FINAL REPORT

THIS REPORT WAS PREPARED FOR THE
MOBILE SOURCE AIR POLLUTION REDUCTION REVIEW COMMITTEE (MSRC)
UNDER THE AB2766 DISCRETIONARY FUND WORK PROGRAM

PROCUREMENT OF FIFTY LIQUEFIED NATURAL GAS POWERED SOLID RESOURCES COLLECTION VEHICLES

Grant Number: AB2766/ML06022

BY

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SANITATION
SOLID RESOURCES SUPPORT SERVICES DIVISION

February 2008

ABSTRACT

Fifty liquefied natural gas (LNG) powered solid resources collection vehicles (SRCVs) were procured by the City of Los Angeles, Bureau of Sanitation (BOS) with funding support from the Mobile Source Air Pollution Reduction Review Committee Clean Transportation under the grant agreement number AB2766/ML06022. All fifty LNG-powered SRCVs were acquired and deployed in the BOS fleet between December 2006 and November 2007. These vehicles are currently assigned in various district collection yards of the BOS and continually operate 100% in the South Coast Air Basin. The use of these fifty SRCVs will avoid the combustion of more than 5.5 million gallons of diesel for this 10-year project. It is estimated that this project would also result in emissions reduction of approximately 105.2 tons of non-methane hydrocarbons plus oxides of nitrogen (NMHC + NOx) and 11.8 tons of particulate matter (PM).

Table of Contents

1. Background

In August 1998, the California Air Resources Board (CARB) identified diesel particulate matter (PM) as a toxic air contaminant, which can potentially cause cancer and other adverse health effects. By September 2000, the CARB adopted the Diesel Risk Reduction Plan to reduce PM emissions from diesel-powered engines and vehicles. This plan recommended emission control measures to reduce diesel PM and established a goal of reducing diesel PM by 75% by the year 2010 and 85% by 2020.

In June 2000, the South Coast Air Quality Management District adopted Fleet Rule 1193 for on-road solid resources collection vehicles. This rule requires solid resources collection fleet operators to acquire alternative-fueled heavy-duty vehicles when purchasing or leasing vehicles to reduce air toxic and criteria pollutant emissions.

In June 2000, the Los Angeles City Council adopted a Clean Fuel Policy, which guides the City of Los Angeles, Bureau of Sanitation (BOS) in developing a comprehensive strategy in supporting and expanding the use of alternative-fueled vehicles.

In March 2006, Mayor Antonio Villaraigosa directed the BOS to convert its entire SRCV fleet to those operating on clean fuels by 2010.

In January 2001, the BOS acquired its first 10 dual-fuel solid resources collection vehicles (SRCVs) operating on a combination of clean fuel, liquefied natural gas (LNG, 85%) and ultra-low sulfur diesel (ULSD, 15%). Currently, the BOS has more than 300 LNG-powered SRCVs in its fleet of over 700 vehicles.

In FY 06-07, the City of Los Angeles acquired and placed in service fifty LNG-powered SRCVs. The City was awarded a funding support from the Mobile Source Air Pollution Reduction Review Committee (Grant Agreement number AB2766/ML06022) to offset the cost of purchasing these clean fuel vehicles.

2. Project Description

The objective of this project was the continued support for the City's commitment in providing its residents with clean air quality by reducing criteria pollutants and toxic air emissions from its fleet of heavy-duty solid resources collection vehicles (SRCVs). Contract agreement number AB2766/ML06022 from the Mobile Source Air Pollution Reduction Review Committee (MSRC) Clean Transportation provided funding to the City of Los Angeles, Bureau of Sanitation (BOS) a maximum award of $1,250,000 for the purchase of fifty SRCVs equipped with dedicated liquefied natural gas (LNG) engines. The total cost for the fifty LNG-powered SRCVs including tax amounted to $11,144,589.25. With the MSRC's contribution, their funding support for this project amounted to 11.2%.

