RALEY'S FINAL DATA REPORT

ALTERNATIVE FUEL TRUCK
EVALUATION PROJECT

Raley's LNG Truck Site Final Data Report

DOE/NREL Alternative Fuel Truck Evaluation Project

For

**National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401**

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Battelle
... Putting Technology To Work
505 King Avenue
Columbus, Ohio 43201-2693

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Final Data Report

Raley's LNG Truck Site

Introduction

Raley's is a 120-store grocery chain with headquarters in Sacramento, California, that has been operating eight heavy-duty LNG trucks (Kenworth T800 trucks with Cummins L10-300G engines) and two LNG yard tractors (Ottawa trucks with Cummins B5.9G engines) since April 1997. This report describes the results of data collection and evaluation of the eight heavy-duty LNG trucks compared to similar heavy-duty diesel trucks operating at Raley's. The data collection and evaluation are a part of the U.S. Department of Energy (DOE)/National Renewable Energy Laboratory (NREL) Alternative Fuel Truck Evaluation Project. Several trucking companies are planned to participate in the evaluation project. To date, four truck sites have been added to the project, including:

- Raley's (Sacramento, California)
- Pima Gro Systems, Inc./Orange County Sanitation District (Fountain Valley, California)
- Waste Management (Washington, Pennsylvania)
- United Parcel Service (Hartford, Connecticut)

The sites in this project have been selected by NREL and Battelle (NREL's subcontractor for this project) according to the alternative fuel technology, type of trucks and engines, availability of diesel comparison ("control") vehicles, and interest from the trucking company in participation. The intent for this project is to select sites operating the newest alternative fuel technology available for medium- and heavy-duty trucks.

Comparative data are being collected on operations, maintenance, fueling, performance, and emissions characteristics of each alternative fuel fleet and comparable diesel control fleet operating at the same site. The data collection has been designed to cause as little disruption for the host sites as possible. In most cases, staff at the participating site send copies (electronic and/or paper) of data already part of normal business operations. All fleets participating in the project have access to all data being collected from their site and other data available from the project. Summaries of the data collected, evaluations, and analyses of the data are distributed to designated staff at the host site for review and input.

Report Organization

This report includes a technical review of data collected from the Raley's LNG truck site. Raley's was chosen because of their dedication to integrating the LNG trucks into their daily operations. This report is

intended to serve as a summary of data collection, analysis, and evaluation. The report is organized into six chapters:

- Overview of Evaluation Site and Data Presentation
- Facility and Capital Cost Descriptions
- Vehicle System and Expected Operation Descriptions
- Operational Results: Fuel Consumption, Engine Oil Consumption, and Maintenance Costs
- Summary of Operating Costs
- Emissions Test Results.

Summary of Results

The major conclusions from the evaluation of the Raley's LNG truck site include the following:

- The LNG trucks have been used as planned. The LNG trucks have been used for local Sacramento area pickup and delivery at the request of the Sacramento Metropolitan Air Quality Management District in return for funding to help establish LNG operations.
- Drivers perceive the LNG trucks to be slightly under-powered for Raley's operation.
- The emissions results from the Raley's project show large decreases in NOx and PM for the LNG trucks. The NOx reduction for the eight LNG trucks using the West Virginia University (WVU) testing results would have a nearly 7 tons per year reduction compared to diesel trucks running in place of the LNG trucks.
- Energy equivalent fuel economies between in-use fuel data and emissions testing fuel economies are essentially consistent. The energy equivalent fuel economy comparison between LNG and diesel trucks at Raley's is about 38 percent lower for the LNG trucks. This has caused some problems with range for the LNG trucks. This lower fuel economy has been aggravated by having fuel gauges that are not reliable.
- Mileage per vehicle per calendar month and year was significantly lower for the LNG trucks compared to the diesel control trucks. This lower mileage for the LNG trucks was caused by how the trucks have been used (routes closer to the Distribution Center in the Sacramento area) as well as problems with lower range than the diesel trucks and engine problems experienced early in the data collection period. The lower vehicle mileage for the LNG trucks has caused the cost per mile for maintenance to be biased higher than expected because the preventive maintenance actions are performed on a quarterly basis, not a mileage basis. To better understand how the LNG trucks have performed, the maintenance cost analysis has been made on a cost per truck basis for the same length of data period to account for this bias. Maintenance costs per mile are also provided.

- Operations and LNG fuel costs during the evaluation were affected by a change from a temporary to a permanent LNG fueling and storage station at Raley's. There were several major delays in starting and completing the construction of the permanent LNG station. The permanent LNG station allows Raley's to purchase a full tanker truckload of LNG, thus reducing the cost by \$0.10 per LNG gallon.
- Availability of LNG in the local Sacramento, California area could reduce LNG fuel cost significantly by reducing transportation costs (currently coming from Wyoming or Arizona).
- Raley's staff indicated that their operation would benefit from a larger LNG storage tank at the permanent fueling station (currently 13,000 gallons). The tank has reserve for vapor and liquid that cannot be used, which reduces the useable volume to about 11,500 gallons. This leaves a margin for error of 1,500 gallons when ordering fuel. Fuel shipments must be scheduled carefully, or the station will either run out of fuel or will not be able to accommodate the full incoming shipment, which results in lost fuel that Raley's must pay for.
- There were some problems with the LNG engines, such as with the wastegate, ignition modules, and sensor calibration. The LNG engine manufacturer, Cummins, was supportive and responsive to these problems. Operations were fairly trouble-free at the end of the evaluation.
- Raley's intends to expand their LNG truck operations; however, there are few choices of heavy-duty natural gas truck technologies.
- As part of this project, Raley's purchased two LNG yard tractors. These vehicles have been extremely successful for Raley's. The drivers have noted that, compared to the older diesel yard tractors, the LNG yard tractors offer reduced noise and vibration as well as a lack of diesel fumes.

Overview of Evaluation Site and Data Presentation

Raley's is a 120-store grocery chain centered in Sacramento, California, with operations in the Sacramento and San Jose, California, areas as well as Reno, Nevada (a listing of store locations and maps are shown in Appendix A). At the time of this evaluation, Raley's had a 64-truck fleet with eight model year 1997, Class 8 Kenworth T800 tractors using Cummins L10-300G engines and operating on LNG fuel. The diesel control vehicles used for this study were three model year 1996, Class 8 Kenworth T400 tractors using Cummins M11-330 engines. The LNG trucks were used to haul perishable goods from the Raley's Distribution Center in Sacramento to local and nearby Raley's, Bel Air, and Nob Hill grocery locations. The diesel control trucks are used to service Raley's, Bel Air, and Nob Hill grocery locations South and West of Sacramento on routes over terrain similar to those of routes covered by the LNG trucks. The LNG trucks started operation on April 17, 1997, and the diesel vehicles started operation in late 1995 and early 1996. Raley's also has two Ottawa LNG yard tractors using Cummins B5.9G engines.

The data analysis and evaluation results for vehicle and fuel usage are shown for two time periods: before January 1, 1998 (April 1997 through December 1997) and after January 1, 1998 (January 1998 through December 1998). January 1, 1998, is considered the "clean point" for the evaluation, because by that time, early problems with the natural gas engines had been resolved through engine modifications (e.g., component and engine map modifications). Most of the analyses in this report are presented as either "before clean point" or "after clean point."

The focus of this report will be on the results of operations after the clean point with a few comparisons of changes between the two data periods. Maintenance data has been compared between similar vehicle/engine life (based on mileage and calendar time from start of operation of each truck). Maintenance data from the LNG trucks start after the data clean point. Data for the diesel control trucks match the same vehicle life as the LNG trucks.

Facility and Capital Cost Descriptions

Prior to November 1998, refueling for the LNG trucks was provided by a 5,000-gallon Quick Response System (QRS) temporary station from MVE, Inc. (Figure 1). The temporary station was located at the Raley's Distribution Center, shown in Figure 2. A permanent 13,000-gallon LNG refueling station (Figure 3) was constructed at the Distribution Center and is estimated to cost about \$350,000. With the completion of the permanent refueling station, Raley's was able to receive a complete tanker truckload of LNG fuel (10,000 gallons) instead of a partial load (5,000 gallons). The full loads of LNG fuel cost \$0.10 per gallon less (reduced from \$0.575 to \$0.475 per LNG gallon) than the partial loads. The permanent station significantly reduced fuel costs.

At the Distribution Center, the trucks are stored outside (Figure 4). At the maintenance facility (Figure 5), the LNG trucks have the fuel system shut off before entering for maintenance. The LNG trucks are stored outside if the truck is left at the maintenance facility for more than a work shift. No changes were made to the maintenance facility and therefore there was no increased cost for the operation and servicing of LNG trucks.

Raley's leased all of the trucks taking part in the evaluation (both diesel and LNG) from Ozark Trucking. The original purchase prices were \$72,000 for the diesel trucks and \$107,000 for the LNG trucks (a difference of \$35,000). One of the LNG yard tractors is shown in Figure 6.

Figure 1. LNG Refueling at the Quick Response System (QRS) Temporary Station

Figure 2. Raley's Distribution Center

Figure 3. Raley's Permanent LNG Refueling Station

Figure 4. LNG Trucks Parked Outside at the Distribution Center

Figure 5. Maintenance Facility For All Raley's Trucks at Ozark Trucking

Figure 6. LNG Yard Tractor at Work

Vehicle System and Expected Operation Descriptions

Descriptions and specifications of major systems for each vehicle in the evaluation were written at the beginning of the data collection, and were revised when any major systems were altered. The specifications describe the main systems in the vehicle powertrain as well as accessory equipment. This information documents the similarity of the LNG and diesel trucks, and also documents specific equipment that may affect the performance of the vehicles in regard to fuel economy and overall reliability.

A description of the expected vehicle operations was developed to give analysts an understanding of the amount of work the study trucks were expected to accomplish in a given time frame. The description includes the number of stores the trucks usually service in a trip or on each day, the load that the truck sees (full or partial load on delivery and/or on return), and the expected number of hours and miles in service.

Vehicle System Descriptions

The Raley's LNG and diesel truck systems are described in summary in Table 1 and in full in Appendix B. The chassis used for the trucks was the T400 for the diesel control vehicles and the T800 for the LNG vehicles. The differences between the T400 and T800 models were described as minor by a Kenworth engineer. A comparison of similar operations of these two models was considered acceptable by the Kenworth engineer. The differences between the T400 and T800 are basically that the T400 is 9 inches shorter in length (from front bumper to back of the cab) than the T800, and the T800 is slightly more aerodynamic because of its curved windshield. The standard (at Kenworth) engine and transmission for both models are the Cummins M11-330 engine and the Fuller RTX 13710C transmission. The base model price for the T400 is approximately \$1,800 cheaper than the T800. The T400 diesel control trucks at Raley's are a year older than the T800 LNG vehicles. Back maintenance data were collected for the T400s, so that the maintenance cost comparisons would match trucks of similar age.

The Cummins L10-300G (LNG) and M11-330 (diesel) engines were considered to be comparable. The L10 has been phased out by Cummins for diesel truck operations. Also, Mr. Don Welliver (Cummins Chief Engineer - L10/M11 Natural Gas Engine Development) supported the comparison of the M11 and Cummins L10-280/300G engines for emissions testing. Mr. Welliver commented that the two engines were slightly different in configuration; however, the comparison made sense because Cummins does not have a natural gas version of the M11 engine.

Table 1. Vehicle System Descriptions – Raley’s

Description	Diesel Control Trucks	LNG Trucks
Chassis Manufacturer/Model	Kenworth T400, Class 8	Kenworth T800, Class 8
Chassis Model Year	1996	1997
Engine Manufacturer/Model	Cummins M11-330	Cummins L10-300G
Engine Ratings Max. Horsepower Max. Torque	330 hp @1600 rpm 1250 lb-ft @ 1200 rpm	300 hp @ 2100 rpm 900 lb-ft @ 1300 rpm
Fuel System Storage Capacity	114 gallons	174 LNG gallons total (104 diesel energy equivalent gallons) – 2 LNG saddle tanks from MVE, Inc.
Transmission Manufacturer/Model	Fuller RTL12610B, 10 speed	Fuller RT11710B, 10 speed
Catalytic Converter Used (Y/N)	No	No
Vehicle Cost in Comparison to Diesel	-	+\$35,000

Duty Cycle Descriptions

The LNG trucks at Raley’s are used for routes in the Sacramento area and nearby suburbs. This has been done at the request of the Sacramento Metropolitan Air Quality Management District to maximize the emissions benefits within the Sacramento Air Basin. The diesel control trucks used in this study traveled on similar terrain, but went farther (outside of the Sacramento area) to make deliveries and pick ups. This decision to operate the LNG trucks only in the Sacramento area has caused the LNG trucks to have significantly lower mileage per calendar month than the diesel control trucks. This difference in mileage for the two fleets is addressed in more detail later.

Each LNG truck at Raley’s is commonly used up to six days a week and two shifts per day. The trucks depart the Distribution Center loaded and return nearly empty (returning with empty pallets and spoiled/damaged goods) unless the truck stopped to backhaul goods to the Distribution Center. The trucks are used most heavily during the week or two before holidays such as Christmas, Thanksgiving, or Memorial Day.

Raley’s data have been analyzed on a per-trip and per-day basis (shown in Tables 2 and 3) as well as overall vehicle usage (mileage) per month (shown in Table 4 and Figure 7). Table 2 shows the trip information before the clean point in the data (before January 1998) and Table 3 shows the results after the clean point in the data (after January 1, 1998). Appendix C shows a more detailed per-trip and per-day summary for each vehicle on a monthly basis. The per-trip and per-day data does not indicate reliability. The data shown in the tables are for days that the trucks have been used and does not include any calculation or indication of downtime. A trip is defined as the route for each truck leaving the Distribution Center, making deliveries (or picking up), and returning to the Distribution Center. The

backhauls are calculated as the total number of backhaul operations divided by the number of trips taken by the fleet. A backhaul calculation of 0.2 indicates that 2 out of 10 trips has a backhaul within the trip.

**Table 2. Truck Usage Per Trip and Per Day
Before Clean Point (May 97 – December 97)**

Vehicle	Average Per Trip				Average Per Day			
	Miles	Hours	Stores	Back Haul	Miles	Hours	Stores	Back Haul
1501	50.5	3.6	2.1	0.1	146.4	10.4	6.0	0.2
1502	59.2	3.9	2.3	0.2	171.5	11.3	6.5	0.5
1503	67.2	4.2	2.4	0.1	189.9	11.9	6.7	0.3
1504	61.9	3.9	2.1	0.1	189.6	12.0	6.6	0.3
1505	47.9	3.7	2.3	0.1	136.2	10.7	6.5	0.4
1506	59.8	4.0	2.4	0.2	178.1	11.9	7.0	0.7
1507	102.6	5.2	2.8	0.3	242.7	12.4	6.6	0.6
1508	68.6	4.1	2.1	0.1	210.9	12.6	6.6	0.4
LNG	63.8	4.1	2.3	0.2	183.5	11.7	6.6	0.4
1586	188.5	8.0	3.5	1.0	233.5	9.9	4.3	1.2
1592	226.1	9.9	4.3	1.6	232.9	10.2	4.4	1.6
1593	212.6	9.0	3.9	1.3	250.3	10.6	4.6	1.5
Diesel	208.2	8.9	3.9	1.3	238.8	10.2	4.4	1.5

**Table 3. Truck Usage Per Trip and Per Day
After Clean Point (January 98 – December 98)**

Vehicle	Average Per Trip				Average Per Day			
	Miles	Hours	Stores	Back Haul	Miles	Hours	Stores	Back Haul
1501	57.2	3.9	2.3	0.1	157.5	10.6	6.3	0.2
1502	67.9	4.1	2.3	0.1	185.3	11.2	6.3	0.3
1503	71.3	4.3	2.3	0.1	210.2	12.6	6.9	0.3
1504	77.1	4.6	2.5	0.2	233.4	13.8	7.6	0.5
1505	76.3	4.5	2.4	0.1	192.3	11.2	5.9	0.3
1506	62.0	4.1	2.4	0.1	177.4	11.8	6.8	0.3
1507	70.4	4.3	2.4	0.1	202.3	12.3	6.8	0.3
1508	78.7	4.4	2.2	0.1	198.5	11.0	5.6	0.3
LNG	69.9	4.3	2.4	0.1	194.8	11.9	6.6	0.3
1586	220.2	8.2	3.1	0.3	287.9	10.7	4.1	0.4
1592	185.4	8.5	3.7	1.2	215.4	9.9	4.3	1.4
1593	230.1	9.2	3.9	0.8	265.5	10.6	4.4	0.9
Diesel	211.8	8.6	3.5	0.8	255.8	10.4	4.3	0.9

Table 4. Average Monthly Mileage

Vehicle	Before Clean Point (May 97 – Dec 97)			After Clean Point (Jan 98 – Dec 98)		
	Mileage	Months	Monthly Avg	Mileage	Months	Monthly Avg
1501	31,948	8	3,994	46,050	12	3,838
1502	30,922	8	3,865	55,833	12	4,653
1503	36,054	8	4,507	50,842	12	4,237
1504	40,716	8	5,090	67,580	12	5,632
1505	24,408	8	3,051	52,334	12	4,361
1506	34,848	8	4,356	52,460	12	4,372
1507	37,905	8	4,738	55,855	12	4,655
1508	40,954	8	5,119	50,014	12	4,168
LNG	277,755	64	4,340	430,968	96	4,489
1586	37,115	6	6,186	83,488	12	6,957
1592	35,420	6	5,903	64,889	12	5,407
1593	36,424	6	6,071	74,186	12	6,182
Diesel	108,959	18	6,053	222,563	36	6,182

Figure 7. Average Monthly Mileage Per Truck

The statistics in Table 3 show that each LNG truck is used on three separate trips in a day. The LNG trucks operate nearly 12 hours per day, deliveries are made to (or from) 6 to 7 stores, mileage per day averages 195 miles per truck, and a backhaul is made on every third truck on any given day of operation. The diesel trucks since the clean point were used mostly on one route in a given day with another very short route, in other words, there is little difference between the per-trip mileage and the per-day mileage.

The diesel trucks averaged 10 hours, 4 to 5 stores, and one backhaul daily per truck. The average mileage per day for the diesel trucks was 256 miles per truck.

For comparing before and after the clean point in the data, the LNG trucks have increased in mileage per day by 6 percent and the hours of operation have increased slightly. The diesel control trucks have had a 7 percent increase in mileage per day, the hours of operation have increased slightly, but the backhauls have decreased by one-third. Both the LNG and diesel trucks have increased usage, most likely from the increase in number of stores in the Raley's operation with the acquisition of Nob Hill in mid-1998.

At the start of operation of the LNG trucks (May-July 1997), a study of average vehicle speed during vehicle operation (excluding time at the loading docks) was completed. Raley's trucks have an onboard computer monitoring system from Cadec. This monitoring system tracks vehicle operation, idle time, and the stores that are serviced by the truck. The average vehicle speeds were 45 mph for the diesel control trucks and 39 mph for the LNG trucks. During November 1998, average speeds were measured again. The diesel control trucks showed an average speed of 40 mph, and the LNG trucks had an average speed of 37 mph. Both groups of trucks had a slightly lower, but similar average speed in November 1998 as compared to results from 1997. The average speed of the diesel trucks is slightly higher than the LNG trucks. This difference in speed is most likely a result of LNG trucks servicing more stores per day as indicated in the trip data (6.6 average number of stores per day for each LNG truck as compared to 4.2 stores per day for each diesel truck).

Table 4 shows average monthly mileage for each truck in the study for before and after the clean point in the data. Average mileage for both study fleets has increased slightly (2 to 3 percent) since the clean point as compared to before the clean point. The LNG study fleet has consistently been about 27 percent lower for average monthly mileage per truck. Figure 7 shows the average monthly mileage per truck for the LNG and diesel study fleets for the data collection period. This shows that the diesel trucks have consistently averaged higher mileage. Also, between March and August 1998, the LNG trucks have consistently averaged 5,000 miles and the diesel trucks have had the average mileage increase significantly to nearly 8,000 miles per month. This change in the diesel truck usage as well as the slight increase in the LNG truck usage is directly related to the addition of the Nob Hill stores into the operation from the Raley's Distribution Center. The average mileage for the diesel trucks had come back down to about 5,000 miles per truck by the end of the data collection period. This occurred due to more trucks being added to the fleet to better accommodate the Nob Hill stores.

The LNG and diesel trucks saw significantly different usage during the evaluation, based on the trip, average speed data, and monthly mileage. These differences impact fuel economy and wear and tear on the vehicles. The in-use fuel economy results have been compared to the emissions testing fuel economy results to help resolve the differences in duty cycle of the in-use data. The maintenance data analysis has been used to investigate the difference in the mileage base by analyzing cost per mile and cost per truck for the same length of data period.

Operational Results:

Fuel Consumption, Engine Oil Consumption, and Maintenance Costs

Data Collection Methods

Data were gathered from Raley's and Ozark Trucking's fuel and maintenance tracking systems on a daily basis and then transferred to Battelle on a monthly basis. Diesel fuel data were collected electronically from the on-site fueling station, and LNG fuel data were collected on log forms at the on-site fueling station. Diesel and LNG fuel data were transferred to Battelle with the daily dispatching log (truck assignments for each day). Engine oil additions were tracked in the fuel tracking systems. Fuel cost data were provided for diesel fuel electronically with the diesel log forms, and LNG costs were provided in the form of the actual invoices from the LNG fuel provider. Maintenance data were provided by Ozark Trucking on a quarterly basis after each of the study trucks was serviced for scheduled preventive maintenance. Copies of the actual maintenance work order forms and supporting paperwork were sent to Battelle.

Data from Raley's and Ozark Trucking were processed and analyzed soon after receipt at Battelle. Any potentially missing or incorrect data were investigated through the analysis and then in discussions with Raley's and/or Ozark Trucking. On a regular basis during the data collection period, updated analyses were provided to Raley's and Ozark Trucking for review and comment.

Vehicle operational data were collected at each fuel fill, at each change in fuel price, at each addition of engine oil, and at each oil change. The following values were recorded for analysis:

- Fuel fill – amount of fuel, odometer reading, date
- Fuel price change – type of fuel, price, date
- Addition of engine oil – amount of oil, odometer reading, date
- Oil change (usually within scope of preventive maintenance) – amount of oil, odometer reading, date.

Maintenance data were collected at each repair action, such as preventive maintenance, unscheduled maintenance, road calls, and warranty repair actions. The following values were recorded for analysis:

- Date of repair, labor hours, number of days out of service, odometer reading, parts replaced, parts cost, and descriptions of problem reported and actual repair performed.

Maintenance cost data were used (along with fuel and engine oil consumption costs) to estimate operating costs and as a measure of reliability and durability. Technical information on repairs covered by the vehicle warranties was collected primarily for indications of reliability and durability. Warranty repair costs (i.e., those costs reimbursed by the manufacturer), however, were considered to have been included

in the purchase price of the vehicle and were not included in the cost analysis. Labor costs for warranty repairs were included, if Ozark Trucking's mechanic did the work and those hours were not reimbursed under the warranty agreement.

Safety incidents affecting the vehicles or occurring at Raley's fueling station or in the maintenance facilities were planned to be tracked, including a description of the nature of the incident or accident and the vehicles or facilities involved. Also, records were planned to be made of any changes in procedures or hardware required to help prevent future safety incidents. However, no safety incidents were reported during the data collection period.

Summary of Operational Results

The following sections summarize the operational results of the evaluation. Detailed data analyses are presented in the following appendices:

- Appendix D – Statistics of all operational costs for the LNG and diesel control trucks
- Appendix E – Fuel and engine oil consumption and fuel economy by truck and month
- Appendix F – LNG and diesel fuel costs
- Appendix G – Monthly maintenance costs by truck.

Fuel Consumption, Fuel Economy, and Cost

LNG Fuel Measurement and Losses to Atmosphere – Measurement of LNG fuel has been an issue since the beginning of LNG truck operations at Raley's. The temporary fueling station, or QRS, was filled by a partial tanker truckload of LNG. When the tanker truck unloads the LNG, pressure at the station must be reduced so that the fuel will flow from the tanker truck to the LNG station. This depressurization required a significant amount of natural gas to be vented to the atmosphere.

Raley's paid for all of the fuel offloaded from the tanker truck, including the vented fuel from the station. The fuel lost from the refueling station was not measured. This venting did not affect the measurement of LNG consumed by Raley's trucks participating in the evaluation. However, the cost that Raley's paid for the LNG fuel in reality was slightly higher than the fuel cost as documented, because the natural gas lost to atmosphere was not available for use by the fleet. This loss from the QRS was probably on the order of \$0.01 per gallon of LNG.

LNG fuel was also lost to atmosphere during truck refueling. To speed up the fueling process of the LNG-powered trucks, the vent on each truck's fuel tank was held open during the fueling process (vent filling). The vent released natural gas from the fuel tank to the atmosphere. This lost vent gas reduced the fuel economy of the truck slightly. More accurate fuel economy results based solely on the LNG engine fuel consumption were not determined in this evaluation. The need for vent filling was removed

by the use of the permanent LNG fueling station. The amount of the LNG fuel vented to atmosphere during fueling was probably less than one percent of the fuel loaded on-board the truck.

Near the end of the data collection, the permanent LNG station was completed and started operation. The permanent LNG fueling station controlled most of the vent losses during station resupply and truck refueling. The new station was able to keep the LNG fuel colder, and the station operated at lower pressure than the QRS, which reduced venting from the fuel station. The new station was designed to pressure fill the LNG trucks. The pressure to fill the trucks was produced using warmed natural gas from a vaporizer added to a smaller tank with LNG at the station. The pressurized LNG in the smaller tank is then used to fill the LNG trucks at a higher pressure, and therefore faster, than the temporary station without the need to vent fill the trucks. An LNG truck being fueled is shown in Figure 8.

Figure 8. LNG Truck at Raley's Being Fueled

Fuel Consumption and Fuel Economy – Raley's LNG trucks (8 LNG tractors and 2 yard tractors) used 500 to 700 gallons of LNG per work day (6 days a week), and each LNG truck used 77 gallons of LNG on average per day of operation. On average, the 3 diesel control trucks used 36 gallons of diesel per day of operation.

Tables 5 and 6 show fuel consumption and economy for both fleets before the data clean point (April 97 – December 97) and after the data clean point (January 98 – December 98). Diesel energy equivalent gallons are calculated based on a standard LNG gallon and divided by 1.67 (the conversion factor for pure methane). The fuel supplier, Jack B. Kelley, for Raley's confirmed that the LNG used during the evaluation was essentially pure methane.

**Table 5. Fuel Consumption and Economy
Before Clean Point (April 97 – December 97)**

Vehicle	Mileage	LNG Gal.	Miles/LNG Gal.	Diesel Energy Equivalent Gal.*	MPEG**
1501	33,241	12,401	2.68	7,426	4.48
1502	31,888	12,516	2.55	7,494	4.25
1503	35,917	13,962	2.57	8,361	4.30
1504	40,085	14,437	2.78	8,645	4.64
1505	25,197	10,161	2.48	6,085	4.14
1506	34,342	13,271	2.59	7,946	4.32
1507	37,150	13,814	2.69	8,272	4.49
1508	40,717	15,117	2.69	9,052	4.50
LNG	278,537	105,679	2.64	63,281	4.40
1586	39,463	—	—	5,580	7.07
1592	38,756	—	—	5,419	7.15
1593	38,317	—	—	5,601	6.84
Diesel	116,536	—	—	16,600	7.02

Note: the mileage and LNG gallons columns show the amount used in the calculations, not the total amount used in-service.

* Diesel energy equivalent gallons are calculated by LNG Gal / 1.67

** MPEG – miles per equivalent gallon

**Table 6. Fuel Consumption and Economy
After Clean Point (January 98 – December 98)**

Vehicle	Mileage	LNG Gal.	Miles/LNG Gal.	Diesel Energy Equivalent Gal.*	MPEG**
1501	43,616	16,695	2.61	9,997	4.36
1502	51,552	19,283	2.67	11,547	4.46
1503	47,359	18,812	2.52	11,265	4.20
1504	60,416	23,009	2.63	13,778	4.39
1505	48,066	18,907	2.54	11,322	4.25
1506	48,446	19,152	2.53	11,468	4.22
1507	51,982	20,284	2.56	12,146	4.28
1508	44,680	16,944	2.64	10,146	4.40
LNG	396,118	153,084	2.59	91,667	4.32
1586	75,173	—	—	10,703	7.02
1592	58,554	—	—	8,384	6.98
1593	67,234	—	—	9,544	7.04
Diesel	200,961	—	—	28,630	7.02

Note: the mileage and LNG gallons columns show the amount used in the calculations, not the total amount used in-service.

* Diesel energy equivalent gallons are calculated by LNG Gal / 1.67

** MPEG – miles per equivalent gallon

The fuel consumption was higher for the LNG trucks than for the diesel trucks. Before the clean point, the average energy equivalent fuel economy was 37 percent lower for the LNG trucks than for the diesel trucks. After the clean point, the difference in the fuel economies changed slightly to 38 percent lower.

The energy equivalent fuel economy of the LNG trucks was not expected to be 37 to 38 percent lower than the diesel trucks. In other heavy-duty applications of the L10 natural gas engine (such as transit buses), the energy equivalent fuel economy difference was 20 to 25 percent lower compared to similar diesel engines. Fuel economy measurements made as part of the emissions testing on a dynamometer (described in detail elsewhere) confirm the difference in fuel economy seen in field operations. Emissions testing was performed on the Raley's study vehicles twice during the data collection period. The two-part emissions test showed the LNG trucks averaging about 33 percent lower energy equivalent fuel economy than the diesel trucks (30 percent lower than diesel in the first test, and 35 percent lower in the second test).

Energy equivalent fuel economy for the LNG trucks, as compared with the diesel trucks, was better in the emissions tests than in the field. Several factors may explain this difference. In general, since the emissions testing is a controlled test with a specific duty cycle, this will be somewhat to significantly different in comparison to the in-use duty cycle of the trucks both in acceleration profiles and average speed. For the in-use fuel economy, the measurement of LNG in the fuel tanks and losses from vent filling as discussed earlier in this section, may also have affected the fuel consumption results.

Overall, the fuel economies from the emissions testing and in-use data in regards to difference between the LNG and diesel control trucks are similar.

Fuel Costs – With taxes, the average LNG cost was much higher than the average diesel cost. Raley's LNG was delivered to Sacramento by Jack B. Kelley from supplies in Wyoming and Arizona. Transportation costs (based on distance to be trucked) for LNG (or any commodity being trucked) are a significant portion of the overall cost. Also, during the early part of the evaluation, Raley's purchased LNG in quantities less than a full truckload, because of the limited capacity of the QRS (5,000 gallons). Transportation costs for a partial truckload of LNG were the same as those for a full truckload (10,000 gallons), so the cost per gallon of LNG delivered to the QRS was much higher than the cost per gallon using the permanent fueling station. The permanent LNG station (13,000-gallon total capacity) could receive a full truckload of LNG. For fuel delivery to the QRS (partial truckload), the LNG cost was \$0.575 per gallon plus tax by contract after April 1998; with the permanent station, the cost per gallon was \$0.475 plus tax. The LNG fuel cost could be reduced even further if fuel were available from a source closer to Raley's because the transportation costs would be reduced significantly.

During the data collection period, diesel costs started high, as high as \$1.29 per gallon including tax, and dropped to very low levels, as low as \$0.94 per gallon including tax. Table 7 shows monthly average fuel costs paid for LNG (with and without tax) and diesel (with tax). Federal tax rates for LNG changed during the data collection period. As shown in Table 7, the LNG diesel equivalent cost per gallon with

tax included the Federal tax for LNG (\$0.183 per LNG gallon) in effect through the end of 9/97 and then the new Federal tax for LNG (\$0.119 per LNG gallon) beginning in 10/97. Although the diesel costs have been low during most of the data collection period, as of March 31, 1999, the diesel price at Raley's was \$1.38 per gallon with taxes.

Table 7. Monthly Average Fuel Costs

Month	Avg. LNG Cost per Gal. (\$)	Avg. LNG Diesel Equivalent Cost per Gal. With Tax (\$)	Avg. Diesel Cost per Gal. With Tax (\$)
4/97	0.583	1.38	
5/97	0.550	1.32	
6/97	0.558	1.34	
7/97	0.550	1.32	1.05
8/97	0.550	1.32	1.20
9/97	0.550	1.32	1.19
10/97	0.550	1.22	1.18
11/97	0.550	1.22	1.23
12/97	0.550	1.22	1.11
1/98	0.550	1.22	1.09
2/98	0.550	1.22	1.03
3/98	0.550	1.22	0.99
4/98	0.562	1.24	1.06
5/98	0.575	1.26	1.03
6/98	0.575	1.26	0.99
7/98	0.595	1.29	0.98
8/98	0.575	1.26	0.99
9/98	0.575	1.26	1.02
10/98	0.575	1.26	1.00
11/98	0.575	1.26	0.99
12/98	0.534	1.19	0.89
Average – Before Clean Point	0.554	1.29	1.17
Average – After Clean Point	0.566	1.24	1.01
Cost of LNG at Lower Rate for New Station	0.475	1.09	

Note: Average LNG cost per gallon reflects any charges from the trucking company for driver or special unloading.

Taxes prior to 10/1/97 were \$0.183 (federal) + \$0.06 (CA) = \$0.243 per LNG gal.

Taxes from 10/1/97 on were \$0.119 (federal) + \$0.06 (CA) = \$0.179 per LNG gal.

LNG gallons are converted to diesel energy equivalent gallons by multiplying by 1.67.

Fuel usage cost per mile is derived from the volume of fuel used, the cost of that fuel, and the number of miles that the trucks have traveled using the fuel. In other words, fuel usage cost is a function of the cost of the fuel and the vehicle's fuel economy. As Table 8 shows, the fuel usage cost per mile was much higher for the LNG trucks. As discussed earlier in this section, several factors may have contributed to

this higher fuel usage cost for the LNG trucks. First, the fuel economy was 38 percent lower for the LNG fleet on an energy equivalent basis. Second, the fuel cost per gallon on an energy equivalent basis was 10 percent higher for LNG before the clean point (\$1.29 per energy equivalent gallon for LNG and \$1.17 per gallon for diesel) and 23 percent higher after the clean point (\$1.24 per energy equivalent gallon for LNG and \$1.01 per gallon for diesel). Diesel fuel cost was very low in the last 12 months of the data collection period.

Table 8. Fuel Usage Cost Analysis

Data Period	Fleet	Mileage	Diesel (Equiv.) Used	Diesel (Equiv.) Cost/Gal. (\$)	Fuel Usage Cost per Mile (\$)
Before Clean Point (4/97 – 12/97)	LNG	278,536	63,281	1.29	0.293
	Diesel	116,536	16,599	1.17	0.167
After Clean Point (1/98 – 12/98)	LNG	396,118	91,667	1.24	0.287
	Diesel	200,961	28,630	1.01	0.144
After Clean Point Using Current Prices	LNG	396,118	91,667	1.09	0.252
	Diesel	200,961	28,630	1.38*	0.197
After Clean Point Using Potential Prices	LNG	396,118	91,667	0.88**	0.204
	Diesel	200,961	28,630	1.50	0.214

* Diesel fuel price at Raley's as of 3/31/99

** Local LNG price has been suggested as low as \$0.35 per LNG gallon

Note: Mileage shown is not all mileage during the data periods, but the portion used for this analysis.

Equation for Fuel Usage Cost per Miles is Diesel (Equiv.) Used * Diesel (Equiv.) Cost/Gal. / Mileage

For data before the clean point, the fuel usage cost per mile was 75 percent higher for LNG. After the clean point, the fuel usage cost per mile was 99 percent higher for LNG. Fuel usage costs for the LNG trucks were much higher after the clean point because of the low diesel fuel cost, which was temporary. Using 3/31/99 prices of fuel and the fuel economy data for after the clean point (\$1.38 per diesel gallon and \$1.09 per diesel equivalent gallon for LNG), the fuel usage costs were \$0.252 per mile for the LNG trucks and \$0.197 per mile for the diesel trucks (28 percent higher for LNG).

Another factor affecting fuel cost is local fuel availability. Using small-scale liquefaction for the LNG, prices have been discussed to be as low as \$0.35 per LNG gallon delivered to Raley's. Also, diesel fuel prices in California have historically been volatile and may go as high as \$1.50 per gallon in the near future. Using these two potential fuel prices, the fuel usage cost per mile would be 5 percent lower for the LNG trucks.

Engine Oil Consumption and Cost

Engine oil consumption is the amount of engine oil consumed by the engine, measured by recording the volume of engine oil added between oil changes. For most engines, a certain level of engine oil consumption is expected. Greater than expected engine oil consumption is a precursor to engine

problems. Engine oil consumption for the LNG trucks at Raley's was recorded; however, engine oil consumption for the diesel trucks was not tracked on an individual truck basis. As indicated in Appendix E, the LNG trucks consumed on average 1.14 quarts of engine oil consumed per 1,000 miles before the clean point and 1.02 quarts of engine oil per 1,000 miles after the clean point. Based on discussions with Cummins and Raley's/Ozark Trucking concerning past experience with other heavy-duty engines, engine oil consumption around 1 quart per 1,000 miles is as good as or better than can be expected.

Oil for the LNG engines costs more than twice as much as oil for the diesel engines: \$1.67 per quart for the LNG engines and \$0.81 per quart for the diesel engines. The higher cost for the LNG engine oil is due to the low demand required by a small population of heavy-duty natural gas engines and the special (low ash) oil specification. Operating cost comparisons could not be made between LNG and diesel oil usage. Engine oil consumption costs tend to be very small compared to the fuel and maintenance costs; however, the extra cost of the special engine oil is a factor to be considered in the operation of heavy-duty alternative fuel trucks.

Maintenance, Maintenance Costs, and Warranty

Maintenance and warranty data were collected from Ozark Trucking quarterly for this study, through Ozark Trucking's normal preventive maintenance action (PMA) cycle. The PMAs are numbered sequentially in this analysis starting with the first PMA (truck would be three months old) for each vehicle. All unscheduled maintenance actions were tracked on forms for each vehicle for parts used and labor hours spent on each vehicle. That information was then combined with the PMA forms.

After the vehicles were through a PMA cycle, Ozark Trucking sent Battelle copies of all paperwork (including invoices from Cummins on warranty claims) for each of the study vehicles since the last PMA. Maintenance data analysis included the following:

- General maintenance costs by vehicle and total
- Maintenance costs broken down by vehicle system
- Driver complaints
- Warranty data broken down by month and by issue.

Maintenance Cost Data Summary – Total maintenance costs by truck are shown in Table 9. Because the diesel trucks were 1 year older than the LNG trucks at the time of the evaluation, maintenance data on the diesel trucks were collected back to the beginning of operation (when the trucks were new). Data back to the start of operation for the LNG trucks also were collected. In order to measure differences in maintenance actions and costs between the diesel and LNG fleets, a similar portion of the vehicle lives was chosen for the maintenance analyses.

The PMA milestones have not occurred in the same calendar time frame for the two study fleets (diesel – late 95 through mid-97; LNG – Spring 97 through the end of 98). The labor hour cost for maintenance .

has been held fixed at \$50 per hour, and the parts costs have been set using a listing of the costs as of 3/31/99, so the maintenance cost analysis was performed using constant dollars. PMA 1 has been removed from the data analysis because the first PMA information includes vehicle preparation for operation (painting, putting vehicle numbers on, and putting chrome parts on) and other maintenance actions such as operation start up problems that are not consistent between vehicles.

Table 9 presents data for PMA 2 through 3 and for PMA 4 through 7. PMA 2 through 3 represents approximately 6 months of operation, and PMA 4 through 7 represents approximately 12 months of operation. Maintenance data were also collected between the PMA milestones, including all unscheduled maintenance actions. Warranty actions not paid for by the trucking company were not included in the cost analysis, but are addressed separately later in this section.

Table 9. Maintenance Costs

Vehicle	PMA 2 Through 3				PMA 4 Through 7			
	Mileage	Parts (\$)	Labor Hrs.	Cost (\$) per Mile	Mileage	Parts (\$)	Labor Hrs.	Cost (\$) per Mile
1501	24,941	415.72	26.1	0.069	46,032	3,100.71	37.8	0.108
1502	20,568	382.25	24.8	0.079	56,275	2,275.24	34.5	0.071
1503	26,920	759.49	30.8	0.085	53,665	3,678.21	48.0	0.113
1504	27,417	1,499.87	18.9	0.089	65,853	2,718.03	40.7	0.072
1505	18,394	1,276.18	21.8	0.129	52,663	3,361.31	39.6	0.101
1506	23,715	571.26	18.3	0.063	54,206	4,404.40	40.1	0.118
1507	25,991	301.61	24.1	0.058	58,519	3,242.06	47.2	0.096
1508	30,690	569.48	18.4	0.049	50,978	2,601.40	43.8	0.094
LNG	198,636	5,775.86	183.2	0.075	438,191	25,381.36	331.7	0.096
Avg. per Truck	24,830	721.98	22.9	—	54,774	3,172.67	41.5	—
1586	38,901	284.49	18.0	0.030	72,980	1,487.00	32.1	0.042
1592	32,167	455.37	18.9	0.044	67,552	928.11	32.3	0.038
1593	39,133	243.63	18.6	0.030	82,312	3,048.96	39.1	0.061
Diesel	110,201	983.49	55.5	0.034	222,844	5,464.09	103.5	0.048
Avg. per Truck	36,734	327.83	18.5	—	74,281	1,821.36	34.5	—
Percent Difference	-32	+120	+24	—	-26	+74	+20	—

Note: LNG and diesel data are for the same life of the vehicles – preventive maintenance actions (PMA) 2 through 3 and PMA 4 through 7. These periods are 6-months and 12-months long respectively and represent the second through seventh time the vehicles were brought in for PMA service. This also includes all unscheduled maintenance during each PMA period except for warranty actions.

Labor rate used for calculations was \$50 per hour. Cost per mile calculation is (Part Cost + (Labor Hrs * 50)) / Mileage.

Percent difference is calculated by (LNG number/Diesel number - 1) * 100

The major indicator for this maintenance data analysis is cost. Higher cost for a given vehicle system in one fleet is an indicator that potentially there is a reliability and/or maintainability issue. The significant difference in usage between diesel and LNG vehicles in the field affects maintenance cost data and .

understanding reliability of the LNG trucks because the costs per mile are biased higher. The LNG and diesel trucks operated on Raley's routes and met Raley's trucking needs. The study trucks have been used on similar terrain; however, the diesel trucks saw significantly higher mileage because of their longer routes (and range). This analysis has been based on the same time frame in the life of the trucks and on similar calendar duration. Cost per mile is also shown for comparison.

For PMA 2 through 3, the LNG trucks had 32 percent lower mileage per truck for the 6-month data period. For PMA 4 through 7, the mileage difference was smaller but still significant at 26 percent lower per truck for the LNG vehicles. The decrease in the difference in mileage between the diesel and LNG trucks (6 percent) over time shows an increase in Raley's confidence in operating the LNG trucks after working through start-up problems with the trucks and learning the actual range of the trucks.

