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ARB LPG Fuel Blends Evaluation Project October 1999 Progress Report

submitted to:

LPG Fuel Blends Evaluation Project Task Group and Co-Sponsors

American Automobile Manufacturers Association, ARCO Products Co., California Air Resources Board, Cummins Engine Co., Engine Manufacturers Association, Equilon, Ford Motor Co., GFI, IMPCO, National Propane Gas Association, National Renewable Energy Laboratory, Natural Resources Canada, Propane Education and Research Council, Railroad Commission of Texas Alternative Fuels Research & Education Division, South Coast Air Quality Management District, Tosco Refining Co., and Western Propane Gas Association

I. Executive Summary

Medium and Light-duty emissions tests were completed in 1998. Performance/Combustion tests were completed in January 1999 at Southwest Research Institute (SwRI). Durability tests at Bodycote ORTECH (Bodycote) continued. Project fundraising and management continued.

II. Test Program Work Performed

A. Fuel Composition Tests

One (1) LPG blend composition test was received from Dixie Services, Inc. (see attached). Table 1 provides a summary of the results.

Fuel composition data from the Emissions, Performance/Combustion, and Durability tests can be accessed in prior monthly reports at ARB's website:

<http://www.arb.ca.gov/altfuels/lpg/mvlpge/mvlpge.htm>.

Table 1: Dixie Fuel Blend Composition Matrix

| Components | 4-Jun-99 | 17-Jun-99 | 21-Sep-99 | 11-Oct-99 | Average | Standard |
|------------|----------|-----------|-----------|-----------|----------|-----------|
| | (vol. %) | (vol. %) | (vol. %) | (vol. %) | (vol. %) | Deviation |
| Methane | 0.06 | 0.08 | 0.10 | 0.05 | 0.08 | 0.02 |
| Ethane | 3.96 | 4.20 | 4.15 | 3.75 | 4.02 | 0.16 |
| Propane | 80.87 | 81.32 | 80.94 | 81.38 | 81.13 | 0.23 |
| Propylene | 10.73 | 10.25 | 10.45 | 10.46 | 10.47 | 0.13 |
| Isobutane | 0.72 | 0.69 | 0.71 | 0.71 | 0.71 | 0.02 |
| n-Butane | 3.59 | 3.41 | 3.58 | 3.58 | 3.54 | 0.07 |
| t-2-Butene | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.00 |
| Isopentane | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.00 |
| c-2-Butene | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 |

B. Medium-Duty Engine (Cummins B5.9LPG) Emissions Tests at Bodycote

Tests were completed in August 1998. Final Report was submitted in November 1998. Prior monthly reports and the Final Report can be accessed on ARB's website: <http://www.arb.ca.gov/altfuels/lpg/mvlpge/mvlpge.htm>.

C. Light-Duty Truck (F150 Bi-Fuel) Emissions Tests at ARB Haagen Smit Laboratory

Tests were completed in September 1998. ARB's Final Report was posted on ARB's website in mid-July 1999. Prior monthly reports can also be accessed at ARB's website: <http://www.arb.ca.gov/altfuels/lpg/mvlpge/mvlpge.htm>.

D. Performance/Combustion Tests at SwRI

Tests were completed in January 1999. The Final Report was submitted in February 1999. Test program protocol and previous reports can be accessed at ARB's website: <http://www.arb.ca.gov/altfuels/lpg/mvlpge/mvlpge.htm>.

E. Durability Tests at Bodycote

The durability tests at Bodycote continued according to established protocol.

AA#2 is still under review and negotiation.

Test program protocol and previous reports can be accessed at ARB's website: <http://www.arb.ca.gov/altfuels/lpg/mvlpge/mvlpge.htm>.

III. Project Management Support and Administrative Work Performed

A. Project Fundraising

ADEPT continued attempts to process the TAFC awarded funds. The funding was granted but it has yet to be received.

ADEPT has obtained permission to resubmit its application to NPGA's Executive Committee for \$6,500.

B. Project Expenditures

Table 2 shows October expenditures and total expenditures to date.¹ Table 3 shows total funds received to date, by respective funder.

