prior to UPS's ownership of the LNG station. UPS was unable to reach an agreement with the company holding the access codes, and within the time limits of the grant and contract, resulting in the removal of the LNG dispenser from the station upgrades. See Table 1 for the Proposed and Actual Actions for this project.

Table 1: Scope of Work Transitions at UPS Ontario, CA (2012-2015)

Proposed Action	Actual Action	Explanation of Any Changes
Install new 18,000 gallon LNG Tank	Repair of existing 6,000 gallon LNG Tank	Improved reliability of LNG fuel delivery meant that the current LNG tank had sufficient capacity once repaired.
Install new LNG Dispenser	Continued use of existing LNG Dispenser	Contractor unable to negotiate on proprietary software rights for new dispenser; determined that replacing the LNG dispenser was not cost effective at this time.
Refurbishment of LNG Tank	Refurbishment of LNG Tank completed	No Change
Install new LNG and LCNG Pumps; Repair existing LNG and LCNG Pumps	Proposed Action completed	No Change
Service and repair piping; re-vacuum system; replace safety systems; service and repair air compressor	Proposed Action Completed	No Change
Paint CNG tanks	Proposed Action completed	No Change
Install new CNG Dispensers	Proposed Action completed	No Change
Install New CNG Blowers; Install New CNG PRVs	Proposed Action completed	No Change

Source: GP Strategies

UPS was responsible for the following upgrades and refurbishments, shown in Figures 5-9, of the LNG/CNG refueling station:

- Remove and Replace LNG submersible pump
- Rebuild old pump and place in onsite spare parts inventory
- Remove and Replace CNG pump cold ends; rebuild old cold ends and place in onsite spare parts inventory
- Remove and Replace CNG dispensers with new dual hose 3,600 psi dispensers
- Remove and Replace odorant injection system.
- Perform corrosion control on CNG storage vessels and repaint vessels
- Identify leaks on LNG storage vessel and repair as necessary
- Test LNG tank and vacuum jacketed piping for proper vacuum
- Re-pull vacuum on LNG tank and lines when repairs are completed
- Service Air System, change air compressor oil and replace air filters
- Change system desiccant dryer material and leak test all connection points
- Repair leaks as necessary

Figure 5: LNG Pump



Source: GP Strategies

Figure 6: CNG Vessels Corrosion Control and Paint



Source: GP Strategies

Figure 7: LCNG Pump Cold Ends



Source: GP Strategies

Figure 8: CNG 3600 psi Dispenser



Source: GP Strategies

Figure 9: Vacuum Testing LNG Tank and Jacketed Piping



Source: GP Strategies

All work was performed under contract with GP Strategies (Huntington Beach, CA). All equipment meets all American Petroleum Institute, American Society of Mechanical Engineers, International Society of Automation, American Gas Association, National Electric Code, and National Fire Protection Association requirements. National Fire Protection Association requirements.

CHAPTER 3:

Construction and Operations

UPS completed several technical tasks to construct, complete the LNG/CNG upgrades in an orderly and efficient manner. In particular, UPS completed the technical tasks listed below.

Task 2: Station Construction/Upgrade

UPS finalized all station refurbishments, except the LNG dispenser replacement. The refurbishments included: replacing the LNG submersible pump, rebuilding the existing LNG pump, upgrading the private CNG dispensers from one 3,000 psig hose and one 3,600 psig hose to two new dispensers, each with two 3,600 psig hoses, including one heavy-duty high flow nozzle and one conventional "light-duty vehicle" nozzle, replacing the CNG pump, rebuilding the existing, CNG pump, replacing the odorant injection system, performed corrosion control on CNG high pressure storage vessels, repainting the CNG high pressure storage vessels, identified and repaired leaks on LNG storage vessel, tested LNG tank and vacuum jacketed piping for proper vacuum, and re-pulled vacuum on LNG tank and lines following completion of repairs, serviced the air compressor system, changed air compressor oil and replaced air filters, changed system desiccant dryer material and leak tested all connection points.

Task 3: Station Commissioning

UPS performed the start-up activities for the site, including the successful final commissioning of the site into service.

Task 4: Station Operation and Maintenance

UPS continues to collect and analyze data on the economic benefits and local impacts of the project, including the station throughput and associated project emission benefits.

Annual Fuel Throughput

The UPS Ontario LNG/CNG station became operational in 1997. The station provides natural gas fueling to UPS' fleet of 38 CNG-powered heavy-duty vehicles and 44 LNG-powered heavy-duty trucks operating in Southern California, as well as public access for both LNG and CNG fueling. The following throughput tables (Tables 2-7) show CNG and LNG fuel usage at this location over for calendar year 2014, 2015 and the first six months of 2016. Usage is separated into UPS fuel use and "Other" fuel users. Total petroleum displacement over 2.5 years totals 1.9 million gallons.