For PMA 2 through 3, the maintenance costs for parts per truck were much higher for the LNG trucks (120 percent) and the labor hours were higher (24 percent). The higher parts costs for the LNG trucks were expected because of the higher cost for the engine oil, fuel filter, and spark plugs. The higher labor hours per truck were caused by time spent troubleshooting and repairing fuel leaks, running out of fuel, and repairing rough-running engines.

For PMA 4 through 7, the maintenance costs for parts per truck continued to be higher for the LNG trucks (74 percent), but not to the level seen in PMA 2 through 3. This reflects a drop in parts usage and costs. The labor hours were higher for the LNG trucks for PMA 4 through 7 (20 percent). The higher labor and parts cost per truck were caused by the fuel system (leak repair, leak detection system repair, and higher cost of fuel filters), non-lighting electrical (spark plugs and wires), and engine (rough running and oil changes).

Table 10 shows maintenance costs by vehicle system. The vehicle systems shown in Table 10 include the following:

- Engine/fuel-related systems – exhaust, fuel, engine, electrical minus lighting, air intake, and cooling
- PMA inspections
- Cab, body, and accessories systems – cab and sheet metal, accessories such as phones and fifth wheel, and body
- Frame, steering, and suspension systems
- Axle, wheel, and drive shaft systems
- Tires
- Lighting.

Discussion of Maintenance Costs

The discussion presented here is based on the cost per truck results in the categories shown in Table 10..

Table 10. Maintenance Costs by Vehicle System

Maintenance System Costs	PMA 2 Through 3 (6 Months)		PMA 4 Through 7 (12 Months)	
	LNG	Diesel	LNG	Diesel
Mileage Base Used	198,636	110,201	438,191	222,844
Total Engine/Fuel-Related Systems (VMRS Codes 30, 31, 32, 33, 41, 42, 43, 44, 45)				
Parts Cost (\$)	3,561.21	456.90	13,103.31	1,328.30
Labor Hours	65.8	9.1	67.7	3.4
Total Cost (\$)	6,851.21	911.90	16,488.31	1,498.30
Total Cost (\$) per Truck	856.40	303.97	2,061.04	499.43
Total Cost (\$) per Mile	0.0345	0.0083	0.0376	0.0067
Exhaust System Repairs (VMRS Code 43)				
Parts Cost (\$)	16.58	25.50	0.00	25.50
Labor Hours	1.3	0.5	0.8	0.5
Total Cost (\$)	81.58	50.50	40.00	50.50
Total Cost (\$) per Truck	10.20	16.83	5.00	16.83
Total Cost (\$) per Mile	0.0004	0.0005	0.0001	0.0002
Fuel System Repairs (VMRS Code 44)				
Parts Cost (\$)	1,059.58	39.90	1,905.58	446.53
Labor Hours	31.7	0.8	43.2	1.3
Total Cost (\$)	2,644.58	79.90	4,065.58	511.53
Total Cost (\$) per Truck	330.57	26.63	508.20	170.51
Total Cost (\$) per Mile	0.0133	0.0007	0.0093	0.0023
Engine System Repairs (VMRS Code 45)				
Parts Cost (\$)	1,847.05	391.50	3,760.66	802.50
Labor Hours	24.8	7.3	8.4	0.6
Total Cost (\$)	3,087.05	756.50	4,180.66	832.50
Total Cost (\$) per Truck	385.88	252.17	522.58	277.50
Total Cost (\$) per Mile	0.0155	0.0069	0.0095	0.0037
Electrical System Repairs (VMRS Codes 30-General Electrical, 31-Charging, 32-Cranking, 33-Ignition)				
Parts Cost (\$)	610.19	0.00	7,381.45	44.50
Labor Hours	7.2	0.5	13.7	0.5
Total Cost (\$)	970.19	25.00	8,066.45	69.50
Total Cost (\$) per Truck	121.27	8.33	1,008.31	23.17
Total Cost (\$) per Mile	0.0049	0.0002	0.0184	0.0003
Air Intake System Repairs (VMRS Code 41)				
Parts Cost (\$)	0.00	0.00	0.00	0.00
Labor Hours	0.0	0.0	0.0	0.0
Total Cost (\$)	0.00	0.00	0.00	0.00
Total Cost (\$) per Truck	0.00	0.00	0.00	0.00
Total Cost (\$) per Mile	0.0000	0.0000	0.0000	0.0000
Cooling System Repairs (VMRS Code 42)				
Parts Cost (\$)	27.81	0.00	55.62	9.27
Labor Hours	0.8	0.0	1.6	0.5
Total Cost (\$)	67.81	0.00	135.62	34.27
Total Cost (\$) per Truck	8.48	0.00	16.95	11.42
Total Cost (\$) per Mile	0.0003	0.0000	0.0003	0.0002

Table 10. Maintenance Costs by Vehicle System (continued)

Maintenance System Costs	PMA 2 Through 3 (6 Months)		PMA 4 Through 7 (12 Months)	
	LNG	Diesel	LNG	Diesel
Mileage	198,636	110,201	438,191	222,844
PMA Inspections – no parts replacements (101)				
Parts Cost (\$)	0.00	0.00	0.00	0.00
Labor Hours	73.5	30.0	145.6	60.0
Total Cost (\$)	3,675.00	1,500.00	7,280.00	3,000.00
Total Cost (\$) per Truck	459.38	500.00	910.00	1,000.00
Total Cost (\$) per Mile	0.0185	0.0136	0.0166	0.0135
Cab, Body, and Accessories Systems Repairs (VMRS Codes 02-Cab and Sheet Metal, 50-Accessories, 71-Body)				
Parts Cost (\$)	1,450.79	209.76	2,211.38	694.31
Labor Hours	24.4	7.0	51.0	18.5
Total Cost (\$)	2,670.79	559.76	4,761.38	1,619.31
Total Cost (\$) per Truck	333.85	186.59	595.17	539.77
Total Cost (\$) per Mile	0.0134	0.0051	0.0109	0.0073
Frame, Steering, and Suspension System Repairs (VMRS Codes 14-Frame, 15-Steering, 16-Suspension)				
Parts Cost (\$)	80.00	30.00	317.34	105.32
Labor Hours	0.0	1.3	3.7	2.3
Total Cost (\$)	80.00	95.00	502.34	220.32
Total Cost (\$) per Truck	10.00	31.67	62.79	73.44
Total Cost (\$) per Mile	0.0004	0.0009	0.0011	0.0010
Axle, Wheel, and Drive Shaft System Repairs (VMRS Codes 11-Front Axle, 18-Wheel, 22-Rear Axle, 24-Drive Shaft)				
Parts Cost (\$)	0.60	0.00	20.14	190.00
Labor Hours	0.8	0.0	0.0	0.0
Total Cost (\$)	40.60	0.00	20.14	190.00
Total Cost (\$) per Truck	5.08	0.00	2.52	63.33
Total Cost (\$) per Mile	0.0002	0.0000	0.0000	0.0009
Tire System Repairs (VMRS Code 17)				
Parts Cost (\$)	480.00	215.00	9,108.50	2,635.00
Labor Hours	6.3	2.4	21.4	9.3
Total Cost (\$)	795.00	335.00	10,178.50	3,100.00
Total Cost (\$) per Truck	99.38	111.67	1,272.31	1,033.33
Total Cost (\$) per Mile	0.0040	0.0030	0.0232	0.0139
Lighting System Repairs (VMRS Code 34)				
Parts Cost (\$)	133.98	44.00	356.76	146.01
Labor Hours	8.8	4.1	21.8	5.8
Total Cost (\$)	573.98	249.00	1,446.76	436.01
Total Cost (\$) per Truck	71.75	83.00	180.85	145.34
Total Cost (\$) per Mile	0.0029	0.0023	0.0033	0.0020

VMRS – vehicle maintenance reporting system codes from American Trucking Associations.

Engine/Fuel-Related Systems – Parts and labor hours per truck were consistently much higher for the LNG trucks. The low number of labor hours for the diesel trucks showed that labor for these systems for the diesel trucks was covered almost exclusively by the PMA inspection hours. For exhaust repairs, the diesel control cost per truck was higher. For the fuel system, the LNG cost per truck was much higher.

than the diesel trucks. These higher costs for the LNG trucks were made up of LNG tank problems and leaks, fuel gauge complaints, fuel leak sensors, throttle pedal issues, fuel filter cost (\$25 for LNG vs. \$7 for diesel), and cases when LNG trucks ran out of fuel, including towing costs. The engine system repairs were nearly double for the LNG trucks. These extra costs were due to the higher cost of the engine oil (\$1.67 per quart for LNG vs. \$0.81 per quart for diesel) for the LNG trucks and the labor for troubleshooting low power and rough running issues for the LNG trucks. The electrical system repair costs were also much higher for the LNG trucks. For PMA 4 through 7, the higher costs were based on 15 sets of six spark plugs (all for PMA) being replaced for the LNG trucks at a cost of \$164 per set of spark plugs. There also were four sets of spark plug wires (6 per set) replaced as part of PMAs for \$709 per set. There were no costs for air intake repairs for either study fleet. Cooling system repair costs were low and about the same for both fleets.

PMA Inspections – This category consists of labor for PMA inspections of the vehicles. On a per-truck basis, the costs were essentially the same for the PMA 2 through 3 and PMA 4 through 7 data periods. This indicates that neither set of trucks was getting more or less PMA inspection time.

Cab, Body, and Accessories Systems – The LNG and diesel trucks had about the same cost per truck.

Frame, Steering, and Suspension Systems – The diesel trucks were higher in per-truck costs. Each fleet had one leveling valve replaced and a few labor hours.

Axle, Wheel, and Driveshaft Systems – The diesel trucks also had higher per-truck costs for these repairs, because two of the diesel trucks had front end alignments done at \$95 each.

Tires – Costs for both fleets were high, but close to the same on a per-truck basis. The LNG trucks had a slightly higher cost per truck for tires, possibly due to more non-highway driving based on the higher number of stores per day.

Lighting System – Costs were approximately the same for both fleets on a per-truck basis.

Driver Comments on Vehicles

As part of the data collection at Raley's, driver complaints were collected for the LNG and diesel trucks. Raley's policy is to collect driver complaints on a regular basis to track and report maintenance that needs to be performed by Ozark Trucking, because the trucks are leased. A summary of the complaints is shown in Table 11. The driver complaints are shown for before and after the data clean point (January 1, 1998) for the LNG trucks. The diesel trucks have six months of complaints summarized.

The major complaints of the LNG trucks were problems with engine low power, running rough; body damage; lights out; fuel gauges; and CB/radio/phone/antenna problems. The problems with the engine low power, running rough had the highest number of complaints, 51 percent before the clean point and 24

percent after. Many of these complaints stemmed from the differences between operating an LNG truck and the diesel trucks. The LNG trucks were equipped with an L10-300G engine versus the diesels, which were equipped with M11-330s. The M11 had higher available torque (1250 ft-lb for the M11 vs. 900 ft-lb for the natural gas L10). Combined with the lower horsepower, this difference in torque was noticeable to the drivers.

Table 11. Number of Driver Complaints by Category

Complaint Category	LNG (4/97 – 12/97)		LNG (1/98 – 12/98)		Diesel (7/98 – 12/98)	
	Number of Complaints	Percent of Total (%)	Number of Complaints	Percent of Total (%)	Number of Complaints	Percent of Total (%)
Body Damage	28	7	67	17	8	21
Lights	42	10	40	10	10	26
Engine Low Power, Rough	216	51	94	24	0	0
Low Fuel Pressure Light	5	1	34	9	0	0
Fuel Leak	25	6	15	4	0	0
Fuel Gauge	32	8	29	7	0	0
Air/Suspension	7	2	16	4	3	8
AC/Heat	9	2	13	3	1	3
CB/Radio/Phone/Antenna	23	5	27	7	3	8
Fifth Wheel	6	1	2	1	0	0
Cruise Control	4	1	7	2	6	16
Wheels	3	1	1	0	0	0
Clutch	2	1	1	0	1	3
CADEC	2	1	9	2	0	0
Starter/Alternator/Battery	10	2	12	3	1	3
Tire	1	0	16	4	3	8
Other	5	1	10	3	2	4
Total	420	100	393	100	38	100
Complaints per Truck	53	–	49	–	13	–

Also, early in the deployment of the LNG trucks, several part quality and hardness issues arose. Under warranty, Cummins changed wastegate valves, several sensors, spark plugs and wires, and ignition modules on all of the trucks over the period of time that these issues were being investigated. As of January 1998, Cummins believed that these start up issues were resolved. As Figure 9 shows, the trend in complaints from drivers of the LNG trucks was consistent with the history of engine issues and their resolution in late December 1997. In Figure 9, each peak is in response to new drivers starting to use the LNG trucks. Within a month or two of a change in drivers, the number of complaints on the engine low power issue went up, peaked, and went back down. The number of complaints in 1998 for the engine low power issue went down dramatically.

Figure 9. Number of Driver Complaints for Low Power and Rough Operation by Month for LNG Trucks

The complaints for the diesel trucks were mostly for lights, body damage, cruise control, tires, suspension, and CB/radio/phone/antenna. These complaints are very similar to the LNG trucks except for the low power complaints.

Warranty Repairs

In regards to warranty repair actions, Table 12 shows the warranty items replaced by truck since the start of operation of the LNG trucks. As mentioned above, Cummins had problems with the wastegate, which has been modified for operation at Raley's. These engines were developed for the transit bus market and have operated successfully for several years. The ignition modules on the trucks had problems in their manufacture. These problems led to numerous spark plug, wire, and ignition coil replacements during the evaluation. Each of the LNG trucks had the HOS sensor replaced several times. Figure 10 shows the number of warranty claims from Cummins during the operation of the LNG trucks at Raley's. The curve shows a large number of claims in the early months of operation; however, as suggested by Cummins, most of the claims and problems had been resolved by January 1998. No warranty information was collected for the diesel trucks.

Table 12. Cummins Warranty Engine Items Replaced by Truck

Warranty Item Replaced	1501	1502	1503	1504	1505	1506	1507	1508	Total
Sensor – HOS	3	3	2	5	3	2	5	3	26
Sensor – PRS	0	1	0	1	1	1	0	0	4
Sensor – Mass Flow	0	0	0	1	1	0	1	0	3
Wastegate	3	3	3	2	3	2	2	2	20
Spark Plugs	18	12	12	19	14	6	23	12	116
Spark Plug Wires	3	8	0	1	0	3	1	1	17
Ignition Module	3	1	1	2	1	1	1	3	13
Ignition Coil	0	0	0	2	0	0	2	2	6
Governor	1	1	2	0	0	0	0	0	4
Valve – Fuel Pressure	0	1	2	2	0	0	3	0	8
Sensor – Fuel Pressure	0	0	0	0	0	0	1	0	1
Valve - Fuel	0	0	0	0	3	0	2	0	5
Actuator – Wastegate	1	1	0	0	0	0	0	0	2
Turbocharger	0	0	1	0	0	0	0	0	1
Throttle Pedal	1	0	0	1	0	0	0	0	2
Air Compressor	0	0	0	0	0	0	1	0	1
Total Warranty Cost (\$)	11,903	11,538	12,561	13,981	8,104	6,951	13,829	6,577	85,444

Figure 10. Number of Cummins Warranty Claims by Month for LNG Trucks

As shown in Figures 9 and 10, the driver complaints and warranty repairs for the LNG trucks had a peak in September 1998. This was caused by problems with trucks 1501, 1503, and 1506. All three trucks were running badly (low power and back firing) and had the wastegate valve replaced along with other repair actions such as resetting calibration of the HOS sensor and ECM.

Safety Incidents

There were no safety incidents reported at Raley's or Ozark Trucking during the data collection. A few minor body damage incidents were reported, but none involved the LNG systems.

Summary of Operations Costs

Table 13 provides a summary of the operations costs for the LNG and diesel trucks at Raley's without the driver labor cost. The fuel costs used are the average for the after clean point data period for diesel and the new LNG cost for the permanent LNG station at Raley's (\$1.01 per gallon diesel and \$1.09 per diesel energy equivalent gallon for LNG). The maintenance costs do not include warranty repairs paid for by the manufacturers, and the labor cost is assumed to be \$50 per hour.

Table 13. Summary of Operations Costs

Truck	Fuel Usage Cost/Mile (\$)	Maintenance Cost/Mile (\$)	Total Cost/Mile (\$)
1501	0.250	0.108	0.358
1502	0.244	0.071	0.315
1503	0.259	0.113	0.372
1504	0.249	0.072	0.321
1505	0.257	0.101	0.358
1506	0.258	0.118	0.376
1507	0.255	0.096	0.351
1508	0.248	0.094	0.342
LNG	0.252	0.096	0.348
1586	0.144	0.042	0.186
1592	0.145	0.038	0.183
1593	0.143	0.061	0.204
Diesel	0.144	0.048	0.192

Emissions Test Results

One purpose in using alternative fuel vehicles is to reduce harmful emissions associated with traditional motor fuels such as gasoline and diesel fuel. As part of the evaluation of LNG and diesel fleets at Raley's, tests were conducted to compare the emissions of both types of trucks quantitatively.

The Department of Mechanical and Aerospace Engineering at West Virginia University (WVU) tested the emissions of the Raley's LNG and diesel control trucks soon after the LNG trucks went into service (July and August 1997) and then again in early 1998 (February and March 1998). Appendix H shows the detailed data reports from WVU for both emissions testing visits to Raley's.

Emissions Testing Mobile Laboratory

Under sponsorship of the U.S. Department of Energy (DOE), WVU designed and constructed a transportable chassis dynamometer to test for emissions levels from heavy-duty vehicles. The purpose of the transportable chassis dynamometer is to allow for a large number of "real-world" emissions tests to be performed on heavy-duty vehicles around the country. The first transportable unit was built in 1991, and WVU has been traveling to transit agencies and heavy-duty vehicle sites around the country testing buses and trucks since early 1992. WVU built a second unit in 1994 and began testing vehicles with the second unit in 1995.

Emissions data are collected by WVU personnel using the mobile chassis dynamometer laboratory at least once for each participating site in this project. The WVU transportable laboratory can measure particulate matter (PM), carbon monoxide (CO), carbon dioxide (CO₂), nitrogen oxides (NO_x), total hydrocarbons (HC), methane (CH₄), methanol (CH₃OH), formaldehyde (HCHO), and other emissions components. WVU uses a five peak, five-mile simulated route shown in Figure 11 to test each truck. The route is defined as a fixed distance route (five miles). The time the truck takes to finish the route may change depending on the truck's ability to accelerate. The length of the constant speed (cruise) portions of the route is adjusted to add or subtract time at constant speed based on the time taken for the truck to accelerate. All results from emissions testing are provided to the participating site as soon as the information is available. WVU strives to reduce any disruptions to normal operations at the host site during emissions testing.

Emissions Test Results at Raley's

Figure 12 shows the WVU laboratory set up at Raley's during the second round of testing. As shown in Table 14, NO_x (LNG 5.16 and 5.23 g/mi; diesel 31.83 and 19.59 g/mi) and PM (LNG 0.07 and 0.04 g/mi; diesel 0.84 and 1.22 g/mi) are much lower for the LNG trucks. When comparing non-methane hydrocarbons (NMHC) for the LNG trucks and HC for the diesel control trucks (NMHC for the diesel trucks is essentially the same as HC results, very little methane), the results show the LNG trucks have

Figure 11. WVU Five-Peak Truck Cycle

Table 14. Summary of Emissions Testing Results

Test Date	Fleet	Cycle	CO (g/mi)	NO _x (g/mi)	HC (g/mi)	NMHC (g/mi)	PM (g/mi)	CO ₂ (g/mi)	MPEG
7/97-8/97	LNG	5-Mile Route	7.12	5.16	17.51	0.60	0.07	1657	4.39
	Diesel	5-Mile Route	1.88	31.83	1.29		0.84	1620	6.26
2/98-3/98	LNG	5-Mile Route	7.92	5.25	21.37	0.62	0.04	1821	4.00
	Diesel	5-Mile Route	2.26	19.59	1.70		1.22	1658	6.11
7/97-8/97	LNG/Diesel	5-Mile Route	279%	-84%		-53%	-92%	2%	-30%
2/98-3/98	LNG/Diesel	5-Mile Route	250%	-73%		-64%	-97%	10%	-35%

LNG/Diesel data are calculated by the following equation – (LNG/Diesel – 1) * 100

MPEG – miles per energy equivalent diesel gallon

Figure 12. WVU Dynamometer Laboratory at Raley's

significantly lower results (LNG 0.60 and 0.62 g/mi NMHC; diesel 1.29 and 1.70 g/mi HC). The LNG trucks have significantly higher CO results and modestly higher CO₂ results. The miles per diesel energy equivalent gallon (MPEG) shown in the table is essentially the same in respect to the difference between the diesel and LNG energy equivalent results as compared to the in-use fuel economy data.

Note that some differences in the LNG truck results have occurred between the two testing visits. This is most likely related to the changes to the engine configuration and some of the components that were

upgraded as part of the warranty repairs. For the two diesel testing results, the NO_x results are significantly lower for the second testing visit. This lower NO_x result is most likely an issue of engine map (calibration) and which gears were used during the drive cycle. The continuous NO_x data suggests that an off-cycle injection timing strategy was at play for the diesel vehicles.

For reference, Table 15 shows the emissions certification standards for the model years and actual results for the LNG and diesel engines used in this study. The newer Cummins L10 natural gas engine emissions certification testing results are also shown. The numbers in Table 15 do not relate directly to the emissions results from the WVU testing. The results in Table 15 have been compiled from engine certification testing and the results from the WVU testing were compiled from chassis dynamometer testing.

**Table 15. Heavy Engine Emissions Certification Standards
and Certification Data for Raley's Trucks
(grams per brake-horsepower hour)**

Standard/Certification	NMHC (HC)	CO	NO _x	PM	EPA Engine Family Name
1994-1997 EPA/CARB Truck	1.2 (1.3)	15.5	5.0	0.10	
1998 EPA/CARB Truck	1.2 (1.3)	15.5	4.0	0.10	
Truck L10-300G – 1997					
With Catalyst	0.5	5.3	2.4	0.03	VCE611FBCABW
Without Catalyst	1.1	11.2	3.5	0.06	VCE611EBCARW
Truck L10-300G – 1998					
With Catalyst	0.1	4.6	1.6	0.02	WCEXH0611LAB
Without Catalyst	0.8	10.6	2.5	0.07	WCEXH0611LAC
Truck M11-330 - 1996	(0.2)	1.4	4.2	0.07	TCE661EJDASW

Raley's LNG engines are not equipped with a catalyst, but have the same engine calibration as the 1998 certification without catalyst

Raley's diesel control trucks are model year 1996.

Conclusions

The major conclusions from the evaluation of the Raley's LNG truck site include the following:

- The LNG trucks have been used as planned. The LNG trucks have been used for local Sacramento area pickup and delivery at the request of the Sacramento Metropolitan Air Quality Management District in return for funding to help establish LNG operations.
- Drivers perceive the LNG trucks to be slightly under-powered for Raley's operation.
- The emissions results from the Raley's project show large decreases in NOx and PM for the LNG trucks. The NOx reduction for the eight LNG trucks using the WVU testing results would have a nearly 7 tons per year reduction compared to diesel trucks running in place of the LNG trucks.
- Energy equivalent fuel economies between in-use fuel data and emissions testing fuel economies are essentially consistent. The energy equivalent fuel economy comparison between LNG and diesel trucks at Raley's is about 38 percent lower for the LNG trucks. This has caused some problems with range for the LNG trucks. This lower fuel economy has been aggravated by having fuel gauges that are not reliable.
- Mileage per vehicle per calendar month and year was significantly lower for the LNG trucks compared to the diesel control trucks. This lower mileage for the LNG trucks was caused by how the trucks have been used (routes closer to the Distribution Center in the Sacramento area) as well as problems with lower range than the diesel trucks and engine problems experienced early in the data collection period. The lower vehicle mileage for the LNG trucks has caused the cost per mile for maintenance to be biased higher than expected because the preventive maintenance actions are performed on a quarterly basis, not a mileage basis. To better understand how the LNG trucks have performed, the maintenance cost analysis has been made on a cost per truck basis for the same length of data period to account for this bias. Maintenance costs per mile are also provided.
- Operations and LNG fuel costs during the evaluation were affected by a change from a temporary to a permanent LNG fueling and storage station at Raley's. There were several major delays in starting and completing the construction of the permanent LNG station. The permanent LNG station allows Raley's to purchase a full tanker truckload of LNG, thus reducing the cost by \$0.10 per LNG gallon.
- Availability of LNG in the local Sacramento, California area could reduce LNG fuel cost significantly by reducing transportation costs (currently coming from Wyoming or Arizona).

- Raley's staff indicated that their operation would benefit from a larger LNG storage tank at the permanent fueling station (currently 13,000 gallons). The tank has reserve for vapor and liquid that cannot be used, which reduces the useable volume to about 11,500 gallons. This leaves a margin for error of 1,500 gallons when ordering fuel. Fuel shipments must be scheduled carefully, or the station with either run out of fuel or will not be able to accommodate the full incoming shipment, which results in lost fuel that Raley's must pay for.
- There were some problems with the LNG engines, such as with the wastegate, ignition modules, and sensor calibration. The LNG engine manufacturer, Cummins, was supportive and responsive to these problems. Operations were fairly trouble-free at the end of the evaluation.
- Raley's intends to expand their LNG truck operations; however, there are few choices of heavy-duty natural gas truck technologies.
- As part of this project, Raley's purchased two LNG yard tractors. These vehicles have been extremely successful for Raley's. The drivers have noted that, compared to the older diesel yard tractors, the LNG yard tractors offer reduced noise and vibration as well as a lack of diesel fumes.

Status of Site in Project

Data collection and evaluation for this project were completed with data from December 1998. As of the end of December 1998, the new LNG station was online. Raley's planned to return the QRS refueling station to Cummins West. Raley's had planned to allow public access to their LNG station to help other fleets get started using LNG and to help offset the fuel station cost. However, public access to the new LNG station was waiting for approval from Weights and Measures as of the writing of this report. There was a discrepancy in how to measure LNG fuel accurately for dispensing fuel for sale to other fleets.

Raley's was looking at options to expand their LNG fleet. The Cummins L10-300G engine was discontinued for new LNG purchases because of low sales volume and because the L10 was discontinued for diesel as well. Raley's is currently in discussions with Cummins West to possibly be involved with a research project to test one or two prototype 400 hp engines. Other potential technology options to expand the fleet in the future may be Caterpillar Dual-Fuel (C10 or C12), Mack (E7), Detroit Diesel (Series 60), and Westport high-pressure direct injection technology.

Other Project-Related Reports

Battelle, *Raley's LNG Truck Fleet, Start-Up Experience*, National Renewable Energy Laboratory, Golden, CO, 1997, NREL/BR-540-23402.

Battelle, *Dual-Fuel Truck Fleet, Start-Up Experience*, National Renewable Energy Laboratory, Golden, CO, 1998, NREL/BR-540-25118.

Chandler, K., Norton, P., Clark, N., 1999, *Interim Results from Alternative Fuel Truck Evaluation Project*, 1999, SAE International, Warrendale, PA, SAE Pub. #1999-01-1505.

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Clark, N., Lyons, D., Rapp, B., Gautam, M., Wang, W., Norton, P., White, C., Chandler, K., *Emissions from Trucks and Buses Powered by Cummins L-10 Natural Gas Engines*, 1998, 981393, SAE International, Warrendale, PA.

Project Guidelines, *Alternative Fuel Truck Evaluation Project*, 1998, Battelle, Columbus, Ohio.

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Contacts

Stan Sasaki

Manager of Transportation
Raley's Distribution Center
4061 Gateway Park Boulevard
Sacramento, California 95834
Phone: (916) 928-7747
Fax: (916) 928-0761

Kevin Chandler

Project Manager
Battelle
505 King Avenue
Columbus, Ohio 43201
Phone: (614) 424-5127
Fax: (614) 424-5069
e-mail: chandlek@battelle.org

Paul Norton

Senior Project Engineer
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401
Phone: (303) 275-4424
Fax: (303) 275-4415
e-mail: Paul_Norton@nrel.gov

Ed Gamache

Fleet Maintenance Manager
Ozark Trucking Inc.
900 E Street
West Sacramento, California 95605
Phone: (916) 372-1472
Fax: (916) 371-2119

Vinod Duggal

Director
Advanced Engineering, Alternate Fuels
Cummins Engine Company, Inc.
1900 McKinley Avenue
Columbus, Indiana 47201
Phone: (812) 377-7338
Fax: (812) 377-2029

Appendix A

Map of Raley's Locations and Listing of Locations

All Raley's Store Locations

Nob Hill Stores

Bel Air Stores

Raley's Stores

Raley's Support Stores

Warehouse Concepts Stores

Store No.	Name	Street	City	State	Zip	Phone
102/182	Raley's Superstores	2895 North McCarran Boulevard	Sparks	NV	89431-1882	702-353-8800
103/183	Raley's Superstores	1441 Mayberry Drive	Reno	NV	89501-2430	702-786-0270
104/184	Raley's Superstores	4047 South Virginia Street	Reno	NV	89502-6007	702-825-2151
106/186	Raley's Superstores	701 Keystone Avenue	Reno	NV	89503-4103	702-747-5267
108/188	Raley's Superstores	18144 Wedge Parkway	Reno	NV	89511-8168	702-850-8900
109/189	Raley's Superstores	Highway 395 South, Box 668	Gardnerville	NV	89410-0668	702-782-5130
111/191	Raley's Superstores	1125 West Winnemucca Avenue	Winnemucca	NV	89445-3636	702-623-2577
113/194	Raley's Superstores	930 Tahoe Boulevard, Box 3507	Incline Village	NV	89450-3507	702-831-3400
114/196	Raley's Superstores	3701 South Carson Street	Carson City	NV	89701-5534	702-883-8301
115/195	Raley's Superstores	1075 North Hills Boulevard	Reno	NV	89506-5700	702-677-8777
117/197	Raley's Superstores	2505 Mountain City Highway	Elko	NV	89801-4496	702-738-2775
118/198	Raley's Superstores	2105 West Williams Avenue	Fallon	NV	89406-2612	702-423-7114
119/159	Raley's Superstores	4005 Highway 50, Box 4520	S. Lake Tahoe	CA	95729-0520	916-544-3417
127/167	Raley's Superstores	1038 Emerald Bay Road	S. Lake Tahoe	CA	95731-6200	916-541-5160
206/276	Raley's Superstores	367 West Main Street	Woodland	CA	95696-3204	916-666-1156
213/293	Raley's Superstores	692 Freeman Lane	Grass Valley	CA	95949-9616	916-272-1958
227/267	Raley's Superstores	1915 Douglas Boulevard	Roseville	CA	95661-3833	916-781-7845
229/269	Raley's Superstores	13386 Lincoln Way	Auburn	CA	95603-3239	916-885-0669
231/271	Raley's Superstores	6119 Horseshoe Bar Road	Loomis	CA	95650-8582	916-652-5765
233/283	Raley's Superstores	725 South Main Street	Red Bluff	CA	96080-4338	916-527-6902
236/286	Raley's Superstores	2325 Meyers Street	Oroville	CA	95965-5334	916-533-2515
239/279	Raley's Superstores	7847 Lichen Drive	Citrus Heights	CA	95621-1074	916-969-4686
242/257	Raley's Superstores	700 D Onstott Road	Yuba City	CA	95991-3511	916-673-5931
246/284	Raley's Superstores	1110 Hartnell Avenue	Redding	CA	96001842	916-221-1061
247/285	Raley's Superstores	1842 Fort Jones Street	Yreka	CA	96097-9531	916-842-4307
248/268	Raley's Superstores	201 Lake Boulevard	Redding	CA	96003-2506	916-246-3508
249/287	Raley's Superstores	2485 Notre Dame Boulevard	Chico	CA	95928-7162	916-895-0933
304/394	Raley's Superstores	2077 Main Street	Oakley	CA	94561-3302	510-625-0744
307/397	Raley's Superstores	4300 Sonoma Boulevard	Vallejo	CA	94589-2230	707-642-1175
308/358	Raley's Superstores	3430 Tully Road	Modesto	CA	95350-0840	209-527-2201
309/359	Raley's Superstores	3550 North G Street	Merced	CA	95348-0691	209-722-3689
310/390	Raley's Superstores	2900 Geer Road	Turlock	CA	95380-1142	209-667-5253
311/391	Raley's Superstores	1280 Lathrop Road	Manteca	CA	95336-9671	209-825-0242
312/392	Raley's Superstores	1611 East Hatch Road	Modesto	CA	95351	209-537-1770
313/353	Raley's Superstores	1407 Fulton Road	Santa Rosa	CA	95407-1809	707-546-3435
314/384	Raley's Superstores	6397 Jarvis Avenue	Newark	CA	94560-1214	510-797-1148
315/385	Raley's Superstores	39200 Paseo Padre Parkway	Fremont	CA	94528-1616	510-791-0233

Store No.	Name	Street	City	State	Zip	Phone
316/386	Raley's Superstores	5420 Sunol Boulevard, Suite 1	Pleasanton	CA	94566-7701	510-846-4471
319/369	Raley's Superstores	217 Soscol Avenue	Napa	CA	94559-4007	707-224-7897
321/351	Raley's Superstores	3360 San Pablo Dam Road	San Pablo	CA	94806-2724	510-222-5935
328/388	Raley's Superstores	1315 North State Street	Ukiah	CA	95482-3419	707-468-5178
330/380	Raley's Superstores	270 Sunset Avenue	Suisun City	CA	94585-1766	707-426-1023
331/371	Raley's Superstores	3330 North Texas Street	Fairfield	CA	94533-9715	707-421-9990
332/372	Raley's Superstores	3001 Travis Boulevard	Fairfield	CA	94533-3442	707-429-8410
333/373	Raley's Superstores	3632 Lone Tree Way	Antioch	CA	94509-6001	510-754-2522
334/374	Raley's Superstores	2401 East Orangeburg Avenue	Modesto	CA	95355-3351	209-577-5656
335/375	Raley's Superstores	1369 Buchanan Road	Pittsburg	CA	94565-6406	510-432-1900
337/377	Raley's Superstores	100 Raley's Town Center	Rohnert Park	CA	94928-2440	707-585-3222
340/350	Raley's Superstores	40041 Highway 41, Box 367	Oakhurst	CA	93644-0367	209-683-8300
341/356	Raley's Superstores	8852 Lakewood Drive	Windsor	CA	95492-9595	707-838-6604
343/381	Raley's Superstores	890 Southampton Road	Benicia	CA	94510-1907	707-746-1203
344/382	Raley's Superstores	3063 Alamo Drive	Vacaville	CA	95687-6394	707-446-8707
402/452	Raley's Superstores	7477 Watt Avenue	No. Highlands	CA	95660-2606	916-332-2635
405/453	Raley's Superstores	4850 Freeport Boulevard	Sacramento	CA	95822-2401	916-452-6861
409/489	Raley's Superstores	715 East Bidwell Street	Folsom	CA	95630-3341	916-983-7267
412/492	Raley's Superstores	6847 Douglas Boulevard	Roseville	CA	95661-8528	916-791-8000
415	Raley's Superstores	3431 Watt Avenue	Sacramento	CA	95821-3612	916-483-0424
416/456	Raley's Superstores	3518 Marconi Avenue	Sacramento	CA	95821-5302	916-972-7177
417/454	Raley's Superstores	4830 San Juan Avenue	Fair Oaks	CA	95628-4719	916-967-4718
418/455	Raley's Superstores	10385 Folsom Boulevard	Rancho Cordova	CA	95670-3518	916-363-2691
420/460	Raley's Superstores	8391 Folsom Boulevard	Sacramento	CA	95826-3538	916-383-6622
421/461	Raley's Superstores	8870 Madison Avenue	Fair Oaks	CA	95628-3908	916-966-2201
422/462	Raley's Superstores	160 Placerville Drive	Placerville	CA	95667-3919	916-622-6800
424/464	Raley's Superstores	3935 Park Drive	El Dorado Hills	CA	95762-4561	916-933-0518
426/466	Raley's Superstores	781 South Highway 49	Jackson	CA	95642	209-223-9650
431/471	Raley's Superstores	5159 Fair Oaks Boulevard	Carmichael	CA	95608-5750	916-483-9033
438/478	Raley's Superstores	4551 Mack Road	Sacramento	CA	95823-4532	916-421-4523
444/484	Raley's Superstores	9149 East Stockton Boulevard	Elk Grove	CA	95624-9504	916-685-1200
445/483	Raley's Superstores	311 Lower Sacramento Road	Lodi	CA	95240-2167	209-369-1917
448/486	Raley's Superstores	1601 West Capitol Avenue	West Sacramento	CA	95691-3219	916-372-3000
501	Bel Air Markets	6231 Fruitridge Road	Sacramento	CA	95820-5814	916-739-8647
502	Bel Air Markets	4320 Arden Way	Sacramento	CA	95864-3103	916-972-0555
503	Bel Air Markets	5450 Dewey Drive	Fair Oaks	CA	95628-3138	916-967-4766
506	Bel Air Markets	1301 Florin Road	Sacramento	CA	95831-3618	916-421-6766

Store No.	Name	Street	City	State	Zip	Phone
508	Bel Air Markets	8787 Elk Grove Boulevard	Elk Grove	CA	95624-1742	916-685-2225
509	Bel Air Markets	1039 Sunrise Avenue	Roseville	CA	95661-7004	916-786-6101
510	Bel Air Markets	1540 West El Camino Avenue	Sacramento	CA	95833-1946	916-920-2493
511	Bel Air Markets	4005 Manzanita Avenue	Carmichael	CA	95608-1770	916-483-2691
512	Bel Air Markets	4008 Foothills Boulevard	Roseville	CA	95747-7223	916-783-1173
514	Bel Air Markets	7465 Rush River Drive	Sacramento	CA	95831-5255	916-399-9091
515	Bel Air Markets	3510 Palmer Drive	Cameron Park	CA	95682-8202	916-676-0512
516	Bel Air Markets	5100 Laguna Boulevard	Elk Grove	CA	95758-4159	916-684-7000
517	Bel Air Markets	2222 Grass Valley Highway	Auburn	CA	95603-2536	916-889-8626
518	Bel Air Markets	2341 Sunset Boulevard	Rocklin	CA	95765-4337	916-632-0180
519	Bel Air Markets	7901 Walerga Road	Antelope	CA	95843-5722	916-725-0333
521	Bel Air Markets	1286 Stabler Lane	Yuba City	CA	95993-2620	916-755-3991
522	Bel Air Markets	2155 Golden Centre Lane	Gold River	CA	95670-4477	916-858-0494
598-Bake	Bel Air Markets	849 F Street	West Sacramento	CA	95691-2313	916-371-8402
601	Nob Hill Foods	945 N Street	Newman	CA	95360-1148	209-862-1002
602	Nob Hill Foods	7900 Westwood Drive	Gilroy	CA	95020-4732	408-847-4857
603	Nob Hill Foods	451 Vineyard Town Center	Morgan Hill	CA	95037-5631	408-779-8485
604	Nob Hill Foods	15710 Los Gatos Boulevard	Los Gatos	CA	95032-2504	408-356-0421
605	Nob Hill Foods	1700 Airline Highway	Hollister	CA	95023-5621	408-637-7447
606	Nob Hill Foods	1602 West Campbell Avenue	Campbell	CA	95008-1535	408-379-6650
607	Nob Hill Foods	1320 South Main Street	Salinas	CA	93901-2109	408-758-8481
608	Nob Hill Foods	1179 Saratoga-Sunnyvale Road	San Jose	CA	95129-3661	408-255-5955
610	Nob Hill Foods	3112 Santa Rita Road	Pleasanton	CA	94566-8300	925-484-0100
611	Nob Hill Foods	500 Walnut Avenue	Greenfield	CA	93927-4926	408-674-5281
612	Nob Hill Foods	900 Lighthouse Avenue	Monterey	CA	93940-1013	408-375-8220
613	Nob Hill Foods	1040 North Davis Road	Salinas	CA	93907-1944	408-757-7235
614	Nob Hill Foods	111 East El Camino Real	Sunnyvale	CA	94087-1937	408-737-7087
615	Nob Hill Foods	809 Bay Avenue	Capitola	CA	95010-2145	408-476-5600
617	Nob Hill Foods	1912 Main Street	Watsonville	CA	95076-3066	408-728-9555
618	Nob Hill Foods	2930 Pacific Avenue	Livermore	CA	94550-4815	925-447-6051
619	Nob Hill Foods	1350 Grant Road	Mountain View	CA	94040-3279	415-961-3400
620	Nob Hill Foods	222 Mount Hermon Road	Scotts Valley	CA	95066-4032	408-438-1611
621	Nob Hill Foods	520 Center Avenue	Martinez	CA	94553-4600	925-370-9400
622	Nob Hill Foods	401 Jacklin Road	Milpitas	CA	95035-3226	408-263-7050
623	Nob Hill Foods	611 Trancas Street	Napa	CA	94558-3084	707-224-8583
624	Nob Hill Foods	7076 Santa Teresa	San Jose	CA	95139-1348	408-226-0203
625	Nob Hill Foods	6061 Snell Avenue	San Jose	CA	95123-4127	408-225-0546

Store No.	Name	Street	City	State	Zip	Phone
626	Nob Hill Foods	12185 Alcosta Boulevard	San Ramon	CA	94583-2652	925-828-4120
627	Nob Hill Foods	2266 Oak Grove Road	Walnut Creek	CA	94598-2509	925-256-7188
628	Nob Hill Foods	270 Redwood Shores Parkway	Redwood City	CA	94085-1173	650-654-2106
650	Nob Hill Foods	14406 Union Road	San Jose	CA	95124-2815	408-377-1580
7	Warehouse Concepts	7745 Greenback Lane	Citrus Heights	CA	95610-5864	916-723-8610
700	Warehouse Concepts	1006 Riley Street	Folsom	CA	95630-3266	916-983-1865
701	Warehouse Concepts	6681 Stanford Ranch Road	Rocklin	CA	95765-2674	916-630-1670
702	Warehouse Concepts	6966 Mack Road	Sacramento	CA	95823-4646	916-392-0693
710	Warehouse Concepts	26905 Mission Boulevard	Hayward	CA	94544-4131	510-728-0240
835-Unsl	Raley's Support	2421 Del Monte Street	West Sacramento	CA	95691-3827	916-372-8492
836-Dist	Raley's Support	4061 Gateway Park Boulevard	Sacramento	CA	95834-1951	916-928-0575
900-Main	Raley's Support	500 West Capitol Avenue	West Sacramento	CA	95605-2624	916-373-3333
901-Rale	Raley's Support	681 West Capitol Avenue	West Sacramento	CA	95605-2319	916-373-6300
935-Main	Raley's Support	4360 Roseville Road	No. Highlands	CA	95660-5711	916-481-7509
960-Reno	Raley's Support	1277 West 7th Street	Reno	NV	89503-4163	702-747-1628
Main Office	Nob Hill Foods	200 East 10th Street	Gilroy	CA	95920-6564	408-842-6441
Ozark Trucking	Raley's Support	900 E Street	West Sacramento	CA	95605-3912	916-371-2090
POS Main	Raley's Support	2421 Del Monte Street	West Sacramento	CA	95691-3827	916-372-8494

