CITY OF LOS ANGELES
DEPARTMENT OF AIRPORTS

COMPRESSED NATURAL GAS
35-FOOT TRANSIT BUSES

CONTRACT NUMBER ML09032

FINAL REPORT
APRIL 2015

SUBMITTED BY:
LOS ANGELES WORLD AIRPORTS
MAINTENANCE DIVISION

Prepared for the Mobile Source Air Pollution Review Committee (MSRC) under the AB 2766 Discretionary Fund Work Program

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ABSTRACT

In an effort to reduce vehicle emissions and improve air quality in the South Coast Air Basin, Los Angeles World Airports (LAWA) has made a commitment to use alternative fuel vehicles in LAWA operations whenever feasible. LAWA recognizes the air quality benefits to the community when using clean alternative fuel heavy-duty vehicles instead of diesel-powered equipment. The Mobile Source Air Pollution Reduction Review Committee's (MSRC) On-Road and Off-Road Heavy-Duty Vehicle Diesel Pollution Reduction Program presented an excellent opportunity to purchase seven new 35-foot low floor on-road heavy-duty compressed natural gas (CNG) North American Bus Industries transit buses in lieu of diesel vehicles to achieve near-term air pollution emission reductions. The City of Los Angeles Environmental Affairs Department (EAD) supported the project by assisting with the grant application and report writing necessary for the purchase and deployment of the CNG transit buses for use at Los Angeles International Airport (LAX).

Annual mileage and fuel usage data is provided to facilitate the final calculation of NOx reduction and project cost effectiveness.

ACKNOWLEDGMENTS

LAWA's purchase of seven CNG powered transit buses is the result of a multi-departmental cooperative effort, directed by LAWA staff from the Maintenance Services Division, and Executive Director Gina Marie Lindsey, under the authority of the Board of Airport Commissioners. City of Los Angeles staff specializing in environmental affairs project support provided key assistance, particularly Gretchen Hardison and Wayne King.

This report was submitted in fulfillment of Contract No. ML09032 by LAWA under the partial sponsorship of the Mobile Source Air Pollution Reduction Review Committee (MSRC). Work was completed in calendar year 2012.

REPORT

Purpose

LAWA is currently operating over 650 alternative fuel vehicles. In 1999, by Resolution No. 20609, the Board of Airport Commissioners adopted the Los Angeles World Airports Alternative Fuels Vehicle Program. Recognizing the environmental benefits to be derived from alternative fuel vehicles, this policy states in part that "Los Angeles World Airports is committed to identifying and replacing fossil fuel vehicles and equipment, including vehicles powered by compressed natural gas, liquefied natural gas, electricity, hydrogen and other clean burning alternative fuels." Accordingly, LAWA has undertaken many significant projects at substantial cost to reduce emissions and improve air quality.

To that end, LAWA purchased seven dedicated CNG heavy-duty transit buses to integrate into the LAX parking and Green Line shuttle fleet. The buses are fueled at the existing LNG/CNG fuel site at 7350 World Way West, Los Angeles, CA 90045, and at a commercially owned public access refueling site on the corner of 104th Street and Aviation Boulevard in Los Angeles.

The primary goal of this program is to achieve emission reductions that are real, quantifiable, enforceable and cost-effective, in accordance with California Air Resources Board (CARB) and SCAQMD guidelines.

The contract between LAWA and MSRC provided partial funding for the purchase and deployment of the CNG buses. In accordance with the contract between LAWA and MSRC, the following scope of work was performed as part of this project:

Scope of Work

LAWA undertook the following tasks:

- Procurement of equipment by:
    - Finding and ordering transit buses that fit specifications developed by LAWA's Construction and Maintenance Services
    - Advertising and releasing competitive Request for Bid No. 110-053 and evaluating bid submissions, and awarding to the lowest responsive, responsible bidders
    - Purchasing the buses
- Deployment of equipment by:
    - Taking delivery of the buses
    - Using the buses in routine operations at LAX
- Project Management and Reporting by:
    - Overseeing project implementation
    - Obtaining user feedback and collecting data
    - Preparing and submitting interim progress reports
    - Preparing and submitting final project report