Table 2: Fuel Usage 2014

Month	Customer	CNG GGE / Fuelings		LNG DGE / Fuelings		Total LNG Gallons	Total petroleum displacement GGE+DGE
January	Ontario - UPS	21,476	2,067	37,864	903	102,004	59,340
	Ontario - All Other	8,902	385	4,631	111	22,453	13,533
	Totals	30,378	2,452	42,496	1,014	124,458	72,873
February	Ontario - UPS	19,458	1,840	31,642	755	87,646	51,101
	Ontario - All Other	7,749	320	4,677	149	20,702	12,426
	Totals	27,207	2,160	36,320	904	108,348	63,526
March	Ontario - UPS	21,201	2,043	37,590	986	101,075	58,791
	Ontario - All Other	6,956	328	6,658	188	22,991	13,613
	Totals	28,157	2,371	44,248	1,174	124,066	72,404
April	Ontario - UPS	28,863	2,313	36,607	956	111,497	65,470
	Ontario - All Other	7,118	301	5,366	161	20,935	12,485
	Totals	35,982	2,614	41,973	1,117	132,432	77,955
May	Ontario - UPS	29,862	2,406	32,194	1,050	105,176	62,056
	Ontario - All Other	6,967	305	3,906	143	18,077	10,873
	Totals	36,828	2,711	36,100	1,193	123,253	72,929
June	Ontario - UPS	28,452	2,401	24,620	811	89,360	53,072
	Ontario - All Other	6,117	307	3,318	137	15,673	9,435
	Totals	34,569	2,708	27,938	948	105,033	62,507
July	Ontario - UPS	24,581	2,405	23,165	886	80,599	47,746

Month	Customer	CNG		LNG		Total LNG Gallons	Total petroleum displacement GGE+DGE
		GGE / Fuelings		DGE / Fuelings			
	Ontario - All Other	6,250	345	2,868	118	15,079	9,119
	Totals	30,831	2,750	26,034	1,004	95,678	56,865
August	Ontario - UPS	30,152	2,446	29,731	1,025	101,224	59,884
	Ontario - All Other	6,173	312	2,206	95	13,768	8,379
	Totals	36,325	2,758	31,937	1,120	114,992	68,262
September	Ontario - UPS	31,851	2,679	36,501	1,406	116,057	68,352
	Ontario - All Other	5,969	298	2,049	90	13,162	8,018
	Totals	37,820	2,977	38,550	1,496	129,219	76,370
October	Ontario - UPS	35,881	3,032	39,784	1,522	128,347	75,664
	Ontario - All Other	9,604	405	2,692	98	20,095	12,296
	Totals	45,484	3,437	42,476	1,620	148,442	87,961
November	Ontario - UPS	33,779	2,585	37,445	799	120,814	71,224
	Ontario - All Other	8,167	318	2,623	85	17,686	10,790
	Totals	41,946	2,903	40,068	884	138,500	82,014
December	Ontario - UPS	41,511	3,215	33,464	762	125,973	74,975
	Ontario - All Other	9,655	390	2,853	93	20,464	12,508

Source: UPS

Table 3: Total Fuel Usage 2014

	CNG		LNG		Total LNG Gallon	Total petroleum displacement GGE +DGE
	GGE/Fuelings		DGE/Fuelings			
Totals	51,166	3,605	36,317	855	146,438	87,483
Totals	436,693	33,446	444,456	13,329	1,490,858	881,149
UPS annual	347,067	29,432	400,608	11,861	1,269,772	747,675
Others annual	89,626	4,014	43,848	1,468	221,086	133,474
UPS (monthly avg.)	28,922	2,453	33,384	988	105,814	62,306
Others (monthly avg.)	7,469	335	3,654	122	18,424	11,123
Monthly totals	36,391	2,787	37,038	1,111	124,238	73,429

Source: UPS

Table 4: Fuel Usage 2015

2015	Customer	CNG		LNG		Total LNG gal	Total petroleum displacement GGE+DGE
		GGE/Fuelings		DGE/Fuelings			
January	Ontario - UPS	35,885	2,830	27,110	644	105,641	62,995
	Ontario - All Other	8,221	334	2,580	88	17,696	10,802
	Totals	44,106	3,164	29,690	732	123,337	73,796
February	Ontario - UPS	32,006	2,145	24,594	550	94,965	56,600
	Ontario - All Other	6,293	270	2,070	61	13,715	8,363
	Totals	38,299	2,415	26,664	611	108,680	64,963
March	Ontario - UPS	30,273	2,377	21,998	486	87,558	52,272
	Ontario - All Other	8,090	340	3,233	105	18,658	11,323
	Totals	38,363	2,717	25,232	591	106,215	63,595