Appendix B

Vehicle Descriptions

Raley's LNG and Diesel Control Trucks

Vehicle ID	Decal ID	VIN	ESN
1501	RA001LKC	1XKDD59X0VR745373	34845353
1502	RA002LKC	1XKDD59X2VR745374	34847352
1503	RA003LKC	1XKDD59X4VR745375	34847353
1504	RA004LKC	1XKDD59X6VR745376	34847019
1505	RA005LKC	1XKDD59X8VR745377	34849168
1506	RA006LKC	1XKDD59XXVR745378	34849166
1507	RA007LKC	1XKDD59X1VR745379	34849167
1508	RA008LKC	1XKDD59X8VR745380	34849165
1586	RA009DKCC	1XKBD99X9TS690099	34776206
1592	RA010DKCC	1XKBD99X2TS712783	34786945
1593	RA011DKCC	1XKBD99X4TS712784	34787997

Vehicle System Descriptions

Diesel

Requested Information	Description	Site Data
Vehicle Description		
Owner/Operator	Name of organization that owns and/or operates vehicle	Ozark Trucking/Raley's
Decal ID	A unique alphanumeric code for a vehicle used in this program	Shown in separate table
Vehicle ID Number (VIN)	Vehicle Identification Number	Shown in separate table
Fleet Vehicle ID	Vehicle Identification Number used by fleet	1586, 1592, 1593
Vehicle Make	Name of vehicle manufacturer	Kenworth
Vehicle Model	Truck model number	T400
Vehicle Year	Year vehicle was manufactured	1996
Service Date	Date vehicle was put into service by fleet	10/1/95
Start Mileage	Mileage on vehicle at the start of the fleet demonstration	0
Activity Code	Type of activity vehicle is used for (Code 1 from VMRSH)	12 (line-haul, re Fridgerated)
Equipment Category Code	Type of optional equipment installed on vehicle	
Body Manufacturer Code	Name of body manufacturer	
Body Description Code	Type of body attached to cab (Code 48 from VMRSH)	
Engine Serial Number	Serial number of the engine	Shown in separate table
New Vehicle or Conv. Cost	Cost for each new vehicle or the conversion cost	\$72,000
Engine		
OEM Retrofit	Is the engine OEM or a retrofit?	OEM
Engine Manufacturer Code	Name of engine manufacturer	Cummins Engine Co.
Engine Model	Engine model number	M11-330
Engine Configuration Code	Engine Configuration Code (Code 35 from VMRSH)	12
Engine Cubic Inches	Engine size in cubic inches	661

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Number of Cylinders	Number of cylinders	6
Engine Year	Year engine was manufactured	1996
Cycle	Is the engine 2 cycle or 4 cycle?	4
Compression Ratio	Compression ratio	16.1:1
Ignition Aid Type	Type of ignition aids used	None
EPA Certified (Y/N)	Is the engine configuration EPA certified	Y
Maximum bHp	Rated maximum brake horsepower of engine	330
RPM of Max bHp	RPM at rated maximum brake horsepower	1600
Maximum Torque (ft-lbs)	Rated maximum torque of engine	1250
RPM of Max Torque	RPM at rated maximum torque	1200
Oil Capacity (qts)	Oil capacity in quarts	40
Blower? (Y/N)	Does the engine have a blower?	N
Turbocharger? (Y/N)	Does the engine have a turbocharger?	Y
EPA Engine Family Name	Code assigned to engine by EPA for certification tracking	TCE661EJDASW
Fuel System		
Fuel Type Code	What type of fuel is the engine designed for?	Diesel
Diesel Additives	Type of additives used in diesel fuel	None
Alt Fuel Additives	Type of additives used in alternative fuel	N/A
Mechanical or Electric	For liquid fuel engines, are the injectors mechanically or electronically controlled	Electronic
Injector Manufacturer	Name of liquid fuel injector manufacturer	Cummins
Injector Model	Liquid fuel injector model number	Celect

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Number of Injectors	Number of liquid fuel injectors	6
Liquid Fuel Filter Manufacturer	Name of liquid fuel filter manufacturer	Fleetguard
Liquid Fuel Filter Model	Liquid fuel filter model number	FS 1000
Fuel Induction	For gaseous fuel engines, is it injection or fumigation?	N/A
Air Intake Throttle (Y/N)	Does the engine use an air intake throttle?	N
Gas Equip (OEM/Retrofit)	Is the gas fuel system OEM or retrofit?	N/A
Number of Alt Fuel Tanks	Number of alternative fuel tanks	0
Number of Diesel Tanks	Number of diesel fuel tanks	1
AF Max Work Press (psi)	Alternative fuel maximum working pressure in psi	0
Amount of Useable AF	Total useful alternative fuel in tank(s)	0
Alt Fuel Units	Units used for alternative fuel tank(s) useful volume	N/A
Amount of Useable Diesel	Total useful diesel fuel in tank(s)	114
Diesel Fuel Units	Units used for diesel fuel tank(s) useful volume	GAL
AF Tank Manufacturer	Name of alternative fuel tank(s) manufacturer	N/A
Diesel Tank Manufacturer	Name of diesel fuel tank(s) manufacturer	Kenworth
Alt Fuel Tank Model	Alternative fuel tank(s) model number	N/A
Diesel Tank Model	Diesel fuel tank(s) model number	Kenworth
Alt Fuel Empty Tank Wt	Alternative fuel tank(s) empty weight	0
Alt Fuel Tank Wt Units	Units used for alternative fuel tank(s) empty weight	N/A
Diesel Empty Tank Wt	Diesel fuel tank(s) empty weight	
Diesel Tank Wt Units	Units used for diesel fuel tank(s) empty weight	LBS

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Transmission		
Transmission Manufacturer	Name of transmission manufacturer	Fuller
Transmission Model Number	Transmission model number	RTL012610B
Transmission Year of Mfr	Transmission year of manufacture	1996
Transmission Type Code	Type of Transmission (Code 7 from VMRSH)	1
Forward Speeds	Number of forward speeds	10
Reverse Speeds	Number of reverse speeds	2
Retarder (Y/N)	Is the truck equipped with a retarder/Jake brake	Y
Axle		
Axle Type Code	Type of axle configuration (Code 3 from VMRSH)	D
Axle Front Weight	Axle front weight	12,000 LBS
Front Tire Size	Size of front tires	295/75R22.5
Rear Tire Size	Size of rear tires	295/75R22.5
Axle Manufacturer Code	Name of drive axle manufacturer (from VMRSH)	Eaton
Axle Model	Drive axle model number	DS 402
Rear Axle Config Code	Rear axle configuration (Code 37 from VMRSH)	
Rear Axle Setup Code	Setup of rear axle configuration (Code 38 from VMRSH)	2
Axle Ratio Low	Low axle ratio	4.33:1
Axle Ratio High	High axle ratio	
Total GVW Wt (lb)	Total gross vehicle weight in pounds	80,000 LBS
Total Curb Wt (lb)	Total weight with the truck in curb weight configuration	14,440 LBS

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Torque Converter Ratio	Torque converter ratio	N/A
Wheelbase	Length of wheelbase	170
Emission		
Catalytic Converter	Does the vehicle have a catalytic converter?	N
Catalytic Converter Mfr	Name of catalytic converter manufacturer	
Catalytic Converter Model	Model number of the catalytic converter	
Diesel Particulate Trap	Does the vehicle have a diesel particulate trap?	N
Trap Manufacturer	Name of the particulate trap manufacturer	
Trap Model	Model number of the particulate trap	
Trap Regeneration Type	Type of trap regeneration process	
Trap Configuration	Particulate trap configuration	
Number of Trap Elements	Number of particulate trap elements	
Trap System Weight	Weight of the particulate trap system	

VMRSH - Vehicle Maintenance Reporting Standards Handbook from the American Trucking Associations and published by Management Systems Council.

Vehicle System Descriptions

LNG

Requested Information	Description	Site Data
Vehicle Description		
Owner/Operator	Name of organization that owns and/or operates vehicle	Ozark Trucking/Raley's
Decal ID	A unique alphanumeric code for a vehicle used in this program	Shown in separate table
Vehicle ID Number (VIN)	Vehicle Identification Number	Shown in separate table
Fleet Vehicle ID	Vehicle Identification Number used by fleet	1501-1508
Vehicle Make	Name of vehicle manufacturer	Kenworth
Vehicle Model	Truck model number	T800
Vehicle Year	Year vehicle was manufactured	1997
Service Date	Date vehicle was put into service by fleet	4/9/97
Start Mileage	Mileage on vehicle at the start of the fleet demonstration	0
Activity Code	Type of activity vehicle is used for (Code 1 from VMRSH)	12 (line-haul, re Fridgerated)
Equipment Category Code	Type of optional equipment installed on vehicle	
Body Manufacturer Code	Name of body manufacturer	
Body Description Code	Type of body attached to cab (Code 48 from VMRSH)	
Engine Serial Number	Serial number of the engine	Shown in separate table
New Vehicle or Conv. Cost	Cost for each new vehicle or the conversion cost	\$107,816
Engine		
OEM Retrofit	Is the engine OEM or a retrofit?	OEM
Engine Manufacturer Code	Name of engine manufacturer	Cummins Engine Co.
Engine Model	Engine model number	L10-300G
Engine Configuration Code	Engine Configuration Code (Code 35 from VMRSH)	12
Engine Cubic Inches	Engine size in cubic inches	611

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Number of Cylinders	Number of cylinders	6
Engine Year	Year engine was manufactured	1997
Cycle	Is the engine 2 cycle or 4 cycle?	4
Compression Ratio	Compression ratio	10.5:1
Ignition Aid Type	Type of ignition aids used	Spark plugs
EPA Certified (Y/N)	Is the engine configuration EPA certified	Y
Maximum bHp	Rated maximum brake horsepower of engine	300
RPM of Max bHp	RPM at rated maximum brake horsepower	2100
Maximum Torque (ft-lbs)	Rated maximum torque of engine	900
RPM of Max Torque	RPM at rated maximum torque	1300
Oil Capacity (qts)	Oil capacity in quarts	40
Blower? (Y/N)	Does the engine have a blower?	N
Turbocharger? (Y/N)	Does the engine have a turbocharger?	Y
EPA Engine Family Name	Code assigned to engine by EPA for certification tracking	VCE611EBCARW
Fuel System		
Fuel Type Code	What type of fuel is the engine designed for?	LNG
Diesel Additives	Type of additives used in diesel fuel	N/A
Alt Fuel Additives	Type of additives used in alternative fuel	None
Mechanical or Electric	For liquid fuel engines, are the injectors mechanically or electronically controlled	N/A
Injector Manufacturer	Name of liquid fuel injector manufacturer	
Injector Model	Liquid fuel injector model number	

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Number of Injectors	Number of liquid fuel injectors	
Liquid Fuel Filter Manufacturer	Name of liquid fuel filter manufacturer	Fleetguard
Liquid Fuel Filter Model	Liquid fuel filter model number	
Fuel Induction	For gaseous fuel engines, is it injection or fumigation?	Fumigation
Air Intake Throttle (Y/N)	Does the engine use an air intake throttle?	Y
Gas Equip (OEM/Retrofit)	Is the gas fuel system OEM or retrofit?	OEM
Number of Alt Fuel Tanks	Number of alternative fuel tanks	2
Number of Diesel Tanks	Number of diesel fuel tanks	0
AF Max Work Press (psi)	Alternative fuel maximum working pressure in psi	150
Amount of Useable AF	Total useful alternative fuel in tank(s)	174
Alt Fuel Units	Units used for alternative fuel tank(s) useful volume	GAL
Amount of Useable Diesel	Total useful diesel fuel in tank(s)	0
Diesel Fuel Units	Units used for diesel fuel tank(s) useful volume	N/A
AF Tank Manufacturer	Name of alternative fuel tank(s) manufacturer	MVE
Diesel Tank Manufacturer	Name of diesel fuel tank(s) manufacturer	N/A
Alt Fuel Tank Model	Alternative fuel tank(s) model number	24" X 71"
Diesel Tank Model	Diesel fuel tank(s) model number	N/A
Alt Fuel Empty Tank Wt	Alternative fuel tank(s) empty weight	930
Alt Fuel Tank Wt Units	Units used for alternative fuel tank(s) empty weight	LBS
Diesel Empty Tank Wt	Diesel fuel tank(s) empty weight	0
Diesel Tank Wt Units	Units used for diesel fuel tank(s) empty weight	N/A

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Transmission		
Transmission Manufacturer	Name of transmission manufacturer	Fuller
Transmission Model Number	Transmission model number	RT11710B
Transmission Year of Mfr	Transmission year of manufacture	1997
Transmission Type Code	Type of Transmission (Code 7 from VMRSH)	1
Forward Speeds	Number of forward speeds	10
Reverse Speeds	Number of reverse speeds	2
Retarder (Y/N)	Is the truck equipped with a retarder/Jake brake?	Y
Axle		
Axle Type Code	Type of axle configuration (Code 3 from VMRSH)	D
Axle Front Weight	Axle front weight	12,000 LBS
Front Tire Size	Size of front tires	295/75R22.5
Rear Tire Size	Size of rear tires	295/75R22.5
Axle Manufacturer Code	Name of drive axle manufacturer (from VMRSH)	Eaton
Axle Model	Drive axle model number	DS 404
Rear Axle Config Code	Rear axle configuration (Code 37 from VMRSH)	
Rear Axle Setup Code	Setup of rear axle configuration (Code 38 from VMRSH)	2
Axle Ratio Low	Low axle ratio	4.11:1
Axle Ratio High	High axle ratio	
Total GVW Wt (lb)	Total gross vehicle weight in pounds	80,000 LBS
Total Curb Wt (lb)	Total weight with the truck in curb weight configuration	15,620 LBS

Vehicle System Descriptions (continued)

Requested Information	Description	Site Data
Torque Converter Ratio	Torque converter ratio	N/A
Wheelbase	Length of wheelbase	170
Emission		
Catalytic Converter	Does the vehicle have a catalytic converter?	N
Catalytic Converter Mfr	Name of catalytic converter manufacturer	
Catalytic Converter Model	Model number of the catalytic converter	
Diesel Particulate Trap	Does the vehicle have a diesel particulate trap?	N
Trap Manufacturer	Name of the particulate trap manufacturer	
Trap Model	Model number of the particulate trap	
Trap Regeneration Type	Type of trap regeneration process	
Trap Configuration	Particulate trap configuration	
Number of Trap Elements	Number of particulate trap elements	
Trap System Weight	Weight of the particulate trap system	

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Appendix C

Detail Trip Summary, Average Speed Summary, and Average Monthly Mileage Summary

Vehicle Usage Statistics

3/10/99

Vehicle	Month	Total						Per Trip				Per Day			
		Miles	Hours	Days	Trips	Stores	BkHl	Miles	Hours	Stores	BkHl	Miles	Hours	Stores	BkHl
1501	May	872.1	54.75	6	15	30	0	58.1	3.7	2.0	0.0	145.4	9.1	5.0	0.0
	Jun	3285.4	212.63	22	59	114	2	55.7	3.6	1.9	0.0	149.3	9.7	5.2	0.1
	Jul	1745.0	121.82	14	33	68	3	52.9	3.7	2.1	0.1	124.6	8.7	4.9	0.2
	Aug	2178.8	153.95	17	42	88	7	51.9	3.7	2.1	0.2	128.2	9.1	5.2	0.4
	Sep	3008.5	223.32	22	64	132	6	47.0	3.5	2.1	0.1	136.8	10.2	6.0	0.3
	Oct	4205.7	311.55	27	86	186	6	48.9	3.6	2.2	0.1	155.8	11.5	6.9	0.2
	Nov	2917.2	205.10	19	58	116	4	50.3	3.5	2.0	0.1	153.5	10.8	6.1	0.2
	Dec	3741.3	282.25	23	78	170	3	48.0	3.6	2.2	0.0	162.7	12.3	7.4	0.1
	1998 Jan	1688.0	127.85	15	37	77	5	45.6	3.5	2.1	0.1	112.5	8.5	5.1	0.3
	Feb	2096.3	158.62	17	44	96	2	47.6	3.6	2.2	0.0	123.3	9.3	5.6	0.1
	Mar	3154.9	220.95	22	58	133	4	54.4	3.8	2.3	0.1	143.4	10.0	6.0	0.2
	Apr	2287.2	139.88	15	33	76	3	69.3	4.2	2.3	0.1	152.5	9.3	5.1	0.2
	May	3892.7	236.93	19	57	130	1	68.3	4.2	2.3	0.0	204.9	12.5	6.8	0.1
	Jun	3916.1	250.33	23	64	146	0	61.2	3.9	2.3	0.0	170.3	10.9	6.3	0.0
	Jul	4693.9	287.50	24	69	161	7	68.0	4.2	2.3	0.1	195.6	12.0	6.7	0.3
	Aug	3060.2	233.30	21	64	149	8	47.8	3.6	2.3	0.1	145.7	11.1	7.1	0.4
	Sep	1809.9	138.83	13	39	88	2	46.4	3.6	2.3	0.1	139.2	10.7	6.8	0.2
	Oct	3115.4	224.35	21	60	139	4	51.9	3.7	2.3	0.1	148.4	10.7	6.6	0.2
	Nov	3355.0	217.32	20	55	130	4	61.0	4.0	2.4	0.1	167.8	10.9	6.5	0.2
	Dec	2208.5	148.85	14	37	92	0	59.7	4.0	2.5	0.0	157.8	10.6	6.6	0.0
	Total	57232.1	3950.08	374	1052	2321	71	54.4	3.8	2.2	0.1	153.0	10.6	6.2	0.2
Since 1/98		35278.1	2384.71	224	617	1417	40	57.2	3.9	2.3	0.1	157.5	10.6	6.3	0.2
Before 1/98		21954.0	1565.37	150	435	904	31.0	50.5	3.6	2.1	0.1	146.4	10.4	6.0	0.2
1502	May	1257.7	82.38	6	22	45	1	57.2	3.7	2.0	0.0	209.6	13.7	7.5	0.2
	Jun	4172.8	265.07	22	68	142	9	61.4	3.9	2.1	0.1	189.7	12.0	6.5	0.4
	Jul	2945.8	199.55	20	52	113	6	56.7	3.8	2.2	0.1	147.3	10.0	5.7	0.3
	Aug	3747.7	255.40	22	67	145	10	55.9	3.8	2.2	0.1	170.4	11.6	6.6	0.5
	Sep	3580.8	260.35	24	70	157	13	51.2	3.7	2.2	0.2	149.2	10.8	6.5	0.5
	Oct	4551.2	294.13	26	72	175	15	63.2	4.1	2.4	0.2	175.0	11.3	6.7	0.6
	Nov	3056.3	197.73	19	49	115	13	62.4	4.0	2.3	0.3	160.9	10.4	6.1	0.7
	Dec	4134.9	260.38	21	64	155	10	64.6	4.1	2.4	0.2	196.9	12.4	7.4	0.5
	1998 Jan	3562.0	230.28	23	62	130	6	57.5	3.7	2.1	0.1	154.9	10.0	5.7	0.3
	Feb	2970.0	201.40	18	52	113	0	57.1	3.9	2.2	0.0	165.0	11.2	6.3	0.0
	Mar	2806.7	200.03	19	54	115	2	52.0	3.7	2.1	0.0	147.7	10.5	6.1	0.1
	Apr	4589.2	275.70	24	66	145	4	69.5	4.2	2.2	0.1	191.2	11.5	6.0	0.2
	May	4244.6	244.43	19	56	132	3	75.8	4.4	2.4	0.1	223.4	12.9	6.9	0.2
	Jun	4499.4	248.35	23	57	138	6	78.9	4.4	2.4	0.1	195.6	10.8	6.0	0.3
	Jul	4483.8	269.75	23	64	150	12	70.1	4.2	2.3	0.2	194.9	11.7	6.5	0.5
	Aug	4334.4	231.77	19	48	124	9	90.3	4.8	2.6	0.2	228.1	12.2	6.5	0.5
	Sep	3957.3	226.82	20	52	123	5	76.1	4.4	2.4	0.1	197.9	11.3	6.2	0.3
	Oct	3638.6	224.87	21	58	128	8	62.7	3.9	2.2	0.1	173.3	10.7	6.1	0.4
	Nov	3366.3	205.32	18	50	118	7	67.3	4.1	2.4	0.1	187.0	11.4	6.6	0.4
	Dec	2760.4	182.40	17	47	111	5	58.7	3.9	2.4	0.1	162.4	10.7	6.5	0.3
	Total	72659.9	4556.11	404	1130	2574	144	64.3	4.0	2.3	0.1	179.9	11.3	6.4	0.4
Since 1/98		45212.7	2741.12	244	666	1527	67	67.9	4.1	2.3	0.1	185.3	11.2	6.3	0.3
Before 1/98		27447.2	1814.99	160	464	1047	77.0	59.2	3.9	2.3	0.2	171.5	11.3	6.5	0.5
1503	May	1219.5	70.88	6	16	36	2	76.2	4.4	2.3	0.1	203.3	11.8	6.0	0.3
	Jun	4313.5	266.60	21	66	142	11	65.4	4.0	2.2	0.2	205.4	12.7	6.8	0.5
	Jul	3882.9	244.82	20	56	133	6	69.3	4.4	2.4	0.1	194.1	12.2	6.7	0.3
	Aug	2503.2	149.78	17	33	85	5	75.9	4.5	2.6	0.2	147.2	8.8	5.0	0.3
	Sep	3634.1	240.90	21	56	139	6	64.9	4.3	2.5	0.1	173.1	11.5	6.6	0.3

Vehicle Usage Statistics

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Vehicle	Month	Total						Per Trip				Per Day			
		Miles	Hours	Days	Trips	Stores	BkHl	Miles	Hours	Stores	BkHl	Miles	Hours	Stores	BkHl
1998	Oct	5775.5	370.80	27	89	211	9	64.9	4.2	2.4	0.1	213.9	13.7	7.8	0.3
	Nov	3976.8	255.53	23	64	145	4	62.1	4.0	2.3	0.1	172.9	11.1	6.3	0.2
	Dec	4311.9	263.58	21	61	148	6	70.7	4.3	2.4	0.1	205.3	12.6	7.0	0.3
	Jan	4586.2	290.33	23	70	166	5	65.5	4.1	2.4	0.1	199.4	12.6	7.2	0.2
	Feb	3275.5	205.15	17	49	116	2	66.8	4.2	2.4	0.0	192.7	12.1	6.8	0.1
	Mar	4619.9	293.95	23	69	168	3	67.0	4.3	2.4	0.0	200.9	12.8	7.3	0.1
	Apr	5256.0	335.87	24	80	187	3	65.7	4.2	2.3	0.0	219.0	14.0	7.8	0.1
	May	4331.6	259.08	20	60	142	4	72.2	4.3	2.4	0.1	216.6	13.0	7.1	0.2
	Jun	5324.4	299.10	21	67	154	10	79.5	4.5	2.3	0.1	253.5	14.2	7.3	0.5
	Jul	4201.6	229.80	17	49	123	7	85.7	4.7	2.5	0.1	247.2	13.5	7.2	0.4
	Aug	4445.9	260.02	21	59	141	9	75.4	4.4	2.4	0.2	211.7	12.4	6.7	0.4
	Sep	2117.9	112.70	10	25	56	3	84.7	4.5	2.2	0.1	211.8	11.3	5.6	0.3
	Oct	2233.5	139.92	11	35	77	3	63.8	4.0	2.2	0.1	203.0	12.7	7.0	0.3
	Nov	488.7	31.67	5	9	16	1	54.3	3.5	1.8	0.1	97.7	6.3	3.2	0.2
	Dec	1571.4	90.28	10	23	50	1	68.3	3.9	2.2	0.0	157.1	9.0	5.0	0.1
	Total	72070.0	4410.76	358	1036	2435	100	69.6	4.3	2.4	0.1	201.3	12.3	6.8	0.3
Since 1/98		42452.6	2547.87	202	595	1396	51	71.3	4.3	2.3	0.1	210.2	12.6	6.9	0.3
Before 1/98		29617.4	1862.89	156	441	1039	49.0	67.2	4.2	2.4	0.1	189.9	11.9	6.7	0.3
1504	May	1172.1	67.58	6	18	32	1	65.1	3.8	1.8	0.1	195.4	11.3	5.3	0.2
	Jun	5645.2	312.78	20	76	156	4	74.3	4.1	2.1	0.1	282.3	15.6	7.8	0.2
	Jul	4194.8	242.95	19	61	122	7	68.8	4.0	2.0	0.1	220.8	12.8	6.4	0.4
	Aug	3137.3	202.80	20	54	110	4	58.1	3.8	2.0	0.1	156.9	10.1	5.5	0.2
	Sep	4164.8	260.83	26	70	138	8	59.5	3.7	2.0	0.1	160.2	10.0	5.3	0.3
	Oct	3234.2	211.22	20	52	122	8	62.2	4.1	2.3	0.2	161.7	10.6	6.1	0.4
	Nov	3770.0	266.60	22	69	156	12	54.6	3.9	2.3	0.2	171.4	12.1	7.1	0.5
	Dec	4263.6	312.18	23	78	189	10	54.7	4.0	2.4	0.1	185.4	13.6	8.2	0.4
	1998 Jan	3949.6	253.57	23	58	148	9	68.1	4.4	2.6	0.2	171.7	11.0	6.4	0.4
	Feb	3670.2	193.92	14	38	104	10	96.6	5.1	2.7	0.3	262.2	13.9	7.4	0.7
	Mar	6498.9	352.00	22	66	185	21	98.5	5.3	2.8	0.3	295.4	16.0	8.4	1.0
	Apr	6433.3	346.02	23	65	181	17	99.0	5.3	2.8	0.3	279.7	15.0	7.9	0.7
	May	4345.3	277.75	20	65	158	10	66.9	4.3	2.4	0.2	217.3	13.9	7.9	0.5
	Jun	4798.2	292.75	22	67	162	8	71.6	4.4	2.4	0.1	218.1	13.3	7.4	0.4
	Jul	5508.1	325.90	23	73	175	16	75.5	4.5	2.4	0.2	239.5	14.2	7.6	0.7
	Aug	5655.4	346.88	24	77	189	8	73.4	4.5	2.5	0.1	235.6	14.5	7.9	0.3
	Sep	4854.5	287.03	19	64	160	10	75.9	4.5	2.5	0.2	255.5	15.1	8.4	0.5
	Oct	4505.5	277.33	21	70	157	7	64.4	4.0	2.2	0.1	214.5	13.2	7.5	0.3
	Nov	4262.0	251.10	21	57	140	8	74.8	4.4	2.5	0.1	203.0	12.0	6.7	0.4
	Dec	4099.4	262.52	19	60	153	4	68.3	4.4	2.6	0.1	215.8	13.8	8.1	0.2
	Total	88162.4	5343.71	407	1238	2937	182	71.2	4.3	2.4	0.1	216.6	13.1	7.2	0.4
Since 1/98		58580.4	3466.77	251	760	1912	128	77.1	4.6	2.5	0.2	233.4	13.8	7.6	0.5
Before 1/98		29582.0	1876.94	156	478	1025	54.0	61.9	3.9	2.1	0.1	189.6	12.0	6.6	0.3
1505	May	956.3	71.82	6	19	43	3	50.3	3.8	2.3	0.2	159.4	12.0	7.2	0.5
	Jun	3534.8	257.67	20	65	151	5	54.4	4.0	2.3	0.1	176.7	12.9	7.6	0.3
	Jul	2647.0	194.72	17	52	116	4	50.9	3.7	2.2	0.1	155.7	11.5	6.8	0.2
	Aug	1860.1	175.82	17	49	110	10	38.0	3.6	2.2	0.2	109.4	10.3	6.5	0.6
	Sep	1745.6	155.87	19	44	96	9	39.7	3.5	2.2	0.2	91.9	8.2	5.1	0.5
	Oct	3553.9	271.42	24	71	167	13	50.1	3.8	2.4	0.2	148.1	11.3	7.0	0.5
	Nov	2909.8	217.25	20	57	133	8	51.0	3.8	2.3	0.1	145.5	10.9	6.7	0.4
	Dec	2275.0	180.20	20	50	111	5	45.5	3.6	2.2	0.1	113.8	9.0	5.6	0.3
	1998 Jan	1945.4	139.73	14	37	84	1	52.6	3.8	2.3	0.0	139.0	10.0	6.0	0.1
	Feb	1387.1	88.20	9	21	51	4	66.1	4.2	2.4	0.2	154.1	9.8	5.7	0.4

Vehicle Usage Statistics

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Vehicle	Month	Total						Per Trip				Per Day			
		Miles	Hours	Days	Trips	Stores	BkHl	Miles	Hours	Stores	BkHl	Miles	Hours	Stores	BkHl
	Mar	3053.3	207.78	19	48	124	11	63.6	4.3	2.6	0.2	160.7	10.9	6.5	0.6
	Apr	3775.1	253.38	21	59	152	10	64.0	4.3	2.6	0.2	179.8	12.1	7.2	0.5
	May	3966.8	210.10	16	44	106	6	90.2	4.8	2.4	0.1	247.9	13.1	6.6	0.4
	Jun	4984.6	250.53	23	52	118	4	95.9	4.8	2.3	0.1	216.7	10.9	5.1	0.2
	Jul	5400.0	315.02	23	69	158	10	78.3	4.6	2.3	0.1	234.8	13.7	6.9	0.4
	Aug	4195.6	258.62	22	61	135	6	68.8	4.2	2.2	0.1	190.7	11.8	6.1	0.3
	Sep	3724.2	203.70	18	43	101	4	86.6	4.7	2.3	0.1	206.9	11.3	5.6	0.2
	Oct	3186.4	166.95	17	37	82	5	86.1	4.5	2.2	0.1	187.4	9.8	4.8	0.3
	Nov	3527.2	200.77	20	45	107	3	78.4	4.5	2.4	0.1	176.4	10.0	5.4	0.2
	Dec	2965.5	163.90	17	36	85	5	82.4	4.6	2.4	0.1	174.4	9.6	5.0	0.3
	Total	61593.7	3983.45	362	959	2230	126	64.2	4.2	2.3	0.1	170.1	11.0	6.2	0.3
	Since 1/98	42111.2	2458.68	219	552	1303	69	76.3	4.5	2.4	0.1	192.3	11.2	5.9	0.3
	Before 1/98	19482.5	1524.77	143	407	927	57.0	47.9	3.7	2.3	0.1	136.2	10.7	6.5	0.4
1506	May	1186.0	69.28	4	15	39	2	79.1	4.6	2.6	0.1	296.5	17.3	9.8	0.5
	Jun	4489.2	307.57	21	75	180	14	59.9	4.1	2.4	0.2	213.8	14.6	8.6	0.7
	Jul	3332.1	238.98	20	61	144	11	54.6	3.9	2.4	0.2	166.6	11.9	7.2	0.6
	Aug	3957.0	286.78	24	74	173	15	53.5	3.9	2.3	0.2	164.9	11.9	7.2	0.6
	Sep	3780.5	255.92	25	65	154	19	58.2	3.9	2.4	0.3	151.2	10.2	6.2	0.8
	Oct	4780.8	314.03	26	81	185	17	59.0	3.9	2.3	0.2	183.9	12.1	7.1	0.7
	Nov	2886.9	209.28	21	57	125	15	50.6	3.7	2.2	0.3	137.5	10.0	6.0	0.7
	Dec	4787.7	269.18	23	60	147	19	79.8	4.5	2.5	0.3	208.2	11.7	6.4	0.8
	1998 Jan	3788.2	263.93	24	63	165	5	60.1	4.2	2.6	0.1	157.8	11.0	6.9	0.2
	Feb	4269.1	262.88	21	60	151	5	71.2	4.4	2.5	0.1	203.3	12.5	7.2	0.2
	Mar	4536.2	289.13	23	67	172	4	67.7	4.3	2.6	0.1	197.2	12.6	7.5	0.2
	Apr	4580.4	323.47	21	74	187	6	61.9	4.4	2.5	0.1	218.1	15.4	8.9	0.3
1998	May	3271.8	230.22	19	59	130	4	55.5	3.9	2.2	0.1	172.2	12.1	6.8	0.2
	Jun	3363.4	227.32	20	57	128	4	59.0	4.0	2.2	0.1	168.2	11.4	6.4	0.2
	Jul	3266.7	197.95	17	47	112	9	69.5	4.2	2.4	0.2	192.2	11.6	6.6	0.5
	Aug	2828.6	182.10	16	44	99	8	64.3	4.1	2.3	0.2	176.8	11.4	6.2	0.5
	Sep	2348.5	176.65	17	45	107	5	52.2	3.9	2.4	0.1	138.1	10.4	6.3	0.3
	Oct	3165.2	202.45	18	51	113	5	62.1	4.0	2.2	0.1	175.8	11.2	6.3	0.3
	Nov	3236.9	211.00	19	52	118	8	62.2	4.1	2.3	0.2	170.4	11.1	6.2	0.4
	Dec	2313.5	165.15	16	42	96	4	55.1	3.9	2.3	0.1	144.6	10.3	6.0	0.3
	Total	70168.7	4683.27	395	1149	2725	179	61.1	4.1	2.4	0.2	177.6	11.9	6.9	0.5
	Since 1/98	40968.5	2732.25	231	661	1578	67	62.0	4.1	2.4	0.1	177.4	11.8	6.8	0.3
	Before 1/98	29200.2	1951.02	164	488	1147	112.0	59.8	4.0	2.4	0.2	178.1	11.9	7.0	0.7
1507	May	1902.8	85.25	6	16	41	4	118.9	5.3	2.6	0.3	317.1	14.2	6.8	0.7
	Jun	5307.6	273.42	19	52	146	14	102.1	5.3	2.8	0.3	279.3	14.4	7.7	0.7
	Jul	4547.3	229.47	15	41	118	13	110.9	5.6	2.9	0.3	303.2	15.3	7.9	0.9
	Aug	4071.7	213.05	17	39	113	10	104.4	5.5	2.9	0.3	239.5	12.5	6.6	0.6
	Sep	2765.4	155.20	18	32	87	7	86.4	4.9	2.7	0.2	153.6	8.6	4.8	0.4
	Oct	5720.6	297.17	26	57	161	21	100.4	5.2	2.8	0.4	220.0	11.4	6.2	0.8
	Nov	5069.6	255.55	23	51	134	11	99.4	5.0	2.6	0.2	220.4	11.1	5.8	0.5
	Dec	6536.7	327.55	24	62	174	11	105.4	5.3	2.8	0.2	272.4	13.6	7.3	0.5
	1998 Jan	4281.8	252.15	23	54	151	9	79.3	4.7	2.8	0.2	186.2	11.0	6.6	0.4
	Feb	3107.2	188.37	17	45	106	4	69.0	4.2	2.4	0.1	182.8	11.1	6.2	0.2
	Mar	3504.7	217.37	20	51	129	4	68.7	4.3	2.5	0.1	175.2	10.9	6.5	0.2
	Apr	3544.0	235.02	22	60	137	11	59.1	3.9	2.3	0.2	161.1	10.7	6.2	0.5
1998	May	3584.1	230.90	18	58	123	4	61.8	4.0	2.1	0.1	199.1	12.8	6.8	0.2
	Jun	5155.2	304.28	22	67	168	8	76.9	4.5	2.5	0.1	234.3	13.8	7.6	0.4
	Jul	3611.5	227.43	19	56	124	4	64.5	4.1	2.2	0.1	190.1	12.0	6.5	0.2

Vehicle Usage Statistics

3/10/99

Vehicle	Month	Total						Per Trip				Per Day			
		Miles	Hours	Days	Trips	Stores	BkHI	Miles	Hours	Stores	BkHI	Miles	Hours	Stores	BkHI
	Aug	6019.3	331.37	22	68	176	11	88.5	4.9	2.6	0.2	273.6	15.1	8.0	0.5
	Sep	4513.8	267.30	17	62	145	4	72.8	4.3	2.3	0.1	265.5	15.7	8.5	0.2
	Oct	4126.0	241.35	20	61	131	4	67.6	4.0	2.1	0.1	206.3	12.1	6.6	0.2
	Nov	3151.8	202.70	19	49	115	9	64.3	4.1	2.3	0.2	165.9	10.7	6.1	0.5
	Dec	3340.6	205.68	18	50	117	6	66.8	4.1	2.3	0.1	185.6	11.4	6.5	0.3
	Total	83861.7	4740.58	385	1031	2596	169	81.3	4.6	2.5	0.2	217.8	12.3	6.7	0.4
	Since 1/98	47940.0	2903.92	237	681	1622	78	70.4	4.3	2.4	0.1	202.3	12.3	6.8	0.3
	Before 1/98	35921.7	1836.66	148	350	974	91.0	102.6	5.2	2.8	0.3	242.7	12.4	6.6	0.6
1508	May	1484.7	86.57	6	22	43	1	67.5	3.9	2.0	0.0	247.5	14.4	7.2	0.2
	Jun	4377.1	258.23	19	63	130	13	69.5	4.1	2.1	0.2	230.4	13.6	6.8	0.7
	Jul	3939.9	255.68	20	63	140	13	62.5	4.1	2.2	0.2	197.0	12.8	7.0	0.7
	Aug	4004.9	249.20	22	60	131	17	66.7	4.2	2.2	0.3	182.0	11.3	6.0	0.8
	Sep	3580.6	251.00	23	66	140	8	54.3	3.8	2.1	0.1	155.7	10.9	6.1	0.3
	Oct	6197.5	339.35	25	79	177	9	78.4	4.3	2.2	0.1	247.9	13.6	7.1	0.4
	Nov	4586.6	275.03	23	72	143	6	63.7	3.8	2.0	0.1	199.4	12.0	6.2	0.3
	Dec	5790.5	306.38	23	70	155	5	82.7	4.4	2.2	0.1	251.8	13.3	6.7	0.2
	1998 Jan	4025.6	221.10	21	52	118	6	77.4	4.3	2.3	0.1	191.7	10.5	5.6	0.3
	Feb	3896.5	222.92	20	52	123	4	74.9	4.3	2.4	0.1	194.8	11.1	6.2	0.2
	Mar	4009.4	239.20	22	57	129	6	70.3	4.2	2.3	0.1	182.2	10.9	5.9	0.3
	Apr	2794.4	160.63	14	34	83	6	82.2	4.7	2.4	0.2	199.6	11.5	5.9	0.4
	May	1271.7	58.50	4	11	28	0	115.6	5.3	2.5	0.0	317.9	14.6	7.0	0.0
	Jun	4315.1	236.28	19	54	116	8	79.9	4.4	2.1	0.1	227.1	12.4	6.1	0.4
	Jul	2904.3	160.43	16	36	79	5	80.7	4.5	2.2	0.1	181.5	10.0	4.9	0.3
	Aug	4440.8	240.82	21	54	118	6	82.2	4.5	2.2	0.1	211.5	11.5	5.6	0.3
	Sep	3177.4	161.17	15	34	75	7	93.5	4.7	2.2	0.2	211.8	10.7	5.0	0.5
	Oct	2860.2	162.53	15	41	83	1	69.8	4.0	2.0	0.0	190.7	10.8	5.5	0.1
	Nov	3365.1	190.17	18	47	97	1	71.6	4.0	2.1	0.0	187.0	10.6	5.4	0.1
	Dec	2829.0	158.30	16	35	81	4	80.8	4.5	2.3	0.1	176.8	9.9	5.1	0.3
	Total	73851.3	4233.49	362	1002	2189	126	73.7	4.2	2.2	0.1	204.0	11.7	6.0	0.3
	Since 1/98	39889.5	2212.05	201	507	1130	54	78.7	4.4	2.2	0.1	198.5	11.0	5.6	0.3
	Before 1/98	33961.8	2021.44	161	495	1059	72.0	68.6	4.1	2.1	0.1	210.9	12.6	6.6	0.4
LNG	May	10051.2	588.51	46	143	309	14	70.3	4.1	2.2	0.1	218.5	12.8	6.7	0.3
	Jun	35125.6	2153.97	164	524	1161	72	67.0	4.1	2.2	0.1	214.2	13.1	7.1	0.4
	Jul	27234.8	1727.99	145	419	954	63	65.0	4.1	2.3	0.2	187.8	11.9	6.6	0.4
	Aug	25460.7	1686.78	156	418	955	78	60.9	4.0	2.3	0.2	163.2	10.8	6.1	0.5
	Sep	26260.3	1803.39	178	467	1043	76	56.2	3.9	2.2	0.2	147.5	10.1	5.9	0.4
	Oct	38019.4	2409.67	201	587	1384	98	64.8	4.1	2.4	0.2	189.2	12.0	6.9	0.5
	Nov	29173.2	1882.07	170	477	1067	73	61.2	3.9	2.2	0.2	171.6	11.1	6.3	0.4
	Dec	35841.6	2201.70	178	523	1249	69	68.5	4.2	2.4	0.1	201.4	12.4	7.0	0.4
	1998 Jan	27826.8	1778.94	166	433	1039	46	64.3	4.1	2.4	0.1	167.6	10.7	6.3	0.3
	Feb	24671.9	1521.46	133	361	860	31	68.3	4.2	2.4	0.1	185.5	11.4	6.5	0.2
	Mar	32184.0	2020.41	170	470	1155	55	68.5	4.3	2.5	0.1	189.3	11.9	6.8	0.3
	Apr	33259.6	2069.97	164	471	1148	60	70.6	4.4	2.4	0.1	202.8	12.6	7.0	0.4
	May	28908.6	1747.91	135	410	949	32	70.5	4.3	2.3	0.1	214.1	12.9	7.0	0.2
	Jun	36356.4	2108.94	173	485	1130	48	75.0	4.3	2.3	0.1	210.2	12.2	6.5	0.3
	Jul	34069.9	2013.78	162	463	1082	70	73.6	4.3	2.3	0.2	210.3	12.4	6.7	0.4
	Aug	34980.2	2084.88	166	475	1131	65	73.6	4.4	2.4	0.1	210.7	12.6	6.8	0.4
	Sep	26503.5	1574.20	129	364	855	40	72.8	4.3	2.3	0.1	205.5	12.2	6.6	0.3
	Oct	26830.8	1639.75	144	413	910	37	65.0	4.0	2.2	0.1	186.3	11.4	6.3	0.3
	Nov	24753.0	1510.05	140	364	841	41	68.0	4.1	2.3	0.1	176.8	10.8	6.0	0.3
	Dec	22088.3	1377.08	127	330	785	29	66.9	4.2	2.4	0.1	173.9	10.8	6.2	0.2