Table 2: October Expenditures and Total Expenditures to Date

| Item | Funds Expended In October | Funds Expended to Date |
|--|------------------------------|---------------------------|
| Fuel (Air Liquide, Phillips) | \$0.00 | \$38,607.72 |
| Emissions Tests (Bodycote) | \$0.00 | \$176,351.07 ² |
| Perf./Comb. Tests (SwRI) | \$0.00 | \$84,032.62 |
| Fuel Properties (Dixie) | \$475.00 | \$13,768.46 |
| Engine | \$0.00 | \$17,063.47 |
| Raw Durability Tests (Bodycote, Hertz) | \$0.00 | \$19,000.00 |
| Project Management | \$876.84 | \$118,489.57 |
| Attorney Fees | \$0.00 | \$2,250.00 |
| Subcontractor | \$36.00 | \$4,547.79 |
| Miscellaneous | \$10.00 | \$742.93 |
| TOTAL | \$1,397.84 | \$474,853.63 |

¹ All outlays above \$1,000 are pre-approved by the LPG Task Group and/or the TAC.

² Total includes \$23,422.55 (CAN\$35,931.02), paid directly to Bodycote by PGAC.

Table 3: Total Funds Received to Date

| Funder | Amount |
|--------------------|---------------------------|
| ARB (ULTRAMAR) | \$100,000.00 |
| ARCO | \$50,000.00 |
| Cummins Engine Co. | \$6,155.57 |
| EMA | \$1,000.00 |
| NPGA | \$8,920.00 |
| NRCan | \$126,033.95 ³ |
| PERC | \$25,000.00 ⁴ |
| SCAQMD | \$82,876.64 |
| Shell/Equilon | \$40,000.00 |
| Tosco | \$25,000.00 |
| WPGA | \$12,000.00 |
| TOTAL | \$476,986.16 |

Project Account Balance at month's end: **\$2,132.53**

Table 4 summarizes the in-kind services received to date, by respective funder.

Table 4: In-Kind Services Received to Date

| Funder | Item | Estimated Value |
|---------------|---|------------------------|
| ARB | ARB-El Monte Light-Duty Emissions Tests | \$90,000 |
| Cummins | Test Support | \$8,000 |
| Ford | Vehicle and Test Support | \$23,500 |
| NREL | Cummins B5.9LPG Engine | \$15,000 |
| TOTAL | | \$136,500 |

C. Project Contracts and Other Documents

The final September 1999 Progress Report was distributed to the Task Group.

Travel associated with effort described:

No travel was conducted in October.

³ Total of three payments: one at US\$61,356.48 (conversion ratio of 0.6817), one at US\$34,721.92 (conversion ratio of 0.6518), one at US\$23,422.55 (conversion ratio of 0.6519), and one at US\$6,533.00 (conversion ratio of 0.6533).

⁴ Total PERC award was \$30,000. \$5,000 was allotted to PVC for its project costs.

IV. Work planned for the next reporting period (November 1-31, 1999)

Project Management-ADEPT

1. Continue general project management.
2. Prepare and complete funding contracts for co-sponsors.
3. Continue to prepare the Final Report.

V. Attachment

Dixie fuel composition test results (10/11/99).

VI. Disclaimer

This report was prepared by ADEPT as result of work co-sponsored by the SCAQMD and Task Group members. Opinions, findings, conclusions, and recommendations within are those of the author and do not necessarily represent SCAQMD's views. SCAQMD, their officers, employees, contractors, and subcontractors make no warranty, expressed or implied, and assumes no legal liability for the information in this report. SCAQMD has not approved or disapproved this report, nor have they passed upon the accuracy or adequacy of the information contained herein.

VII. Glossary of Acronyms

| | |
|----------|---|
| ARB | California Air Resources Board |
| ARCO | ARCO Products Co. |
| Bodycote | Bodycote ORTECH |
| Cummins | Cummins Engine Co. |
| Dixie | Dixie Services Inc. |
| EMA | Engine Manufacturers Association |
| Ford | Ford Motor Co. |
| LPG | liquefied petroleum gases |
| NPGA | National Propane Gas Association |
| NRCan | Natural Resources Canada |
| PGAC | Propane Gas Association of Canada |
| PERC | Propane Education and Research Council |
| Phillips | Phillips 66 Propane Co. |
| PVC | Propane Vehicle Council |
| SCAQMD | South Coast Air Quality Management District |
| SwRI | Southwest Research Institute |
| TAC | Technical Assessment Committee |
| TAFC | Texas Alternative Fuels Commission |
| Tosco | Tosco Refining Co. |
| WPGA | Western Propane Gas Association |