2015	Customer	CNG		LNG		Total LNG gal	Total petroleum displacement GGE+DGE
		GGE/Fuelings		DGE/Fuelings			
April	Ontario - UPS	30,125	2,365	31,041	1,997	103,529	61,167
	Ontario - All Other	7,098	292	3,294	107	17,189	10,392
	Totals	37,223	2,657	34,336	2,104	120,718	71,559
May	Ontario - UPS	20,519	2,287	35,665	770	96,541	56,184
	Ontario - All Other	5,813	237	2,134	65	13,068	7,947
	Totals	26,332	2,524	37,799	835	109,609	64,131
June	Ontario - UPS	21,784	2,462	35,005	722	97,370	56,789
	Ontario - All Other	4,688	203	2,717	96	12,324	7,405
	Totals	26,472	2,665	37,722	818	109,693	64,194
July	Ontario - UPS	22,347	2,477	34,348	693	97,088	56,695
	Ontario - All Other	3,325	144	2,616	82	9,976	5,941
	Totals	25,672	2,621	36,965	775	107,063	62,637
August	Ontario - UPS	20,158	2,242	32,547	658	90,379	52,705
	Ontario - All Other	3,554	150	2,718	90	10,522	6,272
	Totals	23,712	2,392	35,265	748	100,901	58,977
September	Ontario - UPS	19,893	2,226	29,060	642	83,709	48,953
	Ontario - All Other	3,924	168	2,337	72	10,427	6,261
	Totals	23,817	2,394	31,397	714	94,136	55,214
October	Ontario - UPS	20,646	2,418	30,593	632	87,653	51,239

2015	Customer	CNG GGE/Fuelings		LNG DGE/Fuelings		Total LNG gal	Total petroleum displacement GGE+DGE
	Ontario - All Other	4,375	168	2,759	86	11,901	7,134
	Totals	25,021	2,586	33,352	718	99,554	58,373
November	Ontario - UPS	20,458	2,318	29,635	613	85,637	50,093
	Ontario - All Other	2,573	110	1,795	50	7,307	4,368
	Totals	23,031	2,428	31,429	663	92,944	54,460
December	Ontario - UPS	24,357	2,790	29,987	638	92,469	54,344
	Ontario - All Other	1,368	72	2,099	60	5,936	3,467
	Totals	25,725	2,862	32,086	698	98,405	57,811

Source: UPS

Table 5: Total Fuel Usage 2015

	CNG		LNG		Total LNG Gallons	Total petroleum displacement GGE + DGE
	GGE/Fuelings		DGE/Fuelings			
Totals	357,773	31,425	391,938	10,007	1,271,257	749,711
UPS annual	298,451	28,937	361,585	9,045	1,122,539	660,036
Others annual	59,322	2,488	30,353	962	148,718	89,675
UPS (monthly avg.)	24,871	2,411	30,132	754	93,545	55,003
Others (monthly avg.)	4,943	207	2,529	80	12,393	7,473
Monthly totals	29,814	2,619	32,662	834	105,938	62,476

Source: UPS

Table 6: Fuel Usage 2016

2016	Customer	CNG		LNG		Total LNG Gallons	Total petroleum displacement GGE + DGE
		GGE/Fuelings		DGE/Fuelings			
January	Ontario - UPS	18,168	2,170	25,568	549	74,707	43,736
	Ontario - All Other	1,486	100	1,927	61	5,817	3,413
	Totals	19,654	2,270	27,495	610	80,524	47,149
February	Ontario - UPS	14,933	1,967	28,560	613	74,925	43,493
	Ontario - All Other	2,050	103	2,374	72	7,515	4,424
	Totals	16,983	2,070	30,934	685	82,440	47,917

2016	Customer	CNG		LNG		Total LNG Gallons	Total petroleum displacement GGE + DGE
		GGE/Fuelings		DGE/Fuelings			
March	Ontario - UPS	17,567	2,223	28,348	572	78,734	45,915
	Ontario - All Other	3,548	165	2,136	82	9,469	5,684
	Totals	21,115	2,388	30,484	654	88,203	51,599
April	Ontario - UPS	20,263	2,381	26,214	552	79,196	46,477
	Ontario - All Other	2,495	106	2,130	67	7,784	4,625
	Totals	22,758	2,487	28,344	619	86,980	51,102
May	Ontario - UPS	20,301	2,276	24,239	510	75,718	44,540
	Ontario - All Other	1,587	70	1,678	53	5,530	3,265
	Totals	21,888	2,346	25,917	563	81,248	47,805
June	Ontario - UPS	21,072	2,371	29,451	627	86,283	50,523
	Ontario - All Other	1,567	78	1,643	59	5,437	3,210
	Totals	22,639	2,449	31,094	686	91,720	53,733