Vehicle Usage Statistics

3/10/99

Vehicle	Month	Total						Per Trip				Per Day			
		Miles	Hours	Days	Trips	Stores	BkHl	Miles	Hours	Stores	BkHl	Miles	Hours	Stores	BkHl
1586	Total	579599.8	35901.45	3047	8597	20007	1097	67.4	4.2	2.3	0.1	190.2	11.8	6.6	0.4
	Since 1/98	352433.0	21447.37	1809	5039	11885	554	69.9	4.3	2.4	0.1	194.8	11.9	6.6	0.3
	Before 1/98	227166.8	14454.08	1238	3558	8122	543.0	63.8	4.1	2.3	0.2	183.5	11.7	6.6	0.4
1998	May	1505.5	62.82	6	7	25	9	215.1	9.0	3.6	1.3	250.9	10.5	4.2	1.5
	Jun	4824.5	206.68	21	27	85	21	178.7	7.7	3.1	0.8	229.7	9.8	4.0	1.0
	Jul	4391.9	187.87	19	22	80	25	199.6	8.5	3.6	1.1	231.2	9.9	4.2	1.3
	Aug	4710.3	215.53	22	27	99	31	174.5	8.0	3.7	1.1	214.1	9.8	4.5	1.4
	Sep	4703.1	206.25	21	23	93	36	204.5	9.0	4.0	1.6	224.0	9.8	4.4	1.7
	Oct	5738.3	252.85	25	28	117	38	204.9	9.0	4.2	1.4	229.5	10.1	4.7	1.5
	Nov	4439.7	194.05	21	27	90	18	164.4	7.2	3.3	0.7	211.4	9.2	4.3	0.9
	Dec	6813.2	248.40	24	36	94	10	189.3	6.9	2.6	0.3	283.9	10.4	3.9	0.4
	Jan	6844.1	241.27	22	31	84	6	220.8	7.8	2.7	0.2	311.1	11.0	3.8	0.3
	Feb	4217.4	149.25	16	21	54	10	200.8	7.1	2.6	0.5	263.6	9.3	3.4	0.6
	Mar	4457.5	171.45	19	27	66	10	165.1	6.4	2.4	0.4	234.6	9.0	3.5	0.5
	Apr	5847.8	237.48	23	34	93	19	172.0	7.0	2.7	0.6	254.3	10.3	4.0	0.8
	May	6668.0	241.28	20	22	96	11	303.1	11.0	4.4	0.5	333.4	12.1	4.8	0.6
	Jun	8415.7	280.72	23	26	99	9	323.7	10.8	3.8	0.3	365.9	12.2	4.3	0.4
	Jul	8943.5	315.52	26	31	115	9	288.5	10.2	3.7	0.3	344.0	12.1	4.4	0.3
	Aug	3802.9	159.13	17	21	64	10	181.1	7.6	3.0	0.5	223.7	9.4	3.8	0.6
	Sep	4467.8	178.00	17	24	72	3	186.2	7.4	3.0	0.1	262.8	10.5	4.2	0.2
	Oct	5239.4	193.02	20	24	74	6	218.3	8.0	3.1	0.3	262.0	9.7	3.7	0.3
	Nov	4498.3	180.32	17	24	74	5	187.4	7.5	3.1	0.2	264.6	10.6	4.4	0.3
	Dec	3968.0	154.70	14	21	60	4	189.0	7.4	2.9	0.2	283.4	11.1	4.3	0.3
	Total	104496.9	4076.59	393	503	1634	290	207.7	8.1	3.2	0.6	265.9	10.4	4.2	0.7
Since 1/98		67370.4	2502.14	234	306	951	102	220.2	8.2	3.1	0.3	287.9	10.7	4.1	0.4
Before 1/98		37126.5	1574.45	159	197	683	188.0	188.5	8.0	3.5	1.0	233.5	9.9	4.3	1.2
1592	May	1817.3	77.50	6	8	32	13	227.2	9.7	4.0	1.6	302.9	12.9	5.3	2.2
	Jun	6105.8	255.33	22	23	102	46	265.5	11.1	4.4	2.0	277.5	11.6	4.6	2.1
	Jul	4880.1	208.20	21	21	87	32	232.4	9.9	4.1	1.5	232.4	9.9	4.1	1.5
	Aug	4848.6	222.55	23	23	96	33	210.8	9.7	4.2	1.4	210.8	9.7	4.2	1.4
	Sep	5475.1	248.52	24	25	112	42	219.0	9.9	4.5	1.7	228.1	10.4	4.7	1.8
	Oct	5876.1	253.90	25	25	112	40	235.0	10.2	4.5	1.6	235.0	10.2	4.5	1.6
	Nov	4728.6	214.82	22	23	93	32	205.6	9.3	4.0	1.4	214.9	9.8	4.2	1.5
	Dec	5165.9	228.88	24	24	103	36	215.2	9.5	4.3	1.5	215.2	9.5	4.3	1.5
	Jan	4776.1	216.82	23	25	97	34	191.0	8.7	3.9	1.4	207.7	9.4	4.2	1.5
	Feb	4101.5	190.17	18	21	86	29	195.3	9.1	4.1	1.4	227.9	10.6	4.8	1.6
	Mar	4676.5	228.25	22	22	101	44	212.6	10.4	4.6	2.0	212.6	10.4	4.6	2.0
	Apr	5368.0	247.32	24	26	105	39	206.5	9.5	4.0	1.5	223.7	10.3	4.4	1.6
	May	4352.2	199.30	20	23	84	26	189.2	8.7	3.7	1.1	217.6	10.0	4.2	1.3
	Jun	5627.1	266.33	24	27	109	44	208.4	9.9	4.0	1.6	234.5	11.1	4.5	1.8
	Jul	5652.6	262.65	26	32	105	31	176.6	8.2	3.3	1.0	217.4	10.1	4.0	1.2
	Aug	4687.0	209.45	22	25	88	27	187.5	8.4	3.5	1.1	213.0	9.5	4.0	1.2
	Sep	3096.3	153.78	16	22	72	22	140.7	7.0	3.3	1.0	193.5	9.6	4.5	1.4
	Oct	3863.9	173.03	19	27	81	19	143.1	6.4	3.0	0.7	203.4	9.1	4.3	1.0
	Nov	3261.1	134.35	15	18	62	16	181.2	7.5	3.4	0.9	217.4	9.0	4.1	1.1
	Dec	2438.1	102.42	12	12	45	12	203.2	8.5	3.8	1.0	203.2	8.5	3.8	1.0
	Total	90797.9	4093.57	408	452	1772	617	200.9	9.1	3.9	1.4	222.5	10.0	4.3	1.5
Since 1/98		51900.4	2383.87	241	280	1035	343	185.4	8.5	3.7	1.2	215.4	9.9	4.3	1.4
Before 1/98		38897.5	1709.70	167	172	737	274.0	226.1	9.9	4.3	1.6	232.9	10.2	4.4	1.6
1593	May	1021.7	40.50	4	4	18	6	255.4	10.1	4.5	1.5	255.4	10.1	4.5	1.5
	Jun	5752.6	243.32	22	29	103	29	198.4	8.4	3.6	1.0	261.5	11.1	4.7	1.3

Vehicle Usage Statistics

3/10/99

Vehicle	Month	Total						Per Trip				Per Day			
		Miles	Hours	Days	Trips	Stores	BkHl	Miles	Hours	Stores	BkHl	Miles	Hours	Stores	BkHl
1998	Jul	5146.2	216.18	19	26	91	25	197.9	8.3	3.5	1.0	270.9	11.4	4.8	1.3
	Aug	5868.9	250.13	24	27	109	37	217.4	9.3	4.0	1.4	244.5	10.4	4.5	1.5
	Sep	5441.4	244.08	23	25	116	46	217.7	9.8	4.6	1.8	236.6	10.6	5.0	2.0
	Oct	5342.3	232.78	23	25	105	42	213.7	9.3	4.2	1.7	232.3	10.1	4.6	1.8
	Nov	5712.2	221.58	22	25	90	31	228.5	8.9	3.6	1.2	259.6	10.1	4.1	1.4
	Dec	5263.8	219.67	21	25	99	28	210.6	8.8	4.0	1.1	250.7	10.5	4.7	1.3
	Jan	4503.4	182.42	18	18	79	21	250.2	10.1	4.4	1.2	250.2	10.1	4.4	1.2
	Feb	3878.5	161.82	16	16	73	22	242.4	10.1	4.6	1.4	242.4	10.1	4.6	1.4
	Mar	4061.5	166.03	17	19	74	20	213.8	8.7	3.9	1.1	238.9	9.8	4.4	1.2
	Apr	5159.0	197.18	19	23	79	16	224.3	8.6	3.4	0.7	271.5	10.4	4.2	0.8
	May	5367.2	214.75	20	24	92	16	223.6	8.9	3.8	0.7	268.4	10.7	4.6	0.8
	Jun	6638.4	263.20	24	30	108	17	221.3	8.8	3.6	0.6	276.6	11.0	4.5	0.7
	Jul	7847.6	307.98	26	37	131	20	212.1	8.3	3.5	0.5	301.8	11.8	5.0	0.8
	Aug	6385.0	256.68	24	28	110	20	228.0	9.2	3.9	0.7	266.0	10.7	4.6	0.8
	Sep	4365.0	173.85	17	18	74	16	242.5	9.7	4.1	0.9	256.8	10.2	4.4	0.9
	Oct	3787.9	148.45	14	14	64	18	270.6	10.6	4.6	1.3	270.6	10.6	4.6	1.3
	Nov	4400.1	172.55	17	20	72	13	220.0	8.6	3.6	0.7	258.8	10.2	4.2	0.8
	Dec	4134.5	163.08	16	16	69	17	258.4	10.2	4.3	1.1	258.4	10.2	4.3	1.1
	Total	100077.2	4076.23	386	449	1756	460	222.9	9.1	3.9	1.0	259.3	10.6	4.5	1.2
Since 1/98		60528.1	2407.99	228	263	1025	216	230.1	9.2	3.9	0.8	265.5	10.6	4.5	0.9
Before 1/98		39549.1	1668.24	158	186	731	244.0	212.6	9.0	3.9	1.3	250.3	10.6	4.6	1.5
Diesel	May	4344.5	180.82	16	19	75	28	228.7	9.5	3.9	1.5	271.5	11.3	4.7	1.8
	Jun	16682.9	705.33	65	79	290	96	211.2	8.9	3.7	1.2	256.7	10.9	4.5	1.5
	Jul	14418.2	612.25	59	69	258	82	209.0	8.9	3.7	1.2	244.4	10.4	4.4	1.4
	Aug	15427.8	688.21	69	77	304	101	200.4	8.9	3.9	1.3	223.6	10.0	4.4	1.5
	Sep	15619.6	698.85	68	73	321	124	214.0	9.6	4.4	1.7	229.7	10.3	4.7	1.8
	Oct	16956.7	739.53	73	78	334	120	217.4	9.5	4.3	1.5	232.3	10.1	4.6	1.6
	Nov	14880.5	630.45	65	75	273	81	198.4	8.4	3.6	1.1	228.9	9.7	4.2	1.2
	Dec	17242.9	696.95	69	85	296	74	202.9	8.2	3.5	0.9	249.9	10.1	4.3	1.1
	Jan	16123.6	640.51	63	74	260	61	217.9	8.7	3.5	0.8	255.9	10.2	4.1	1.0
	Feb	12197.4	501.24	50	58	213	61	210.3	8.6	3.7	1.1	243.9	10.0	4.3	1.2
	Mar	13195.5	565.73	58	68	241	74	194.1	8.3	3.5	1.1	227.5	9.8	4.2	1.3
	Apr	16374.8	681.98	66	83	277	74	197.3	8.2	3.3	0.9	248.1	10.3	4.2	1.1
	May	16387.4	655.33	60	69	272	53	237.5	9.5	3.9	0.8	273.1	10.9	4.5	0.9
	Jun	20681.2	810.25	71	83	316	70	249.2	9.8	3.8	0.8	291.3	11.4	4.5	1.0
	Jul	22443.7	886.15	78	100	351	60	224.4	8.9	3.5	0.6	287.7	11.4	4.5	0.8
	Aug	14874.9	625.26	63	74	262	57	201.0	8.4	3.5	0.8	236.1	9.9	4.2	0.9
	Sep	11929.1	505.63	50	64	218	41	186.4	7.9	3.4	0.6	238.6	10.1	4.4	0.8
	Oct	12891.2	514.50	53	65	219	43	198.3	7.9	3.4	0.7	243.2	9.7	4.1	0.8
	Nov	12159.5	487.22	49	62	208	34	196.1	7.9	3.4	0.5	248.2	9.9	4.2	0.7
	Dec	10540.6	420.20	42	49	174	33	215.1	8.6	3.6	0.7	251.0	10.0	4.1	0.8
	Total	295372.0	12246.39	1187	1404	5162	1367	210.4	8.7	3.7	1.0	248.8	10.3	4.3	1.2
Since 1/98		179798.9	7294.00	703	849	3011	661	211.8	8.6	3.5	0.8	255.8	10.4	4.3	0.9
Before 1/98		115573.1	4952.39	484	555	2151	706.0	208.2	8.9	3.9	1.3	238.8	10.2	4.4	1.5

Note: Number of stores includes backhauls.

Route/Duty Cycle

4/20/99

Fleet Comparison

Raley's Diesel Control and LNG Trucks

Period: May, June, July, 1997

Diesel Control	Total Mileage	Total Hours	Avg. MPH	Mileage per Day	Trips per Day	Avg No. of Stores per Trip	Avg No. of Backhaul Stops
1586	7679.9	171.97	45	259	1.2	2.3	0.9
1592	7825.7	167.83	47	270	1.0	2.6	1.5
1593	8250.2	186.83	44	268	1.2	2.7	1.1

Fleet Average: 45 266 1.1 2.5 1.2

LNG	Total Mileage	Total Hours	Avg. MPH	Mileage per Day	Trips per Day	Avg No. of Stores per Trip	Avg No. of Backhaul Stops
1501	5698.7	148.76	38	184	2.9	2.2	0.0
1502	5477.2	140.82	39	183	3.1	2.1	0.1
1503	6529.4	164.92	40	204	2.8	2.2	0.1
1504	7275.7	182.17	40	243	3.5	2.0	0.1
1505	4673.4	125.70	37	156	2.6	2.2	0.1
1506	6180.0	164.22	38	206	3.0	2.3	0.2
1507	5916.0	142.90	41	219	2.2	2.5	0.3
1508	5480.7	134.92	41	189	3.0	2.0	0.1

Fleet Average: 39 198 2.9 2.2 0.1

**Average Speed
Fleet Comparison**

4/20/99

Raley's Diesel Control and LNG Trucks

Period: 11/13/98 through 11/21/98

Truck	Total Mileage	Drive Time	Idle Time	MPH	Stores	Trips	Stores/Trip
1586	1552.0	2251	133	39.1	29	8	3.6
1592	1320.5	1848	1	42.9	24	8	3.0
1593	1416.1	2216	57	37.4	19	6	3.2
Sum/Avg.	4288.6	6315	191	39.6	72	22	3.3
1501	1116.1	1761	67	36.6	45	20	2.3
1502	839.6	1386	97	34.0	33	15	2.2
1504	1459.1	2261	17	38.4	39	18	2.2
1505	1106.7	1798	73	35.5	36	15	2.4
1506	1012.8	1606	4	37.7	30	14	2.1
1508	1326.0	2115	8	37.5	29	15	1.9
Sum/Avg.	6860.3	10927	266	36.8	212	97	2.2

Raley's
Monthly Mileage Calculations

3/23/99

Vehicle	End Odometer	End Date	Before 1/98				Since 1/98			
			Start Odometer	Start Date	Total Mileage	Avg per Month	Start Odometer	Start Date	Total Mileage	Avg per Month
1586	273792	12/31/98	153189	6/30/97	37115	6186	190304	12/31/97	83488	6957
1592	225511	12/31/98	125202	6/30/97	35420	5903	160622	12/31/97	64889	5407
1593	269861	12/31/98	159251	6/30/97	36424	6071	195675	12/31/97	74186	6182
Total		12/31/98		6/30/97	108959	6053		12/31/97	222563	6182
1501	79363	12/31/98	1365	4/30/97	31948	3994	33313	12/31/97	46050	3838
1502	88168	12/31/98	1413	4/30/97	30922	3865	32335	12/31/97	55833	4653
1503	88214	12/31/98	1318	4/30/97	36054	4507	37372	12/31/97	50842	4237
1504	109614	12/31/98	1318	4/30/97	40716	5090	42034	12/31/97	67580	5632
1505	77877	12/31/98	1135	4/30/97	24408	3051	25543	12/31/97	52334	4361
1506	88731	12/31/98	1423	4/30/97	34848	4356	36271	12/31/97	52460	4372
1507	95206	12/31/98	1446	4/30/97	37905	4738	39351	12/31/97	55855	4655
1508	93133	12/31/98	2165	4/30/97	40954	5119	43119	12/31/97	50014	4168
Total		12/31/98		4/30/97	277755	4340		12/31/97	430968	4489

Appendix D

Summary Statistics

Raley's/Ozark Trucking (Sacramento, CA) Fleet Summary Statistics

4/26/99

Fleet Operations and Economics	PMA 2-3		PMA 4-7	
	Diesel Control	LNG	Diesel Control	LNG
Number of Vehicles	3	8	3	8
Period Used for Fuel and Oil Op Anaysis	6/97 - 12/97	4/97 - 12/97	1/98 - 12/98	1/98 - 12/98
Total Number of Months in Period	6.5	8.5	12	12
Fuel and Oil Analysis Base Fleet Mileage	116,536	278,536	200,961	396,118
Period Used for Maintenance Op Analysis	12/95 - 6/96	8/97 - 12/97	6/96 - 5/97	1/98 - 12/98
Total Number of Months in Period	6	6	12	12
Maintenance Analysis Base Fleet Mileage	110,201	198,636	222,844	438,191
Average Monthly Mileage per Vehicle	6,053	4,340	6,182	4,489
Fleet Fuel Usage in Diesel #2 Equiv. Gal.	16,599	63,281	28,630	91,667
Representative Fleet MPG (energy equiv)	7.02	4.40	7.02	4.32
Ratio of MPG (AF/DC)		0.63		0.62
Average Fuel Cost as Reported (with tax)	1.17	0.74	1.01	0.65
	per Gal D2	per Gal LNG	per Gal D2	per Gal LNG
Average Fuel Cost per Energy Equivalent	1.17	1.29	1.01	1.09
Fuel Cost per Mile	0.167	0.293	0.144	0.252
Total Scheduled Repair Cost per Mile	0.018	0.028	0.021	0.038
Total Unscheduled Repair cost per Mile	0.016	0.047	0.026	0.058
Total Maintenance Cost per Mile	0.034	0.075	0.048	0.096
Total Operating Cost per Mile	0.201	0.368	0.192	0.348

Maintenance Costs

	Diesel Control	LNG	Diesel Control	LNG
Fleet Mileage	110,201	198,636	222,844	438,191
Total Parts Cost	983.49	5,775.86	5,464.09	25,381.36
Total Labor Hours	55.5	183.2	103.5	331.7
Average Labor Cost (@ \$50.00 per hour)	2,775.00	9,160.00	5,175.00	16,585.00
Total Maintenance Cost	3,758.49	14,935.86	10,639.09	41,966.36
Total Maintenance Cost per Truck	1,252.83	1,866.98	3,546.36	5,245.80
Total Maintenance Cost per Mile	0.034	0.075	0.048	0.096

Breakdown of Maintenance Costs by Vehicle System

	Diesel Control	LNG	Diesel Control	LNG
Fleet Mileage	110,201	198,636	222,844	438,191
Total Engine/Fuel-Related Systems (ATA VMRS 30, 31, 32, 33, 41, 42, 43, 44, 45)				
Parts Cost	456.90	3,561.21	1,328.30	13,103.31
Labor Hours	9.1	65.8	3.4	67.7
Average Labor Cost	455.00	3,290.00	170.00	3,385.00
Total Cost (for system)	911.90	6,851.21	1,498.30	16,488.31
Total Cost (for system) per Truck	303.97	856.40	499.43	2,061.04
Total Cost (for system) per Mile	0.0083	0.0345	0.0067	0.0376
Exhaust System Repairs (ATA VMRS 43)				
Parts Cost	25.50	16.58	25.50	0.00
Labor Hours	0.5	1.3	0.5	0.8
Average Labor Cost	25.00	65.00	25.00	40.00
Total Cost (for system)	50.50	81.58	50.50	40.00
Total Cost (for system) per Truck	16.83	10.20	16.83	5.00
Total Cost (for system) per Mile	0.0005	0.0004	0.0002	0.0001
Fuel System Repairs (ATA VMRS 44)				
Parts Cost	39.90	1,059.58	446.53	1,905.58
Labor Hours	0.8	31.7	1.3	43.2
Average Labor Cost	40.00	1,585.00	65.00	2,160.00
Total Cost (for system)	79.90	2,644.58	511.53	4,065.58
Total Cost (for system) per Truck	26.63	330.57	170.51	508.20
Total Cost (for system) per Mile	0.0007	0.0133	0.0023	0.0093
Power Plant (Engine) Repairs (ATA VMRS 45)				
Parts Cost	391.50	1,847.05	802.50	3,760.66
Labor Hours	7.3	24.8	0.6	8.4
Average Labor Cost	365.00	1,240.00	30.00	420.00
Total Cost (for system)	756.50	3,087.05	832.50	4,180.66
Total Cost (for system) per Truck	252.17	385.88	277.50	522.58
Total Cost (for system) per Mile	0.0069	0.0155	0.0037	0.0095
Electrical System Repairs (ATA VMRS 30-Electrical General, 31-Charging, 32-Cranking, 33-Ignition)				
Parts Cost	0.00	610.19	44.50	7,381.45
Labor Hours	0.5	7.2	0.5	13.7
Average Labor Cost	25.00	360.00	25.00	685.00
Total Cost (for system)	25.00	970.19	69.50	8,066.45
Total Cost (for system) per Truck	8.33	121.27	23.17	1,008.31
Total Cost (for system) per Mile	0.0002	0.0049	0.0003	0.0184

Breakdown of Maintenance Costs by Vehicle System (continued)

	Diesel Control	LNG	Diesel Control	LNG
Air Intake System Repairs (ATA VMRS 41)				
Parts Cost	0.00	0.00	0.00	0.00
Labor Hours	0.0	0.0	0.0	0.0
Average Labor Cost	0.00	0.00	0.00	0.00
Total Cost (for system)	0.00	0.00	0.00	0.00
Total Cost (for system) per Truck	0.00	0.00	0.00	0.00
Total Cost (for system) per Mile	0.0000	0.0000	0.0000	0.0000
Cooling System Repairs (ATA VMRS 42)				
Parts Cost	0.00	27.81	9.27	55.62
Labor Hours	0.0	0.8	0.5	1.6
Average Labor Cost	0.00	40.00	25.00	80.00
Total Cost (for system)	0.00	67.81	34.27	135.62
Total Cost (for system) per Truck	0.00	8.48	11.42	16.95
Total Cost (for system) per Mile	0.0000	0.0003	0.0002	0.0003
Brake System Repairs (ATA VMRS 13)				
Parts Cost	0.00	0.00	83.60	0.00
Labor Hours	0.0	0.0	1.5	0.6
Average Labor Cost	0.00	0.00	75.00	30.00
Total Cost (for system)	0.00	0.00	158.60	30.00
Total Cost (for system) per Truck	0.00	0.00	52.87	3.75
Total Cost (for system) per Mile	0.0000	0.0000	0.0007	0.0001
Transmission Repairs (ATA VMRS 26)				
Parts Cost	0.00	0.00	0.00	0.00
Labor Hours	0.0	0.0	0.0	0.0
Average Labor Cost	0.00	0.00	0.00	0.00
Total Cost (for system)	0.00	0.00	0.00	0.00
Total Cost (for system) per Truck	0.00	0.00	0.00	0.00
Total Cost (for system) per Mile	0.0000	0.0000	0.0000	0.0000
Clutch Repairs (ATA VMRS 23)				
Parts Cost	0.00	0.00	0.00	3.77
Labor Hours	0.0	0.3	0.0	0.3
Average Labor Cost	0.00	15.00	0.00	15.00
Total Cost (for system)	0.00	15.00	0.00	18.77
Total Cost (for system) per Truck	0.00	1.88	0.00	2.35
Total Cost (for system) per Mile	0.0000	0.0001	0.0000	0.0000

Breakdown of Maintenance Costs by Vehicle System (continued)

	Diesel Control	LNG	Diesel Control	LNG
Cab, Body, and Accessories Systems Repairs (ATA VMRS 02-Cab and Sheet Metal, 50-Accessories, 71-Body)				
Parts Cost	209.76	1,450.79	694.31	2,211.38
Labor Hours	7.0	24.4	18.5	51.0
Average Labor Cost	350.00	1,220.00	925.00	2,550.00
Total Cost (for system)	559.76	2,670.79	1,619.31	4,761.38
Total Cost (for system) per Truck	186.59	333.85	539.77	595.17
Total Cost (for system) per Mile	0.0051	0.0134	0.0073	0.0109
Inspections Only - no parts replacements (101)				
Parts Cost	0.00	0.00	0.00	0.00
Labor Hours	30.0	73.5	60.0	145.6
Average Labor Cost	1,500.00	3,675.00	3,000.00	7,280.00
Total Cost (for system)	1,500.00	3,675.00	3,000.00	7,280.00
Total Cost (for system) per Truck	500.00	459.38	1,000.00	910.00
Total Cost (for system) per Mile	0.0136	0.0185	0.0135	0.0166
HVAC System Repairs (ATA VMRS 01)				
Parts Cost	8.36	0.00	28.47	43.12
Labor Hours	0.3	1.7	1.4	4.4
Average Labor Cost	15.00	85.00	70.00	220.00
Total Cost (for system)	23.36	85.00	98.47	263.12
Total Cost (for system) per Truck	7.79	10.63	32.82	32.89
Total Cost (for system) per Mile	0.0002	0.0004	0.0004	0.0006
Air System Repairs (ATA VMRS 10)				
Parts Cost	19.47	69.28	253.08	217.04
Labor Hours	1.3	1.6	1.3	15.2
Average Labor Cost	65.00	80.00	65.00	760.00
Total Cost (for system)	84.47	149.28	318.08	977.04
Total Cost (for system) per Truck	28.16	18.66	106.03	122.13
Total Cost (for system) per Mile	0.0008	0.0008	0.0014	0.0022
Lighting System Repairs (ATA VMRS 34)				
Parts Cost	44.00	133.98	146.01	356.76
Labor Hours	4.1	8.8	5.8	21.8
Average Labor Cost	205.00	440.00	290.00	1,090.00
Total Cost (for system)	249.00	573.98	436.01	1,446.76
Total Cost (for system) per Truck	83.00	71.75	145.34	180.85
Total Cost (for system) per Mile	0.0023	0.0029	0.0020	0.0033

Breakdown of Maintenance Costs by Vehicle System (continued)

	Diesel Control	LNG	Diesel Control	LNG
Frame, Steering, and Suspension Repairs (ATA VMRS 14-Frame, 15-Steering, 16-Suspension)				
Parts Cost	30.00	80.00	105.32	317.34
Labor Hours	1.3	0.0	2.3	3.7
Average Labor Cost	65.00	0.00	115.00	185.00
Total Cost (for system)	95.00	80.00	220.32	502.34
Total Cost (for system) per Truck	31.67	10.00	73.44	62.79
Total Cost (for system) per Mile	0.0009	0.0004	0.0010	0.0011
Axle, Wheel, and Drive Shaft Repairs (ATA VMRS 11-Front Axle, 18-Wheels, 22-Rear Axle, 24-Drive Shaft)				
Parts Cost	0.00	0.60	190.00	20.14
Labor Hours	0.0	0.8	0.0	0.0
Average Labor Cost	0.00	40.00	0.00	0.00
Total Cost (for system)	0.00	40.60	190.00	20.14
Total Cost (for system) per Truck	0.00	5.08	63.33	2.52
Total Cost (for system) per Mile	0.0000	0.0002	0.0009	0.0000
Tire Repairs (ATA VMRS 17)				
Parts Cost	215.00	480.00	2,635.00	9,108.50
Labor Hours	2.4	6.3	9.3	21.4
Average Labor Cost	120.00	315.00	465.00	1,070.00
Total Cost (for system)	335.00	795.00	3,100.00	10,178.50
Total Cost (for system) per Truck	111.67	99.38	1,033.33	1,272.31
Total Cost (for system) per Mile	0.0030	0.0040	0.0139	0.0232

Notes

1. The alternative fuel affected systems were chosen to include only those systems of the vehicles that could be directly impacted by the selection of an alternative fuel.
2. ATA VMRS coding is based on parts that were replaced. If there was no part replaced in a given repair, then the code was chosen by the system being worked on.
3. In general, inspections (with no part replacements) were only included in the overall totals (not by system). 101 was created to track labor costs for PMA inspections.
4. ATA VMRS 02-Cab and Sheet Metal represents seats, doors, etc.; ATA VMRS 50-Accessories represents things like fire extinguishers, test kits, etc.; ATA VMRS 71-Body represent mostly windows and windshields.
5. Average labor cost is assumed to be \$50 per hour.
6. Warranty costs are not included.
7. Diesel and LNG fuel prices shown include federal and state tax. Diesel price is calculated as a weighted average of fuel used in the analysis period.

Appendix E

Monthly Fuel and Engine Oil Consumption by Truck and Fuel Economy Analysis

Raley's Fueling
April 16, 1997 through December 31, 1998

4/22/99

Group Total	Diesel Control																				Before 1/98		After 1/98	
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total	
Total Mileage			13,116	19,673	17,637	17,494	18,659	16,810	18,686	17,256	15,451	16,069	20,007	22,662	23,336	23,679	18,851	17,376	16,750	15,582	15,544	122,075	222,563	
Fuel Mileage Base			13,116	18,532	17,637	14,128	18,096	16,341	18,686	15,833	13,673	13,724	19,455	20,813	19,828	21,136	17,980	16,679	14,445	14,045	13,350	116,536	200,961	
Fuel (D2)			1856.7	2622.6	2559.6	1977.4	2570.6	2340.2	2672.2	2376.2	1988.3	1979.5	2723.1	2894.2	2751.2	3015.1	2530.0	2328.3	2042.7	2095.3	1906.4	16599.2	28630.3	
MPG			7.06	7.07	6.89	7.14	7.04	6.98	6.99	6.66	6.88	6.93	7.14	7.19	7.21	7.01	7.11	7.16	7.07	6.70	7.00	7.02	7.02	
Oil Consumption			0	7	3	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Oil Qts per 1000																								
Min Odometer			125,202	131,723	918	6,861	12,650	2,766	8,616	14,281	19,407	24,740	30,825	36,650	43,171	49,564	55,268	59,950	65,171	69,418	73,505			
Max Odometer			159,251	165,776	137,065	143,101	149,573	19,131	26,304	33,195	38,750	44,022	51,206	60,634	69,660	79,325	85,437	91,968	98,728	104,347	109,792			

Group Total	LNG Trucks																				Before 1/98	Since 1/98	
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	10,486	38,407	37,751	32,610	32,267	32,173	39,102	31,720	33,723	34,695	27,109	40,192	40,276	39,507	41,215	37,058	38,180	35,960	35,657	29,900	31,221	288,239	430,970
Fuel Mileage Base	10,486	38,086	36,035	31,254	30,730	30,563	38,150	30,506	32,726	33,665	24,051	37,274	36,194	35,345	38,342	31,879	37,089	34,282	31,892	25,909	30,196	278,536	396,118
Fuel (LNG, lbs)	15,436	49,480	47,897	42,640	40,760	40,913	50,076	41,254	44,589	45,106	33,062	49,712	48,042	46,952	50,469	43,889	53,905	47,148	39,571	35,666	35,236	373,045	528,757
LNG std gal	4,372.8	14,017.0	13,568.6	12,079.2	11,546.7	11,590.1	14,185.9	11,686.8	12,631.5	12,778.0	9,365.9	14,082.6	13,609.7	13,300.8	14,297.1	12,433.1	15,270.6	13,356.3	12,415.7	10,103.6	12,071.3	105,678.5	153,084.4
Fuel (D2 EQ)	2,618.4	8,393.4	8,124.9	7,233.1	6,914.2	6,940.2	8,494.5	6,998.1	7,563.8	7,651.5	5,608.3	8,432.7	8,149.5	7,964.5	8,561.1	7,445.0	9,144.1	7,997.8	7,434.5	6,050.0	7,228.3	63,280.6	91,667.3
MPG	2.40	2.72	2.66	2.59	2.66	2.64	2.69	2.61	2.59	2.63	2.57	2.65	2.66	2.66	2.68	2.56	2.43	2.57	2.57	2.56	2.50	2.64	2.59
MPEG	4.00	4.54	4.44	4.32	4.44	4.40	4.49	4.36	4.33	4.40	4.29	4.42	4.44	4.44	4.48	4.28	4.06	4.29	4.29	4.28	4.18	4.40	4.32
Oil Consumption			46	37	31	8	44	59	48	27	74	20	20	37	51	20	52	32	24	44	40	273.00	441.00
Oil Qts per 1000			1.22	1.18	1.11	0.91	0.95	1.09	1.14	1.09	1.24	1.15	1.08	1.07	1.09	1.05	1.07	1.06	1.03	1.05	1.07	1.14	1.02
Min Odometer	1,135	4,555	8,026	11,037	12,839	15,019	19,558	23,192	25,543	28,070	29,152	33,175	37,811	43,173	48,898	54,073	58,723	63,837	68,401	72,633	77,877		
Max Odometer	2,165	7,789	12,598	17,954	23,443	28,803	33,698	38,553	43,119	48,746	53,099	59,744	66,700	71,769	77,084	82,735	88,324	94,353	99,450	104,396	109,614		

1586	Diesel Control																				Before 1/98	After 1/98	
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage			3,971	6,627	6,089	5,515	6,398	5,313	7,173	6,891	5,555	5,272	7,184	9,428	9,026	9,665	6,112	6,531	6,760	5,619	5,445	41,086	83,488
Fuel Mileage Base			3,971	6,627	6,089	4,254	6,036	5,313	7,173	6,891	4,660	5,272	7,184	8,001	7,323	8,699	6,112	5,834	5,400	5,619	4,178	39,463	75,173
Fuel (D2)			563.1	924.4	859.1	599.8	839.7	761.7	1031.8	1075.2	680.8	747.3	1001.3	1117.3	982.1	1212.4	837.4	807.5	774.6	869.1	597.8	5579.5	10702.7
MPG			7.05	7.17	7.09	7.09	7.19	6.98	6.95	6.41	6.85	7.05	7.17	7.16	7.46	7.18	7.30	7.22	6.97	6.47	6.99	7.07	7.02
Oil Consumption				3.00			6.00																
Oil Qts per 1000																							
End Odometer			153,189	159,816	1,905	7,420	13,818	19,131	26,304	33,195	38,750	44,022	51,206	60,634	69,660	79,325	85,437	91,968	98,728	104,347	109,792	26,304	109,792

1592	Diesel Control																				Before 1/98	After 1/98	
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage			4,740	6,521	5,342	6,036	6,472	5,199	5,850	5,665	5,126	5,333	6,085	5,825	6,521	6,393	5,704	4,682	5,221	4,247	4,087	40,160	64,889
Fuel Mileage Base			4,740	6,521	5,342	5,302	6,271	4,730	5,850	4,709	4,243	4,530	6,085	5,403	5,318	6,393	5,704	4,682	4,560	3,304	3,623	38,756	58,554
Fuel (D2)			674.1	900.2	771.0	721.3	878.2	661.2	812.8	663.2	606.3	643.4	867.8	750.7	761.2	924.0	825.0	687.7	657.7	462.5	534.5	5418.8	8383.8
MPG			7.03	7.24	6.93	7.35	7.14	7.15	7.20	7.10	7.00	7.04	7.01	7.20	6.99	6.92	6.91	6.81	6.93	7.14	6.78	7.15	6.98
Oil Consumption				4.00	3.00																		
Oil Qts per 1000																							
End Odometer			125,202	131,723	137,065	143,101	149,573	2,766	8,616	14,281	19,407	24,740	30,825	36,650	43,171	49,564	55,268	59,950	65,171	69,418	73,505	8,616	73,505

1593	Diesel Control																					Before 1/98	After 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage			4,405	6,525	6,206	5,943	5,789	6,298	5,663	4,700	4,770	5,464	6,738	7,409	7,789	7,621	7,035	6,163	4,769	5,716	6,012	40,829	74,186
Fuel Mileage Base			4,405	5,384	6,206	4,572	5,789	6,298	5,663	4,233	4,770	3,922	6,186	7,409	7,187	6,044	6,164	6,163	4,485	5,122	5,549	38,317	67,234
Fuel (D2)			619.5	798.0	929.5	656.4	852.7	917.3	827.6	637.9	701.3	588.8	854.0	1026.2	1008.0	878.7	867.6	833.1	610.4	763.7	774.1	5601.0	9543.8
MPG			7.11	6.75	6.68	6.97	6.79	6.87	6.84	6.64	6.80	6.66	7.24	7.22	7.13	6.88	7.10	7.40	7.35	6.71	7.17	6.84	7.04
Oil Consumption																							
Oil Qts per 1000																							
End Odometer			159,251	165,776	918	6,861	12,650	18,948	24,611	29,311	34,081	39,545	46,283	53,692	61,481	69,102	76,137	82,300	87,069	92,785	98,797	24,611	98,797

1501	LNG Truck																					Before 1/98	Since 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	1,293	4,421	4,643	3,138	4,033	4,053	4,328	3,430	3,902	2,031	2,648	3,634	3,115	5,416	4,880	5,303	4,101	3,017	4,597	4,102	3,206	33,241	46,050
Fuel Mileage Base	1,293	4,421	4,643	3,138	4,033	4,053	4,328	3,430	3,902	2,031	2,648	3,634	2,737	4,887	4,880	4,591	3,825	3,017	4,597	3,564	3,206	33,241	43,616
Fuel (LNG, lbs)	2317.14	5834.42	6128.94	4275.81	5065.76	5086.03	5692.51	4245.62	5129.62	2889.57	3350.02	4868.30	3492.95	6294.00	6243.91	6294.38	5740.28	4465.12	5815.45	4798.21	3377.27	43775.85	57629.46
LNG std gal	656.4	1,652.8	1,736.2	1,211.3	1,435.1	1,440.8	1,612.6	1,202.7	1,453.2	818.6	949.0	1,379.1	989.5	1,783.0	1,768.8	1,783.1	1,626.1	1,264.9	1,710.4	1,359.3	1,262.8	12,401.1	16,694.6
Fuel (D2 EQ)	393.1	989.7	1,039.7	725.3	859.3	862.8	965.6	720.2	870.1	490.2	568.3	825.8	592.5	1,067.7	1,059.2	1,067.7	973.7	757.4	1,024.2	813.9	756.1	7,425.8	9,996.8
MPG	1.97	2.67	2.67	2.59	2.81	2.81	2.68	2.85	2.68	2.48	2.79	2.64	2.77	2.74	2.76	2.57	2.35	2.39	2.69	2.62	2.54	2.68	2.61
MPEG	3.29	4.47	4.47	4.33	4.69	4.70	4.48	4.76	4.48	4.14	4.66	4.40	4.62	4.58	4.61	4.30	3.93	3.98	4.49	4.38	4.24	4.48	4.36
Oil Consumption			4.00	8.00	4.00	2.00	12.00	8.00	8.00	0.00	4.00	4.00	0.00	10.00	12.00	8.00	12.00	0.00	7.00	4.00	4.00	46.00	65.00
Oil Qts per 1000			0.86	1.54	1.35	1.13	1.49	1.61	1.67	1.56	1.55	1.51	1.39	1.44	1.54	1.54	1.64	1.56	1.55	1.52	1.51	1.67	1.41
End Odometer	1,365	5,786	10,429	13,567	17,600	21,653	25,981	29,411	33,313	35,344	37,992	41,626	44,741	50,157	55,037	60,340	64,441	67,458	72,055	76,157	79,363	33,313	79,363

1502	LNG Truck																				Before 1/98		Since 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	1,288	4,443	4,580	3,508	3,738	3,429	4,757	2,572	3,895	4,400	3,234	3,415	5,401	6,085	4,663	5,003	5,158	5,653	4,910	3,515	4,396	32,210	55,833
Fuel Mileage Base	1,288	4,443	4,580	3,508	3,738	3,429	4,435	2,572	3,895	4,400	2,906	3,415	4,879	5,828	4,663	3,432	5,158	4,992	4,435	3,048	4,396	31,888	51,552
Fuel (LNG, lbs)	1791.81	5702.89	6078.60	4979.38	5115.89	5036.15	6205.35	3791.98	5478.01	6055.07	3932.73	4809.37	6458.01	7365.47	5921.75	4432.07	7038.76	6413.88	5134.26	4128.84	4580.50	44180.06	66270.71
LNG std gal	507.6	1,615.5	1,722.0	1,410.6	1,449.3	1,426.7	1,757.9	1,074.2	1,551.8	1,715.3	1,114.1	1,362.4	1,829.5	2,086.5	1,677.5	1,255.5	1,994.0	1,817.0	1,638.9	1,169.6	1,622.3	12,515.6	19,282.7
Fuel (D2 EQ)	303.9	967.4	1,031.1	844.7	867.8	854.3	1,052.6	643.2	929.2	1,027.1	667.1	815.8	1,095.5	1,249.4	1,004.5	751.8	1,194.0	1,088.0	981.4	700.4	971.4	7,494.4	11,546.5
MPG	2.54	2.75	2.66	2.49	2.58	2.40	2.52	2.39	2.51	2.57	2.61	2.51	2.67	2.79	2.78	2.73	2.59	2.75	2.71	2.61	2.71	2.55	2.67
MPEG	4.24	4.59	4.44	4.15	4.31	4.01	4.21	4.00	4.19	4.28	4.36	4.19	4.45	4.66	4.64	4.56	4.32	4.59	4.52	4.35	4.53	4.25	4.46
Oil Consumption			6.00	0.00	2.00	0.00	2.00	8.00	3.00	4.00	4.00	0.00	0.00	2.00	11.00	2.00	13.00	6.00	6.00	4.00	5.00	21.00	57.00
Oil Qts per 1000			1.31	0.74	0.68	0.52	0.50	0.80	0.79	0.81	0.85	0.77	0.68	0.63	0.78	0.75	0.89	0.91	0.93	0.94	0.95	0.79	1.02
End Odometer	1,413	5,856	10,436	13,944	17,682	21,111	25,868	28,440	32,335	36,735	39,969	43,384	48,785	54,870	59,533	64,536	69,694	75,347	80,257	83,772	88,168	32,335	88,168