The City of Los Angeles issued purchase order number 643406 in 2006 for the procurement of fifty LNG-powered SRCVs. All fifty SRCVs are 2007 Condor PRL-42L model equipped with 8.9L Cummins ISL Gas Plus engine (2006 engine model year). The first twenty-five SRCVs are equipped with Amrep automated side loader solid resources collection bodies and fuel tanks with a capacity of 150 gallons (See Figure 1). The final twenty-five SRCVs are equipped with Amrep front loader solid resources collection bodies and fuel tanks with a capacity of 119 gallons (See Figure 2). All SRCVs are fueled with LNG and have been deployed in the BOS fleet between December 2006 and November 2007.

As the BOS started receiving the new vehicles, BOS staff was experiencing performance issues with the vehicles, specifically with the acceleration and overall operation. BOS operational needs were not met, but with staff assistance the manufacturer was able to address the problems. After manufacturer modifications, the new LNG-powered SRCVs were able to perform at an acceptable level. These improved modifications made to the vehicle performance caused a delay in the delivery and deployment of the fifty LNG-powered SRCVs in the BOS fleet. However, as of November 2007, all fifty LNG-powered SRCVs that are funded in part under the MSRC's Contract Agreement number AB2766/ML06022 have been received and placed in service. All of these vehicles are presently operated in the South Coast Air Basin.

All pertinent information related to the MSRC funded vehicles are listed in Table 1.

Table 1: Pertinent information on the 50 LNG-powered SRCVs supported by the MSRC contract #AB2766/ML06022