Source: UPS

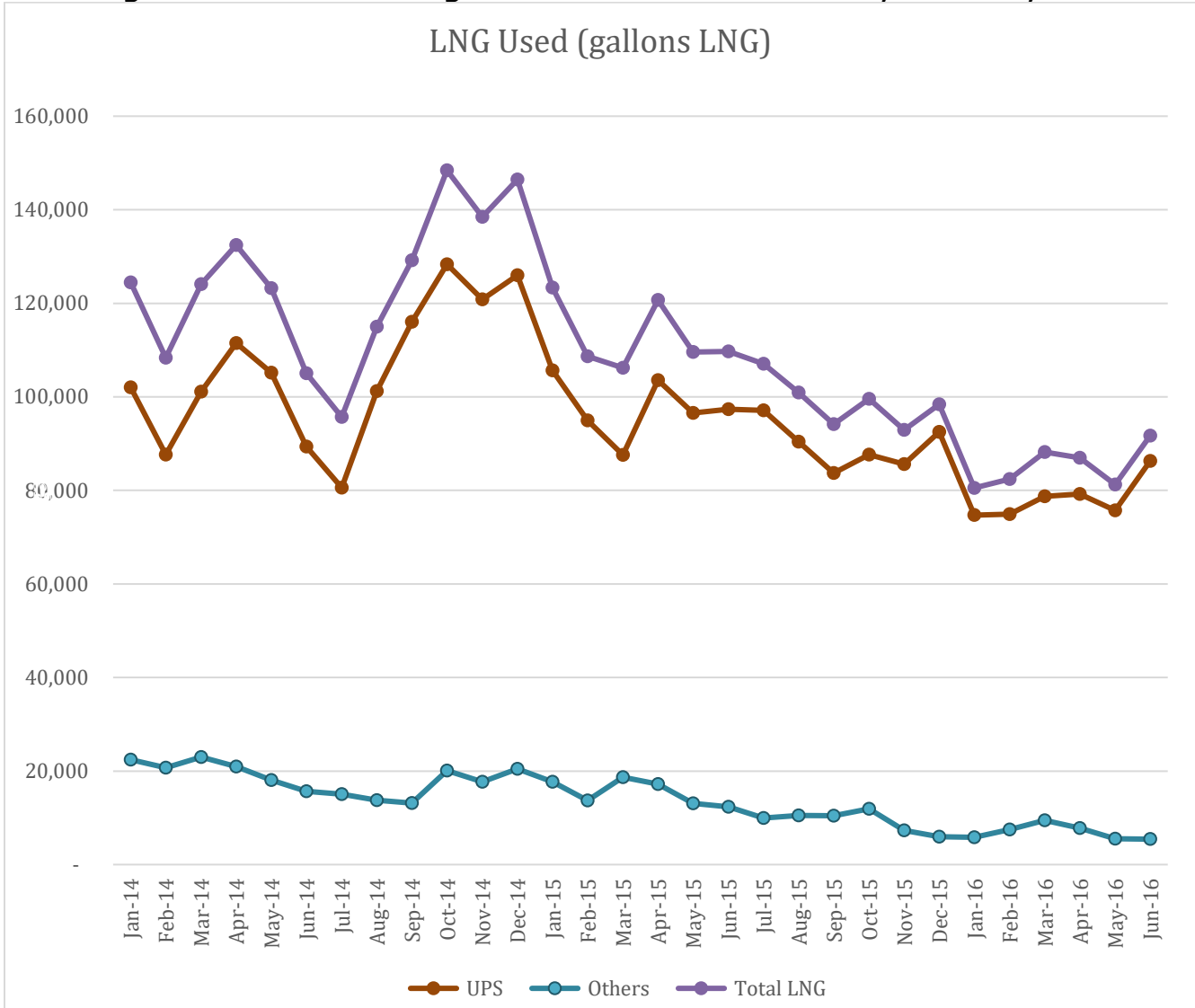
Table 7: Total Fuel Usage 2016

	CNG		LNG		Total LNG Gallons	Total petroleum displacement GGE + DGE
	GGE/Fuelings		DGE/Fuelings			
Totals	125,037	14,010	174,267	3,817	511,115	299,304
UPS annual	112,304	13,388	162,378	3,423	469,563	274,682
Others annual	12,733	622	11,889	394	41,551	24,622
UPS (monthly avg.)	18,717	2,231	27,063	571	78,261	45,780
Others (monthly avg.)	2,122	104	1,981	66	6,925	4,104
Monthly totals	20,840	2,335	29,044	636	85,186	49,884

Source: UPS

Tables 2 through 7 show the monthly amounts of CNG fuel (GGE) and LNG fuel (DGE) used by both UPS and non-UPS vehicles between January 2014 and June 2016. These tables also total the amount of LNG (gallons) that this facility dispensed as either CNG or LNG each month. A graph is also provided below (Figure 10) that shows the amounts of LNG gallons used each month by UPS and non-UPS vehicles as well as each month's total LNG gallons used at this site. All refurbishments performed at this location under this grant occurred between January and March 2015. Refueling capabilities during this period were not disrupted. The station shutdowns were kept to a minimum and were performed during times when fueling was not affected. The amount of petroleum fuel displacement attributed to this facility between 2014 and the first six months of 2016 totals 1.83 million DGEs.