1503	LNG Truck																					Before 1/98	Since 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	1,228	4,941	4,888	4,936	2,816	3,581	6,020	4,356	4,516	5,650	3,858	5,398	6,083	5,878	6,264	4,404	4,718	2,657	3,778	320	1,834	37,282	50,842
Fuel Mileage Base	1,228	4,941	4,521	4,548	2,816	3,581	5,738	4,356	4,188	5,564	3,858	5,398	5,638	4,730	5,470	3,897	4,718	2,657	3,275	320	1,834	35,917	47,359
Fuel (LNG, lbs)	2169.01	6547.27	5933.27	5874.85	4245.85	5121.01	7596.92	6112.00	5685.77	7457.16	5468.47	7370.92	7386.43	6756.54	7413.35	5116.47	7441.50	3674.37	4247.24	538.19	2717.86	49285.95	65588.50
LNG std gal	614.5	1,854.8	1,680.8	1,664.3	1,202.8	1,450.7	2,152.1	1,731.4	1,610.7	2,112.5	1,549.1	2,088.1	2,092.5	1,914.0	2,100.1	1,449.4	2,108.1	1,040.9	1,367.6	152.5	837.4	13,962.0	18,812.2
Fuel (D2 EQ)	367.9	1,110.6	1,006.5	996.6	720.2	868.7	1,288.7	1,036.8	964.5	1,265.0	927.6	1,250.3	1,253.0	1,146.1	1,257.5	867.9	1,262.3	623.3	818.9	91.3	501.4	8,360.5	11,264.8
MPG	2.00	2.66	2.69	2.73	2.34	2.47	2.67	2.52	2.60	2.63	2.49	2.59	2.69	2.47	2.60	2.69	2.24	2.55	2.39	2.10	2.19	2.57	2.52
MPEG	3.34	4.45	4.49	4.56	3.91	4.12	4.45	4.20	4.34	4.40	4.16	4.32	4.50	4.13	4.35	4.49	3.74	4.26	4.00	3.51	3.66	4.30	4.20
Oil Consumption			3.00	10.00	6.00	2.00	16.00	12.00	12.00	7.00	15.00	4.00	8.00	3.00	4.00	2.00	7.00	0.00	0.00	0.00	0.00	61.00	50.00
Oil Qts per 1000			0.61	1.32	1.50	1.29	1.66	1.84	1.96	1.85	2.04	1.89	1.82	1.69	1.59	1.51	1.51	1.46	1.39	1.39	1.35	1.96	0.98
End Odometer	1,318	6,259	11,147	16,083	18,899	22,480	28,500	32,856	37,372	43,022	46,880	52,278	58,361	64,239	70,503	74,907	79,625	82,282	86,060	86,380	88,214	37,372	88,214

1504	LNG Truck																				Before 1/98		Since 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	1,212	5,574	5,706	5,356	5,489	5,360	3,424	4,397	5,410	5,767	4,028	7,916	6,956	5,069	5,315	5,651	5,589	6,029	5,097	4,946	5,218	41,928	67,581
Fuel Mileage Base	1,212	5,574	5,706	5,356	5,021	4,612	3,424	3,771	5,410	5,506	3,144	7,044	6,525	4,114	5,315	4,609	5,200	6,029	4,035	4,314	4,581	40,085	60,416
Fuel (LNG, lbs)	1672.28	6864.05	7263.21	6686.60	6137.01	5544.54	4595.95	5131.85	7067.79	7307.87	4347.02	8989.26	8772.23	5344.07	6856.31	6400.10	7410.99	8026.15	4924.18	6058.42	5117.29	50963.28	79553.89
LNG std gal	473.7	1,944.5	2,057.6	1,894.2	1,738.5	1,570.7	1,302.0	1,453.8	2,002.2	2,070.2	1,231.5	2,546.5	2,485.1	1,513.9	1,942.3	1,813.1	2,099.4	2,273.7	1,505.0	1,716.3	1,811.9	14,437.2	23,008.8
Fuel (D2 EQ)	283.7	1,164.4	1,232.1	1,134.3	1,041.0	940.5	779.6	870.5	1,198.9	1,239.7	737.4	1,524.9	1,488.1	906.5	1,163.1	1,085.7	1,257.1	1,361.5	901.2	1,027.7	1,085.0	8,645.0	13,777.7
MPG	2.56	2.87	2.77	2.83	2.89	2.94	2.63	2.59	2.70	2.66	2.55	2.77	2.63	2.72	2.74	2.54	2.48	2.65	2.68	2.51	2.53	2.78	2.63
MPEG	4.27	4.79	4.63	4.72	4.82	4.90	4.39	4.33	4.51	4.44	4.26	4.62	4.39	4.54	4.57	4.25	4.14	4.43	4.48	4.20	4.22	4.64	4.39
Oil Consumption			9.00	3.00	2.00	2.00	0.00	5.00	6.00	4.00	8.00	0.00	8.00	7.00	4.00	0.00	8.00	8.00	7.00	7.00	4.00	27.00	65.00
Oil Qts per 1000			1.58	1.08	0.85	0.73	0.63	0.71	0.77	0.76	0.87	0.74	0.79	0.83	0.83	0.76	0.81	0.85	0.88	0.90	0.90	0.77	0.96
End Odometer	1,318	6,892	12,598	17,954	23,443	28,803	32,227	36,624	42,034	47,800	51,828	59,744	66,700	71,769	77,084	82,735	88,324	94,353	99,450	104,396	109,614	42,034	109,614

1505	LNG Truck																				Before 1/98		Since 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	789	3,420	3,471	3,011	1,802	2,180	4,539	3,634	2,351	2,527	1,082	4,023	4,636	5,362	5,725	5,175	4,650	5,114	4,564	4,232	5,244	25,197	52,334
Fuel Mileage Base	789	3,420	3,471	3,011	1,802	2,180	4,539	3,634	2,351	2,294	1,082	3,687	4,214	4,639	5,012	4,543	4,650	5,114	3,945	3,642	5,244	25,197	48,066
Fuel (LNG, lbs)	1189.74	4846.85	4897.27	4420.74	2609.19	3337.10	6122.30	4958.20	3487.58	2977.79	1669.98	4970.32	5771.07	6213.11	6488.65	6162.92	6950.65	7127.20	4946.03	5103.13	6579.01	35868.97	64959.86
LNG std gal	337.0	1,373.0	1,387.3	1,252.3	739.1	945.4	1,734.4	1,404.6	988.0	843.6	473.1	1,408.0	1,634.9	1,760.1	1,838.1	1,745.9	1,969.0	2,019.0	1,585.1	1,445.6	2,184.5	10,161.2	18,906.9
Fuel (D2 EQ)	201.8	822.2	830.7	749.9	442.6	566.1	1,038.5	841.1	591.6	505.1	283.3	843.1	979.0	1,053.9	1,100.7	1,045.4	1,179.1	1,209.0	949.1	865.7	1,308.1	6,084.5	11,321.5
MPG	2.34	2.49	2.50	2.40	2.44	2.31	2.62	2.59	2.38	2.72	2.29	2.62	2.58	2.64	2.73	2.60	2.36	2.53	2.49	2.52	2.40	2.48	2.54
MPEG	3.91	4.16	4.18	4.02	4.07	3.85	4.37	4.32	3.97	4.54	3.82	4.37	4.30	4.40	4.55	4.35	3.94	4.23	4.16	4.21	4.01	4.14	4.25
Oil Consumption			4.00	4.00	4.00	0.00	0.00	7.00	7.00	0.00	4.00	4.00	0.00	5.00	8.00	0.00	4.00	4.00	0.00	8.00	9.00	26.00	46.00
Oil Qts per 1000			1.15	1.23	1.45	1.15	0.80	1.02	1.24	1.11	1.22	1.19	1.02	1.01	1.06	0.95	0.94	0.93	0.86	0.93	0.98	1.24	0.88
End Odometer	1,135	4,555	8,026	11,037	12,839	15,019	19,558	23,192	25,543	28,070	29,152	33,175	37,811	43,173	48,898	54,073	58,723	63,837	68,401	72,633	77,877	25,543	77,877

1506	LNG Truck																					Before 1/98	Since 1/98
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total
Total Mileage	1,316	4,612	4,986	4,705	4,189	5,106	4,682	2,968	3,600	4,545	4,351	5,640	5,520	4,625	4,188	4,247	3,891	3,350	4,144	4,240	3,719	36,164	52,460
Fuel Mileage Base	1,316	4,612	4,864	4,481	3,922	4,245	4,334	2,968	3,600	4,096	3,657	4,682	4,515	4,344	4,188	4,247	3,891	3,350	4,038	3,719	3,719	34,342	48,446
Fuel (LNG, lbs)	1944.81	6337.43	6571.15	5988.37	5351.12	5641.83	5548.69	4203.62	5257.91	5638.76	5124.23	6233.59	6217.05	6151.74	6068.54	6039.42	5769.93	4675.76	5027.63	5059.24	4461.90	46844.93	66467.79
LNG std gal	550.9	1,795.3	1,861.5	1,696.4	1,515.9	1,598.3	1,571.9	1,190.8	1,489.5	1,597.4	1,451.6	1,765.9	1,761.2	1,742.7	1,719.1	1,710.9	1,634.5	1,324.6	1,558.0	1,433.2	1,452.5	13,270.5	19,151.7
Fuel (D2 EQ)	329.9	1,075.0	1,114.7	1,015.8	907.7	957.0	941.2	713.1	891.9	956.5	869.2	1,057.4	1,054.6	1,043.5	1,029.4	1,024.5	978.8	793.2	932.9	858.2	869.8	7,946.4	11,468.1
MPG	2.39	2.57	2.61	2.64	2.59	2.66	2.76	2.49	2.42	2.56	2.52	2.65	2.56	2.49	2.44	2.48	2.38	2.53	2.59	2.59	2.56	2.59	2.53
MPEG	3.99	4.29	4.36	4.41	4.32	4.44	4.60	4.16	4.04	4.28	4.21	4.43	4.28	4.16	4.07	4.15	3.98	4.22	4.33	4.33	4.28	4.32	4.22
Oil Consumption			10.00	2.00	4.00	2.00	0.00	2.00	0.00	0.00	12.00	0.00	0.00	4.00	2.00	0.00	4.00	0.00	0.00	5.00	9.00	20.00	36.00
Oil Qts per 1000			2.01	1.24	1.15	0.95	0.76	0.75	0.66	0.58	0.82	0.71	0.64	0.66	0.64	0.60	0.62	0.59	0.56	0.60	0.68	0.66	0.69
End Odometer	1,423	6,035	11,021	15,726	19,915	25,021	29,703	32,671	36,271	40,816	45,167	50,807	56,327	60,952	65,140	69,387	73,278	76,628	80,772	85,012	88,731	36,271	88,731

1507	LNG Truck																				Before 1/98		Since 1/98	
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total	
Total Mileage	1,342	5,372	4,816	3,641	4,570	2,975	5,538	5,508	5,485	4,147	3,555	5,053	4,777	4,791	5,511	4,378	5,029	5,583	5,265	4,098	3,668	39,247	55,855	
Fuel Mileage Base	1,342	5,372	4,096	3,248	4,516	2,975	5,538	4,920	5,143	4,147	3,525	4,689	4,378	4,523	4,572	4,005	5,029	5,151	4,651	3,645	3,668	37,150	51,982	
Fuel (LNG, lbs)	1717.97	6640.18	5676.49	4614.91	5963.29	4016.31	7016.81	6312.70	6805.77	5651.81	4647.42	6330.28	5728.22	5887.22	6008.60	5847.22	7315.10	7323.64	5523.92	5169.40	4121.79	48764.43	69554.62	
LNG std gal	486.7	1,881.1	1,608.1	1,307.3	1,689.3	1,137.8	1,987.8	1,788.3	1,928.0	1,601.1	1,316.5	1,793.3	1,622.7	1,667.8	1,702.2	1,656.4	2,072.3	2,074.7	1,820.5	1,464.4	1,492.2	13,814.3	20,284.0	
Fuel (D2 EQ)	291.4	1,126.4	962.9	782.8	1,011.6	681.3	1,190.3	1,070.8	1,154.5	958.7	788.4	1,073.8	971.7	998.7	1,019.3	991.9	1,240.9	1,242.3	1,090.1	876.9	893.5	8,272.0	12,146.1	
MPG	2.76	2.86	2.55	2.48	2.67	2.61	2.79	2.75	2.67	2.59	2.68	2.61	2.70	2.71	2.69	2.42	2.43	2.48	2.55	2.49	2.46	2.69	2.56	
MPEG	4.60	4.77	4.25	4.15	4.46	4.37	4.65	4.59	4.45	4.33	4.47	4.37	4.51	4.53	4.49	4.04	4.05	4.15	4.27	4.16	4.11	4.49	4.28	
Oil Consumption			10.00	4.00	4.00	0.00	4.00	4.00	4.00	6.00	11.00	4.00	0.00	6.00	2.00	4.00	4.00	7.00	4.00	8.00	2.00	30.00	58.00	
Oil Qts per 1000			2.08	1.66	1.38	1.12	1.02	0.96	0.92	0.98	1.17	1.13	1.02	1.04	0.98	0.97	0.96	0.98	0.97	1.02	1.00	0.92	1.04	
End Odometer	1,446	6,818	11,634	15,275	19,845	22,820	28,358	33,866	39,351	43,498	47,053	52,106	56,883	61,674	67,185	71,563	76,592	82,175	87,440	91,538	95,206	39,351	95,206	

1508	LNG Truck																				Before 1/98		Since 1/98	
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total	Total	
Total Mileage	2,018	5,624	4,661	4,315	5,630	5,489	5,814	4,855	4,566	5,627	4,353	5,113	3,788	2,281	4,669	2,897	5,044	4,557	3,302	4,447	3,936	42,972	50,014	
Fuel Mileage Base	2,018	5,303	4,155	3,963	4,882	5,489	5,814	4,855	4,238	5,627	3,231	4,725	3,308	2,281	4,242	2,555	4,618	3,972	2,916	3,657	3,548	40,717	44,680	
Fuel (LNG, lbs)	2633.19	6706.88	5348.18	5798.97	6271.69	7130.09	7297.53	6498.46	5676.72	7128.18	4521.66	6139.60	4216.15	2939.60	5467.72	3596.18	6237.93	5441.47	3952.69	4810.14	4280.43	53361.71	58731.75	
LNG std gal	745.9	1,900.0	1,515.1	1,642.8	1,776.7	2,019.9	2,067.3	1,840.9	1,608.1	2,019.3	1,280.9	1,739.3	1,194.4	832.7	1,548.9	1,018.7	1,767.1	1,541.5	1,230.2	1,362.6	1,407.7	15,116.6	16,943.5	
Fuel (D2 EQ)	446.7	1,137.7	907.2	983.7	1,063.9	1,209.5	1,237.9	1,102.3	963.0	1,209.2	767.0	1,041.5	715.2	498.7	927.5	610.0	1,058.2	923.0	736.6	816.0	842.9	9,051.9	10,145.8	
MPG	2.71	2.79	2.74	2.41	2.75	2.72	2.81	2.64	2.64	2.79	2.52	2.72	2.77	2.74	2.74	2.51	2.61	2.58	2.37	2.68	2.52	2.69	2.64	
MPEG	4.52	4.66	4.58	4.03	4.59	4.54	4.70	4.40	4.40	4.65	4.21	4.54	4.63	4.57	4.57	4.19	4.36	4.30	3.96	4.48	4.21	4.50	4.40	
Oil Consumption			0.00	6.00	5.00	0.00	10.00	13.00	8.00	6.00	16.00	4.00	4.00	0.00	8.00	4.00	0.00	7.00	0.00	8.00	7.00	42.00	64.00	
Oil Qts per 1000			0.00	0.67	0.75	0.55	0.81	1.11	1.19	1.17	1.41	1.35	1.33	1.27	1.31	1.31	1.22	1.24	1.18	1.22	1.24	1.19	1.28	
End Odometer	2,165	7,789	12,450	16,765	22,395	27,884	33,698	38,553	43,119	48,746	53,099	58,212	62,000	64,281	68,950	71,847	76,891	81,448	84,750	89,197	93,133	43,119	93,133	

101	LNG Yard Tractor																					
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total
Hours	32	305	313	194	166	157	186	156	201	223	162	170	185	223	260	273	299	315	309	340	342	4,811
Fuel (LNG, lbs)	668.80	5234.32	6005.96	3599.61	2856.12	2533.57	2933.59	1996.73	2490.72	2833.33	1518.82	2132.49	2307.02	3226.43	3621.96	4618.15	5490.57	5750.94	4531.14	5154.39	4571.51	74076.17
LNG std gal	189.5	1,482.8	1,701.4	1,019.7	809.1	717.7	831.0	565.6	705.6	802.6	430.3	604.1	653.5	914.0	1,026.1	1,308.3	1,555.4	1,629.2	1,283.6	1,460.2	1,440.9	21,130.6
Fuel (D2 EQ)	113.5	887.9	1,018.8	610.6	484.5	429.8	497.6	338.7	422.5	480.6	257.6	361.7	391.3	547.3	614.4	783.4	931.4	975.5	768.6	874.4	862.8	12,653.1
GPH	5.92	4.86	5.43	5.27	4.87	4.57	4.48	3.62	3.52	3.59	2.66	3.55	3.53	4.10	3.95	4.79	5.20	5.17	4.16	4.29	4.21	4.39
EGPH	3.55	2.91	3.25	3.15	2.92	2.73	2.68	2.17	2.11	2.15	1.59	2.13	2.12	2.45	2.36	2.87	3.11	3.10	2.49	2.57	2.52	2.63
End Hours	74.0	379.0	692.4	886.0	1,052.0	1,209.2	1,394.9	1,551.0	1,751.6	1,975.0	2,137.0	2,307.0	2,492.0	2,715.0	2,975.0	3,248.0	3,547.0	3,862.1	4,171.0	4,511.0	4,852.9	4,852.9

102	LNG Yard Tractor																					
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Total
Hours				236	289	305	307	344	333	313	321	392	408	412	376	417	393	388	407	387	362	6,390
Fuel (LNG, lbs)				2974.28	3314.49	3639.59	3666.29	3837.44	3363.97	3647.47	2678.56	4455.58	4256.00	3900.87	3876.47	4928.84	5542.35	5000.97	4337.31	4710.60	4525.21	72656.29
LNG std gal				842.6	938.9	1,031.0	1,038.6	1,087.1	953.0	1,033.3	758.8	1,262.2	1,205.7	1,105.1	1,098.2	1,396.3	1,570.1	1,416.7	1,228.7	1,334.4	1,376.3	20,676.9
Fuel (D2 EQ)				504.5	562.2	617.4	621.9	651.0	570.6	618.7	454.4	755.8	722.0	661.7	657.6	836.1	940.2	848.3	735.7	799.1	824.1	12,381.4
GPH				3.58	3.25	3.38	3.39	3.16	2.86	3.30	2.36	3.22	2.96	2.68	2.92	3.35	4.00	3.65	3.02	3.45	3.80	3.24
EGPH				2.14	1.95	2.02	2.03	1.89	1.71	1.98	1.42	1.93	1.77	1.61	1.75	2.01	2.39	2.19	1.81	2.06	2.28	1.94
End Hours				239.0	528.0	833.2	1,139.9	1,484.0	1,817.2	2,130.0	2,451.0	2,843.0	3,251.0	3,663.0	4,039.0	4,456.0	4,849.0	5,237.0	5,644.0	6,031.0	6,393.0	6,393.0

GPH - gallons per hour

EGPH - energy equivalent diesel #2 gallons per hour

MPG - miles per gallon

MPEG - miles per energy equivalent diesel #2 gallon

Raley's Truck 1586
June 1997 to December 1997

Raley's Truck 1586
January 1998 to December 1998

Appendix F

LNG and Diesel Fuel Costs

Raley's Fuel Shipments from JBK

Date	Amount	Cost/Gal	Fuel Cost	Other Cost	Total Cost	Cost/Gal
4/8/97	8614	0.55	4737.70	465.00	5202.70	0.604
4/28/97	5440	0.55	2992.00	0.00	2992.00	0.550
5/8/97	5606	0.55	3083.30	0.00	3083.30	0.550
5/19/97	4607	0.55	2533.85	0.00	2533.85	0.550
5/27/97	5080	0.55	2794.00	0.00	2794.00	0.550
6/5/97	5524	0.55	3038.20	0.00	3038.20	0.550
6/16/97	5012	0.55	2756.60	0.00	2756.60	0.550
6/25/97	4985	0.55	2741.75	120.00	2861.75	0.574
7/6/97	5112	0.55	2811.60	0.00	2811.60	0.550
7/16/97	4265	0.55	2345.75	0.00	2345.75	0.550
7/28/97	4518	0.55	2484.90	0.00	2484.90	0.550
8/8/97	5001	0.55	2750.55	0.00	2750.55	0.550
8/20/97	4968	0.55	2732.40	0.00	2732.40	0.550
8/29/97	5035	0.55	2769.25	0.00	2769.25	0.550
9/5/97	3500	0.55	1925.00	0.00	1925.00	0.550
9/15/97	4963	0.55	2729.65	0.00	2729.65	0.550
9/25/97	5195	0.55	2857.25	0.00	2857.25	0.550
10/4/97	4990	0.55	2744.50	0.00	2744.50	0.550
10/12/97	5000	0.55	2750.00	0.00	2750.00	0.550
10/24/97	5479	0.55	3013.45	0.00	3013.45	0.550
11/3/97	5480	0.55	3014.00	0.00	3014.00	0.550
11/13/97	5447	0.55	2995.85	0.00	2995.85	0.550
11/22/97	5502	0.55	3026.10	0.00	3026.10	0.550
12/4/97	4857	0.55	2671.35	0.00	2671.35	0.550
12/16/97	4657	0.55	2561.35	0.00	2561.35	0.550
12/25/97	4735	0.55	2604.25	0.00	2604.25	0.550
1/5/98	5046	0.55	2775.30	0.00	2775.30	0.550
1/19/98	4790	0.55	2634.50	0.00	2634.50	0.550
1/28/98	4954	0.55	2724.70	0.00	2724.70	0.550
2/8/98	4751	0.55	2613.05	0.00	2613.05	0.550
2/18/98	4904	0.55	2697.20	0.00	2697.20	0.550
3/1/98	4643	0.55	2553.65	0.00	2553.65	0.550
3/8/98	4351	0.55	2393.05	0.00	2393.05	0.550
3/16/98	4565	0.55	2510.75	0.00	2510.75	0.550
3/27/98	4612	0.55	2536.60	0.00	2536.60	0.550
4/5/98	4946	0.55	2720.30	0.00	2720.30	0.550
4/12/98	4612	0.55	2536.60	0.00	2536.60	0.550
4/19/98	4340	0.575	2495.50	0.00	2495.50	0.575
4/29/98	4587	0.575	2637.53	0.00	2637.53	0.575
5/7/98	4679	0.575	2690.43	0.00	2690.43	0.575
5/17/98	4729	0.575	2719.18	0.00	2719.18	0.575
5/26/98	4599	0.575	2644.43	0.00	2644.43	0.575
6/6/98	4624	0.575	2658.80	0.00	2658.80	0.575
6/12/98	4451	0.575	2559.33	0.00	2559.33	0.575
6/28/98	4801	0.575	2760.58	0.00	2760.58	0.575
7/5/98	5154	0.575	2963.55	300.00	3263.55	0.633
7/18/98	9961	0.475	4731.48	1180.00	5911.48	0.593
7/24/98	4104	0.575	2359.80	0.00	2359.80	0.575
7/31/98	4871	0.575	2800.83	0.00	2800.83	0.575
8/8/98	4557	0.575	2620.28	0.00	2620.28	0.575
8/19/98	4421	0.575	2542.08	0.00	2542.08	0.575
8/27/98	4762	0.575	2738.15	0.00	2738.15	0.575
9/12/98	5049	0.575	2903.18	0.00	2903.18	0.575
10/1/98	4843	0.575	2784.73	0.00	2784.73	0.575
10/13/98	4407	0.575	2534.03	0.00	2534.03	0.575
10/20/98	3871	0.575	2225.83	0.00	2225.83	0.575
10/28/98	4585	0.575	2636.38	0.00	2636.38	0.575
11/9/98	4479	0.575	2575.43	0.00	2575.43	0.575
11/17/98	4040	0.575	2323.00	0.00	2323.00	0.575
11/24/98	5421	0.575	3117.08	0.00	3117.08	0.575
12/4/98	4846	0.575	2786.45	0.00	2786.45	0.575
12/10/98	9469	0.475	4497.78	0.00	4497.78	0.475
12/15/98	4276	0.575	2458.70	0.00	2458.70	0.575
12/29/98	4412	0.575	2536.90	0.00	2536.90	0.575
1/11/99	6191	0.575	3559.83	0.00	3559.83	0.575
1/26/99	9949	0.475	4725.78	0.00	4725.78	0.475
Total	336224		185747.25	2065.00	187812.25	0.559

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1592	7/18/97	Diesel	47.62	129311	52.860	49.5266	
1593	7/18/97	Diesel	40.01	162980	44.410	41.6093	
1586	7/19/97	Diesel	37.06	156852	41.140	38.5458	
1593	7/19/97	Diesel	19.00	163077	21.090	19.76	
1586	7/21/97	Diesel	36.63	157133	40.660	38.0959	
1592	7/21/97	Diesel	32.59	129547	36.170	33.8887	
1586	7/22/97	Diesel	48.55	157454	53.890	50.4915	
1592	7/22/97	Diesel	44.24	129827	49.110	46.0132	
1593	7/22/97	Diesel	43.00	163367	47.730	44.72	
1586	7/23/97	Diesel	32.49	157704	36.060	33.7857	
1592	7/23/97	Diesel	27.81	130037	30.870	28.9233	
1593	7/23/97	Diesel	41.78	163826	46.380	43.4554	
1586	7/24/97	Diesel	40.42	157967	43.650	40.8206	
1592	7/24/97	Diesel	39.98	130334	43.180	40.3814	
1593	7/24/97	Diesel	36.37	164089	39.280	36.7341	
1586	7/25/97	Diesel	32.01	158195	34.570	32.3293	
1592	7/25/97	Diesel	26.71	130547	28.850	26.9803	
1593	7/25/97	Diesel	38.99	164362	42.110	39.3807	
1586	7/25/97	Diesel	36.81	158479	39.750	37.1733	
1586	7/26/97	Diesel	29.12	158703	31.450	29.4116	
1592	7/26/97	Diesel	30.07	130759	32.480	30.3751	
1586	7/28/97	Diesel	38.86	158996	41.970	39.2498	
1592	7/28/97	Diesel	35.40	131015	38.230	35.752	
1593	7/28/97	Diesel	60.02	165044	64.820	60.6186	
1586	7/29/97	Diesel	36.56	159250	42.780	40.2208	
1592	7/29/97	Diesel	36.28	131261	42.450	39.9104	
1593	7/29/97	Diesel	39.52	165325	46.240	43.4736	
1586	7/30/97	Diesel	40.65	159531	47.560	44.7145	
1592	7/30/97	Diesel	28.48	131473	33.320	31.3264	
1593	7/30/97	Diesel	32.07	165404	37.520	35.2751	
1586	7/31/97	Diesel	42.26	159816	49.440	46.4818	
1592	7/31/97	Diesel	35.61	131723	41.660	39.1673	
1593	7/31/97	Diesel	38.55	165776	45.100	42.4015	1.05
1586	8/1/97	Diesel	36.02	160077	42.140	39.6186	
1593	8/1/97	Diesel	47.87	166108	56.010	52.6591	
1592	8/1/97	Diesel	35.61	131971	41.660	39.1673	
1592	8/2/97	Diesel	20.03	132100	23.440	22.0379	
1593	8/2/97	Diesel	51.05	166412	59.730	56.1565	
1586	8/2/97	Diesel	18.66	160250	21.830	20.5238	
1586	8/4/97	Diesel	63.32	160876	79.150	74.7176	
1592	8/4/97	Diesel	36.86	132393	46.080	43.4998	
1593	8/4/97	Diesel	35.80	166661	44.750	42.244	
1586	8/5/97	Diesel	38.25	161146	47.810	45.1325	
1592	8/5/97	Diesel	30.39	132637	37.990	35.8627	
1593	8/5/97	Diesel	41.35	166947	51.690	48.7955	
1592	8/6/97	Diesel	30.40	132875	38.000	35.872	
1586	8/7/97	Diesel	68.05	161442	85.060	80.2965	
1593	8/7/97	Diesel	41.37	167220	51.710	48.8141	
1592	8/8/97	Diesel	58.79	133219	74.660	70.5447	
1586	8/8/97	Diesel	22.75	161615	28.890	27.2975	
1593	8/8/97	Diesel	35.19	167430	44.690	42.2267	
1586	8/9/97	Diesel	34.68	161850	44.040	41.6124	
1592	8/9/97	Diesel	25.60	133411	32.510	30.718	
1593	8/9/97	Diesel	36.95	167745	46.930	44.3435	

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1586	8/11/97	Diesel	53.98	162132	68.550	64.7714	
1592	8/11/97	Diesel	34.00	133639	43.180	40.8	
1593	8/11/97	Diesel	33.46	167993	42.490	40.1478	
1586	8/12/97	Diesel	33.10	162374	42.040	39.723	
1592	8/12/97	Diesel	25.81	133854	32.780	30.9733	
1593	8/12/97	Diesel	44.58	168284	56.620	53.4994	
1586	8/13/97	Diesel	36.27	162633	46.060	43.5211	
1592	8/13/97	Diesel	32.91	134068	41.800	39.4963	
1593	8/13/97	Diesel	29.84	168506	37.900	35.8112	
1586	8/14/97	Diesel	36.34	162898	46.150	43.6062	
1592	8/14/97	Diesel	39.31	134350	49.920	47.1683	
1593	8/14/97	Diesel	40.06	168763	50.880	48.0758	
1586	8/15/97	Diesel	24.44	163070	31.280	29.5692	
1592	8/15/97	Diesel	32.35	134612	41.410	39.1455	
1593	8/15/97	Diesel	47.62	169025	60.950	57.6166	
1586	8/16/97	Diesel	26.93	163255	34.470	32.5849	
1592	8/16/97	Diesel	24.98	134815	31.970	30.2214	
1593	8/16/97	Diesel	24.00	169187	30.720	29.04	
1586	8/18/97	Diesel	27.55	163473	35.260	33.3315	
1592	8/18/97	Diesel	33.97	135048	43.480	41.1021	
1593	8/18/97	Diesel	37.98	169426	48.610	45.9514	
1586	8/19/97	Diesel	37.45	163750	48.310	45.6885	
1592	8/19/97	Diesel	25.83	135253	33.320	31.5119	
1593	8/19/97	Diesel	46.44	169698	59.910	56.6592	
1586	8/20/97	Diesel	36.05	164000	46.600	44.0765	
1592	8/20/97	Diesel	60.19	135463	77.650	73.4367	
1593	8/20/97	Diesel	45.99	169894	59.330	56.1107	
1586	8/21/97	Diesel	18.82	252	24.280	22.9626	
1592	8/21/97	Diesel	15.96	135673	20.590	19.4728	
1593	8/21/97	Diesel	33.17	170148	42.790	40.4681	
1586	8/22/97	Diesel	40.60	475	52.370	49.528	
1593	8/22/97	Diesel	28.41	170409	36.650	34.6613	
1592	8/23/97	Diesel	38.98	135883	50.280	47.5514	
1593	8/23/97	Diesel	47.18	170667	60.860	57.5574	
1586	8/25/97	Diesel	37.24	701	48.040	45.4332	
1592	8/25/97	Diesel	38.45	136134	49.600	46.9085	
1593	8/25/97	Diesel	49.88	170799	64.340	60.8484	
1586	8/26/97	Diesel	37.76	996	48.710	46.0668	
1593	8/26/97	Diesel	37.99	171064	49.010	46.3507	
1586	8/27/97	Diesel	36.74	1265	47.390	44.8182	
1592	8/27/97	Diesel	35.68	136364	46.030	43.5324	
1593	8/27/97	Diesel	23.99	184	30.950	29.2707	
1586	8/28/97	Diesel	29.20	1454	37.380	35.336	
1592	8/28/97	Diesel	27.38	136571	35.050	33.1334	
1592	8/29/97	Diesel	30.30	136790	38.780	36.659	
1593	8/29/97	Diesel	40.57	730	51.930	49.0901	
1586	8/29/97	Diesel	28.89	1665	36.980	34.9577	
1586	8/30/97	Diesel	35.97	1905	46.040	43.5221	
1592	8/30/97	Diesel	37.23	137065	47.650	45.0439	
1593	8/30/97	Diesel	28.75	918	36.800	34.7875	1.20
1586	9/1/97	Diesel	35.46	2164	45.390	42.9078	
1592	9/1/97	Diesel	38.30	137351	49.020	46.339	
1593	9/1/97	Diesel	39.83	1177	50.980	48.1919	
1586	9/2/97	Diesel	41.57	2246	53.210	50.3001	

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1592	9/2/97	Diesel	30.01	137564	38.410	36.3093	
1593	9/2/97	Diesel	30.99	1427	39.670	37.5007	
1586	9/3/97	Diesel	31.27	2684	40.030	37.8411	
1592	9/3/97	Diesel	32.00	137773	40.960	38.72	
1593	9/3/97	Diesel	46.36	1750	59.340	56.0948	
1586	9/4/97	Diesel	36.02	2750	46.110	43.5886	
1593	9/4/97	Diesel	31.21	2009	39.950	37.7653	
1592	9/4/97	Diesel	25.43	137973	32.550	30.7699	
1592	9/5/97	Diesel	44.88	138298	57.450	54.3084	
1593	9/5/97	Diesel	49.98	2303	63.970	60.4714	
1586	9/5/97	Diesel	21.98	3091	28.130	26.5914	
1592	9/6/97	Diesel	30.01	138523	38.410	36.3093	
1593	9/6/97	Diesel	21.39	2500	27.380	25.8827	
1586	9/8/97	Diesel	41.49	3450	53.110	50.2057	
1593	9/8/97	Diesel	30.94	2723	39.600	37.4342	
1592	9/9/97	Diesel	46.70	139050	59.780	56.511	
1593	9/9/97	Diesel	47.31	3006	60.560	57.2483	
1586	9/10/97	Diesel	32.48	3795	40.600	38.3264	
1592	9/10/97	Diesel	27.00	139277	33.750	31.86	
1586	9/11/97	Diesel	36.24	4066	45.300	42.7632	
1592	9/11/97	Diesel	40.02	139545	50.030	47.2286	
1593	9/11/97	Diesel	41.04	3281	51.300	48.4272	
1586	9/12/97	Diesel	43.75	4398	54.690	51.6275	
1592	9/12/97	Diesel	33.85	139774	42.310	39.9405	
1593	9/12/97	Diesel	39.26	3542	49.080	46.3318	
1586	9/13/97	Diesel	29.06	4633	36.330	34.2958	
1592	9/13/97	Diesel	28.30	139994	35.400	33.419	
1592	9/15/97	Diesel	26.10	140201	32.660	30.833	
1593	9/15/97	Diesel	42.09	3826	52.610	49.6637	
1586	9/16/97	Diesel	30.05	4875	37.260	35.1565	
1592	9/16/97	Diesel	30.40	140550	37.700	35.572	
1593	9/16/97	Diesel	31.99	4100	39.670	37.4307	
1586	9/17/97	Diesel	38.74	5432	48.040	45.3282	
1592	9/17/97	Diesel	32.08	140620	39.780	37.5344	
1593	9/17/97	Diesel	37.14	4294	46.050	43.4502	
1586	9/18/97	Diesel	36.44	5700	45.190	42.6392	
1592	9/18/97	Diesel	28.63	140835	35.500	33.4959	
1593	9/18/97	Diesel	32.18	4533	39.900	37.6474	
1586	9/19/97	Diesel	16.29	5846	20.200	19.0597	
1592	9/19/97	Diesel	31.15	141066	38.630	36.4495	
1586	9/20/97	Diesel	8.98	5896	11.140	10.5114	
1592	9/20/97	Diesel	24.99	141279	30.990	29.2407	
1593	9/20/97	Diesel	27.27	4976	33.810	31.9011	
1586	9/22/97	Diesel	23.20	6068	29.000	27.376	
1592	9/22/97	Diesel	30.42	141485	38.030	35.9006	
1593	9/22/97	Diesel	28.89	5226	36.110	34.0877	
1586	9/23/97	Diesel	34.29	6295	42.860	40.4597	
1593	9/23/97	Diesel	36.29	5488	45.360	42.8197	
1586	9/24/97	Diesel	27.57	6556	34.460	32.5301	
1592	9/24/97	Diesel	60.05	141931	75.060	70.8565	
1593	9/24/97	Diesel	24.00	5651	30.000	28.32	
1586	9/25/97	Diesel	46.88	6847	58.130	54.8484	
1592	9/25/97	Diesel	30.37	142143	37.660	35.5341	
1593	9/25/97	Diesel	37.84	5909	46.920	44.2712	

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1586	9/26/97	Diesel	29.00	7086	35.960	33.93	
1592	9/26/97	Diesel	31.18	142383	38.660	36.4774	
1592	9/27/97	Diesel	29.71	142599	36.840	34.7603	
1593	9/27/97	Diesel	20.75	6200	25.730	24.2775	
1586	9/29/97	Diesel	33.64	7316	41.710	39.3552	
1592	9/29/97	Diesel	38.12	142867	47.270	44.6016	
1593	9/29/97	Diesel	27.98	6587	34.700	32.7414	
1586	9/30/97	Diesel	38.06	7420	47.190	44.5258	
1592	9/30/97	Diesel	24.41	143101	30.270	28.5613	
1593	9/30/97	Diesel	36.54	6861	45.310	42.7522	1.19
1586	10/1/97	Diesel	34.62	7650	42.930	40.5066	
1592	10/1/97	Diesel	33.73	143280	41.830	39.4689	
1593	10/1/97		0.00	0	0.000		
1586	10/2/97	Diesel	42.65	7975	52.890	49.9045	
1592	10/2/97	Diesel	30.17	143518	37.410	35.2981	
1593	10/2/97	Diesel	40.99	7121	50.830	47.9607	
1586	10/3/97	Diesel	29.45	8337	36.520	34.4585	
1592	10/3/97	Diesel	34.42	143738	42.680	40.2706	
1593	10/3/97	Diesel	40.99	7397	50.830	47.9607	
1586	10/4/97	Diesel	24.99	8508	30.990	29.2407	
1592	10/4/97	Diesel	28.31	143961	35.100	33.1183	
1593	10/4/97	Diesel	0.00	0	0.000		
1593	10/5/97	Diesel	49.99	7674	61.990	58.4907	
1586	10/6/97	Diesel	40.54	8762	50.270	47.4322	
1592	10/6/97	Diesel	40.13	144224	49.760	46.9509	
1593	10/6/97	Diesel	40.52	7960	50.240	47.4036	
1586	10/7/97	Diesel	35.69	9041	44.260	41.7617	
1592	10/7/97	Diesel	33.19	144482	41.160	38.8367	
1593	10/7/97	Diesel	43.03	8227	53.360	50.3479	
1586	10/8/97	Diesel	37.95	9311	47.060	44.4035	
1592	10/8/97	Diesel	28.66	144683	35.540	33.5338	
1593	10/8/97	Diesel	30.03	8493	37.240	35.1379	
1586	10/9/97	Diesel	34.05	9561	42.220	39.8365	
1592	10/9/97	Diesel	28.47	144786	35.300	33.3071	
1586	10/10/97	Diesel	40.41	9834	50.110	47.2813	
1592	10/10/97	Diesel	41.08	145190	50.940	48.0644	
1593	10/10/97	Diesel	46.07	8791	57.130	53.9051	
1586	10/11/97	Diesel	0.00	0	0.000		
1592	10/11/97	Diesel	34.14	145410	42.330	39.9402	
1593	10/11/97	Diesel	24.29	8931	30.120	28.4197	
1586	10/13/97	Diesel	31.27	10086	38.770	36.5811	
1592	10/13/97	Diesel	36.20	145676	44.890	42.356	
1593	10/13/97	Diesel	42.50	9190	52.700	49.725	
1586	10/14/97	Diesel	46.60	10402	57.780	54.518	
1592	10/14/97	Diesel	28.80	145883	35.710	33.694	
1593	10/14/97	Diesel	36.27	9468	44.970	42.4311	
1586	10/15/97	Diesel	32.33	10684	40.090	37.8269	
1592	10/15/97	Diesel	24.93	146191	30.910	29.1649	
1593	10/15/97	Diesel	0.00	0	0.000		
1586	10/16/97	Diesel	45.83	10985	56.830	53.6219	
1592	10/16/97	Diesel	31.01	146304	38.450	36.2793	
1593	10/16/97	Diesel	39.74	9734	49.280	46.4982	
1586	10/17/97	Diesel	27.61	11211	34.240	32.3073	
1592	10/17/97	Diesel	42.97	146656	53.280	50.2721	

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1593	10/17/97	Diesel	39.94	10020	49.530	46.7342	
1586	10/18/97	Diesel	21.95	11378	27.220	25.6835	
1592	10/18/97	Diesel	27.99	146880	34.710	32.7507	
1593	10/18/97	Diesel	35.91	10286	44.530	42.0163	
1586	10/20/97	Diesel	34.92	11630	43.300	40.8556	
1592	10/20/97	Diesel	35.99	147152	44.630	42.1107	
1593	10/20/97	Diesel	34.29	10523	42.520	40.1197	
1586	10/21/97	Diesel	31.31	11872	38.820	36.6283	
1592	10/21/97	Diesel	29.31	147362	36.340	34.2883	
1593	10/21/97	Diesel	35.00	10760	43.400	40.95	
1586	10/22/97	Diesel	33.85	12100	41.970	39.6005	
1592	10/22/97	Diesel	31.49	147571	39.050	36.8457	
1593	10/22/97	Diesel	0.00	0	0.000		
1586	10/23/97	Diesel	40.99	12394	51.240	48.3707	
1592	10/23/97	Diesel	24.39	147875	30.490	28.7827	
1593	10/23/97	Diesel	39.33	11034	49.160	46.4069	
1586	10/24/97	Diesel	37.18	12628	46.480	43.8774	
1592	10/24/97	Diesel	63.10	148181	78.880	74.463	
1593	10/24/97	Diesel	45.47	11311	56.840	53.6571	
1586	10/25/97	Diesel	22.05	12799	27.560	26.0165	
1592	10/25/97	Diesel	28.00	148413	35.000	33.04	
1593	10/25/97	Diesel	33.61	11548	42.010	39.6573	
1586	10/27/97	Diesel	37.93	13052	47.410	44.7549	
1592	10/27/97	Diesel	39.02	148699	48.780	46.0486	
1593	10/27/97	Diesel	36.39	11800	45.490	42.9427	
1586	10/28/97	Diesel	30.07	13250	39.090	36.9851	
1592	10/28/97	Diesel	19.16	148900	24.910	23.5688	
1593	10/28/97	Diesel	34.49	12062	44.840	42.4257	
1586	10/29/97	Diesel	35.69	13555	46.400	43.9017	
1592	10/29/97	Diesel	30.53	149103	39.690	37.5529	
1593	10/29/97	Diesel	22.12	12200	28.760	27.2116	
1586	10/30/97	Diesel	39.19	13818	50.950	48.2067	
1592	10/30/97	Diesel	36.18	149361	47.040	44.5074	
1593	10/30/97	Diesel	31.28	12420	40.660	38.4704	
1586	10/31/97	Diesel	0.00	0	0.000		
1592	10/31/97	Diesel	36.00	149573	46.800	44.28	
1593	10/31/97	Diesel	30.49	12650	39.640	37.5057	1.179634435
1586	11/1/97	Diesel	23.01	13973	29.910	28.2993	
1592	11/1/97	Diesel	33.26	149777	43.240	40.9118	
1593	11/1/97	Diesel	0.00	0	0.000		
1586	11/3/97	Diesel	45.06	14294	61.280	58.1258	
1592	11/3/97	Diesel	34.16	150027	46.460	44.0688	
1593	11/3/97	Diesel	43.80	12917	59.570	56.504	
1586	11/4/97	Diesel	36.53	14583	49.680	47.1229	
1593	11/4/97	Diesel	41.36	13200	56.250	53.3548	
1586	11/5/97	Diesel	36.57	14485	49.740	47.1801	
1592	11/5/97	Diesel	32.75	150496	44.540	42.2475	
1593	11/5/97	Diesel	30.00	13454	40.800	38.7	
1593	11/5/97	Diesel	40.63	13757	55.260	52.4159	
1586	11/6/97	Diesel	33.65	15092	45.760	43.4045	
1592	11/6/97	Diesel	30.38	150700	41.320	39.1934	
1593	11/6/97	Diesel	57.48	14097	78.170	74.1464	
1586	11/7/97	Diesel	37.97	15368	51.640	48.9821	
1592	11/7/97	Diesel	28.20	150932	38.350	36.376	