Count	Vehicle Number	License Number	Location	In-Service Date	VIN	Engine Year	Engine Family	Engine Serial Number	Vehicle Cost
1	36879	1242619	South L.A.	05/30/07	49HHBVDN17RX08651	2006	6CEXHO540LBA	46591777	$236,205.83
2	36880	1229581	South L.A.	12/05/06	5SXHANDN17RX70743	2006	6CEXHO540LBA	46604075	$236,205.83
3	36881	1229582	East Valley	12/11/06	5SXHANDN37RX70744	2006	6CEXHO540LBA	46603284	$236,205.83
4	36882	1229583	East Valley	12/05/06	5SXHANDN57RX70745	2006	6CEXHO540LBA	46603081	$236,205.83
5	36883	1229585	South L.A.	05/25/07	5SXHANDN77RX70746	2006	6CEXHO540LBA	46610514	$236,205.83
6	36884	1229586	South L.A.	12/11/06	5SXHANDN97RX70747	2006	6CEXHO540LBA	46611423	$236,205.83
7	36885	1229587	South L.A.	12/05/06	5SXHANDN07RX70748	2006	6CEXHO540LBA	46610459	$236,205.83
8	36886	1216242	South L.A.	06/05/07	5SXHANDN27RX70749	2006	6CEXHO540LBA	466614580	$236,205.83
9	36887	1235183	South L.A.	05/30/07	5SXHANDN97RX70750	2006	6CEXHO540LBA	46624625	$236,205.83
10	36888	1229584	East Valley	12/15/06	5SXHANDN07RX70751	2006	6CEXHO540LBA	46620577	$236,205.83
11	36889	1226243	East Valley	01/15/07	5SXHANDN27RX70752	2006	6CEXHO540LBA	46622328	$236,205.83
12	36890	1216241	South L.A.	05/24/07	5SXHANDN47RX70753	2006	6CEXHO540LBA	46622344	$236,205.83
13	36891	1235182	South L.A.	05/24/07	5SXHANDN67RX70754	2006	6CEXHO540LBA	46627896	$236,205.83
14	36892	1235181	South L.A.	05/30/07	5SXHANDN87RX70755	2006	6CEXHO540LBA	46638468	$236,205.83
15	36893	1235180	South L.A.	01/15/07	5SXHANDNX7RX70756	2006	6CEXHO540LBA	46638432	$236,205.83
16	36894	1216712	West Valley	05/24/07	5SXHANDN17RX70757	2006	6CEXHO540LBA	46644028	$236,205.83
17	36895	1242618	South L.A.	05/25/07	5SXHANDN37RX70758	2006	6CEXHO540LBA	46657207	$236,205.83
18	36896	1216715	West Valley	05/25/07	5SXHANDN57RX70759	2006	6CEXHO540LBA	46657404	$236,205.83
19	36897	1242619	South L.A.	05/24/07	5SXHANDN17RX70760	2006	6CEXHO540LBA	46657404	$236,205.83
20	36898	1216711	South L.A.	05/24/07	5SXHANDN37RX70761	2006	6CEXHO540LBA	46666631	$236,205.83
21	36899	1236306	West Valley	05/24/07	5SXHANDN57RX70762	2006	6CEXHO540LBA	46666528	$236,205.83
22	36900	1216713	East Valley	05/24/07	5SXHANDN77RX70763	2006	6CEXHO540LBA	46669411	$236,205.83
23	36901	1242620	West Valley	05/24/07	5SXHANDN97RX70764	2006	6CEXHO540LBA	46674976	$236,205.83
24	36902	1236305	East Valley	05/24/07	5SXHANDN07RX70765	2006	6CEXHO540LBA	46676418	$236,205.83
25	36903	1242621	West Valley	05/24/07	5SXHANDN27RX70766	2006	6CEXHO540LBA	46676636	$236,205.83
26	36904	1229579	East Valley	08/03/07	5SXHANDN87RX53860	2006	6CEXH0540LBA	46603173	$214,080.61
27	36905	1229580	South L.A.	06/11/07	5SXHANDNX7RX70496	2006	6CEXH0540LBA	46602946	$214,080.61
28	36906	1216714	East Valley	06/11/07	5SXHANDN17RX70497	2006	6CEXH0540LBA	46602871	$214,080.61
29	36907	1236264	West Valley	07/05/07	5SXHANDN37RX70498	2006	6CEXH0540LBA	46604059	$214,080.61
30	36908	1242639	East Valley	06/07/07	5SXHANDN57RX70499	2006	6CEXH0540LBA	46610496	$214,080.61
31	36909	1236304	South L.A.	06/11/07	5SXHANDN87RX70500	2006	6CEXH0540LBA	46611501	$214,080.61
32	36910	1236263	East Valley	07/27/07	5SXHANDNX7RX70501	2006	6CEXH0540LBA	46611462	$214,080.61
33	36911	1236303	Harbor	07/13/07	5SXHANDN17RX70502	2006	6CEXH0540LBA	46611440	$214,080.61
34	36912	1242640	East Valley	06/21/07	5SXHANDN37RX70503	2006	6CEXH0540LBA	46614143	$214,080.61
35	36913	1242616	South L.A.	06/11/07	5SXHANDN57RX70504	2006	6CEXH0540LBA	46614148	$214,080.61
36	36914	1242641	West Valley	11/13/07	5SXHANDN77RX70505	2006	6CEXH0540LBA	46622333	$214,080.61
37	36915	1236307	West Valley	08/07/07	5SXHANDN97RX70506	2006	6CEXH0540LBA	46603131	$214,080.61
38	36916	1236302	West Valley	07/13/07	5SXHANDN07RX70507	2006	6CEXH0540LBA	46622310	$214,080.61
39	36917	1236308	East Valley	07/27/07	5SXHANDN27RX70508	2006	6CEXH0540LBA	46638645	$214,080.61
40	36918	1242617	South L.A.	07/12/07	5SXHANDN47RX70509	2006	6CEXH0540LBA	46638044	$214,080.61
41	36919	1236309	West Valley	08/10/07	5SXHANDN07RX70510	2006	6CEXH0540LBA	46638078	$214,080.61
42	36920	1236301	East Valley	07/19/07	5SXHANDN27RX70511	2006	6CEXH0540LBA	46657217	$214,080.61
43	36921	1242642	West Valley	06/21/07	5SXHANDN47RX70512	2006	6CEXH0540LBA	46655498	$214,080.61
44	36922	1236310	West Valley	07/02/07	5SXHANDN67RX70513	2006	6CEXH0540LBA	46657281	$214,080.61
45	36923	1236262	South L.A.	05/24/07	5SXHANDN57RX70518	2006	6CEXHO540LBA	46661362	$214,080.61

Table 1 (Continued): Pertinent information on the 50 LNG-powered SRCVs supported by the MSRC