Figure 10: LNG Fuel Usages Jan. 2014-June 2016: UPS, Non-UPS, Total



Source: UPS

The graph above shows the monthly amounts of LNG dispensed to UPS vehicles, non-UPS vehicles and the Total LNG gallons dispensed between January 2014 and June 2016. The graph above shows significant variation in fuel usage in this period. The increased fuel usage in 2014 is due to UPS temporarily deploying 10 additional natural gas tractors in Ontario because their intended location in Los Angeles was not ready. These 10 tractors added to the fuel use for several months, then were transferred back out. Fuel usage decline in 2015 is partly attributed to the removal of two older LNG tractors. Additional reduction in fuel usage in 2015 and the first part of 2016 is attributed to a higher than normal number of vehicles that were out of commission even though the number of days they were down about normal, which averages 11 days per vehicle and because of changes in some vehicle routes to run locally vs distance to insure service delivery reliability.

Emission Reductions (UPS)

UPS' fleet of Class 8 LNG-powered, and Class 7 CNG-powered heavy-duty vehicles are the largest and most consistent fuel consumers at this refueling facility. As such, a baseline emission reduction assessment for this facility can be performed using the Carl Moyer Program Guidelines (July 2014)¹ methodology for calculating criteria pollutant emission reductions. If it is assumed that a comparable fleet of heavy-duty diesel-powered vehicles, subject to the 1.2 gNOx/bhp-hr standard, used an equivalent amount of diesel fuel as shown in Table 2 (converting CNG to diesel gallon equivalents), the reduction in NOx from the heavy-duty natural gas-powered vehicles would be approximately 13 tons per year. Table 8 shows the NOx reductions for UPS' heavy-duty natural gas-powered vehicle fleet for the two and one-half year period reported in Tables 2-7. Since UPS represents about 80 percent of the fuel used at this location, the total NOx reductions associated with this facility should be greater than the amount shown below.

Table 8: NOx Emission Reduction Calculation

Criteria Pollutant Emission Reduction Calculation	NOx
Baseline Diesel EF 2007 (g/gal) ¹	19.6
Baseline EF Alt Fuel HDV (g/gal) ²	3.7
Fuel Consumption (DGE) 2.5 yr	1,830,000
% Operation in CA	100%
Baseline Emissions (tons) 2.5 yr	39.5
Alt Fuel Emissions (tons) 2.5 yr	7.5
Emission Reductions (tons) 2.5 yr	32.1
Avg. Emission Reductions (tons/yr)	12.8

Source: UPS

As a result of the UPS Ontario, CA LNG/CNG station upgrade project, and expansion of UPS' natural gas heavy-duty vehicle fleet, UPS will achieve nearly 13 tons per year reduction of NOx.

Carbon Reduction Benefits

On-Road Fleet Petroleum Use and Carbon Reductions

1. Method to Calculate On-Road Fleet's Petroleum Energy Use and GHG Footprint
 - a. Fleet Size, vehicle miles traveled, and fuel economy
 - b. Fuel Use (Skip to Question 5)

¹ California Environmental Protection Agency, Air Resources Board, "Carl Moyer Program Guidelines" July 2014 Appendix D – Tables for Emission Reduction and Cost Effectiveness Calculations

5. The Annual Total Fuel Use by On-Road Fleet Vehicles (gallons, cubic feet, or kilowatt-hours) (Table 9)

Table 9: Annual Total Fuel Use by On-Road Fleet Vehicles

	Diesel (gallons)	CNG (cubic feet)	LNG (gallons)
Transport/Drayage/Freight Truck	730,585	45,975,150	724,488
Gasoline Gallon Equivalent Total (gallons)	823,728	393,515	471,359

Source: UPS

7. Results of On-Roads Fleet's Petroleum Usage (barrels) (Table 10)

Table 10: Results of On-Roads Fleet's Petroleum Usage

	Diesel	CNG	LNG
Transport/Drayage/Freight Truck	18,615	49	126
Fuel Total	18,615	49	126
On-Road Fleet Total, barrels oil	18,615	49	126

Source: UPS

8. Results of On-Road Fleet's Greenhouse Gas Emissions (short tons CO₂-equivalent) (Table 11)

Table 11: Results of On-Road Fleet's Greenhouse Gas Emissions

	Diesel	CNG	LNG
Transport/Freight Truck, short tons	10,418	4,351	5,226
Fuel Total, short tons	10,418	4,351	5,226
On-Road Fleet Total, short tons GHG emissions	10,418	4,351	5,226

Source: UPS

CHAPTER 4:

Results

Results

All upgrades, equipment replacements, and equipment repairs for both the LNG and LCNG refueling systems were completed in late February 2015. All aspects of the revised scope of work were completed except the replacement of the LNG dispenser as described in Problems below.