Deployment and Operation

Seven CNG heavy-duty 35-foot, low-floor transit buses were approved for purchase by the Board of Airport Commissioners on April 19, 2010. LAWA conducted a pre-production meeting on June 3, 2010, with a post-production inspection conducted at the manufacturer's dealership on December 16, 2010. Outfitting, testing and preparing the buses for use by the Bus Operations Contractor of LAWA's Landside Operations Division was successfully completed by December 22, 2010 after which the buses were put into service on the LAX shuttle bus fleet that transports airport passengers between the Central Terminal Area and the outlying parking lots. Data on fuel usage and engine operating hours was provided by the LAWA Maintenance Division and Servis Air, which operates the shuttle routes.

Emission Benefits and Cost Effectiveness

One goal of the purchase of the CNG transit buses was to reduce mobile source emissions from the traditional diesel heavy-duty vehicles. The seven 35-foot buses are powered by a Model 2009 CNG-fueled Cummins 8.9L. ISL-G engine. The Cummins engine is certified by CARB at .1 g/bhp-hr NOx per the Executive Order in Appendix I. Data on the fuel consumption, mileage, and hours of operation were collected by LAWA. The average amount of mileage was used to extrapolate an average annual mileage for the vehicle, which was estimated to be 52,000 miles per year. Fuel consumption was estimated in the same way at 22,275 diesel equivalent gallons per year. The cost of purchasing the buses was $2,848,909 with $175,000 from MSRC funds going towards the cost of the vehicles (i.e., $25,000 per vehicle from MSRC). LAWA replaces buses every 12 years.

Photographs and Outreach

Photographs provided herein illustrate that LAWA has affixed the Clean Transportation Funding by MSRC logo on the heavy-duty vehicles purchased as part of the qualifying project. As the purchased CNG buses are utilized in an airport setting through which over 70 million annual passengers circulate, there is significant ongoing visibility of MSRC funding support.

Public awareness of the MSRC support for these vehicle projects began with the acceptance of the Clean Transportation Funding award under Contract ML09032 by the Los Angeles Board of Airport Commissioners (BOAC) on January 10, 2011. The meeting at which this item was approved by the BOAC was televised on City Cable Channel 35, which is available for viewing throughout Los Angeles. Additionally, the written report describing the funding award amount and purpose remains posted on the LAWA website at http://www.lawa.org/ArchivedboacLAWA.aspx under the January 10, 2011 date in the agenda and reports section as Item 22.

As a means of spreading awareness of this project and the Clean Transportation Funding program to a broader set to LAWA partners and contacts, the outreach flyer presented as Appendix II was developed. The current project facts and synopsis of the significant level of MSRC support provided to LAWA over the past seven years was developed to facilitate dissemination of this information at the many environmental fairs, speaking engagements, and community events attended by LAWA staff.

LAWA will continue to pursue all other feasible means of promoting the valuable support we have received from the MSRC for our heavy-duty vehicle replacement and expansion projects implemented with support from the Clean Transportation Funding Program.

Summary and Conclusions

With the help and support of MSRC, LAWA purchased the CNG transit buses as part of a program to reduce emissions from heavy-duty diesel vehicles. The program has been successful in reducing harmful air emissions associated with diesel fuel. LAWA will continue to purchase replacement vehicles and equipment powered by alternative fuels whenever practical and feasible.

Recommendations

Based on the benefits obtained from this medium-heavy duty transit bus program, it is important that the MSRC continue to fund these types of programs as a cost effective way to reduce harmful air emissions in the South Coast Air Basin.