Count	Vehicle Number	License Number	Location	In-Service Date	VIN	Engine Year	Engine Family	Engine Serial Number	Vehicle Cost
46	36924	1242643	South L.A.	05/24/07	5SXHANDNX7RX70515	2006	6CEXHO540LBA	46661362	$214,080.61
47	36925	1236311	South L.A.	06/28/07	5SXHANDN17RX70516	2006	6CEXHO540LBA	46666658	$214,080.61
48	36926	123312	East Valley	06/21/07	5SXHANDN37RX70517	2006	6CEXHO540LBA	46672597	$214,080.61
49	36927	1240954	West Valley	11/13/07	5SXHANDN57RX70518	2006	6CEXHO540LBA	46672557	$214,080.61
50	36928	1236265	South L.A.	06/11/07	5SXHANDN77RX70519	2006	6CEXHO540LBA	46676438	$214,080.61

Footnotes: East Valley: 11050 Pendleton Street, Sun Valley, CA 91352 South L.A.: 786 South Mission Road, Los Angeles, CA 90023
Harbor: 1400 North Gaffey Street, Los Angeles, CA 90731 West Valley: 8820 Vanalden Avenue, Northridge, CA 91324

3. Emissions Benefits

For the fifty LNG-powered SRCVs, the expected annual miles traveled per vehicle is 14,230 per year. Based on the mileage and fuel consumption of MSRC-funded LNG-powered SRCVs from December 2006 to September 2007, the estimated average miles per gallon is 0.82. The estimated annual fuel consumption is 17,354 gallons of LNG per vehicle.

In this report, the energy generated from the combustion of diesel is taken to be 128,100 BTU/gallon while LNG is 81,700 BTU/gallon. Based on the estimated total LNG consumption for fifty vehicles over a 10 year period for this project, the total BTU value is about 709 billion as shown in Table 2. This is equivalent to the avoidance of more than 0.5 million gallons of diesel per year or more than 5.5 million gallons of diesel for this 10-year project.

Table 2 also provides a comparison of emissions between diesel-powered SRCVs and the MSRC-funded LNG-powered SRCVs. The difference in emissions provides a reduction of criteria pollutants attributable to the LNG-powered SRCVs at approximately 105.2 tons of NMHC + NOx and 11.8 tons of PM for this 10-year project.

Table 2: NOx and PM emissions reduction attributable to the operation of 50 MSRC-funded LNG-powered SRCVs.

2005 Diesel SRCVs (Baseline)		**NMHC+NOx**	**PM**
Total BTU (A, Based on 10-year Fuel Use by the 50 MSRC-funded SRCVs)	708,896,951,220		
Average Brake-Specific Fuel Consumption (B, Diesel equivalent lb/bhp-hr)*	0.33		
Diesel Energy Density (C, BTU/lb)**	18,000		
Brake-Specific Energy Consumption (D= BxC, BTU/bhp-hr)	5,940		
Certification Exhaust Emission (E, g/bhp-hr)***		2.0	0.1
Total 10-Year Project Emission (F=AxE/D, g)		238,685,842	11,934,292
Total 10-Year Project Emission (G=F/907,200, ton)		263.1	13.2

Table 2 (continued): NOx and PM emissions reduction attributable to the operation of 50 MSRC-funded LNG-powered SRCVs

2007 LNG SRCVs (Funded in part by MSRC Grant AB2766/ML06022)		**NMHC+NOx**	**PM**
Total BTU (A, Based on 10-year Fuel Use by the 50 MSRC-funded SRCVs)	708,896,951,220		
Average Brake-Specific Fuel Consumption (B, Diesel equivalent lb/bhp-hr)*	0.33		
Diesel Energy Density (C, BTU/lb)**	18,000		
Brake-Specific Energy Consumption (D= BxC, BTU/bhp-hr)	5,940		
Certification Exhaust Emission (E, g/bhp-hr)****		1.2	0.01
Total 10-Year Project Emission (F=AxE/D, g)		143,211,505	1,193,429
Total 10-Year Project Emission (M=F/907,200, ton)		157.9	1.3
Emissions Reduction Using LNG Versus Diesel (N=G-M, ton)		**105.2**	**11.8**