Problems

The following is a summary of the problems encountered with this project from the initial awarding:

- Location change;
- Scope changes including a transition from a new CNG station to a refurbishment of an existing LNG/CNG station;
- Scope reductions due to changes in fuel delivery reliability and insufficient planning by subcontractors in assessing their accessibility to necessary software systems; and
- Adherence to Prevailing Wages in California.

The Project Revisions section below describes the chronology of changes in the Scope of Work on this project from initial award to final project completion. Table 1 lists the elements included or removed in each UPS Scope of Work revision.

The SCAQMD recognizes that this project underwent massive changes from the initial award to the final project completion. The initial award made for a new CNG refueling station was tied to new, unproven entities in retail CNG infrastructure. The retail CNG station in the original proposal is now a functioning, manned, public access station in Ontario that is pursuing plans to expand its CNG fueling throughput capability with an additional compressor. Unfortunately, following the award of this project, the subcontractor developed serious reservations about the qualifications of the partnership and elected to not commit to the project as originally proposed. Additionally, the subcontractor was unable to find a substitute partner in time to continue with the CEC award and hence this project was abandoned. In retrospect, it would be advised that all parties to a proposal are completely vetted to ensure their qualifications.

The subsequent project with UPS gained attention by the SCAQMD for its proposal to expand LNG fueling and CNG fueling capability at an existing and established LNG/CNG facility also in Ontario, CA. The problem that UPS was experiencing at the time of the initial proposal was insufficient and unreliable LNG fuel delivery to sustain operation of their natural gas-powered fleet of heavy-duty vehicles and the near-term expansion of this fleet. UPS believed that increasing the LNG storage capacity at the station would solve this problem and would also potentially provide a basis for expanded LNG infrastructure in this region. Subsequent to the SCAQMD revising the proposal to the CEC and prior to entering into contract with UPS, UPS was already recognizing significant improvements in LNG fuel delivery and reliability. Recognizing the significant costs associated with the purchase and installation of a new 18,000-gallon LNG tank and UPS' specific needs, UPS stated it would prefer to conserve financial resources and reduce the scope of work to a refurbishment and upgrade project. The

SCAQMD elected to submit a revised proposal to the CEC with the understanding that the reduced scope would receive reduced funding in proportion with the original cost-share ratio and cost-share requirements. Finally, the matter pertaining to the LNG dispenser and inaccessibility to software is a significant alert to any fuel dispensing station which uses proprietary software and hardware and ensuring from the outset of purchasing such equipment, that the owner/operator understands their rights to access these systems. UPS and its contractor, GP Strategies, made the determination to continue with the refurbishment tasks in the project and to continue using the existing LNG dispenser while UPS continues efforts to resolve this matter.

In the final analysis, the original project was projected to be a new CNG station, which was reduced to a LNG/CNG station refurbishment and upgrade. The final scope of work resulted in the complete refurbishment of all the essential equipment and systems at the UPS LNG/LCNG station including upgrades of the CNG dispensers to 3600 psi. The removal of the purchase and installation of a new LNG dispenser reduced the project's scope of work and award amount, but it has not reduced the facility's LNG fueling capabilities or UPS' intention to complete this aspect of the project and at its own expense.

Finally, the matter of understanding what the reporting and recordkeeping requirements to meet Prevailing Wages caused some consternation with subcontractors. Subcontractors believed they met California's Prevailing Wages but were not fully aware of the requirements associated with Prevailing Wage language. SCAQMD staff directed subcontractors to refer to the California Department of Industrial Relations on matters pertaining to compliance with Prevailing Wages. The SCAQMD believes that Senate Bill 854, effective 2015, will significantly improve the awareness and implementation of the Prevailing Wage requirements in all subsequent projects involving public funds.

Project Revisions/Lessons Learned

The original project proposed by the SCAQMD under PON-09-006 involved the construction of a new CNG station at an existing retail gasoline station (Ontario Conoco-Phillips-76) located at 1850 E. Holt Blvd., Ontario, CA 91761. This project is referred to as the "Ontario CNG" project. The Ontario CNG project included installation of four CNG dual hose dispensers, a 400 h.p. compressor, and seven CNG storage vessels. This project was to be completed under contract with Earth Energy Fuels who along with the station owner would provide co-funding.