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1593	11/7/97	Diesel	45.31	14424	61.620	58.4483	
1586	11/8/97	Diesel	26.48	15620	36.010	34.1564	
1592	11/8/97	Diesel	24.97	151150	33.960	32.2121	
1586	11/10/97	Diesel	43.19	15818	58.740	55.7167	
1592	11/10/97	Diesel	40.26	151370	54.750	51.9318	
1593	11/10/97	Diesel	41.53	14673	56.480	53.5729	
1586	11/11/97	Diesel	32.01	16054	43.530	41.2893	
1592	11/11/97	Diesel	22.69	151578	30.860	29.2717	
1593	11/11/97	Diesel	32.95	14930	44.810	42.5035	
1586	11/12/97	Diesel	42.25	16336	55.770	52.8125	
1592	11/12/97	Diesel	33.28	151800	43.930	41.6004	
1593	11/12/97	Diesel	28.08	15108	37.070	35.1044	
1586	11/13/97	Diesel	42.64	16608	56.280	53.2952	
1592	11/13/97	Diesel	30.28	152006	39.970	37.8504	
1593	11/13/97	Diesel	35.79	15361	47.240	44.7347	
1586	11/14/97	Diesel	0.00	0	0.000		
1592	11/14/97	Diesel	27.98	212	36.930	34.9714	
1593	11/14/97	Diesel	46.93	15642	61.950	58.6649	
1586	11/15/97	Diesel	43.04	16911	56.810	53.7972	
1592	11/15/97	Diesel	35.03	437	46.240	43.7879	
1593	11/15/97	Diesel	52.00	15996	68.640	65	
1586	11/17/97	Diesel	19.99	17106	26.390	24.9907	
1592	11/17/97	Diesel	35.02	707	46.230	43.7786	
1593	11/17/97	Diesel	36.01	16243	47.530	45.0093	
1586	11/18/97	Diesel	36.96	17338	46.200	43.6128	
1592	11/18/97	Diesel	25.54	919	31.930	30.1422	
1593	11/18/97	Diesel	32.05	16525	40.060	37.8165	
1586	11/19/97	Diesel	32.63	17559	40.790	38.5059	
1592	11/19/97	Diesel	34.42	1157	43.030	40.6206	
1593	11/19/97	Diesel	52.73	16889	65.910	62.2189	
1586	11/20/97	Diesel	40.81	17798	51.010	48.1533	
1592	11/20/97	Diesel	33.30	1363	41.630	39.299	
1593	11/20/97	Diesel	35.64	17120	44.550	42.0552	
1586	11/21/97	Diesel	37.09	18066	46.360	43.7637	
1592	11/21/97	Diesel	44.20	1644	55.230	52.136	
1593	11/21/97	Diesel	42.90	17410	53.630	50.627	
1586	11/22/97	Diesel	16.99	18180	21.240	20.0507	
1593	11/22/97	Diesel	39.00	17675	48.750	46.02	
1592	11/22/97	Diesel	17.97	1706	22.460	21.2021	
1586	11/24/97	Diesel	37.61	18436	46.640	44.0073	
1592	11/24/97	Diesel	31.40	1850	38.940	36.742	
1593	11/24/97	Diesel	31.11	17925	38.580	36.4023	
1586	11/25/97	Diesel	37.28	18703	45.480	42.8704	
1593	11/25/97	Diesel	42.78	18200	52.190	49.1954	
1592	11/25/97	Diesel	0.00	0	0.000		
1592	11/26/97	Diesel	39.43	2038	47.710	44.9499	
1593	11/26/97	Diesel	35.01	18429	42.360	39.9093	
1586	11/26/97	Diesel	0.00	0	0.000		
1586	11/27/97	Diesel	0.00	0	0.000		
1592	11/27/97	Diesel	0.00	0	0.000		
1593	11/27/97	Diesel	0.00	0	0.000		
1586	11/28/97	Diesel	34.98	18964	42.330	39.8814	
1592	11/28/97	Diesel	34.49	2549	41.730	39.3157	
1593	11/28/97	Diesel	31.99	18678	38.710	36.4707	

Truck	Date	Fuel	Amount	Odometer	Cost	Adj. Cost	Monthly Avg
1586	11/29/97	Diesel	24.93	19131	30.170	28.4249	
1592	11/29/97	Diesel	24.98	2766	30.230	28.4814	
1593	11/29/97	Diesel	42.17	18948	51.030	48.0781	1.23
1586	12/1/97	Diesel	47.53	19455	57.510	54.1829	
1592	12/1/97	Diesel	29.65	2969	35.880	33.8045	
1593	12/1/97	Diesel	34.67	19206	41.950	39.5231	
1586	12/2/97	Diesel	0.00	0	0.000		
1592	12/2/97	Diesel	31.57	3175	38.200	35.9901	
1593	12/2/97	Diesel	41.17	19498	49.820	46.9381	
1586	12/3/97	Diesel	0.00	0	0.000		
1586	12/3/97	Diesel	13.54	19452	15.160	15.160	
1592	12/3/97	Diesel	28.01	3386	31.370	31.370	
1593	12/3/97	Diesel	0.00	0	0.000	0.000	
1586	12/4/97	Diesel	29.26	19754	32.770	32.770	
1592	12/4/97	Diesel	35.91	3672	40.220	40.220	
1593	12/4/97	Diesel	41.42	19763	46.390	46.390	
1586	12/5/97	Diesel	65.71	20145	73.600	73.600	
1592	12/5/97	Diesel	33.52	3883	37.540	37.540	
1593	12/5/97	Diesel	37.01	20013	41.450	41.450	
1586	12/6/97	Diesel	46.30	20475	51.860	51.860	
1592	12/6/97	Diesel	26.01	4100	29.130	29.130	
1593	12/6/97	Diesel	42.20	20323	47.260	47.260	
1586	12/8/97	Diesel	29.73	20688	33.300	33.300	
1592	12/8/97	Diesel	41.09	4361	46.020	46.020	
1593	12/8/97	Diesel	41.38	20577	46.350	46.350	
1586	12/9/97	Diesel	30.99	20880	34.710	34.710	
1592	12/9/97	Diesel	28.69	4570	32.130	32.130	
1593	12/9/97	Diesel	42.44	20837	47.530	47.530	
1586	12/10/97	Diesel	72.35	21390	81.030	81.030	
1592	12/10/97	Diesel	29.35	4780	32.870	32.870	
1593	12/10/97	Diesel	0.00	0	0.000	0.000	
1586	12/11/97	Diesel	24.01	21579	26.890	26.890	
1592	12/11/97	Diesel	32.47	5016	36.370	36.370	
1593	12/11/97	Diesel	32.38	21071	36.270	36.270	
1586	12/12/97	Diesel	56.99	21967	63.830	63.830	
1592	12/12/97	Diesel	33.76	5246	37.810	37.810	
1593	12/12/97	Diesel	42.96	21348	48.120	48.120	
1586	12/13/97	Diesel	26.35	22150	29.510	29.510	
1592	12/13/97	Diesel	26.89	5452	30.120	30.120	
1593	12/13/97	Diesel	41.35	21644	46.310	46.310	
1592	12/15/97	Diesel	28.62	5652	32.050	32.050	
1586	12/16/97	Diesel	71.38	22615	79.950	79.950	
1592	12/16/97	Diesel	25.90	5852	29.010	29.010	
1593	12/16/97	Diesel	37.89	21895	42.440	42.440	
1586	12/17/97	Diesel	73.92	23124	82.790	82.790	
1592	12/17/97	Diesel	32.00	6059	35.840	35.840	
1593	12/17/97	Diesel	18.02	22024	20.180	20.180	
1586	12/18/97	Diesel	23.51	23288	25.390	25.390	
1592	12/18/97	Diesel	26.29	6264	28.390	28.390	
1593	12/18/97	Diesel	34.56	22256	37.320	37.320	
1586	12/19/97	Diesel	55.99	23673	60.470	60.470	
1592	12/19/97	Diesel	33.03	6513	35.670	35.670	
1593	12/19/97	Diesel	39.13	22533	42.260	42.260	
1586	12/20/97	Diesel	27.04	23877	29.200	29.200	

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Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1586	1/2/98	Diesel	63.06	26682.0	70.00	
1592	1/2/98	Diesel	33.01	8818.0	36.64	
1593	1/2/98	Diesel	0.00	0.0	0.00	
1586	1/3/98	Diesel	20.04	26810.0	22.24	
1592	1/3/98	Diesel	0.00	0.0	0.00	
1593	1/3/98	Diesel	24.30	25078.0	26.97	
1586	1/5/98	Diesel	0.00	0.0	0.00	
1592	1/5/98	Diesel	32.30	9359.0	35.85	
1593	1/5/98	Diesel	52.27	25356.0	58.02	
1586	1/6/98	Diesel	65.00	27080.0	72.15	
1592	1/6/98	Diesel	27.91	9563.0	30.98	
1593	1/6/98	Diesel	45.16	25638.0	50.13	
1586	1/7/98	Diesel	72.22	27233.0	80.16	
1592	1/7/98	Diesel	34.83	9708.0	38.66	
1586	1/8/98	Diesel	50.83	28065.0	55.91	
1592	1/8/98	Diesel	24.56	9982.0	27.02	
1593	1/8/98	Diesel	36.29	25878.0	39.92	
1586	1/9/98	Diesel	50.30	28366.0	55.33	
1592	1/9/98	Diesel	14.26	10073.0	15.69	
1593	1/9/98	Diesel	35.78	26145.0	39.36	
1586	1/10/98	Diesel	33.01	28598.0	36.31	
1592	1/10/98	Diesel	28.63	10283.0	31.49	
1586	1/12/98	Diesel	50.27	28881.0	55.30	
1592	1/12/98	Diesel	35.38	10554.0	38.92	
1593	1/12/98	Diesel	39.46	26400.0	43.41	
1586	1/13/98	Diesel	34.28	29123.0	37.71	
1592	1/13/98	Diesel	27.25	10763.0	29.98	
1593	1/13/98	Diesel	42.53	26681.0	46.78	
1586	1/14/98	Diesel	77.82	29297.0	85.60	
1592	1/14/98	Diesel	31.37	11013.0	34.51	
1592	1/15/98	Diesel	24.21	11272.0	26.63	
1593	1/15/98	Diesel	33.94	26952.0	37.33	
1586	1/16/98	Diesel	83.02	30211.0	89.66	
1592	1/16/98	Diesel	32.81	11505.0	35.43	
1593	1/16/98	Diesel	36.02	27189.0	38.90	
1586	1/17/98	Diesel	22.75	30376.0	24.57	
1592	1/17/98	Diesel	29.28	11595.0	31.62	
1586	1/19/98	Diesel	34.01	30597.0	36.73	
1592	1/19/98	Diesel	36.48	11854.0	39.40	
1593	1/19/98	Diesel	45.01	27436.0	48.61	
1592	1/20/98	Diesel	27.86	12062.0	30.09	
1593	1/20/98	Diesel	44.29	27779.0	47.83	
1586	1/20/98	Diesel	32.21	30805.0	34.79	
1592	1/21/98	Diesel	21.33	12267.0	23.04	
1586	1/21/98	Diesel	69.59	31100.0	75.16	
1592	1/22/98	Diesel	29.92	12494.0	32.31	
1593	1/22/98	Diesel	35.15	28011.0	37.96	
1586	1/22/98	Diesel	62.24	31500.0	67.22	
1586	1/23/98	Diesel	70.91	31825.0	76.58	
1592	1/23/98	Diesel	33.62	12755.0	36.31	
1593	1/23/98	Diesel	32.34	28257.0	34.93	
1592	1/24/98	Diesel	34.99	12961.0	37.79	
1593	1/24/98	Diesel	45.56	28510.0	49.20	
1586	1/26/98	Diesel	27.17	32034.0	28.80	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1592	1/26/98	Diesel	31.92	13183.0	33.84	
1593	1/26/98	Diesel	40.23	28802.0	42.64	
1586	1/27/98	Diesel	25.95	32212.0	27.51	
1592	1/27/98	Diesel	29.91	13398.0	31.70	
1593	1/27/98	Diesel	41.13	29059.0	43.60	
1586	1/28/98	Diesel	31.18	32469.0	33.05	
1592	1/28/98	Diesel	20.38	13608.0	21.60	
1592	1/29/98	Diesel	36.03	13854.0	38.19	
1593	1/29/98	Diesel	32.72	29311.0	34.68	
1586	1/30/98	Diesel	68.34	32978.0	72.44	
1592	1/30/98	Diesel	27.16	14079.0	28.79	
1586	1/31/98	Diesel	30.98	33195.0	32.84	
1592	1/31/98	Diesel	31.76	14281.0	33.67	1.09
1586	2/2/98	Diesel	30.51	33407.0	32.34	
1592	2/2/98	Diesel	31.58	14507.0	33.47	
1593	2/2/98	Diesel	51.69	29594.0	54.79	
1593	2/2/98	Diesel	39.57	29846.0	41.94	
1586	2/3/98	Diesel	36.44	33629.0	38.63	
1592	2/3/98	Diesel	41.25	14753.0	43.73	
1593	2/3/98	Diesel	40.40	30116.0	42.82	
1592	2/4/98	Diesel	19.83	14890.0	21.42	
1593	2/5/98	Diesel	34.82	30349.0	37.60	
1586	2/5/98	Diesel	25.08	34049.0	27.09	
1592	2/5/98	Diesel	33.99	15128.0	36.71	
1586	2/6/98	Diesel	77.49	34591.0	81.36	
1592	2/6/98	Diesel	61.91	15506.0	65.01	
1593	2/6/98	Diesel	29.73	30495.0	32.11	
1586	2/7/98	Diesel	0.00	0.0	0.00	
1586	2/9/98	Diesel	38.82	35066.0	40.76	
1592	2/9/98	Diesel	41.26	15996.0	43.32	
1586	2/10/98	Diesel	36.19	35282.0	38.00	
1592	2/10/98	Diesel	33.99	16241.0	35.69	
1593	2/10/98	Diesel	50.97	31001.0	53.52	
1586	2/11/98	Diesel	33.34	35420.0	35.01	
1592	2/11/98	Diesel	32.71	16446.0	34.35	
1592	2/12/98	Diesel	24.81	16702.0	26.05	
1593	2/12/98	Diesel	27.37	31247.0	28.74	
1586	2/13/98	Diesel	68.20	36028.0	71.61	
1592	2/13/98	Diesel	27.82	16867.0	29.21	
1593	2/13/98	Diesel	37.63	31498.0	39.51	
1592	2/14/98	Diesel	34.10	17082.0	35.81	
1586	2/16/98	Diesel	24.98	36222.0	26.23	
1592	2/16/98	Diesel	37.00	17354.0	38.85	
1593	2/16/98	Diesel	47.99	31738.0	50.39	
1586	2/17/98	Diesel	33.46	36438.0	33.46	
1592	2/17/98	Diesel	30.95	17600.0	30.95	
1593	2/17/98	Diesel	40.51	32040.0	40.51	
1586	2/18/98	Diesel	39.87	36715.0	39.87	
1592	2/18/98	Diesel	32.13	17768.0	32.13	
1593	2/18/98	Diesel	40.18	32268.0	40.18	
1592	2/19/98	Diesel	28.04	17978.0	28.04	
1593	2/19/98	Diesel	32.79	32546.0	32.79	
1586	2/20/98	Diesel	78.04	37223.0	78.04	
1592	2/20/98	Diesel	36.84	18218.0	36.84	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	2/20/98	Diesel	27.04	32778.0	27.04	
1586	2/21/98	Diesel	41.41	37506.0	41.41	
1593	2/21/98	Diesel	34.51	32982.0	34.51	
1586	2/23/98	Diesel	38.50	37729.0	38.50	
1593	2/23/98	Diesel	49.83	33275.0	49.83	
1586	2/24/98	Diesel	26.64	37910.0	26.64	
1593	2/24/98	Diesel	42.68	33559.0	42.68	
1586	2/25/98	Diesel	34.94	38135.0	34.94	
1592	2/25/98	Diesel	25.01	18611.0	25.01	
1592	2/26/98	Diesel	35.97	18968.0	35.61	
1593	2/26/98	Diesel	32.99	33799.0	32.66	
1586	2/27/98	Diesel	67.83	38643.0	67.15	
1592	2/27/98	Diesel	35.35	19189.0	35.00	
1593	2/27/98	Diesel	40.55	34081.0	40.14	
1586	2/28/98	Diesel	12.92	38750.0	12.79	
1592	2/28/98	Diesel	28.03	19407.0	27.75	1.03
1593	3/2/98	Diesel	40.65	34594.0	40.24	
1592	3/2/98	Diesel	32.00	19616.0	31.68	
1586	3/3/98	Diesel	41.16	38986.0	40.75	
1593	3/3/98	Diesel	37.86	34852.0	37.48	
1586	3/4/98	Diesel	36.27	39241.0	34.82	
1593	3/5/98	Diesel	51.57	35166.0	49.51	
1586	3/6/98	Diesel	75.17	39766.0	71.41	
1592	3/6/98	Diesel	42.01	19894.0	39.91	
1593	3/6/98	Diesel	37.40	35435.0	35.53	
1586	3/7/98	Diesel	14.55	39885.0	13.82	
1592	3/7/98	Diesel	28.01	20133.0	26.61	
1586	3/9/98	Diesel	37.14	40107.0	35.28	
1592	3/9/98	Diesel	31.29	20357.0	29.73	
1593	3/9/98	Diesel	40.41	35580.0	38.39	
1586	3/10/98	Diesel	29.19	40291.0	27.73	
1592	3/10/98	Diesel	29.32	20546.0	27.85	
1586	3/11/98	Diesel	32.75	40557.0	30.79	
1592	3/11/98	Diesel	33.98	20806.0	31.94	
1592	3/12/98	Diesel	28.52	21052.0	26.81	
1593	3/12/98	Diesel	21.88	35750.0	20.57	
1586	3/13/98	Diesel	77.51	41099.0	72.86	
1592	3/13/98	Diesel	29.69	21265.0	27.91	
1593	3/13/98	Diesel	41.55	36046.0	39.06	
1586	3/14/98	Diesel	20.68	41268.0	19.44	
1592	3/14/98	Diesel	21.63	21467.0	20.33	
1586	3/16/98	Diesel	31.87	41489.0	29.96	
1592	3/16/98	Diesel	36.69	21673.0	34.49	
1593	3/16/98	Diesel	38.01	36711.0	35.73	
1592	3/17/98	Diesel	31.53	21901.0	29.64	
1593	3/17/98	Diesel	42.95	36994.0	40.37	
1586	3/17/98	Diesel	32.13	41605.0	30.20	
1586	3/18/98	Diesel	35.84	41971.0	33.69	
1592	3/18/98	Diesel	30.22	22111.0	28.41	
1593	3/18/98	Diesel	24.02	37195.0	22.58	
1592	3/19/98	Diesel	19.96	22350.0	19.16	
1593	3/19/98	Diesel	33.86	37478.0	32.51	
1586	3/20/98	Diesel	66.23	42481.0	63.58	
1592	3/20/98	Diesel	33.85	22532.0	32.50	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	3/20/98	Diesel	42.62	37758.0	40.92	
1592	3/21/98	Diesel	27.26	22754.0	26.17	
1586	3/23/98	Diesel	50.64	42844.0	49.63	
1592	3/23/98	Diesel	38.05	23004.0	37.29	
1593	3/23/98	Diesel	43.62	38003.0	42.75	
1592	3/24/98	Diesel	28.59	23204.0	28.02	
1593	3/24/98	Diesel	42.84	38281.0	41.98	
1592	3/25/98	Diesel	31.85	23427.0	31.85	
1586	3/27/98	Diesel	72.56	43367.0	79.82	
1592	3/27/98	Diesel	31.44	23991.0	34.58	
1593	3/27/98	Diesel	39.80	38531.0	43.78	
1586	3/28/98	Diesel	33.19	43589.0	36.51	
1592	3/28/98	Diesel	40.78	24256.0	44.86	
1593	3/28/98	Diesel	20.52	38895.0	22.57	
1586	3/30/98	Diesel	27.01	43801.0	29.71	
1592	3/30/98	Diesel	30.54	24502.0	33.59	
1593	3/30/98	Diesel	44.57	39225.0	49.03	
1586	3/31/98	Diesel	33.44	44022.0	36.78	
1592	3/31/98	Diesel	37.54	24740.0	41.29	
1593	3/31/98	Diesel	43.87	39545.0	48.26	0.99
1586	4/1/98	Diesel	33.92	44256.0	37.31	
1592	4/1/98	Diesel	24.16	24944.0	26.58	
1592	4/2/98	Diesel	35.12	25183.0	38.63	
1593	4/2/98	Diesel	46.38	39878.0	51.02	
1586	4/3/98	Diesel	71.42	44766.0	76.48	
1592	4/3/98	Diesel	31.85	25385.0	34.09	
1593	4/3/98	Diesel	43.08	40203.0	46.10	
1592	4/4/98	Diesel	28.81	25592.0	30.83	
1586	4/6/98	Diesel	53.83	45043.0	57.60	
1592	4/6/98	Diesel	39.68	25859.0	42.46	
1593	4/6/98	Diesel	50.24	40538.0	53.76	
1586	4/7/98	Diesel	45.88	45357.0	49.09	
1592	4/7/98	Diesel	30.59	26065.0	32.73	
1593	4/7/98	Diesel	50.91	40916.0	54.47	
1592	4/8/98	Diesel	36.82	26306.0	38.66	
1593	4/8/98	Diesel	27.08	41142.0	28.43	
1586	4/8/98	Diesel	35.10	45626.0	36.86	
1586	4/9/98	Diesel	29.87	45840.0	31.36	
1592	4/9/98	Diesel	23.68	26590.0	24.86	
1593	4/9/98	Diesel	36.51	41375.0	38.34	
1586	4/10/98	Diesel	38.73	46112.0	40.28	
1592	4/10/98	Diesel	31.68	26729.0	32.95	
1593	4/10/98	Diesel	46.76	41707.0	48.63	
1586	4/11/98	Diesel	34.80	46425.0	36.19	
1586	4/11/98	Diesel	55.79	46761.0	58.02	
1592	4/11/98	Diesel	36.35	26956.0	37.80	
1593	4/11/98	Diesel	24.36	41903.0	25.33	
1586	4/13/98	Diesel	32.70	46981.0	34.01	
1592	4/13/98	Diesel	40.77	27213.0	42.40	
1593	4/13/98	Diesel	39.03	42150.0	40.59	
1586	4/14/98	Diesel	32.50	47210.0	33.80	
1592	4/14/98	Diesel	30.28	27434.0	31.49	
1593	4/14/98	Diesel	36.99	42434.0	38.47	
1586	4/15/98	Diesel	39.77	47495.0	40.96	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1592	4/15/98	Diesel	31.02	27688.0	31.95	
1593	4/15/98	Diesel	39.47	42709.0	40.65	
1586	4/16/98	Diesel	32.35	47706.0	33.32	
1592	4/16/98	Diesel	27.29	27925.0	28.11	
1586	4/17/98	Diesel	60.84	48218.0	63.27	
1592	4/17/98	Diesel	32.05	28057.0	33.33	
1593	4/17/98	Diesel	44.30	43038.0	46.07	
1586	4/18/98	Diesel	36.99	48497.0	38.47	
1592	4/18/98	Diesel	40.93	28372.0	42.57	
1593	4/18/98	Diesel	27.15	43300.0	28.24	
1586	4/20/98	Diesel	39.38	48770.0	40.96	
1592	4/20/98	Diesel	31.17	28600.0	32.42	
1593	4/20/98	Diesel	43.80	43539.0	45.55	
1586	4/21/98	Diesel	32.25	49001.0	33.86	
1592	4/21/98	Diesel	32.67	28806.0	34.30	
1593	4/21/98	Diesel	0.00	0.0	0.00	
1586	4/22/98	Diesel	36.36	49256.0	38.18	
1592	4/22/98	Diesel	16.31	29015.0	17.13	
1593	4/22/98	Diesel	40.78	44091.0	42.82	
1586	4/23/98	Diesel	36.07	49504.0	37.87	
1592	4/23/98	Diesel	33.98	29269.0	35.68	
1593	4/23/98	Diesel	52.07	44477.0	54.67	
1586	4/24/98	Diesel	68.18	50015.0	72.27	
1592	4/24/98	Diesel	31.86	29458.0	33.77	
1593	4/24/98	Diesel	37.16	44777.0	39.39	
1586	4/25/98	Diesel	24.30	50211.0	25.70	
1592	4/25/98	Diesel	26.37	29619.0	27.98	
1592	4/25/98	Diesel	53.25	29935.0	56.45	
1593	4/25/98	Diesel	37.72	45001.0	39.98	
1586	4/27/98	Diesel	28.69	50433.0	30.41	
1592	4/27/98	Diesel	30.12	30209.0	31.93	
1593	4/27/98	Diesel	36.81	45307.0	39.02	
1586	4/28/98	Diesel	45.08	50722.0	48.69	
1592	4/28/98	Diesel	21.35	30410.0	23.06	
1593	4/28/98	Diesel	32.22	45583.0	34.82	
1586	4/29/98	Diesel	30.07	50958.0	33.08	
1592	4/29/98	Diesel	35.85	30619.0	39.44	
1593	4/29/98	Diesel	48.13	45892.0	52.97	
1586	4/30/98	Diesel	26.44	51206.0	29.08	
1592	4/30/98	Diesel	33.80	30825.0	37.18	
1593	4/30/98	Diesel	53.84	46283.0	59.22	1.06
1592	5/1/98	Diesel	31.19	31026.0	34.31	
1586	5/1/98	Diesel	81.04	51780.0	89.14	
1593	5/1/98	Diesel	41.12	46619.0	45.23	
1586	5/2/98	Diesel	34.76	51987.0	38.24	
1592	5/2/98	Diesel	31.39	31265.0	34.53	
1593	5/2/98	Diesel	47.04	46925.0	51.74	
1586	5/4/98	Diesel	48.29	52412.0	53.12	
1592	5/4/98	Diesel	33.08	31519.0	36.39	
1593	5/4/98	Diesel	48.63	47222.0	53.49	
1586	5/5/98	Diesel	57.19	52669.0	62.91	
1592	5/5/98	Diesel	37.99	31765.0	41.79	
1593	5/5/98	Diesel	45.28	47575.0	49.81	
1592	5/6/98	Diesel	23.71	31970.0	26.08	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	5/6/98	Diesel	39.63	47832.0	43.59	
1586	5/6/98	Diesel	45.19	53060.0	49.71	
1586	5/7/98	Diesel	59.08	53523.0	64.99	
1593	5/7/98	Diesel	36.33	48107.0	39.96	
1592	5/7/98	Diesel	20.89	32173.0	22.98	
1592	5/8/98	Diesel	37.14	32430.0	40.85	
1593	5/8/98	Diesel	42.67	48430.0	46.90	
1593	5/9/98	Diesel	40.03	48738.0	44.03	
1592	5/9/98	Diesel	0.00	0.0	0.00	
1586	5/10/98	Diesel	78.19	54090.0	86.01	
1586	5/11/98	Diesel	36.03	54395.0	39.63	
1592	5/11/98	Diesel	33.00	32852.0	36.30	
1593	5/11/98	Diesel	43.00	48980.0	47.30	
1586	5/12/98	Diesel	62.01	55035.0	65.73	
1592	5/12/98	Diesel	24.22	33082.0	25.67	
1593	5/12/98	Diesel	11.00	49065.0	11.66	
1586	5/13/98	Diesel	44.59	55392.0	46.82	
1592	5/13/98	Diesel	46.01	33323.0	48.31	
1593	5/13/98	Diesel	36.01	49357.0	37.81	
1586	5/14/98	Diesel	56.63	55867.0	59.46	
1592	5/14/98	Diesel	27.40	33531.0	28.77	
1593	5/14/98	Diesel	44.81	49551.0	47.05	
1586	5/15/98	Diesel	44.84	56155.0	45.28	
1592	5/15/98	Diesel	29.85	33761.0	30.15	
1593	5/15/98	Diesel	33.34	49808.0	33.67	
1593	5/15/98	Diesel	17.38	49748.0	18.25	
1586	5/16/98	Diesel	29.66	56380.0	29.96	
1592	5/16/98	Diesel	32.01	33983.0	32.33	
1593	5/16/98	Diesel	28.68	50252.0	28.97	
1586	5/18/98	Diesel	44.01	56652.0	44.45	
1592	5/18/98	Diesel	33.00	34202.0	33.33	
1593	5/18/98	Diesel	38.16	50492.0	38.54	
1592	5/19/98	Diesel	42.99	34532.0	43.42	
1593	5/19/98	Diesel	29.81	50717.0	30.11	
1586	5/19/98	Diesel	58.98	57100.0	59.57	
1586	5/20/98	Diesel	36.99	57388.0	36.62	
1593	5/20/98	Diesel	47.01	51010.0	46.54	
1586	5/21/98	Diesel	52.78	57635.0	51.72	
1592	5/21/98	Diesel	53.07	34881.0	52.01	
1593	5/21/98	Diesel	41.57	51295.0	40.74	
1586	5/22/98	Diesel	40.75	58117.0	39.94	
1592	5/22/98	Diesel	57.95	35300.0	56.79	
1593	5/22/98	Diesel	37.37	51582.0	36.62	
1586	5/23/98	Diesel	60.63	58570.0	59.42	
1592	5/23/98	Diesel	30.87	35568.0	30.25	
1593	5/23/98	Diesel	33.19	51853.0	32.53	
1592	5/25/98	Diesel	44.00	35851.0	43.12	
1593	5/25/98	Diesel	44.01	52151.0	43.13	
1586	5/25/98	Diesel	35.00	58836.0	34.30	
1586	5/26/98	Diesel	17.25	58911.0	16.91	
1586	5/26/98	Diesel	61.00	59421.0	59.17	
1593	5/26/98	Diesel	29.02	52326.0	28.15	
1586	5/27/98	Diesel	42.97	59769.0	41.68	
1593	5/27/98	Diesel	39.00	52612.0	37.83	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1586	5/28/98	Diesel	27.28	59999.0	26.46	
1592	5/28/98	Diesel	58.09	36276.0	56.35	
1593	5/28/98	Diesel	33.69	52754.0	32.68	
1586	5/29/98	Diesel	45.00	60280.0	43.65	
1592	5/29/98	Diesel	28.30	36490.0	27.45	
1593	5/29/98	Diesel	43.00	53178.0	41.71	
1586	5/30/98	Diesel	55.94	60634.0	54.26	
1592	5/30/98	Diesel	11.52	36528.0	11.17	
1593	5/30/98	Diesel	55.46	53692.0	53.80	
1592	5/30/98	Diesel	15.98	36650.0	15.50	1.03
1586	6/1/98	Diesel	66.00	61170.0	64.02	
1592	6/1/98	Diesel	47.00	37002.0	45.59	
1593	6/1/98	Diesel	54.99	53969.0	53.34	
1592	6/2/98	Diesel	32.00	37207.0	30.08	
1593	6/2/98	Diesel	37.99	54245.0	35.71	
1586	6/3/98	Diesel	43.00	61484.0	40.42	
1592	6/3/98	Diesel	38.00	37466.0	35.72	
1593	6/3/98	Diesel	37.99	54512.0	35.71	
1586	6/5/98	Diesel	44.02	62298.0	41.38	
1593	6/5/98	Diesel	39.79	55073.0	37.40	
1593	6/5/98	Diesel	10.03	55114.0	9.43	
1586	6/6/98	Diesel	45.05	62545.0	42.35	
1592	6/6/98	Diesel	84.02	37708.0	78.98	
1593	6/6/98	Diesel	50.00	55469.0	47.59	
1586	6/8/98	Diesel	39.01	62812.0	37.84	
1593	6/8/98	Diesel	34.42	55739.0	33.39	
1586	6/9/98	Diesel	58.02	63254.0	56.86	
1592	6/9/98	Diesel	67.01	38669.0	65.67	
1593	6/9/98	Diesel	48.00	56048.0	47.04	
1592	6/10/98	Diesel	24.00	38879.0	23.52	
1593	6/10/98	Diesel	37.99	56332.0	37.23	
1586	6/11/98	Diesel	58.76	63715.0	57.58	
1592	6/11/98	Diesel	39.08	39116.0	38.30	
1593	6/11/98	Diesel	35.84	56633.0	35.12	
1592	6/12/98	Diesel	26.40	39325.0	26.14	
1593	6/12/98	Diesel	31.16	56909.0	30.85	
1586	6/13/98	Diesel	55.00	64604.0	54.45	
1592	6/13/98	Diesel	30.71	39519.0	30.40	
1593	6/13/98	Diesel	52.86	57178.0	52.33	
1586	6/15/98	Diesel	32.00	64852.0	31.68	
1592	6/15/98	Diesel	40.02	39787.0	39.62	
1593	6/15/98	Diesel	48.01	57487.0	47.53	
1586	6/16/98	Diesel	62.01	65291.0	61.39	
1592	6/16/98	Diesel	37.00	40019.0	36.63	
1593	6/16/98	Diesel	34.99	57700.0	34.64	
1586	6/17/98	Diesel	39.01	65596.0	39.40	
1592	6/17/98	Diesel	33.99	40257.0	34.33	
1593	6/17/98	Diesel	43.01	58008.0	43.44	
1586	6/18/98	Diesel	57.96	66046.0	58.54	
1592	6/18/98	Diesel	22.91	40479.0	23.14	
1593	6/18/98	Diesel	39.44	58547.0	39.83	
1593	6/18/98	Diesel	29.94	58218.0	30.24	
1586	6/19/98	Diesel	44.88	66389.0	45.33	
1592	6/19/98	Diesel	36.71	40699.0	37.08	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	6/19/98	Diesel	48.79	58973.0	49.28	
1586	6/20/98	Diesel	56.98	66832.0	57.55	
1592	6/20/98	Diesel	21.91	40900.0	22.13	
1592	6/20/98	Diesel	60.07	41282.0	60.67	
1593	6/20/98	Diesel	44.80	58986.0	45.25	
1586	6/22/98	Diesel	34.00	67096.0	34.34	
1592	6/22/98	Diesel	39.97	41574.0	40.37	
1593	6/22/98	Diesel	46.99	59700.0	47.46	
1586	6/23/98	Diesel	56.01	67535.0	56.01	
1593	6/23/98	Diesel	43.00	60000.0	43.00	
1586	6/24/98	Diesel	48.01	67880.0	48.01	
1592	6/24/98	Diesel	61.01	42019.0	61.01	
1593	6/24/98	Diesel	38.01	60275.0	38.01	
1586	6/25/98	Diesel	60.81	68343.0	60.81	
1592	6/25/98	Diesel	28.52	42236.0	28.52	
1593	6/25/98	Diesel	37.28	60557.0	37.28	
1586	6/26/98	Diesel	45.05	68653.0	44.60	
1592	6/26/98	Diesel	34.35	42452.0	34.01	
1593	6/26/98	Diesel	40.12	60838.0	39.72	
1586	6/27/98	Diesel	45.48	68969.0	45.03	
1592	6/27/98	Diesel	39.47	42710.0	39.08	
1593	6/27/98	Diesel	25.01	61033.0	24.76	
1586	6/29/98	Diesel	36.00	69222.0	35.64	
1592	6/29/98	Diesel	36.98	42965.0	36.61	
1593	6/29/98	Diesel	44.02	61303.0	43.58	
1593	6/30/98	Diesel	23.30	61481.0	23.07	
1592	6/30/98	Diesel	31.05	43171.0	30.74	
1586	6/30/98	Diesel	54.02	69660.0	53.48	0.99
1586	7/1/98	Diesel	42.00	69974.0	41.58	
1592	7/1/98	Diesel	27.99	43377.0	27.71	
1593	7/1/98	Diesel	39.01	61759.0	38.62	
1586	7/2/98	Diesel	56.56	70417.0	55.43	
1592	7/2/98	Diesel	36.97	43635.0	36.23	
1593	7/2/98	Diesel	52.24	62106.0	51.20	
1586	7/3/98	Diesel	17.52	70636.0	17.17	
1593	7/3/98	Diesel	31.42	62382.0	30.79	
1592	7/3/98	Diesel	21.14	43846.0	20.72	
1586	7/4/98	Diesel	71.74	71404.0	70.31	
1592	7/4/98	Diesel	51.02	44103.0	50.00	
1593	7/4/98	Diesel	51.39	62600.0	50.36	
1586	7/6/98	Diesel	18.55	71250.0	18.18	
1586	7/6/98	Diesel	52.99	71576.0	51.93	
1592	7/6/98	Diesel	27.75	44342.0	27.20	
1593	7/6/98	Diesel	37.87	63275.0	37.11	
1586	7/7/98	Diesel	60.01	72025.0	58.81	
1592	7/7/98	Diesel	41.04	44521.0	40.22	
1586	7/8/98	Diesel	44.99	72346.0	43.64	
1592	7/8/98	Diesel	20.54	44722.0	19.92	
1593	7/8/98	Diesel	31.92	63543.0	30.96	
1586	7/9/98	Diesel	59.75	72811.0	57.96	
1592	7/9/98	Diesel	38.83	45170.0	37.67	
1593	7/9/98	Diesel	40.44	63825.0	39.23	
1592	7/9/98	Diesel	39.19	44946.0	38.01	
1586	7/10/98	Diesel	44.82	73120.0	43.48	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1592	7/10/98	Diesel	29.02	45377.0	28.15	
1593	7/10/98	Diesel	41.58	64097.0	40.33	
1586	7/11/98	Diesel	36.58	73416.0	35.48	
1592	7/11/98	Diesel	32.19	45677.0	31.22	
1593	7/11/98	Diesel	19.46	64497.0	18.88	
1586	7/13/98	Diesel	48.02	73742.0	46.58	
1592	7/13/98	Diesel	41.99	45900.0	40.73	
1593	7/13/98	Diesel	36.00	64859.0	34.92	
1586	7/14/98	Diesel	59.99	74190.0	58.19	
1592	7/14/98	Diesel	24.42	46108.0	23.69	
1593	7/14/98	Diesel	12.29	64999.0	11.92	
1593	7/14/98	Diesel	39.00	65226.0	37.83	
1593	7/15/98	Diesel	36.33	65518.0	37.42	
1592	7/15/98	Diesel	33.81	46345.0	34.82	
1586	7/16/98	Diesel	57.57	74554.0	59.87	
1592	7/16/98	Diesel	30.25	46544.0	31.46	
1593	7/16/98	Diesel	44.89	65789.0	46.69	
1586	7/17/98	Diesel	48.11	75301.0	50.03	
1592	7/17/98	Diesel	31.78	46788.0	33.05	
1593	7/17/98	Diesel	27.76	66016.0	28.87	
1586	7/18/98	Diesel	34.99	75578.0	36.39	
1592	7/18/98	Diesel	33.94	47001.0	35.30	
1593	7/18/98	Diesel	40.94	66316.0	42.58	
1586	7/20/98	Diesel	45.01	75891.0	46.81	
1592	7/20/98	Diesel	38.01	47271.0	39.53	
1593	7/20/98	Diesel	37.02	66535.0	38.50	
1592	7/21/98	Diesel	30.02	47475.0	31.22	
1593	7/21/98	Diesel	42.01	66813.0	43.69	
1592	7/22/98	Diesel	24.58	47686.0	23.60	
1593	7/22/98	Diesel	41.01	67100.0	39.37	
1586	7/22/98	Diesel	47.00	76206.0	45.12	
1586	7/23/98	Diesel	67.59	76682.0	64.89	
1592	7/23/98	Diesel	29.80	47887.0	28.61	
1593	7/23/98	Diesel	40.51	67388.0	38.89	
1586	7/24/98	Diesel	77.92	77230.0	74.80	
1592	7/24/98	Diesel	40.87	48165.0	39.24	
1586	7/25/98	Diesel	54.96	77672.0	52.76	
1592	7/25/98	Diesel	27.10	48356.0	26.02	
1593	7/25/98	Diesel	50.11	67721.0	48.11	
1586	7/27/98	Diesel	40.00	77977.0	38.40	
1592	7/27/98	Diesel	39.23	48657.0	37.66	
1593	7/27/98	Diesel	38.03	67962.0	36.51	
1586	7/28/98	Diesel	61.99	78431.0	60.13	
1592	7/28/98	Diesel	38.99	48919.0	37.82	
1593	7/28/98	Diesel	39.03	68242.0	37.86	
1586	7/29/98	Diesel	31.73	78696.0	31.10	
1592	7/29/98	Diesel	27.85	49124.0	27.01	
1593	7/29/98	Diesel	39.02	68529.0	38.24	
1586	7/30/98	Diesel	51.76	79019.0	50.72	
1592	7/30/98	Diesel	32.76	49349.0	32.10	
1593	7/30/98	Diesel	40.23	68820.0	39.43	
1586	7/31/98	Diesel	45.85	79325.0	44.93	
1592	7/31/98	Diesel	32.93	49564.0	32.27	
1593	7/31/98	Diesel	34.79	69102.0	34.09	0.98