Footnotes:
*: Beck et al. (1997)
**: California Air Resources Board (2003), Pg. 37
***: Executive Order A-021-0385-2, California Air Resources Board, June 24th 2005
****: Executive Order A-021-0397-A, California Air Resources Board, May 1st 2007

4. Public Outreach

The City of Los Angeles is committed to the successful implementation of the Clean Fuel Program, adopted in June 2000 by the Los Angeles City Council, for its fleet of solid resources collection vehicles. To aid in advancing milestones, an informational brochure about the Clean Fuel Program was developed and continuously updated and distributed in outreach events to educate the public on the City's work in providing City services while reducing air pollutant emissions in their neighborhoods. The brochure includes environmental benefits & regulatory background, program achievements such as the fleet addition of fifty 50 LNG-powered SRCVs, etc. It also highlights funding support from the MSRC and other agencies for the City of Los Angeles Clean Fuel Program.

Outreach events are on going and listed below are past events where the Clean Fuel Program Brochure was distributed and in some events an MSRC supported SRCV (AB2766/ML06022) was also showcased.

- 2006 AltCar Expo in Santa Monica on December 2006 (Both brochures & an SRCV were available on site)
- Grand Opening of the South Los Angeles LNG/CNG Refueling Station on August 2007 (Both brochures & an SRCV were available on site – see Figures 3 & 4)

- 2007 AltCar Expo in Santa Monica in October 2007 (Brochures distributed)
- 2007 Clean Vehicle Technology Expo in Ontario on October 2007 (Brochures distributed)
- Universal Studios Hollywood Eco-Fair in Hollywood on November 2007 (Brochures distributed)
- 1st Alta Med Mom's Reunion in Boyle Heights on November 2007 (Brochures distributed)
- Community Resource Fair in Sylmar on November 2007 (Brochures distributed)
- 2007 Environmental Youth Conference in Los Angeles on December 2007 (Both brochures & an SRCV were available on site – see Figures 5 &6)

5. Summary and Conclusions

The BOS procured fifty LNG-powered SRCVs with funding support from the MSRC Clean Transportation under the grant agreement number AB2766/ML06022. The grant fund award by the MSRC is $1,250,000 and the total cost of the fifty LNG-powered SRCVs is $11,144,589.25. The MSRC support for this project is 11.2% towards the total procurement cost.

All fifty LNG-powered SRCVs were acquired and deployed in the BOS fleet between December 2006 and November 2007. These vehicles are currently assigned in various district collection yards of the BOS as indicated in Table 1 and are continually operated 100% of each vehicle's annual mileage in the South Coast Air Basin.

With the use of these fifty LNG-powered SRCVs, this project will avoid the combustion of more than 0.5 million gallons of diesel per year or more than 5.5 million gallons of diesel for this 10-year project. It is estimated that this project would also result in emissions reduction of approximately 105.2 tons of NMHC + NOx and 11.8 tons of PM.

The City of Los Angeles continues its efforts to provide clean air to its residents. This funding from the MSRC provided assistance in offsetting additional costs in procuring clean fuel vehicles. The City is fully on its way in providing clean air for its citizens with the complete conversion of its fleet of SRCVs to alternative fuel, LNG, and/or equipping them with CARB-verified exhaust after-treatment devices

6. Recommendations

With the higher cost of acquiring alternative-fueled engines in comparison to diesel engines, funding assistance will help offset this additional cost. Additional funding assistance may encourage more fleet operators and owners to incorporate alternative-fueled engines in their fleet as it lessens the incremental costs of clean fuel engines versus diesel engines. Additionally, funding assistance may promote early removal of older and more polluting diesel engines from the active fleet and likewise result in further emission reduction benefits.

Appendix

Figure 1: An LNG-powered automated side loader solid resources collection vehicle (SRCV) operated by the City of Los Angeles, Bureau of Sanitation (BOS). Fifty new LNG-powered SRCVs, supported by MSRC grant #AB2766/ML06022, now operate within the BOS fleet.