The Ontario CNG project was granted \$300,000 by the CEC in May 2010 under ARV 10-035. In September 2010, the SCAQMD Board recognized these CEC funds and directed staff to contract with Earth Energy for this project. The contract between the SCAQMD and the CEC for this project was not executed until February 2012. Presumably contract efforts between the SCAQMD and Earth Energy were in motion during 2012, however in late 2012 the SCAQMD was informed by the Ontario CNG owner that the project would not be able to move forward due to irreconcilable differences and a separation of the partnership with Earth Energy Fuels. As a result, all contract development efforts were cancelled with Earth Energy Fuels.

Concurrent with the cancellation of the contract with Earth Energy Fuels, the SCAQMD Project Officer on this matter became aware of another potential project with UPS at their established

LNG/LCNG station located at 1735 S. Turner Ave, Ontario, CA 91761.² UPS expressed an interest in expanding the size of their natural gas vehicle fleet and also expressed their insecurity in the reliability of LNG supply for their current fleet. These discussions resulted in UPS submitting two proposals for grant consideration: the first proposal included the purchase and installation of a new 18,000 gallon LNG storage vessel to replace their current 6,000 gallon LNG storage tank and performing station upgrades more specific to LNG fueling; the second proposal retained the existing LNG tank and focused on station refurbishments include LCNG upgrades and CNG upgrades. The first proposal from UPS was submitted to the CEC for consideration and ARV-10-035 was amended in early 2013 re-apportioning the \$300,000 grant to the Ontario CNG project to the "UPS Ontario" project. During this same period the SCAQMD Project Officer worked towards and ultimately secured co-funding for this project through the United States Department of Energy; those funds were officially recognized by the SCAQMD in September 2013.

In March of 2014, the SCAQMD received approval from its Governing Board to proceed with the upgrade and expansion of the UPS Ontario station, which included the new 18,000 gallon LNG tank. Subsequent to SCAQMD staff receiving direction to contract with UPS and the execution of this contract, the Project Officer experienced a physical disability that forced him to take an extensive leave-of-absence from work. As his condition and expected return were not determinable, his assignments were not forwarded to other staff. By the time a new Project Officer was brought on, UPS had realized a change in the reliability of their LNG fuel deliveries relative to their initial conversations with the SCAQMD in 2012. As a result, UPS was re-thinking the expenses associated with a new LNG tank considering the much improved reliability of its fuel supply and delivery, and its immediate and near term fleet-fuel demands. Hence, by the time UPS and the new Project Officer commenced contract development, UPS was already revising the project scope to the second proposal, namely a refurbishment and upgrade project that would exclude the purchase and installation of a new 18,000 gallon LNG tank. The revised project would restore the station to near original condition, including the replacement of the LNG dispenser and upgrading the CNG dispensers to 3600 psi.

The SCAQMD and UPS agreed to revise the project scope and resubmit the proposal to the CEC for approval. In October of 2014, the CEC agreed to the reduced project scope and the CEC revised the grant amount to \$96,707 to maintain the original agreed cost share proportions. SCAQMD was able to secure the contract with UPS in January 2015 with the understanding that the project would be completed, and all deliverables provided within the time limits associated with this grant. With the contract execution secured, UPS contracted G.P. Strategies to perform the necessary refurbishments to meet the project deadlines of March 2015. It was not until G.P. Strategies was under contract that a complete analysis of the particulars of all the upgrades was performed, particularly the new LNG dispenser. GP Strategies determined that the new LNG dispenser would not be functional without the necessary software access codes. It was at this time that UPS became aware that they did not have this information and through extensive investigation concluded they would not be able to

² The LNG facility at UPS was originally owned and operated by Alternative LNG Technology and in 2010 reorganized to become Applied LNG and relinquished the LNG facility at UPS to UPS. As stated earlier, all equipment at the UPS Ontario station is owned by UPS except for two public access CNG dispensers which are owned by Applied LNG. In addition, Applied LNG maintains all the equipment at this site under contract with UPS.

get this information and still meet the project's March 2015 deadlines. As a result, UPS was forced to revise the project scope a final time, removing the purchase and installation of the LNG dispenser. The SCAQMD informed the CEC of this last, unexpected development in the project and all parties agreed to the downwardly revised grant award of \$55,792, again in proportion to the revised project costs. As mentioned previously, it is advised that all fuel dispensing station owners/operators have a clear understanding of which systems in their facility utilize proprietary equipment or software and their rights and ability to access such systems. Sponsors of such projects should pay close attention to proprietary rights matters particularly for existing stations.

The SCAQMD appreciates the efforts of all parties involved in this project and in particular the CEC's flexibility in accommodating the many unforeseen developments that occurred throughout the life of this grant, as well as supporting both new and existing alternative fuel infrastructure in this region, and their associated air quality benefits.