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1592	8/1/98	Diesel	23.12	49759.8	22.66	
1593	8/1/98	Diesel	37.23	69344.4	36.49	
1586	8/3/98	Diesel	25.01	79571.0	25.01	
1592	8/3/98	Diesel	28.94	49981.0	28.94	
1593	8/3/98	Diesel	44.47	69600.0	44.47	
1592	8/4/98	Diesel	35.90	50194.0	35.90	
1593	8/4/98	Diesel	31.60	69868.0	31.60	
1586	8/5/98	Diesel	32.81	79788.0	33.14	
1592	8/5/98	Diesel	26.90	50393.0	26.55	
1593	8/5/98	Diesel	36.40	70141.0	36.76	
1586	8/6/98	Diesel	28.70	80020.0	28.99	
1593	8/6/98	Diesel	46.35	70348.0	46.81	
1592	8/7/98	Diesel	62.26	50840.0	62.88	
1593	8/7/98	Diesel	40.99	70726.0	41.40	
1586	8/8/98	Diesel	72.04	80516.0	72.76	
1593	8/8/98	Diesel	36.47	70940.0	36.83	
1586	8/10/98	Diesel	38.22	80871.0	38.60	
1592	8/10/98	Diesel	75.00	51357.0	75.75	
1593	8/10/98	Diesel	39.43	71428.0	39.82	
1586	8/11/98	Diesel	34.98	81117.0	35.33	
1592	8/11/98	Diesel	21.91	51563.0	21.91	
1593	8/11/98	Diesel	27.00	71640.0	27.00	
1592	8/12/98	Diesel	31.53	51771.0	31.53	
1593	8/12/98	Diesel	29.98	71918.0	29.98	
1586	8/13/98	Diesel	54.47	81377.0	54.47	
1592	8/13/98	Diesel	30.39	51979.0	30.39	
1593	8/13/98	Diesel	39.33	72206.0	39.33	
1586	8/14/98	Diesel	49.08	81719.0	49.08	
1592	8/14/98	Diesel	41.76	52262.0	41.76	
1593	8/14/98	Diesel	46.91	72499.0	46.91	
1593	8/15/98	Diesel	28.59	72272.0	28.59	
1586	8/15/98	Diesel	29.03	81961.0	29.03	
1592	8/15/98	Diesel	33.07	52516.0	33.07	
1586	8/15/98	Diesel	41.01	82273.0	41.01	
1586	8/17/98	Diesel	42.98	82565.0	42.55	
1592	8/17/98	Diesel	25.58	52710.0	25.32	
1593	8/17/98	Diesel	40.32	72994.0	40.32	
1586	8/18/98	Diesel	25.65	82760.0	25.39	
1592	8/18/98	Diesel	36.14	52931.0	35.78	
1593	8/18/98	Diesel	30.97	73204.0	30.66	
1586	8/19/98	Diesel	27.23	82936.0	26.96	
1592	8/19/98	Diesel	34.20	53136.0	33.86	
1593	8/19/98	Diesel	37.39	73506.0	37.02	
1586	8/20/98	Diesel	23.22	83133.0	22.99	
1592	8/20/98	Diesel	21.83	53335.0	21.61	
1593	8/20/98	Diesel	32.02	73828.0	31.70	
1586	8/21/98	Diesel	54.03	83478.0	52.95	
1592	8/21/98	Diesel	24.60	53605.0	24.11	
1593	8/21/98	Diesel	42.88	74010.0	42.02	
1586	8/22/98	Diesel	37.49	83775.0	36.74	
1592	8/22/98	Diesel	48.24	53838.0	47.28	
1593	8/22/98	Diesel	35.01	74393.0	34.31	
1586	8/24/98	Diesel	24.35	83966.0	23.86	
1592	8/24/98	Diesel	24.41	54030.0	23.92	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	8/24/98	Diesel	37.08	74874.0	36.34	
1586	8/25/98	Diesel	52.81	84330.0	51.75	
1593	8/25/98	Diesel	31.15	74881.0	30.53	
1586	8/26/98	Diesel	34.22	84563.0	33.54	
1592	8/26/98	Diesel	54.90	54374.0	53.80	
1593	8/26/98	Diesel	47.92	75178.0	46.96	
1586	8/27/98	Diesel	38.10	84883.0	37.34	
1592	8/27/98	Diesel	25.70	54579.0	25.19	
1593	8/27/98	Diesel	31.91	75458.0	31.27	
1592	8/28/98	Diesel	28.02	54797.0	27.46	
1593	8/28/98	Diesel	36.97	75747.0	36.23	
1593	8/28/98	Diesel	16.60	75878.0	16.27	
1586	8/29/98	Diesel	54.64	85354.0	53.55	
1592	8/29/98	Diesel	45.25	55083.0	44.35	
1586	8/31/98	Diesel	17.34	85937.0	16.99	
1592	8/31/98	Diesel	45.31	55268.0	44.40	
1593	8/31/98	Diesel	37.08	76137.0	36.34	0.99
1592	9/1/98	Diesel	38.39	55366.0	37.62	
1593	9/1/98	Diesel	28.25	76344.0	27.69	
1592	9/2/98	Diesel	21.86	55570.0	21.42	
1593	9/2/98	Diesel	29.68	76631.0	29.09	
1586	9/3/98	Diesel	41.15	85716.0	40.33	
1592	9/3/98	Diesel	27.05	55774.0	26.51	
1593	9/3/98	Diesel	31.61	76903.0	30.98	
1592	9/4/98	Diesel	49.35	56106.0	49.35	
1593	9/4/98	Diesel	42.83	77170.0	42.83	
1586	9/5/98	Diesel	52.01	86058.0	52.01	
1586	9/5/98	Diesel	40.74	86344.0	40.74	
1592	9/5/98	Diesel	13.53	56218.0	13.53	
1593	9/5/98	Diesel	33.53	77408.0	33.53	
1586	9/7/98	Diesel	47.53	86658.0	47.52	
1592	9/7/98	Diesel	31.46	56422.0	31.46	
1593	9/7/98	Diesel	38.88	77682.0	38.88	
1586	9/8/98	Diesel	36.09	86903.0	36.09	
1586	9/9/98	Diesel	28.48	87091.0	28.76	
1593	9/9/98	Diesel	40.99	77962.0	41.40	
1586	9/10/98	Diesel	40.70	87418.0	41.51	
1592	9/10/98	Diesel	32.60	56640.0	33.25	
1593	9/10/98	Diesel	34.30	78243.0	34.99	
1592	9/11/98	Diesel	21.92	56788.0	22.80	
1593	9/11/98	Diesel	36.27	78524.0	37.72	
1593	9/11/98	Diesel	4.99	78524.0	5.19	
1586	9/11/98	Diesel	38.61	87747.0	40.15	
1586	9/12/98	Diesel	41.85	88032.0	43.52	
1592	9/12/98	Diesel	27.49	56973.0	28.59	
1593	9/12/98	Diesel	36.87	78792.0	38.34	
1586	9/14/98	Diesel	43.81	88341.0	45.56	
1592	9/14/98	Diesel	32.68	57178.0	33.99	
1593	9/14/98	Diesel	39.27	79058.0	40.84	
1592	9/15/98	Diesel	35.95	57432.0	37.39	
1586	9/16/98	Diesel	24.23	88517.0	25.20	
1592	9/16/98	Diesel	21.52	57637.0	22.38	
1593	9/16/98	Diesel	40.22	79356.0	41.83	
1586	9/17/98	Diesel	4.56	88826.0	4.74	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1592	9/17/98	Diesel	34.23	57845.0	35.60	
1593	9/17/98	Diesel	35.43	79647.0	36.85	
1586	9/17/98	Diesel	36.40	88826.0	37.86	
1586	9/18/98	Diesel	45.13	89157.0	46.03	
1593	9/18/98	Diesel	36.65	79968.0	37.38	
1592	9/19/98	Diesel	13.30	57958.0	13.57	
1593	9/19/98	Diesel	32.68	80133.0	33.33	
1586	9/21/98	Diesel	45.55	89854.0	46.46	
1592	9/21/98	Diesel	42.90	58214.0	43.76	
1593	9/21/98	Diesel	35.03	80391.0	35.73	
1586	9/22/98	Diesel	29.63	90061.0	30.52	
1592	9/22/98	Diesel	27.54	58491.0	28.37	
1586	9/23/98	Diesel	25.40	90238.0	26.16	
1592	9/23/98	Diesel	32.93	58627.0	33.92	
1593	9/23/98	Diesel	36.19	80668.0	37.28	
1586	9/24/98	Diesel	40.71	90563.0	41.52	
1592	9/24/98	Diesel	24.57	58834.0	25.06	
1593	9/24/98	Diesel	35.60	80942.0	36.31	
1586	9/25/98	Diesel	46.54	90912.0	47.94	
1592	9/25/98	Diesel	29.03	59029.0	29.90	
1593	9/25/98	Diesel	39.81	81238.0	41.00	
1586	9/26/98	Diesel	49.74	91227.0	51.23	
1586	9/26/98	Diesel	30.26	91479.0	31.47	
1592	9/26/98	Diesel	38.92	59319.0	40.09	
1593	9/26/98	Diesel	36.42	81509.0	37.51	
1592	9/28/98	Diesel	34.23	59531.0	35.60	
1593	9/28/98	Diesel	35.48	81765.0	36.90	
1586	9/29/98	Diesel	38.24	91756.0	39.39	
1592	9/29/98	Diesel	27.30	59739.0	28.12	
1593	9/29/98	Diesel	35.04	82207.0	36.09	
1586	9/30/98	Diesel	25.72	91968.0	26.49	
1592	9/30/98	Diesel	28.92	59950.0	29.79	
1593	9/30/98	Diesel	37.12	82300.0	38.23	1.02
1592	10/1/98	Diesel	35.68	60203.0	36.75	
1593	10/1/98	Diesel	40.19	82617.0	41.40	
1586	10/1/98	Diesel	46.95	92295.0	48.36	
1586	10/2/98	Diesel	47.06	92633.0	48.47	
1593	10/2/98	Diesel	45.40	82923.0	46.76	
1592	10/5/98	Diesel	19.17	60658.0	19.74	
1593	10/5/98	Diesel	38.78	83205.0	39.94	
1592	10/6/98	Diesel	34.59	61080.0	34.94	
1586	10/7/98	Diesel	30.17	93076.0	30.17	
1592	10/7/98	Diesel	28.38	61084.0	28.38	
1592	10/7/98	Diesel	3.93	61085.0	3.93	
1593	10/7/98	Diesel	44.01	83492.0	44.01	
1586	10/8/98	Diesel	41.53	93407.0	41.11	
1592	10/8/98	Diesel	28.91	61302.0	28.62	
1593	10/8/98	Diesel	31.69	83761.0	31.37	
1586	10/9/98	Diesel	52.00	93753.0	51.48	
1592	10/9/98	Diesel	24.16	61471.0	23.92	
1593	10/9/98	Diesel	38.53	84056.0	38.14	
1586	10/12/98	Diesel	18.64	94164.0	18.45	
1592	10/12/98	Diesel	36.78	61680.0	36.41	
1592	10/13/98	Diesel	18.32	61900.0	18.41	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1592	10/14/98	Diesel	34.24	62026.0	33.90	
1593	10/14/98	Diesel	23.84	84335.0	23.60	
1586	10/15/98	Diesel	50.47	94519.0	49.97	
1592	10/15/98	Diesel	34.96	62302.0	34.61	
1593	10/15/98	Diesel	46.98	84612.0	46.51	
1593	10/16/98	Diesel	45.11	84499.0	44.66	
1592	10/16/98	Diesel	24.41	62462.0	24.17	
1586	10/17/98	Diesel	46.93	94848.0	46.46	
1586	10/17/98	Diesel	44.28	95125.0	43.84	
1592	10/17/98	Diesel	47.22	62763.0	46.75	
1592	10/19/98	Diesel	29.98	62976.0	29.98	
1593	10/19/98	Diesel	36.82	85167.0	36.82	
1586	10/20/98	Diesel	39.13	95659.0	39.13	
1592	10/20/98	Diesel	29.66	63186.0	29.66	
1586	10/20/98	Diesel	44.81	95407.0	44.81	
1586	10/21/98	Diesel	29.73	95864.0	29.73	
1592	10/21/98	Diesel	20.46	63392.0	20.46	
1593	10/21/98	Diesel	36.73	85455.0	36.73	
1586	10/22/98	Diesel	41.47	96185.0	41.47	
1592	10/22/98	Diesel	27.92	63602.0	27.92	
1593	10/22/98	Diesel	30.17	85739.0	30.17	
1586	10/23/98	Diesel	44.56	96503.0	44.56	
1592	10/23/98	Diesel	49.58	63934.0	49.58	
1593	10/23/98	Diesel	36.47	86019.0	36.47	
1586	10/24/98	Diesel	47.95	96788.0	47.95	
1592	10/26/98	Diesel	34.31	64188.0	34.31	
1586	10/27/98	Diesel	30.36	97294.0	30.66	
1592	10/27/98	Diesel	25.23	64391.0	25.48	
1593	10/27/98	Diesel	33.96	86228.0	34.30	
1586	10/28/98	Diesel	28.72	97482.0	29.01	
1592	10/28/98	Diesel	37.00	64648.0	37.37	
1593	10/28/98	Diesel	36.28	86506.0	36.64	
1592	10/29/98	Diesel	29.48	64856.0	29.77	
1593	10/29/98	Diesel	36.55	86767.0	36.92	
1586	10/30/98	Diesel	48.18	97811.0	48.66	
1586	10/30/98	Diesel	46.63	98120.0	47.10	
1592	10/30/98	Diesel	24.05	65047.0	24.29	
1593	10/30/98	Diesel	39.10	87069.0	39.49	
1586	10/31/98	Diesel	25.22	98443.0	25.47	
1586	10/31/98	Diesel	48.95	98728.0	49.44	
1592	10/31/98	Diesel	18.94	65171.0	19.13	1.00
1586	11/3/98	Diesel	44.84	98994.0	45.29	
1592	11/3/98	Diesel	26.43	65705.0	26.69	
1593	11/3/98	Diesel	44.46	87663.0	44.90	
1586	11/4/98	Diesel	24.89	99169.0	25.14	
1592	11/4/98	Diesel	27.52	65921.0	27.80	
1593	11/4/98	Diesel	38.71	87957.0	39.10	
1586	11/5/98	Diesel	39.88	99491.0	40.28	
1592	11/5/98	Diesel	25.62	66125.0	25.88	
1593	11/5/98	Diesel	34.99	88221.0	35.34	
1586	11/6/98	Diesel	39.42	99817.0	40.21	
1592	11/6/98	Diesel	32.32	66373.0	32.97	
1593	11/6/98	Diesel	32.90	88496.0	33.56	
1586	11/7/98	Diesel	52.12	100094.0	53.16	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	11/7/98	Diesel	35.15	88669.0	35.85	
1586	11/9/98	Diesel	53.21	100383.0	54.27	
1593	11/9/98	Diesel	36.28	88942.0	37.01	
1592	11/9/98	Diesel	37.00	66566.0	37.74	
1586	11/10/98	Diesel	20.13	100495.0	20.33	
1592	11/10/98	Diesel	25.84	66773.0	26.10	
1593	11/10/98	Diesel	39.62	89234.0	40.02	
1586	11/11/98	Diesel	23.87	100671.0	24.11	
1592	11/11/98	Diesel	31.04	66976.0	31.35	
1593	11/11/98	Diesel	39.26	89512.0	39.65	
1586	11/12/98	Diesel	25.08	100859.0	25.33	
1592	11/12/98	Diesel	23.34	67179.0	23.57	
1593	11/12/98	Diesel	34.07	89797.0	34.41	
1593	11/13/98	Diesel	38.24	90072.0	38.62	
1586	11/13/98	Diesel	46.27	101179.0	46.73	
1586	11/14/98	Diesel	40.34	101458.0	40.74	
1586	11/16/98	Diesel	50.33	101747.0	49.83	
1592	11/16/98	Diesel	30.72	67391.0	30.41	
1593	11/16/98	Diesel	36.57	90358.0	36.20	
1586	11/17/98	Diesel	27.43	101984.0	26.88	
1592	11/17/98	Diesel	28.34	67958.0	27.77	
1593	11/17/98	Diesel	35.39	90609.0	34.68	
1593	11/18/98	Diesel	39.44	90883.0	38.65	
1586	11/19/98	Diesel	57.85	102220.0	56.69	
1592	11/19/98	Diesel	61.25	68008.0	60.03	
1593	11/19/98	Diesel	43.84	91156.0	42.96	
1586	11/20/98	Diesel	46.57	102688.0	44.71	
1592	11/20/98	Diesel	41.94	68336.0	40.26	
1593	11/20/98	Diesel	41.02	91434.0	39.38	
1586	11/21/98	Diesel	27.90	102900.0	26.78	
1586	11/23/98	Diesel	49.91	103071.0	47.41	
1592	11/23/98	Diesel	39.29	68745.0	37.33	
1593	11/23/98	Diesel	44.56	91600.0	42.33	
1593	11/23/98	Diesel	49.41	91800.0	46.94	
1592	11/24/98	Diesel	37.03	69000.0	35.18	
1593	11/24/98	Diesel	23.08	91951.0	21.93	
1592	11/25/98	Diesel	26.34	69209.0	25.02	
1593	11/25/98	Diesel	35.75	92274.0	33.96	
1586	11/26/98	Diesel	51.86	103434.0	49.26	
1593	11/27/98	Diesel	42.96	92508.0	40.81	
1586	11/28/98	Diesel	49.50	103770.0	47.03	
1586	11/28/98	Diesel	47.64	104049.0	45.26	
1586	11/30/98	Diesel	50.04	104347.0	47.04	
1592	11/30/98	Diesel	34.22	69418.0	32.17	
1593	11/30/98	Diesel	42.43	92785.0	39.88	0.99
1593	12/1/98	Diesel	35.25	93027.0	33.14	
1592	12/2/98	Diesel	28.10	69628.0	26.41	
1593	12/2/98	Diesel	26.95	93232.0	25.33	
1586	12/2/98	Diesel	30.26	104550.0	28.44	
1586	12/3/98	Diesel	46.82	104863.0	43.07	
1592	12/3/98	Diesel	0.10	69836.0	0.09	
1592	12/3/98	Diesel	37.11	69837.0	34.14	
1593	12/3/98	Diesel	38.04	93307.0	35.00	
1586	12/4/98	Diesel	48.50	105183.0	43.17	

Truck	Date	Fuel	Amount	Odometer	Cost	Monthly Avg
1593	12/4/98	Diesel	44.04	93795.0	39.20	
1592	12/7/98	Diesel	31.58	70045.0	28.11	
1593	12/7/98	Diesel	40.19	94080.0	35.77	
1592	12/8/98	Diesel	33.43	70255.0	29.75	
1593	12/8/98	Diesel	56.71	94456.0	50.47	
1586	12/9/98	Diesel	26.59	105568.0	23.40	
1592	12/9/98	Diesel	29.86	70462.0	26.28	
1593	12/9/98	Diesel	45.15	94790.0	39.73	
1586	12/10/98	Diesel	42.20	105879.0	37.14	
1592	12/10/98	Diesel	24.40	70703.0	21.47	
1593	12/10/98	Diesel	32.54	95070.0	28.64	
1586	12/11/98	Diesel	43.89	106199.0	38.62	
1593	12/11/98	Diesel	41.81	95383.0	36.79	
1592	12/14/98	Diesel	44.73	70938.0	39.36	
1593	12/14/98	Diesel	45.44	95641.0	39.99	
1586	12/15/98	Diesel	37.26	106407.0	32.79	
1592	12/15/98	Diesel	27.79	71132.0	24.46	
1593	12/15/98	Diesel	44.70	95958.0	39.34	
1586	12/16/98	Diesel	30.02	106603.0	26.42	
1592	12/16/98	Diesel	32.28	71353.0	28.41	
1593	12/16/98	Diesel	38.30	96232.0	33.70	
1586	12/17/98	Diesel	0.44	106917.0	0.39	
1586	12/17/98	Diesel	0.01	106917.0	0.01	
1586	12/17/98	Diesel	39.88	106917.0	35.49	
1592	12/17/98	Diesel	33.79	71597.0	30.07	
1593	12/17/98	Diesel	38.58	96551.0	34.34	
1586	12/18/98	Diesel	44.01	107237.0	39.17	
1593	12/18/98	Diesel	37.02	96816.0	32.95	
1586	12/20/98	Diesel	0.15	107551.0	0.13	
1586	12/21/98	Diesel	46.41	107988.0	41.30	
1592	12/21/98	Diesel	37.89	71853.0	33.72	
1593	12/21/98	Diesel	47.34	97130.0	42.13	
1586	12/22/98	Diesel	42.16	108289.0	37.52	
1592	12/22/98	Diesel	29.03	72059.0	25.84	
1593	12/22/98	Diesel	28.94	97354.0	25.76	
1586	12/23/98	Diesel	35.02	108492.0	31.17	
1592	12/23/98	Diesel	36.15	72273.0	32.17	
1593	12/23/98	Diesel	42.79	97636.0	38.08	
1586	12/28/98	Diesel	45.98	109060.0	41.38	
1592	12/28/98	Diesel	33.17	72737.0	29.85	
1593	12/28/98	Diesel	30.55	98099.0	27.50	
1586	12/29/98	Diesel	34.15	109295.0	30.74	
1592	12/29/98	Diesel	35.38	72945.0	31.84	
1593	12/29/98	Diesel	24.49	98219.0	22.04	
1586	12/30/98	Diesel	30.02	109511.0	27.02	
1592	12/30/98	Diesel	29.35	73150.0	26.42	
1593	12/30/98	Diesel	41.13	98565.0	37.02	
1592	12/31/98	Diesel	43.51	73505.0	39.16	
1593	12/31/98	Diesel	24.70	98797.0	22.23	
1586	12/31/98	Diesel	46.75	109792.0	42.08	0.89
		Totals	30208.60		30419.90	
				Average	1.01	

Appendix G

Monthly Maintenance Costs by Truck and Driver Complaint Summary

Raley's Maintenance Costs by Vehicle System

VMRS	Description	1501	1502	1503	1504	1505	1506	1507	1508	Total	Avg/Truck	1586	1592	1593	Total DSL	Avg/Truck
01	A/C & Heat	23.36	0.00	72.16	63.80	60.00	0.00	0.00	43.80	263.12	32.89	83.47	0.00	15.00	98.47	32.82
02/71	Cab & Sheet Metal/Body	401.25	101.62	479.85	380.50	301.00	235.66	437.72	165.50	2503.10	312.89	335.53	227.76	492.01	1055.30	351.77
10	Air System	95.35	53.94	0.00	34.47	25.00	10.00	275.00	483.28	977.04	122.13	151.54	0.00	166.54	318.08	106.03
11	Front Axle	0.00	0.00	0.00	0.00	0.00	18.50	0.00	0.00	18.50	2.31	95.00	0.00	95.00	190.00	63.33
13	Brakes	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	30.00	3.75	25.00	0.00	133.60	158.60	52.87
14	Frame	15.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	40.00	5.00	75.00	0.00	25.00	100.00	33.33
15	Steering	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	6.25	0.00	0.00	0.00	0.00	0.00
16	Suspension	20.00	20.00	90.32	20.00	20.00	106.01	20.00	116.01	412.34	51.54	80.32	20.00	20.00	120.32	40.11
17	Tires	1960.00	1456.50	1350.00	1360.00	1150.00	950.00	997.00	955.00	10178.50	1272.31	670.00	595.00	1835.00	3100.00	1033.33
18	Wheels	0.00	0.00	0.00	0.00	0.00	0.00	1.64	0.00	1.64	0.21	0.00	0.00	0.00	0.00	0.00
22	Rear Axle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Clutch	18.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.77	2.35	0.00	0.00	0.00	0.00	0.00
26	Transmission	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	Charging	0.00	0.00	0.00	0.00	0.00	259.00	0.00	0.00	259.00	32.38	0.00	0.00	0.00	0.00	0.00
32	Cranking	160.90	228.85	348.35	413.85	228.85	627.85	507.70	0.00	2516.35	314.54	0.00	0.00	69.50	69.50	23.17
33	Ignition	327.24	163.62	327.24	327.24	1036.44	1036.44	1036.44	1036.44	5291.10	661.39	0.00	0.00	0.00	0.00	0.00
34	Lighting	198.12	199.52	69.27	189.73	224.82	72.26	363.57	129.47	1446.76	180.85	199.97	158.96	77.08	436.01	145.34
42	Cooling	0.00	65.45	6.18	9.27	21.18	0.00	27.36	6.18	135.62	16.95	0.00	34.27	0.00	34.27	11.42
43	Exhaust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00	5.00	0.00	50.50	0.00	50.50	16.83
44	Fuel	305.52	265.52	911.52	368.52	549.94	830.52	383.52	450.52	4065.58	508.20	26.60	26.60	458.33	511.53	170.51
45	Engine	440.20	400.20	410.20	385.20	395.20	1354.26	410.20	385.20	4180.66	522.58	281.10	269.20	282.20	832.50	277.50
50	Accessories	75.00	80.02	391.12	260.45	396.12	28.90	161.91	100.00	1493.52	186.69	68.49	160.82	334.70	564.01	188.00
59	Fifth Wheel	90.00	50.00	592.00	0.00	32.76	0.00	0.00	0.00	764.76	95.60	0.00	0.00	0.00	0.00	0.00
101	Inspections	860.00	865.00	1030.00	940.00	900.00	880.00	925.00	880.00	7280.00	910.00	1000.00	1000.00	1000.00	3000.00	1000.00
	Total	4990.71	4000.24	6078.21	4753.03	5341.31	6409.40	5602.06	4791.40	41966.36	5245.80	3092.02	2543.11	5003.96	10639.09	3546.36

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Group Total Diesel Control

	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97
Mileage	19,173	0	0	57,065	0	18,601	35,299	0	20,532	34,309	19,978	0	35,963	22,014	0	35,035	22,541	16,620	17,555
No. of RC																			
Parts Cost	165.93	0.00	0.00	856.80	0.00	109.92	363.86	0.00	133.71	386.29	610.31	95.00	962.76	991.42	0.00	584.36	466.91	326.69	194.04
Labor Hours	11.9	0.0	0.0	32.3	0.0	10.9	15.5	0.0	7.7	19.0	10.1	0.0	13.6	7.8	0.0	14.2	10.6	10.5	7.7
Total per Mile	0.040			0.043		0.035	0.032		0.025	0.039	0.056		0.046	0.063		0.037	0.044	0.051	0.033
Cum Tot per Mile	0.040	0.040	0.040	0.042	0.042	0.041	0.039	0.039	0.037	0.037	0.039	0.039	0.040	0.042	0.042	0.042	0.042	0.042	0.041

PMA 4-7	222,844
	5464.09
	103.5
	0.048

Group Total Diesel Control

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3
Mileage	17,779	17,032	18,423	20,587	19,171	18,078	17,507	17,995	15,907	17,651	16,094	19,787	16,564	17,633	21,928	24,679	41,959	0	0	0	0	0	693,459	110,201
No. of RC																								
Parts Cost	885.32	180.62	1033.85	1535.29	449.95	725.27	915.93	144.47	1286.12	360.07	438.40	208.96	475.54	1356.62	827.26	411.76	1012.45	0.00	0.00	0.00	0.00	0.00	18,495.88	983.49
Labor Hours	10.6	8.7	8.0	8.3	8.1	9.8	7.6	6.1	7.6	10.1	9.5	8.5	7.2	9.2	7.0	7.0	17.6	0.0	0.0	0.0	0.0	0.0	322.7	55.5
Total per Mile	0.080	0.036	0.078	0.095	0.045	0.067	0.074	0.025	0.105	0.049	0.057	0.032	0.050	0.103	0.054	0.031	0.045						0.050	0.034
Cum Tot per Mile	0.044	0.043	0.045	0.048	0.048	0.048	0.049	0.048	0.050	0.050	0.050	0.050	0.050	0.051	0.052	0.051	0.050	0.050	0.050	0.050	0.050	0.050		

The similar total is for the first four scheduled maintenance actions for each truck; this matches the data for the LNG fleet to date.

Group Total LNG

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage			43,803	36,866	0	79,664	13,503	0	94,105	11,364	0	99,505	0	0	109,267	0	0	110,124	11,400	0	65,205	42,690	717,496	198,636	438,191
No. of RC																									
Parts Cost			1,906.86	1,136.78	443.75	1,660.04	1,369.59	0.00	1,172.98	832.00	0.00	3,550.78	91.50	0.00	7,398.77	237.00	600.00	4,832.70	595.53	0.00	4,753.37	3,321.71	33,903.36	5,775.86	25,381.36
Labor Hours			92.8	65.7	0.0	95.0	7.4	0.0	69.1	11.7	0.0	73.2	0.0	0.0	85.9	0.0	0.0	74.0	13.9	0.0	55.3	29.4	673.4	183.2	331.7
Total per Mile			0.149	0.120		0.080	0.129		0.049	0.125		0.072			0.107			0.077	0.113		0.115	0.112	0.094	0.075	0.096
Cum Tot per Mile			0.149	0.136	0.141	0.111	0.113	0.113	0.090	0.092	0.092	0.087	0.087	0.087	0.091	0.092	0.093	0.090	0.091	0.091	0.093	0.094			

Truck 1586 Diesel Control

	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97
Mileage	19,173			19,787			19,114			18,327			18,947			18,151			17,555
No. of RC																			
Parts Cost	165.93			156.37			128.12			166.66			865.12			261.20			194.04
Labor Hours	11.9			12.1			5.9			9.7			7.8			6.9			7.7
Total per Mile	0.040			0.038			0.022			0.036			0.066			0.033			0.033
End Odometer	19,173			38,960			58,074			76,401			95,348			113,499			131,054

PMA 4-7	72,980
	1,487
	32.1
	0.042

Truck 1586 Diesel Control (continued)

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3
Mileage			18,423			18,078			15,907			19,787			21,928		23,713						248,890	38,901
No. of RC																								
Parts Cost			1,033.85			725.27	99.00		1,286.12			208.96			827.26		874.16						6,992.06	284.49
Labor Hours			8.0			9.8	0.0		7.6			8.5			7.0		11.4						114.3	18.0
Total per Mile			0.078			0.067			0.105			0.032			0.054		0.061						0.051	0.030
End Odometer			149,477			3,555			19,462			39,249			61,177		84,890							

Truck 1592 Diesel Control

	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97
Mileage				17,252			16,185			15,982			17,016			16,884		16,620	
No. of RC																			
Parts Cost				539.51			235.74			219.63			97.64			323.16		326.69	
Labor Hours				12.3			9.6			9.3			5.8			7.3		10.5	
Total per Mile				0.067			0.044			0.043			0.023			0.041		0.051	
End Odometer				17,252			33,437			49,419			66,435			83,319		99,939	

PMA 4-7	67,552
	928.11
	32.3
	0.038

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Truck 1592 Diesel Control (continued)

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3
Mileage		17,032			19,171			17,995			16,094			17,633			18,246						206,110	32,167
No. of RC																								
Parts Cost		180.62			449.95			144.47			438.40			1,356.62			138.29						4,450.72	455.37
Labor Hours		8.7			8.1			6.1			9.5			9.2			6.2						102.6	18.9
Total per Mile		0.036			0.045			0.025			0.057			0.103			0.025						0.046	0.044
End Odometer		116,971			136,142			2,131			18,225			35,858			54,104							

Truck 1593 Diesel Control

	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97		PMA 4-7	
Mileage				20,026		18,601			20,532		19,978			22,014			22,541					82,312
No. of RC																						
Parts Cost				160.92		109.92			133.71		610.31	95.00		991.42			466.91					3,048.96
Labor Hours				7.9		10.9			7.7		10.1	0.0		7.8			10.6					39.1
Total per Mile				0.028		0.035			0.025		0.056			0.063			0.044					0.061
End Odometer				20,026		38,627			59,159		79,137			101,151			123,692					

Truck 1593 Diesel Control (continued)

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3
Mileage	17,779			20,587			17,507			17,651			16,564			24,679							238,459	39,133
No. of RC																								
Parts Cost	885.32			1,535.29			816.93			360.07			475.54			411.76							7,053.10	243.63
Labor Hours	10.6			8.3			7.6			10.1			7.2			7.0							105.8	18.6
Total per Mile	0.080			0.095			0.068			0.049			0.050			0.031							0.052	0.030
End Odometer	141,471			162,058			8,501			26,152			42,716			67,395								

Truck 1501 LNG

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage			7,055			12,552			12,389			7,604			11,512			14,490			12,426		78,028	24,941	46,032
No. of RC																									
Parts Cost			324.67			172.17			243.55			738.44			908.31			1,028.93			425.03		3,841.10	415.72	3,100.71
Labor Hours			18.0			15.9			10.2			8.0			12.1			8.3			9.4		81.9	26.1	37.8
Total per Mile			0.174			0.077			0.061			0.150			0.131			0.100			0.072		0.102	0.069	0.108
End Odom			7,055			19,607			31,996			39,600			51,112			65,602			78,028		78,028	31,996	78,028

Truck 1502 LNG

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage				11,653		8,855			11,713			10,925			14,142			16,448				14,760	88,496	20,568	56,275
No. of RC																									
Parts Cost				308.28	35.00	168.80			178.45			134.03	91.50		1,348.45			376.61				324.65	2,965.77	382.25	2,275.24
Labor Hours				20.2	0.0	13.5			11.3			6.4			11.3			9.1				7.7	79.5	24.8	34.5
Total per Mile				0.113		0.095			0.063			0.042			0.135			0.051				0.048	0.078	0.079	0.071
End Odom				11,653	15,087	20,508			32,221			43,146			57,288			73,736				88,496	88,496	32,221	88,496

Truck 1503 LNG

	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage			7,618			12,505			14,415			14,905			14,803			16,088			7,869		88,203	26,920	53,665
No. of RC																									
Parts Cost			230.28		408.75	205.44			145.30			637.92			1,790.65	180.00		371.07			698.57		4,667.98	759.49	3,678.21
Labor Hours			19.5		0.0	19.6			11.2			11.4			12.1			9.2			15.3		98.3	30.8	48.0
Total per Mile			0.158			0.095			0.049			0.081			0.162			0.052			0.186		0.109	0.085	0.113
End Odom			7,618		17,854	20,123			34,538			49,443			64,246			80,334			88,203		88,203	34,538	88,203

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Truck 1504	LNG																								
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage				13,460		13,012			14,405			17,261			14,125			17,783			16,684		106,730	27,417	65,853
No. of RC																									
Parts Cost				290.55		186.58	1,172.58		140.71			871.94			499.39			898.21			448.49		4,508.45	1,499.87	2,718.03
Labor Hours				25.1		8.9	0.0		10.0			11.1			8.5			9.0			12.1		84.7	18.9	40.7
Total per Mile				0.115		0.049			0.044			0.083			0.065			0.076			0.063		0.082	0.089	0.072
End Odom				13,460		26,472			40,877			58,138			72,263			90,046			106,730		106,730	40,877	106,730

Truck 1505	LNG																								
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage			7,448			7,030				11,364		6,720			15,286			15,997				14,660	78,505	18,394	52,663
No. of RC																									
Parts Cost			867.18	297.50		146.68				832.00		744.08			368.69		90.00	402.07				1,756.47	5,504.67	1,276.18	3,361.31
Labor Hours			18.2	0.0		10.1				11.7		11.2			10.7			7.4				10.3	79.6	21.8	39.6
Total per Mile			0.239			0.093				0.125		0.194			0.059			0.048				0.155	0.121	0.129	0.101
End Odom			7,448			14,478				25,842		32,562			47,848			63,845				78,505	78,505	25,842	78,505

Truck 1506		LNG																								
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7	
Mileage				11,753			13,503		10,212			14,421			15,115				11,400			13,270	89,674	23,715	54,206	
No. of RC																										
Parts Cost				240.45		229.87	197.01		144.38			136.58			1,137.72		510.00	783.98	595.53			1,240.59	5,216.11	571.26	4,404.40	
Labor Hours				20.4		0.0	7.4		10.9			5.1			9.7				13.9			11.4	78.8	18.3	40.1	
Total per Mile				0.107			0.042		0.068			0.027			0.107				0.113			0.136	0.102	0.063	0.118	
End Odom				11,753			25,256		35,468			49,889			65,004				76,404			89,674	89,674	35,468	89,674	

Truck 1507	LNG																								
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage			10,416			11,673			14,318			13,145			13,260			16,367			15,747		94,926	25,991	58,519
No. of RC																									
Parts Cost			248.27			152.68			148.93			147.35			1,010.65	57.00		672.14			1,354.92		3,791.94	301.61	3,242.06
Labor Hours			20.0			16.3			7.8			10.9			11.5			14.4			10.4		91.3	24.1	47.2
Total per Mile			0.120			0.083			0.038			0.053			0.120	0.088		0.085			0.119		0.088	0.058	0.096
End Odom			10,416			22,089			36,407			49,552			62,812			79,179			94,926		94,926	36,407	94,926

Truck 1508	LNG																								
	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Total	PMA 2-3	PMA 4-7
Mileage			11,266			14,037			16,653			14,524			11,024			12,951			12,479		92,934	30,690	50,978
No. of RC																									
Parts Cost			236.46			397.82			171.66			140.44			334.91			299.69			1,826.36		3,407.34	569.48	2,601.40
Labor Hours			17.1			10.7			7.7			9.1			10.0			16.6			8.1		79.3	18.4	43.8
Total per Mile			0.097			0.066			0.033			0.041			0.076			0.087			0.179		0.079	0.049	0.094
End Odom			11,266			25,303			41,956			56,480			67,504			80,455			92,934		92,934	41,956	92,934

Driver Complaint Analysis

July 1998 Through December 31, 1998

Raley's Diesel Study Fleet

4/22/99

Category	Jul	Aug	Sep	Oct	Nov	Dec	Totals	Percent
Body and Damage	0	0	1	2	4	1	8	21
Lights	2	2	2	2	2	0	10	26
Engine - Rough, Power	0	0	0	0	0	0	0	0
Engine - Runs Better	0	0	0	0	0	0	0	0
Low Fuel Pressure Light	0	0	0	0	0	0	0	0
Fuel Leak	0	0	0	0	0	0	0	0
Fuel Gauge	0	0	0	0	0	0	0	0
Air/Suspension	0	0	1	0	1	1	3	8
AC/Heat	1	0	0	0	0	0	1	3
CB/Radio/Phone/Antenna	0	2	0	0	0	1	3	8
Fifth Wheel	0	0	0	0	0	0	0	0
Cruise Control	0	0	0	0	0	6	6	16
Wheels	0	0	0	0	0	0	0	0
Clutch	0	0	0	0	1	0	1	3
CADEC	0	0	0	0	0	0	0	0
Starter/Alternator/Battery	0	0	1	0	0	0	1	3
Tire	1	0	0	2	0	0	3	8
Other	0	2	0	0	0	0	2	5
Total	4	6	5	6	8	9	38	100
Total Complaints	4	6	4	6	6	9	35	

Driver Complaint Analysis
April, 1997 Through December 31, 1998
Raley's LNG Fleet

4/22/99	"Clean Point"												Before 1/98		After 1/98										
Category	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%	Total	%
Body and Damage	4	7	3	2	2	1	3	2	4	10	12	3	3	7	3	7	3	8	7	1	3	28	7	67	17
Lights	6	7	8	2	4	1	6	4	4	5	5	3	5	0	6	2	1	1	2	5	5	42	10	40	10
Engine - Rough, Power	13	22	31	29	16	28	42	26	9	15	7	3	10	8	5	6	7	14	2	4	13	216	51	94	24
Engine - Runs Better	0	1	0	0	0	0	0	3	1	0	0	0	1	0	0	0	0	0	0	0	0	5	1	1	0
Low Fuel Pressure or Temp.	1	1	0	0	0	0	0	1	2	2	3	4	2	5	0	1	0	2	1	4	10	5	1	34	9
Fuel Leak	5	4	6	2	1	0	4	2	1	1	1	5	1	0	0	1	2	3	0	0	1	25	6	15	4
Fuel Gauge	4	3	6	2	1	4	6	3	3	4	3	4	3	6	0	1	2	2	2	1	1	32	8	29	7
Air/Suspension	2	1	0	2	0	0	0	0	2	0	0	2	0	3	1	0	2	1	1	2	4	7	2	16	4
AC/Heat	1	2	0	2	0	1	2	0	1	0	1	1	2	0	3	2	2	0	0	0	2	9	2	13	3
CB/Radio/Phone/Antenna	0	5	2	3	2	2	1	3	5	1	7	1	3	1	1	2	4	2	4	0	1	23	5	27	7
Fifth Wheel	1	1	0	3	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	6	1	2	1
Cruise Control	0	2	0	0	0	2	0	0	0	0	2	2	1	0	0	0	0	0	0	2	0	4	1	7	2
Wheels	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	3	1	1	0
Clutch	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1	0
CADEC	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	3	0	0	2	0	9	2
Starter/Alternator/Battery	0	0	0	2	5	1	0	2	0	1	0	0	1	1	2	4	0	0	1	0	2	10	2	12	3
Tire	0	0	0	0	1	0	0	0	0	1	1	1	1	2	0	0	3	1	2	1	3	1	0	16	4
Other	1	1	2	0	0	0	0	0	1	3	0	0	0	0	0	2	3	0	0	1	1	5	1	10	3
Total	38	57	62	49	33	41	64	46	35	43	42	34	34	34	21	30	30	34	25	21	46	425	100	394	100
Total Complaints	33	48	59	46	30	40	59	44	35	40	35	27	32	30	20	29	28	30	22	21	42	394		356	

Appendix H

Emissions Testing Results

WEST VIRGINIA UNIVERSITY

**Transportable Heavy Duty Vehicle
Emissions Testing Laboratory**

Exhaust Emissions Test Results Report of Raley's Distribution Center Tractors

**Submitted to
Raley's Distribution Center**

**Department of Mechanical & Aerospace Engineering
West Virginia University
Morgantown, WV 26506-6101
Phone: (304) 293-3111
September 30, 1997**

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- 1 Executive Summary**
- 2 Test Circumstance and Characteristics**
 - 2.1 Test Facility**
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 - 2.4 Test Procedure**
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 - 3.1 Summary**
 - 3.2 Short Report**
 - 3.3 Emission Comparison**
 - 3.4 Comments on Results**

1. Executive Summary

In order to collect emissions data from diesel trucks and compare them with their liquefied natural gas (LNG) sister trucks in Sacramento, CA, the West Virginia University (WVU) Transportable Heavy Duty Vehicle Emissions Testing Laboratory conducted a series of emissions tests on four diesel trucks and eight LNG trucks in the summer of 1997, with the cooperation of the Raley's Distribution Center (RDC) in Sacramento, CA. All RDC diesel trucks were powered with Cummins M11-280E engines and LNG trucks were powered with Cummins L10-300G engines. All vehicles were tested in the condition that they were received without any engine adjustments before testing.

Emissions data were acquired using the Five-Mile Route. This cycle was used to test all trucks for emissions comparison with similar trucks. The Five-Mile Route allows free (Maximum) acceleration during each of its five acceleration ramps. Time to complete the route may vary from vehicle type to vehicle type, but the target distance remains at 5 miles. Braking rates are prescribed, not variable. Repeat test-runs were conducted for each cycle with a 20-minute soak between each run.

Test results include both gaseous and particulate matter (PM) emissions as well as fuel economy inferred from emissions measurements. The emissions data, such as carbon monoxide (CO), carbon dioxide (CO₂), oxides of nitrogen (NO_x), and total hydrocarbons (HC), were calculated based on the continuous measurement during a test cycle. Samples of the dilute exhaust were shipped to the Gas Chromatograph laboratory at West Virginia University to obtain the measurement of the non-methane hydrocarbons (NMHC). The PM emissions were measured gravimetrically using a secondary dilution filter (70mm) sampling of the primary diluted exhaust. Fuel economy was determined by carbon-balance method based upon the weight of carbon contained in exhaust constituents. Emissions results were reported in grams/mile whereas fuel economy was presented in miles/gallon and BTU/mile. For LNG fueled vehicles, MPG means miles per equivalent gallon diesel, or 137 cubic feet CNG at standard temperature and pressure is equivalent to 1 gallon of #1 diesel.

Data quality control methods, such as evaluation of continuous data, two-person weighing of particulate filters, and monitoring of individual test results for abnormalities were used throughout the program to assure the reliability of the test emissions data. In each case, variation between repeat runs was noted.