Figure 2: A new LNG-powered front loader solid resources collection vehicle supported by MSRC grant #AB2766/ML06022, now operating within the BOS fleet.

Figure 3: Two LNG-powered SRCVs at the City of Los Angeles' South Los Angeles District Yard LNG Refueling station.

Figure 4: Grand Opening celebration of the BOS South Los Angeles LNG Refueling station on August 2007. Mayor Villaraigosa, along with other City leaders and distinguished guests were at the event. An LNG-powered automated side loader, funded in part by the MSRC grant #AB2766/ML06022, is showcased at this event.

Figure 5: At the 2007 Environmental Youth Conference in December, BOS staff explained the environmental benefits of using LNG-powered solid resources collection vehicles (SRCVs) in the fleet. One of fifty MSRC supported LNG-powered SRCV was also showcased at this event (See Figure 6).

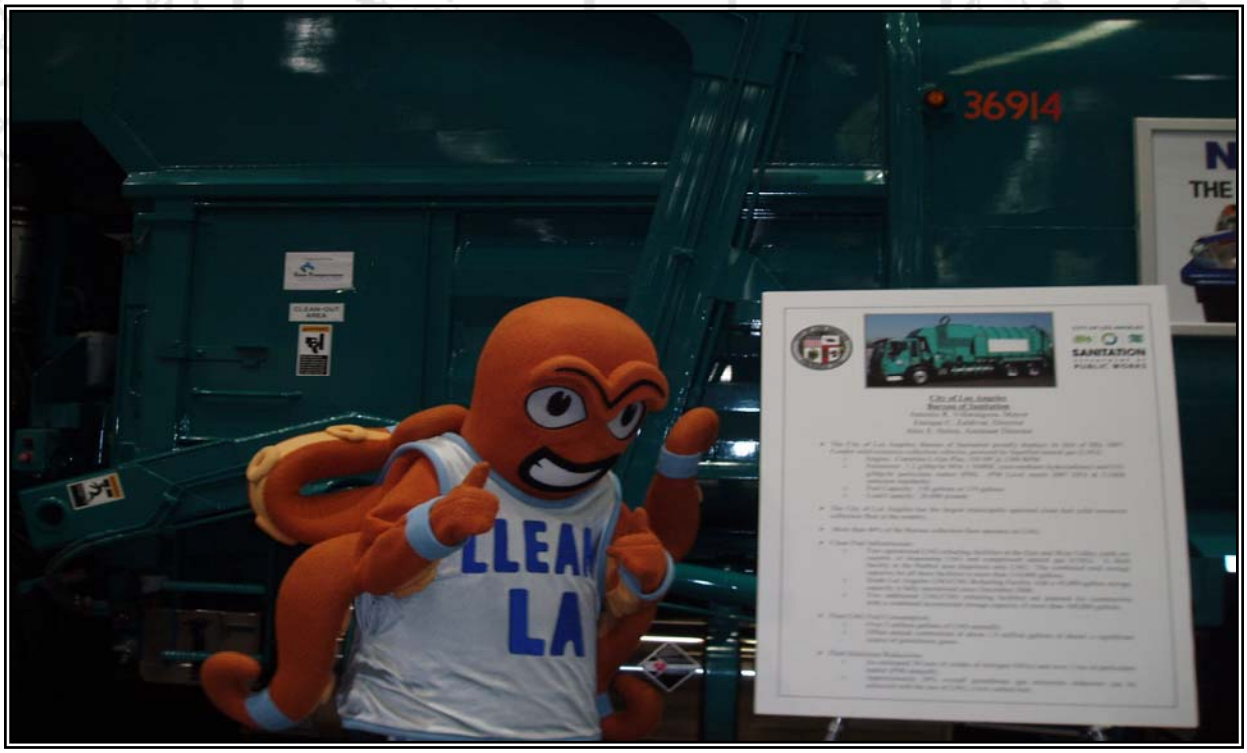

Figure 6: During the 2007 Environmental Youth Conference in December, the City of Los Angeles mascot for "Keep Los Angeles Beautiful", Octoclean, posed for the cameras next to the showcased MSRC supported LNG-powered solid resources collection vehicle.