Benefits

The UPS Ontario, CA LNG/LCNG refurbishment and upgrade project will continue to provide solutions to the development and widespread use of natural gas as a transportation fuel. Public and private fleets will be encouraged to switch to natural gas as additional infrastructure is available due to both the environmental and cost-saving benefits. The objectives of AB 118 Alternative and Renewable Fuel and Vehicle Technology Program are to invest in a portfolio of alternative low-carbon and renewable fuels and advanced vehicles in California to help meet the State's energy, environmental, and economic goals. These include alternative fuel production, distribution and dispensing. Under this definition, the UPS Ontario, CA LNG/LCNG refurbishment and upgrade project meets the goals of AB 118 by continuing to provide for the distribution and dispensing of alternative fuels, much of which is applied towards goods movement and providing benefit to the economy of the State. In addition, this established alternative fuel facility is located adjacent to main interstate and intrastate goods movement corridors and can serve as a primary or back-up fueling location for other goods movement carriers both local and in-transit.

This project is curbing GHGs, reducing petroleum use, and improving air quality in California. UPS remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas fueling stations for use by its fleet.

CHAPTER 5:

Conclusions

This project to refurbish and upgrade a LNG/CNG station that has been in operation at this location since 1997 greatly assists the CEC's efforts to displace petroleum with clean-burning natural gas and reduce greenhouse gas emissions from UPS' fleet. The successful completion of equipment replacements, repairs, rebuilds, re-vacuuming, and leak testing will ensure continued and reliable refueling for UPS' fleet of both CNG- and LNG-powered heavy-duty vehicles and other natural gas vehicle operators that have used this facility and will use this facility.

Natural gas is a clean, safe and abundant fuel that is domestically produced, with 99 percent used in the United States coming from North America. Natural gas contains less carbon than any other fossil fuel and thus produces lower CO₂ and Green House Gas emissions per year. In fact, natural gas vehicles produce 20-30 percent less than greenhouse gas emissions than comparable diesel vehicles.³ UPS is familiar with the many benefits of natural gas, with one of the largest fleets of heavy-duty natural gas vehicles in California and throughout North America. UPS is dedicated to doing business in the most sustainable way possible, as well as offering its customers more ways to live green via the air quality benefits of LNG and CNG.

Commercialization

This project will provide the continued and necessary infrastructure needed to make natural gas a commercially available and preferable fueling option. UPS remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas fueling stations for its fleet and others within the neighborhoods that UPS' employees work and live. This refurbishment project helps to illustrate how the lifespan of a natural gas refueling station can be extended and in turn increase the investment potential and economic attractiveness of natural gas as an alternative fuel.

³ LNG carbon intensity from the 2010 ARB LCFS Look-Up Tables shows a 15 percent carbon reduction from the diesel baseline, whereas CNG shows a 21 percent reduction. LNG has a lower carbon benefit because of the energy needed to cool and compress CNG to its liquid state (LNG).

GLOSSARY

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The 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.

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. (EPA)

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.

DIESEL GALLON-EQUIVALENT (DGE)—Is the amount of alternative fuel it takes to equal the energy content of one liquid gallon of diesel gasoline.

GASOLINE GALLON EQUIVALENT (GGE)—Is the amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. GGE allows consumers to compare the energy content of competing fuels against a commonly known fuel—gasoline. GGE also compares gasoline to fuels sold as a gas (natural gas, propane, and hydrogen) and electricity.

LIQUEFIED 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).

LIQUID COMPRESSED NATURAL GAS (LCNG)—The volume of liquefied compressed natural gas is only around 1/600th of the volume of gaseous natural gas. This results in significant advantages where gas transportation is concerned in particular. Following liquefaction and transportation, the liquefied natural gas (LNG) is regasified (converted into CNG) with subsequent forwarding to grid gas companies via pipelines.

OXIDES OF NITROGEN (NO_x)—Are a chief component of air pollution that can be produced by the burning of fossil fuels. Also called nitrogen oxides.

POUNDS PER SQUARE INCH (PSI)—A unit of pressure or 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.

POUNDS PER SQUARE INCH GUAGE (PSIG)—The pressure relative to atmosphere.

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. It is the second most populated urban area in the United States and one of the smoggiest. Its mission is to clean the air and protect the health of all residents in the South Coast Air District through practical and innovative strategies.

UNITED PARCEL SERVICE (UPS)—United Parcel Service (UPS, stylized as ups) is an American multinational shipping & receiving and supply chain management company founded in 1907. ⁴

⁴ [United Parcel Service - Wikipedia](https://en.wikipedia.org/wiki/United_Parcel_Service) https://en.wikipedia.org/wiki/United_Parcel_Service