California Environmental Protection Agency AIR RESOURCES BOARD	CUMMINS INC.	EXECUTIVE ORDER A-021-0492-1 New On-Road Heavy-Duty Engines Page 1 of 1 Pages

Pursuant to the authority vested in the Air Resources Board by Health and Safety Code Division 26, Part 5, Chapter 2; and pursuant to the authority vested in the undersigned by Health and Safety Code Sections 39515 and 39516 and Executive Order G-02-003;

IT IS ORDERED AND RESOLVED: The engine and emission control systems produced by the manufacturer are certified as described below for use in on-road motor vehicles with a manufacturer's GVWR over 14,000 pounds. Production engines shall be in all material respects the same as those for which certification is granted.

MODEL YEAR	ENGINE FAMILY	ENGINE SIZES (L)	FUEL TYPE [1]	STANDARDS & TEST PROCEDURE	INTENDED SERVICE CLASS [2]	ECS & SPECIAL FEATURES [3]	DIAGNOSTIC [6]
2009	9CEXH0540LBD	8.9	CNG/LNG	Diesel	UB	TBI, TC, CAC, ECM, EGR, TWC, HO2S	N/A

PRIMARY ENGINE'S IDLE EMISSIONS CONTROL [5]	ADDITIONAL IDLE EMISSIONS CONTROL [5]
EXEMPT	N/A

ENGINE (L)	ENGINE MODELS / CODES (rated power, in hp)
8.9	ISL G 320 / 0897;FR91958 (320), ISL G 300 / 0897;FR93055 (300), ISL G 280 / 0897;FR91959 (280), ISL G 250 / 0897;FR92740 (250)
*	*
*	*
*	*

* =not applicable; GVWR=gross vehicle weight rating; 13 CCR xyz=Title 13, California Code of Regulations, Section xyz; 40 CFR 86.abc=Title 40, Code of Federal Regulations, Section 86.abc; L=liter; hp=horsepower; kw=kilowatt; hr=hour;

[1] CNG/LNG=compressed/liquefied natural gas; LPG=liquefied petroleum gas; E85=85% ethanol fuel; MF=multi fuel a.k.a. BF=bi fuel; DF=dual fuel; FF=flexible fuel;

[2] L/M/H HDD=light/medium/heavy heavy-duty diesel; UB=urban bus; HDO=heavy duty Otto;

[3] ECS=emission control system; TWC/OC=three-way/oxidizing catalyst; NAC=NOx adsorption catalyst; SCR-U / SCR-N=selective catalytic reduction – urea / – ammonia; WU (prefix) =warm-up catalyst; DPF=diesel particulate filter; PTOX=periodic trap oxidizer; HO2S/O2S=heated/oxygen sensor; HAFS/AFS=heated/air-fuel-ratio sensor (a.k.a., universal or linear oxygen sensor); TBI=throttle body fuel injection; SFI/MFI=sequential/multi port fuel injection; DGI=direct gasoline injection; GCARB=gaseous carburetor; IDI/DDI=indirect/direct diesel injection; TC/SC=turbo/super charger; CAC=charge air cooler; EGR / EGR-C=exhaust gas recirculation / cooled EGR; PAIR/AIR=pulsed/secondary air injection; SPL=smoke puff limiter; ECM/PCM=engine/powertrain control module; EM=engine modification; 2 (prefix)=parallel; (2) (suffix)=in series;

[5] ESS=engine shutdown system (per 13 CCR 1956.8(a)(6)(A)(1); 30g=30 g/hr NOx (per 13 CCR 1956.8(a)(6)(C); APS =internal combustion auxiliary power system; ALT=alternative method (per 13 CCR 1956.8(a)(6)(D); Exempt=exempted per 13 CCR 1956.8(a)(6)(B) or for CNG/LNG fuel systems; N/A=not applicable (e.g., Otto engines and vehicles);

[6] EMD=engine manufacturer diagnostic system (13 CCR 1971); OBD=on-board diagnostic system (13 CCR 1971.1);

Following are: 1) the FTP exhaust emission standards, or family emission limit(s) as applicable, under 13 CCR 1956.8; 2) the EURO and NTE limits under the applicable California exhaust emission standards and test procedures for heavy-duty diesel engines and vehicles (Test Procedures); and 3) the corresponding certification levels, for this engine family. "Diesel" CO, EURO and NTE certification compliance may have been demonstrated by the manufacturer as provided under the applicable Test Procedures in lieu of testing. (For flexible- and dual-fueled engines, the CERT values in brackets [ ] are those when tested on conventional test fuel. For multi-fueled engines, the STD and CERT values for default operation permitted in 13 CCR 1956.8 are in parentheses.).

In g/bhp-hr	NMHC		NOx		NMHC+NOx		CO		PM		HCHO	
	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO
STD	0.14	0.14	0.20	0.20	*	*	15.5	15.5	0.01	0.01	*	*
FEL	*	*	*	*	*	*	*	*	*	*	*	*
CERT	0.13	0.04	0.10	0.01	*	*	1.2	0.4	0.009	0.000	*	*
NTE	0.21		0.30		*		19.4		0.02		*	

[4] g/bhp-hr=grams per brake horsepower-hour; FTP=Federal Test Procedure; EURO=Euro III European Steady-State Cycle, including RMCSET=ram mode cycle supplemental emissions testing; NTE=Not-to-Exceed; STD=standard or emission test cap; FEL=family emission limit; CERT=certification level; NMHC/HC=non-methane/hydrocarbon; NOx=oxides of nitrogen; CO=carbon monoxide; PM=particulate matter; HCHO=formaldehyde;

(Rev.: 2007-02-26)

BE IT FURTHER RESOLVED: Certification to the FEL(s) listed above, as applicable, is subject to the following terms, limitations and conditions. The FEL(s) is the emission level declared by the manufacturer and serves in lieu of an emission standard for certification purposes in any averaging, banking, or trading (ABT) programs. It will be used for determining compliance of any engine in this family and compliance with such ABT programs.

BE IT FURTHER RESOLVED: For the listed engine models the manufacturer has submitted the materials to demonstrate certification compliance with 13 CCR 1965 (emission control labels) and 13 CCR 2035 et seq. (emission control warranty).

Engines certified under this Executive Order must conform to all applicable California emission regulations.

The Bureau of Automotive Repair will be notified by copy of this Executive Order.

This Executive Order hereby supersedes Executive Order A-021-0492 dated February 3, 2009.

Executed at El Monte, California on this 30th day of March 2009.

Annette Hebert, Chief
Mobile Source Operations Division

Clean Transportation Funding from MSRC: A Valuable LAWA Partnership

Los Angeles World Airports has undertaken an Alternative Fuels Vehicles Program with an objective of replacing traditional fossil fuel vehicles, where feasible and possible, with vehicles powered with alternative fuel. Through this Program, LAWA currently operates over 650 alternative fuel vehicles, including those powered by liquefied natural gas (LNG), liquefied petroleum gas (LPG), compressed natural gas (CNG), electricity and solar power.

A significant source of support for LAWA's efforts to reduce vehicle emissions through the purchase of alternative fuel vehicles is Clean Transportation Funding from the Mobile Source Air Pollution Reduction Review Committee (MSRC). MSRC funding has been an integral tool in LAWA's purchase of heavy-duty alternative fuel vehicles.

Since June 2003, LAWA Clean Transportation Funding awards from the MSRC amount to over $1.7M.

The most recent award received by LAWA from MSRC is a $175,000 amount to support the purchase of seven CNG-fueled 35-foot transit buses.

These new buses provide convenient shuttle service between the Metro Green Line Aviation Station (located at Aviation and Imperial Hwy) and the LAX Central Terminal Area. The availability of this service is not only a convenience to the traveling public, but a valuable measure to reduce vehicle emissions during busy passenger traffic periods.

LAWA values and appreciates the ongoing and successful partnership established with the MSRC and proudly displays the Clean Transportation Funding logo on all supported vehicles.

For additional information regarding LAWA's Clean Transportation Funding from MSRC, please contact Lisa Wellik of the LAWA Grants Administration Unit (424) 646-5254.