2. Test Circumstances and Characteristics

2.1 Test Facility

The WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory (THDVETL) is a chassis dynamometer testing facility that measures exhaust emissions from heavy-duty vehicles, such as transit buses, refuse trucks, and class 8 trucks and tractors. In the past five years, the two WVU transportable emissions testing laboratories have traveled from coast to coast and conducted over 900 tests on heavy duty vehicles and transit buses for 36 fleet owners in 17 states. Details on prior emissions measurements and the alternative fuels program may be found in the following papers: SAE 961082, SAE 951016, and SAE 952746.

2.2 Test Vehicles

A total of twelve tractors was tested in this study. All diesel vehicles were powered with Cummins M11-280E engines, and all LNG vehicles were powered with Cummins L10-300G engines. The diesel vehicles had older vehicle and engine model years and higher mileage accumulation than the LNG vehicles. The diesel vehicles had splitter transmissions while the LNG vehicles had ranger transmissions.

2.3 Cycle

All vehicles were tested using the Five-Mile Route. This cycle was a modification of WVU Five-Peak truck cycle that was originally described in SAE papers 941946 and 951016. The Five-Mile Route is similar to the original WVU Five-Peak truck cycle that has five steady speeds, while it differs from Five-Peak cycle when it accelerates to the steady speed using the highest possible acceleration for each peak speed. To make test results comparable to each other, the driving distance for both of these cycles is held at five miles and the driving duration including idle time is held at 900.1 seconds. A sample actual driving speed for LNG tractor 1501 is shown in figure 1.

**Figure 1. Sample Actual Driving Speed for Tractor 1501
(LNG Fuel, 5-Mile Route)**

2.4 Test Procedure

Test procedure included calibration of equipment, vehicle inspection, actual vehicle testing, data reduction, and data analysis.

In order to make sure that the analyzers and the associated systems were functioning properly and providing measurements accurately, all instruments were calibrated or adjusted daily. Propane injections confirmed reliability of the dilution tunnel system.

Prior to the actual testing, all gearboxes in the power train of the dynamometer were warmed up to minimize loading variability due to the viscosity of the oil. Each test includes several repeat test-runs in order to guarantee that the exhaust emissions measured are a true representation of the test vehicle. The emissions data reported for each vehicle test are the average values of at least three repeat test-runs. All test runs were executed with the vehicle at operating temperature (no cold-start tests were performed).

The following procedures were adopted for the actual vehicle testing:

- 1) The vehicle was inspected prior to testing;
- 2) The vehicle was positioned and mounted on the chassis dynamometer
- 3) The vehicle was driven while on the test bed to warm-up the gearboxes of the power train of the dynamometer until they reached 100° F, also ensuring that the vehicle's engine is at operational temperature before testing.
- 4) A practice test cycle was performed to allow the driver to become familiar with vehicle characteristics and to insure proper range settings of analyzers;
- 5) After completion of the practice run or one test run, the vehicle transmission was set to neutral and the engine was left in this condition for 17 minutes into a 20 minute soak period;
- 6) At 17 minutes into the soak period, the vehicle was driven through three of the CBD ramps to expel collected constituents in the exhaust system. Twenty seconds after completion of the final practice ramp, data collection was initiated.
- 7) 5) and 6) were repeated at least two times.

All emissions data, except for PM and non-methane hydrocarbons, were obtained by continuous readings and the results were integrated over the complete test cycle. PM emissions were measured gravimetrically using a secondary dilution filter sampling of the primary diluted exhaust. Non-methane hydrocarbons were measured by a gas chromatograph (GC) laboratory for all the CNG vehicles. GC results were used to determine the methane/non-methane split, which was applied to the HC data measured in the field. Differing responses of the field instrument to methane and propane were taken into account.

During a test, the driver was provided with a visual trace of the scheduled speed versus time on an interface monitor. The speed trace was a representation of the test cycle being used. The driver followed the speed trace closely to minimize the errors introduced by irregular driving.

All of the vehicles were jacked up with hydraulic jacks placed on scales until the rear tires were no longer on the rollers of the test bed. The vehicle was then lowered onto the rollers until the vehicle was centered on the test bed.

3. Test Results

This section includes all the test results and their comparison from four diesel trucks and eight LNG trucks using the Five-Mile Route.

3.1 Summary

Test results have been presented in three formats: short report, emissions data in grams/mile, and emissions data summary and comparison based on different fuel.

3.2 Short Report

The short report shows the vehicle information, vehicle engine information, emissions data in grams/mile, and fuel economy for each test run, average emissions over all test runs, and brief comments for each test in a compact format on one page. The odometer mileage reading in the short reports is rounded to the nearest 100 miles.

Symbols used in Short Report Emissions data result table:

- a A value was measured and identified as an apparent outlier, and therefore is not reported and not used to compute other parameters or the average values.
- b The residual hydrocarbon emissions (RHC) is calculated from the difference between the methanol (CH_3OH) and the FID-HC concentrations. For 100% alcohol fuels, the value of RHC is small and due to experimental variations, it may be measured as positive or negative but can best be assumed to be zero.
- c A value cannot be calculated because the parameters required for calculation are not available.
- d A value of coefficient variance (CV%) is not meaningful because the average value is too small or not available. A significant coefficient of variance may exist for PM from CNG vehicles, where the PM is at very low levels. Note that CNG PM is more than an order of magnitude less than PM usually measured from diesel vehicles. Similarly some modern diesel vehicles will yield very low hydrocarbon emissions.

All short reports for the Raley's Distribution Center trucks are included in this report.

3.3 Emissions Comparison

The emissions for these tests are compared with each other and other sister vehicles using the same fuels. Emissions units are in grams/mile. Data in the final emissions summary show that NO_x was lower for the LNG trucks than the diesel trucks. LNG also showed significant advantage in PM reduction, but returned CO levels higher than those for diesel. Also the energy-based equivalent fuel consumption of the LNG trucks was about 28.7% lower than the diesel trucks. Although LNG total hydrocarbon emissions were higher than for diesel, only about 5% of the CNG hydrocarbon emissions were non-methane organic gases.

3.4 Comments on Results

The LNG vehicles returned NO_x emissions that were six times lower than those from the diesel trucks. Emissions of NO_x from one of the LNG vehicles were distinctly higher than from the remainder: HC for this vehicle was the lowest, and so it is assumed that this vehicle was operating in a less lean fashion than the other vehicles. PM for the LNG vehicles was at one tenth that of the diesel vehicles, and NMHC for the LNG vehicles was at half of the HC level for the diesel vehicles.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 950

WVU Test Reference Number: WVU-TEDDY2-D2-5MILES

Fleet Owner Full Name West Virginia University
Fleet Address MAE Dept., P. O. Box 6106
Fleet Address (City, State, Zip) Morgantown, WV 26506

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1FUPYSYB7FH258124
Vehicle Manufacturer Freightliner
Vehicle Model Year 1985
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 12000
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 740100
Transmission Type Manual
Transmission Configuration 9-Speed
Number of Axles 3

Engine Type Caterpillar 3406B
Engine ID Number 7FB30060
Engine Displacement (Liter) 14
Number of Cylinders 6
Engine Rated Power (hp) 350

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 7/8/97

Engineer J. Boyce
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
950-3	7.64	39.2	2.16	1.33	1849	5.45	23857	5.00
950-4	8.97	39.0	1.95	1.29	1825	5.52	23571	4.95
950-5	7.84	39.4	2.52	1.44	1833	5.49	23676	4.99
950-6	7.03	39.4	2.02	1.22	1824	5.52	23531	5.00
950 Average	7.87	39.2	2.16	1.32	1833	5.49	23659	4.98
Std. Dev.	0.81	0.2	0.25	0.09	11	0.03	148	0.03
CV%	10.3	0.5	11.7	7.0	0.6	0.6	0.6	0.5

Test Purpose:

Measurement of exhaust constituents from WVU Transportable Heavy Duty Emissions Laboratory-2 control vehicle for comparison of emissions on the same vehicle at different locations.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 968

WVU Test Reference Number: RDC-1504-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X6VR745376
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 16540
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 17000
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34847352
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 7/25/97

Engineer S. McConnell
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
968-1	7.17	13.2	15.3	13.50	0.52	0.069	1647	4.42	29072	5.00
968-2	8.42	12.9	15.5	c	c	0.070	1631	4.46	28840	5.00
968-3	8.04	11.2	15.4	13.59	0.54	0.069	1620	4.49	28644	5.01
968-4	7.36	12.4	14.5	12.69	0.62	0.063	1562	4.66	27587	5.00
968-5	7.62	15.6	14.8	c	c	0.057	1682	4.33	29653	5.01
968-6	7.67	11.6	14.2	12.41	0.59	0.053	1645	4.43	28997	5.00
968 Average	7.71	12.8	15.0	13.05	0.57	0.064	1631	4.46	28799	5.00
Std. Dev.	0.46	1.5	0.5	0.59	0.04	0.007	40	0.11	684	0.00
CV%	5.9	12.1	3.6	4.5	7.5	11.3	2.4	2.4	2.4	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

Special Procedures:

Test program was modified to ensure that 5-Mile-Route finished five miles for each test run even though the road speed governor kept the driver from shifting gears and the driver drove more slowly than normal. All tests running 5-Mile-Route in this test site since this one finished five miles for each test run.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 969

WVU Test Reference Number: RDC-1505-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X8VR745377
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 15720
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 10700
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34849168
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 7/26/97

Engineer S. McConnell
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
969-1	7.53	4.33	20.6	18.21	0.66	0.101	1706	4.24	30342	5.01
969-2	7.36	4.60	19.0	16.74	0.69	0.122	1692	4.28	30026	5.02
969-3	7.22	5.13	18.7	16.50	0.65	0.096	1702	4.26	30172	5.01
969-4	7.00	5.23	18.2	15.95	0.69	0.085	1716	4.23	30372	5.00
969-5	7.04	5.16	17.1	14.99	0.65	0.088	1722	4.22	30435	5.01
969-6	6.77	5.57	16.7	14.69	0.64	0.077	1644	4.42	29070	5.01
969 Average	7.16	5.00	18.4	16.18	0.66	0.095	1697	4.27	30069	5.01
Std. Dev.	0.27	0.45	1.4	1.28	0.02	0.016	28	0.07	512	0.01
CV%	3.8	9.0	7.7	7.9	3.2	16.5	1.7	1.7	1.7	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 970

WVU Test Reference Number: RDC-1506-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59XXVR745378
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 16520
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 15000
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34849166
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 7/28/97

Engineer S. McConnell
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
970-1	6.93	4.45	15.4	13.53	0.56	0.048	1669	4.36	29444	4.99
970-2	6.88	4.56	16.5	14.54	0.58	0.048	1654	4.40	29239	5.00
970-3	6.77	4.34	15.2	13.35	0.55	0.060	1596	4.56	28188	5.00
970-4	6.70	4.66	14.8	13.00	0.57	0.052	1589	4.58	28046	5.00
970 Average	6.82	4.50	15.5	13.61	0.56	0.052	1627	4.48	28729	5.00
Std. Dev.	0.11	0.14	0.7	0.66	0.01	0.006	40	0.11	714	0.01
CV%	1.6	3.1	4.7	4.9	2.0	10.9	2.5	2.5	2.5	0.2

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

Special Procedures:

HC probe heater was found failed during the soak period between test #2 and #3. It was replaced with a new one and returned back to normal functioning. A practice test was run with no data taken to keep the test procedure followed.

Observations:

Driver found the vehicle was a little slower than other sister LNG tractors while it was smoother to shift gears than all others were.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 971

WVU Test Reference Number: RDC-1507-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X1VR745379
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 15585
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 14600
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34849167
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 7/29/97

Engineer S. McConnell
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
971-1	6.49	a	18.8	16.54	0.63	0.083	1668	4.35	29569	5.01
971-2	6.59	3.66	17.9	15.80	0.59	0.069	1709	4.25	30241	5.01
971-3	6.56	3.81	18.6	16.39	0.60	0.080	1758	4.13	31095	5.02
971-4	6.66	3.72	18.7	16.46	0.67	0.059	1761	4.12	31163	5.00
971-5	6.57	3.09	18.0	15.81	0.63	0.064	1665	4.36	29483	5.01
971-6	6.64	3.98	17.9	15.79	0.62	0.071	1639	4.42	29049	5.01
971 Average	6.58	3.65	18.3	16.13	0.62	0.071	1700	4.27	30100	5.01
Std. Dev.	0.06	0.34	0.4	0.37	0.03	0.009	51	0.12	884	0.00
CV%	0.9	9.21	2.3	2.3	4.8	12.8	3.0	2.9	2.9	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 972

WVU Test Reference Number: RDC-1508-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4081 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X8VR745380
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 15680
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 16300
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axes 3

Engine Type Cummins L10-300G
Engine ID Number 34849165
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 7/30/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
972-1	6.59	3.50	18.7	16.54	0.61	0.113	1740	4.17	30809	5.01
972-2	6.46	3.71	19.1	16.83	0.63	0.091	1766	4.11	31267	5.02
972-3	6.68	3.95	18.5	16.29	0.64	0.083	1832	3.97	32366	5.01
972-4	c	4.17	18.3	16.09	0.67	0.086	1788	4.07	31552	5.02
972-5	6.54	3.31	18.9	16.66	0.66	0.098	1726	4.20	30580	5.01
972-6	6.75	4.11	18.3	16.09	0.67	0.081	1738	4.18	30759	5.02
972 Average	6.60	3.79	18.6	16.42	0.64	0.092	1765	4.12	31222	5.01
Std. Dev.	0.11	0.34	0.3	0.31	0.03	0.012	40	0.09	666	0.01
CV%	1.7	9.1	1.7	1.9	3.9	13.0	2.2	2.1	2.1	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 973

WVU Test Reference Number: RDC-1501-LNG-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X0VR745373
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 16520
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 13600
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34845353
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 7/31/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
973-1	7.82	a	22.9	20.27	0.68	0.069	1722	4.18	30728	5.02
973-2	7.83	2.67	19.7	17.34	0.64	0.059	1707	4.24	30322	5.00
973-3	7.53	2.80	20.1	17.71	0.64	0.058	1719	4.21	30528	5.01
973-4	7.41	3.39	20.2	17.83	0.62	0.062	1661	4.35	29539	5.01
973-5	7.43	3.12	19.1	16.82	0.64	0.075	1659	4.36	29453	5.01
973-6	c	3.34	21.5	18.97	0.66	0.062	1656	4.35	29573	5.02
973 Average	7.60	3.06	20.5	18.19	0.65	0.064	1687	4.28	30024	5.01
Std. Dev.	0.21	0.32	1.4	1.25	0.02	0.006	32	0.08	566	0.01
CV%	2.7	10.4	6.8	6.9	3.2	10.1	1.9	1.9	1.9	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

Observations:

Driver found the vehicle was less powerful than other sister LNG tractors and surged during the test.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 974

WVU Test Reference Number: RDC-1502-LNG-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X2VR745374
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 16380
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 13900
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34847019
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 8/1/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mpg/gal	BTU/mile	Miles
974-1	6.70	2.93	17.4	15.37	0.56	0.042	1601	4.53	28376	5.00
974-2	6.57	2.89	16.0	14.13	0.51	0.039	1614	4.50	28525	5.00
974-3	6.75	3.01	16.2	14.32	0.51	0.042	1559	4.66	27600	5.01
974-4	6.52	2.68	16.5	14.59	0.50	0.039	1577	4.60	27912	5.02
974 Average	6.64	2.88	16.5	14.60	0.52	0.041	1588	4.57	28103	5.01
Std. Dev.	0.11	0.14	0.6	0.54	0.03	0.002	25	0.07	425	0.01
CV%	1.6	5.0	3.8	3.7	5.3	4.3	1.5	1.5	1.5	0.2

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

Special Procedures:

New spark plugs were installed before the test.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 975

WVU Test Reference Number: RDC-1503-LNG-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X4VR745375
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 48000
Vehicle Total Curb Weight (lb.) 16560
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 16300
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins L10-300G
Engine ID Number 34847353
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 8/2/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run-Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
975-1	7.03	4.21	17.6	15.49	0.61	0.064	1563	4.63	27734	5.01
975-2	8.10	4.96	18.1	16.04	0.55	0.052	1497	4.82	26660	5.02
975-3	6.60	5.33	16.0	14.04	0.57	0.055	1543	4.70	27314	5.01
975-4	8.61	5.64	17.2	15.18	0.58	0.060	1558	4.64	27684	5.00
975-5	8.45	6.67	17.0	15.03	0.54	0.054	1598	4.53	28349	5.02
975-6	8.16	6.62	17.4	15.31	0.59	0.055	1623	4.46	28791	5.00
975 Average	7.83	5.57	17.2	15.18	0.57	0.056	1564	4.63	27755	5.01
Std. Dev.	0.82	0.96	0.7	0.66	0.03	0.004	44	0.13	752	0.01
CV%	10.4	17.2	4.2	4.4	4.7	7.6	2.8	2.7	2.7	0.2

Test Purpose:

Collection of emissions data from LNG fueled vehicles to establish a data set for use in comparison with diesel emissions.

Special Procedures:

Vehicle tank delivery pressure was low previously. Delivery pressure was supposed to be 100psi, but was only 70psi. Technician raised tank pressure to 110psi to ensure proper delivered pressure.

Observations:

Vehicle surged at the beginning of ramps causing CO emissions to be high.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 976

WVU Test Reference Number: RDC-1586-D2-5MILES-R2

Fleet Owner Full Name
Fleet Address
Fleet Address (City, State, Zip)

Raley's Distribution Center
4061 Gateway Park Blvd.
Sacramento, CA 95834

Vehicle Type
Vehicle ID Number (VIN)
Vehicle Manufacturer
Vehicle Model Year
Gross Vehicle Weight (GVW) (lb.)
Vehicle Total Curb Weight (lb.)
Vehicle Tested Weight (lb.)
Odometer Reading (mile)
Transmission Type
Transmission Configuration
Number of Axles

Tractor Truck
1XKBD99X9TS690099
Kenworth
1995
50000
14440
42000
162700
Manual
10-Speed
3

Engine Type
Engine ID Number
Engine Displacement (Liter)
Number of Cylinders
Engine Rated Power (hp)

Cummins M11-280E
34776206
10.8
6
280

Primary Fuel
Test Cycle
Test Date

D2
5 Mile Route
8/4/97

Engineer
Driver

J. Kopasko
L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
976-2	2.06	27.4	1.58	1.34	1527	6.63	19614	5.02
976-3	1.98	28.2	1.57	1.33	1513	6.69	19426	5.01
976-4	2.03	29.9	1.55	1.35	1560	6.49	20033	5.00
976-5	2.03	28.4	1.55	1.33	1592	6.36	20446	5.01
976 Average	2.02	28.5	1.56	1.34	1548	6.54	19880	5.01
Std. Dev.	0.03	1.0	0.02	0.01	36	0.15	455	0.01
CV%	1.7	3.7	1.0	0.8	2.3	2.3	2.3	0.2

Test Purpose:

Collection of emissions data from diesel fueled vehicles to establish a data set for use in comparison with LNG emissions.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 977

WVU Test Reference Number: RDC-1593-D2-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKBD99X4TS712784
Vehicle Manufacturer Kenworth
Vehicle Model Year 1995
Gross Vehicle Weight (GVW) (lb.) 50000
Vehicle Total Curb Weight (lb.) 14960
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 169400
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins M11-280E
Engine ID Number 34787997
Engine Displacement (Liter) 10.8
Number of Cylinders 6
Engine Rated Power (hp) 280

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 8/8/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO ₂	NO _x	--FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
977-1	1.70	32.4	1.00	0.35	1608	6.30	20620	5.00
977-2	1.69	33.1	1.03	0.34	1636	6.20	20972	5.00
977-3	1.60	31.2	1.08	0.52	1633	6.21	20933	5.00
977-4	1.71	30.8	1.07	0.49	1619	6.26	20763	5.01
977 Average	1.67	31.8	1.04	0.42	1624	6.24	20822	5.00
Std. Dev.	0.05	1.1	0.04	0.09	13	0.05	162	0.01
CV%	3.0	3.4	3.4	22.4	0.8	0.8	0.8	0.1

Test Purpose:

Collection of emissions data from diesel fueled vehicles to establish a data set for use in comparison with LNG emissions.

Special Procedures:

Bees and nest were found in background bag suction tube. They were removed by turning the switch on and off, and filter was replaced.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 978

WVU Test Reference Number: RDC-1592-D2-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKBD99X2TS712783
Vehicle Manufacturer Kenworth
Vehicle Model Year 1995
Gross Vehicle Weight (GVW) (lb.) 50000
Vehicle Total Curb Weight (lb.) 14960
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 132700
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins M11-280E
Engine ID Number 34786945
Engine Displacement (Liter) 10.8
Number of Cylinders 6
Engine Rated Power (hp) 280

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 8/7/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
978-1	1.91	33.6	1.26	0.76	1736	5.84	22267	5.01
978-2	2.01	34.3	1.27	0.73	1653	6.13	21213	5.01
978-3	1.97	35.9	c	0.76	1667	6.08	21388	5.02
978-4	1.94	36.9	1.32	0.75	1695	5.98	21744	5.00
978 Average	1.96	35.2	1.28	0.75	1688	6.01	21652	5.01
Std. Dev.	0.04	1.5	0.03	0.01	36	0.13	465	0.01
CV%	2.2	4.2	2.1	1.5	2.2	2.1	2.1	0.2

Test Purpose:

Collection of emissions data from diesel fueled vehicles to establish a data set for use in comparison with LNG emissions.

WVU Transportable Heavy Duty Vehicle Emissions Testing Laboratory

Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV 26506-6106

Tel: (304) 293-3111 FAX: (304) 293-6689

Test Sequence Number: 979

WVU Test Reference Number: RDC-1579-D2-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKBD99X0SS643610
Vehicle Manufacturer Kenworth
Vehicle Model Year 1994
Gross Vehicle Weight (GVW) (lb.) 50000
Vehicle Total Curb Weight (lb.) 15100
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 237800
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins M11-280E
Engine ID Number 34735917
Engine Displacement (Liter) 10.8
Number of Cylinders 6
Engine Rated Power (hp) 280

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 8/8/97

Engineer J. Kopasko
Driver L. McGrath

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
979-1	2.09	34.0	1.27	0.41	1719	5.89	22058	5.00
979-2	2.12	33.7	1.22	0.41	1766	5.74	22850	5.00
979-3	2.11	32.6	1.23	0.39	1720	5.89	22065	5.01
979-4	2.20	33.8	1.36	0.40	1748	5.80	22432	4.99
979 Average	2.13	33.5	1.27	0.40	1738	5.83	22301	5.00
Std. Dev.	0.05	0.6	0.06	0.01	23	0.08	291	0.01
CV%	2.3	1.9	4.9	2.3	1.3	1.3	1.3	0.2

Test Purpose:

Collection of emissions data from diesel fueled vehicles to establish a data set for use in comparison with LNG emissions.

Emissions Data Summary

Test ID	WVU Ref Num	Run ID	CO	NOx	HC	PM	CO2	CH4	NMHC
971	RDC-1507-LNG	1	6.49		18.77	0.083	1668	16.54	0.63
		2	6.59	3.66	17.91	0.069	1709	15.80	0.59
		3	6.56	3.81	18.56	0.080	1758	16.39	0.60
		4	6.66	3.72	18.72	0.059	1761	16.46	0.67
		5	6.57	3.09	17.97	0.064	1665	15.81	0.63
		6	6.64	3.98	17.93	0.071	1639	15.79	0.62
		Average:	6.58	3.65	18.31	0.071	1700	16.13	0.62
		Standard Deviation:	0.06	0.34	0.41	0.009	51	0.37	0.03
		Coefficient of Variance:	0.9%	9.2%	2.3%	12.8%	3.0%	2.3%	4.8%
972	RDC-1508-LNG	1	6.59	3.50	18.73	0.113	1740	16.54	0.61
		2	6.46	3.71	19.07	0.091	1766	16.83	0.63
		3	6.68	3.95	18.50	0.083	1832	16.29	0.64
		4		4.17	18.31	0.086	1788	16.09	0.67
		5	6.54	3.31	18.93	0.098	1726	16.66	0.66
		6	6.75	4.11	18.32	0.081	1738	16.09	0.67
		Average:	6.60	3.79	18.84	0.092	1765	16.42	0.64
		Standard Deviation:	0.11	0.34	0.32	0.012	40	0.31	0.03
		Coefficient of Variance:	1.7%	9.1%	1.7%	13.0%	2.2%	1.9%	3.9%
976	RDC-1579-D2	2	2.06	27.40	1.58	1.343	1527		
		3	1.98	28.16	1.57	1.332	1513		
		4	2.03	29.90	1.55	1.353	1560		
		5	2.03	28.38	1.55	1.330	1592		
		Average:	2.02	28.46	1.56	1.339	1548		
		Standard Deviation:	0.03	1.05	0.02	0.011	36		
		Coefficient of Variance:	1.7%	3.7%	1.0%	0.8%	2.3%		
977	RDC-1586-D2	1	1.70	32.38	1.00	0.348	1608		
		2	1.69	33.09	1.03	0.337	1636		
		3	1.60	31.15	1.08	0.521	1633		
		4	1.71	30.76	1.07	0.490	1619		
		Average:	1.67	31.85	1.04	0.424	1624		
		Standard Deviation:	0.05	1.08	0.04	0.095	13		
		Coefficient of Variance:	3.0%	3.4%	3.4%	22.4%	0.8%		
978	RDC-1592-D2	1	1.91	33.64	1.26	0.756	1736		
		2	2.01	34.32	1.27	0.732	1653		
		3	1.97	35.86		0.757	1667		
		4	1.94	36.89	1.32	0.747	1695		
		Average:	1.96	35.18	1.28	0.748	1688		
		Standard Deviation:	0.04	1.47	0.03	0.012	36		
		Coefficient of Variance:	2.2%	4.2%	2.1%	1.5%	2.2%		
979	RDC-1593-D2	1	2.09	33.97	1.27	0.409	1719		
		2	2.12	33.74	1.22	0.413	1766		
		3	2.11	32.60	1.23	0.394	1720		
		4	2.20	33.82	1.36	0.396	1748		
		Average:	2.13	33.53	1.27	0.403	1738		
		Standard Deviation:	0.05	0.63	0.06	0.009	23		
		Coefficient of Variance:	2.3%	1.9%	4.9%	2.3%	1.3%		

** Emissions Unit: grams/mile

Emissions Data Summary

Test ID	WVU Ref Num	Run ID	CO	NOx	HC	PM	CO2	CH4	NMHC
973	RDC-1501-LNG	1	7.82		22.89	0.069	1722	20.27	0.68
		2	7.83	2.67	19.65	0.059	1707	17.34	0.64
		3	7.53	2.80	20.06	0.058	1719	17.71	0.64
		4	7.41	3.39	20.16	0.062	1661	17.83	0.62
		5	7.43	3.12	19.08	0.075	1659	16.82	0.64
		6		3.34	21.45	0.082	1656	18.97	0.66
		Average:	7.60	3.06	20.55	0.064	1687	18.16	0.65
		Standard Deviation:	0.21	0.32	1.39	0.008	32	1.25	0.02
		Coefficient of Variance:	2.7%	10.4%	6.8%	10.1%	1.9%	6.9%	3.2%
974	RDC-1502-LNG	1	6.70	2.93	17.40	0.042	1601	15.37	0.56
		2	6.57	2.89	15.99	0.039	1614	14.13	0.51
		3	6.75	3.01	16.20	0.042	1559	14.32	0.51
		4	6.52	2.68	16.49	0.039	1577	14.59	0.50
		Average:	6.64	2.88	16.52	0.041	1588	14.60	0.52
		Standard Deviation:	0.11	0.14	0.62	0.002	25	0.54	0.03
		Coefficient of Variance:	1.6%	5.0%	3.8%	4.3%	1.5%	3.7%	5.3%
975	RDC-1503-LNG	1	7.03	4.21	17.60	0.064	1563	15.49	0.61
		2	8.10	4.96	18.12	0.052	1497	16.04	0.55
		3	6.60	5.33	15.96	0.055	1543	14.04	0.57
		4	8.61	5.64	17.22	0.060	1558	15.18	0.58
		5	8.45	6.67	17.01	0.054	1598	15.02	0.54
		6	8.16	6.62	17.38	0.055	1623	15.31	0.59
		Average:	7.83	5.57	17.22	0.056	1564	15.18	0.57
		Standard Deviation:	0.82	0.96	0.72	0.004	44	0.66	0.03
		Coefficient of Variance:	10.4%	17.2%	4.2%	7.6%	2.8%	4.4%	4.7%
968	RDC-1504-LNG	1	7.17	13.21	15.32	0.069	1647	13.49	0.52
		2	8.42	12.86	15.55	0.070	1631		
		3	8.04	11.20	15.45	0.069	1620	13.59	0.54
		4	7.36	12.41	14.54	0.063	1562	12.68	0.62
		5	7.62	16.57	14.79	0.057	1682		
		6	7.67	11.63	14.20	0.053	1645	12.41	0.59
		Average:	7.71	12.81	14.97	0.064	1631	13.05	0.57
		Standard Deviation:	0.48	1.55	0.55	0.007	40	0.59	0.04
		Coefficient of Variance:	5.9%	12.1%	3.6%	11.3%	2.4%	4.5%	7.5%
969	RDC-1505-LNG	1	7.53	4.33	20.62	0.101	1706	18.21	0.66
		2	7.36	4.60	19.04	0.122	1692	16.74	0.69
		3	7.22	5.13	18.75	0.096	1702	16.50	0.65
		4	7.00	5.23	18.18	0.085	1716	15.95	0.69
		5	7.04	5.16	17.09	0.088	1722	14.99	0.65
		6	6.77	5.57	16.75	0.077	1644	14.69	0.64
		Average:	7.16	5.00	18.41	0.095	1697	16.18	0.66
		Standard Deviation:	0.27	0.45	1.41	0.016	28	1.28	0.02
		Coefficient of Variance:	3.8%	9.0%	7.7%	16.5%	1.7%	7.9%	3.2%
970	RDC-1506-LNG	1	6.93	4.45	15.39	0.048	1669	13.53	0.56
		2	6.88	4.56	16.52	0.048	1654	14.54	0.58
		3	6.77	4.34	15.20	0.060	1596	13.35	0.55
		4	6.70	4.66	14.83	0.052	1589	13.00	0.57
		Average:	6.82	4.50	15.48	0.052	1627	13.60	0.56
		Standard Deviation:	0.11	0.14	0.73	0.006	40	0.66	0.01
		Coefficient of Variance:	1.6%	3.1%	4.7%	10.9%	2.5%	4.9%	2.0%

Emission Summary for LNG Powered Tractors in Sacramento, CA

Test ID	WVU Ref Num	Cycle	Test Date	Fuel	CO	NO _x	HC	PM	CO ₂	MPG	BTU/mile	CH ₄	NMHC
973	RDC-1501-LNG-5MILES-R	5 Mile Route	7/31/97	LNG	7.60	3.08	20.55	0.06	1687	4.28	30024	18.16	0.65
974	RDC-1502-LNG-5MILES-R	5 Mile Route	8/1/97	LNG	6.64	2.88	16.52	0.04	1588	4.57	28103	14.60	0.52
975	RDC-1503-LNG-5MILES-R	5 Mile Route	8/2/97	LNG	7.83	5.57	17.22	0.06	1564	4.63	27755	15.18	0.57
968	RDC-1504-LNG-5MILES	5 Mile Route	7/25/97	LNG	7.71	12.81	14.97	0.06	1631	4.46	28799	13.05	0.57
969	RDC-1505-LNG-5MILES	5 Mile Route	7/26/97	LNG	7.16	5.00	18.41	0.09	1697	4.27	30069	16.18	0.66
970	RDC-1506-LNG-5MILES	5 Mile Route	7/28/97	LNG	6.82	4.50	15.48	0.05	1627	4.48	28729	13.60	0.56
971	RDC-1507-LNG-5MILES	5 Mile Route	7/29/97	LNG	6.58	3.65	18.31	0.07	1700	4.27	30100	16.13	0.62
972	RDC-1508-LNG-5MILES	5 Mile Route	7/30/97	LNG	6.60	3.79	18.64	0.09	1765	4.12	31222	16.42	0.64
Average->					7.12	5.16	17.51	0.07	1657	4.39	29350	15.41	0.60

Emission Summary for diesel Powered Tractors in Sacramento, CA

Test ID	WVU Ref Num	Cycle	Test Date	Fuel	CO	NO _x	HC	PM	CO ₂	MPG	BTU/mile
979	RDC-1579-D2-5MILES-R	5 Mile Route	8/8/97	D2	2.13	33.53	1.27	0.40	1738	5.83	22301
976	RDC-1586-D2-5MILES-R2	5 Mile Route	8/4/97	D2	2.02	28.46	1.56	1.34	1548	6.54	19880
978	RDC-1592-D2-5MILES-R	5 Mile Route	8/7/97	D2	1.96	35.18	1.28	0.75	1688	6.01	21652
977	RDC-1593-D2-5MILES-R	5 Mile Route	8/6/97	D2	1.67	31.85	1.04	0.42	1624	6.24	20822
Average->					1.95	32.25	1.29	0.73	1649	6.16	21164

WEST VIRGINIA UNIVERSITY

**Transportable Heavy Duty Vehicle
Emissions Testing Laboratory**

Exhaust Emissions Test Results Report of

Raley's Distribution Center (RDC) Tractors

Submitted to

**National Renewable Energy Laboratory (NREL)
Raley's Distribution Center (RDC)**

**Department of Mechanical & Aerospace Engineering
West Virginia University
Morgantown, WV 26506-6101
Phone: (304) 293-3111**

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1. Introduction

West Virginia University (WVU) Transportable Heavy Duty Emissions Testing Laboratory, through the funding from the Department of Energy, gathers emissions data from transit fleets operating on alternative and conventional fuels. In cooperation with United States Department of Energy, Office of Transportation Technologies (OTT), The University has designed, constructed and now operates two Transportable Heavy Duty Vehicle Emissions Testing Laboratories which travel to transit agency and trucking facilities across North America to measure vehicle emissions on sites. These emissions data are placed in a database maintained by the National Renewable Energy Laboratories' (NREL) transit bus and heavy-duty truck evaluation programs. Detailed information pertaining to the Transportable Laboratory, NREL database and OTT can be found at through the Internet at the following web sites:

NREL database: http://www.afdc.nrel.gov/web_view/emishdv.html (Heavy-duty truck program)

http://www.afdc.nrel.gov/web_view/emisbus.html (Transit bus program)

WVU Transportable Laboratory: <http://www.cemr.wvu.edu/~wwwatf/TransportableLaboratory.html>

OTT: <http://www.ott.doe.gov/>

2 Test Conditions and Procedures

2.1 Transportable Laboratory

The Transportable Laboratories were constructed to gather emissions data from in-use heavy-duty vehicles. The laboratories are fully self-contained units that can be transported to and set up at or near transit agency maintenance facilities. Emissions tests are performed on location and vehicles are returned to the transit agency, usually within one day. Several technical papers (SAE 961082, SAE 951016, and SAE 952746) have been presented the design of the two laboratories and on emissions data from both conventional and alternatively fueled vehicles.

The laboratory facility arrives on the test site pulled on two trailers, one being a box trailer containing equipment for emissions measurement, data acquisition and control, and the other, a flat bed semi-trailer carrying the power absorber unit. The flat bed is lowered to the ground to provide a chassis dynamometer platform.

The vehicle to be tested is mounted onto the chassis dynamometer platform with the rear drive wheels positioned on free-rolling rollers. The outer wheels of the dual wheel set on each side of the vehicle are connected to the drive shafts of the dynamometer units located on each side of the vehicle. Each dynamometer unit consists of speed-increasing gearboxes with a power absorber and a flywheel set. In the case of the tandem axle tractors discussed in this report, the power divider was locked and power was taken from the forward rear axle. The flywheel sets consist of a series of selectable discs to allow simulation of vehicle inertia. During the test cycle, torque cells and speed transducers in the power absorber drive train measure the actual vehicle load (torque) and speed. The trucks tested in this program were exercised through the Five-Mile Route. This cycle was a modification of WVU Five-Peak truck cycle that was originally described in SAE papers 941946 and 951016. The Five-Mile Route is similar to the original WVU Five-Peak truck cycle that has five steady speeds, while it differs from Five-Peak cycle when it accelerates to the steady speed using the highest possible acceleration for each peak speed. To make test results comparable to each other, the driving distance for both of these cycles is held at five miles and the driving duration including idle time is held at 900.1 seconds. A sample actual driving speed for LNG tractor 1501 is shown in figure 1.

The full exhaust from the tail pipe of the test vehicle is ducted to a 45cm diameter dilution tunnel on top of the emissions trailer. The exhaust is mixed with dilution air and the flow is controlled using a blower with critical flow venturi. Heated sampling probes send diluted exhaust to a number of different gas analysis instruments, via heated lines. Levels of carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NO_x) and hydrocarbons (HC) are measured continuously. A gravimetric measurement of particulate matter (PM) is obtained using 70mm filters, weighed after conditioning for temperature and humidity in an environmental chamber.

In this study, bags of the natural gas fueled vehicles diluted exhaust were shipped to West Virginia University for analysis using a Varian 3600 gas chromatograph. The column (J&W GS-Alumna) used for measurement had an inner diameter of 0.53 mm and a length of 50 meters. The volume injected was 2ml and the oven temperature was for 40° C held for 2.5 minutes, then ramped to 200°C at 20°C per minute then held for 15 minutes. A flame ionization detector (FID) was used and the temperature set at 250°C. Methane and propane standards were used to measure the response factors. Methane response was used to quantify methane and propane response was used to quantify all other non-methane hydrocarbons. These data are used to distinguish methane from non-methane hydrocarbons in the exhaust and ultimately yield information on the atmospheric reactivity of the exhaust hydrocarbons.

2.2 Test Vehicles

LNG Fueled Test Vehicles:

A total of eight tractor trucks (1997 Kenworth) were tested in Sacramento, CA, each with the Cummins 6 cylinder 10-liter engine. The engines (CPL 2110) were spark ignited, turbo-charged (air to air), with a compression ratio of 16.1:1.

Diesel Fueled Test Vehicles:

A total of three tractor trucks (1995 Kenworth) were tested in Sacramento, CA, each with the Cummins M-11E+ diesel engine (CPL 2140) derived from the L-10 block, with displacement increased to 10.8 liters. The diesel vehicles had older vehicle and engine model years and higher mileage accumulation than the LNG vehicles. The diesel vehicles had splitter transmissions while the LNG vehicles had ranger transmissions.

2.3 Test Procedure

Test procedure included calibration of equipment, vehicle inspection, actual vehicle testing, data reduction, and data analysis.

In order to make sure that the analyzers and the associated systems were functioning properly and providing measurements accurately, all instruments were calibrated or adjusted daily. Propane injections confirmed reliability of the dilution tunnel system.

Prior to the actual testing, all gearboxes in the power train of the dynamometer were warmed up to minimize loading variability due to the viscosity of the oil. Each test includes several repeat test-runs in order to guarantee that the exhaust emissions measured are a true representation of the test vehicle. The emissions data reported for each vehicle test are the average values of at least three repeat test-runs. All test runs were executed with the vehicle at operating temperature (no cold-start tests were performed).

The following procedures were adopted for the actual vehicle testing:

- 1) The vehicle was inspected prior to testing;

- 2) The vehicle was positioned and mounted on the chassis dynamometer
- 3) The vehicle was driven while on the test bed to warm-up the gearboxes of the power train of the dynamometer until they reached 100° F, also ensuring that the vehicle's engine is at operational temperature before testing.
- 4) A practice test cycle was performed to allow the driver to become familiar with vehicle characteristics and to insure proper range settings of analyzers;
- 5) After completion of the practice run or one test run, the vehicle transmission was set to neutral and the engine was left in this condition for 17 minutes into a 20 minute soak period;
- 6) At 17 minutes into the soak period, the vehicle was driven through three of the CBD ramps to expel collected constituents in the exhaust system. Twenty seconds after completion of the final practice ramp, data collection was initiated.
- 7) 5) and 6) were repeated at least two times.

All emissions data, except for PM and non-methane hydrocarbons, were obtained by continuous readings and the results were integrated over the complete test cycle. PM emissions were measured gravimetrically using a secondary dilution filter sampling of the primary diluted exhaust. Non-methane hydrocarbons were measured by a gas chromatograph laboratory for all the CNG vehicles and LNG vehicles.

During a test, the driver was provided with a visual trace of the scheduled test route on an interface monitor. The speed trace was a representation of the test cycle being used. The driver followed the speed trace closely to minimize the errors introduced by irregular driving.

All of the vehicles were jacked up with hydraulic jacks placed on scales until the rear tires were no longer on the rollers of the test bed. The vehicle was then lowered onto the rollers until the vehicle was centered on the test bed.

3.1 Emissions Summary and Comparison

This section discusses the contrast between eight tractor trucks with new Cummins L-10 natural gas engines and three M-11 diesel control tractor trucks in Sacramento, CA. The LNG vehicles had an average mileage of 43,000 miles, while the diesel control vehicles' average was 196,000 miles. Table 1 presents the data acquired. PM from the LNG trucks was low, and it was about the one-third of the

diesel PM level. The level of CO for the LNG trucks was higher than that for the diesel trucks, with the average about 3.5 times of the average for the diesel trucks.

The average diesel truck NO_x emissions were 19.6 g/mile. Modern electronic diesel engine control strategy provides for advanced injection timing under warm up conditions, and the advanced timing causes higher NO_x. The average NO_x emissions for the eight LNG trucks was 5.25 g/mile, well below the value for the diesel trucks. These NO_x levels are so low as to be noteworthy in the database; they were also low in the previous year's test.

Non-methane hydrocarbon emissions represented 3.1% of the total hydrocarbon mass emitted for the LNG trucks. Average NMHC, at 0.62 g/mile, was lower than the diesel truck HC emissions, at 1.70 g/mile.

Energy-equivalent fuel consumption of the CNG trucks was 36.5% poorer than for the diesel trucks this year. It is also noticed that the fuel consumption of the diesel trucks stayed the same as tested in the previous year, while for the LNG trucks, it was 10% more this year. This could be due to the weather, since tests were done in summer last year when ambient temperature was higher than this year. Trucks 1503, 1507 and 1508 have fuel economy close to that of last year.

A tune up service over a LNG truck 1501 dropped the emissions dramatically. This truck was tested with the vehicle in original condition as received from the fleet owner in test sequence number 1047. It was re-tested in test sequence number 1058 after one of the spark plugs was found to be in poor condition and replaced with a new one. CO, HC and PM emissions decreased after this tune up service.

In summary, the LNG powered trucks showed their ability to return low NO_x and PM emissions in comparison to diesel counterparts.

3.3 Short Report

The short report shows the vehicle information, vehicle engine information, emissions data in grams/mile, and fuel economy for each test run, average emissions over all test runs, and brief comments for each test in a compact format on one page. The odometer mileage reading or hub mileage reading in the short reports is rounded to the nearest 100 miles.

Symbols used in Short Report Emissions data result table:

- a A value was measured and identified as an apparent outlier, and therefore is not reported and not used to compute other parameters or the average values.
- b The residual hydrocarbon emissions (RHC) is calculated from the difference between the methanol (CH_3OH) and the FID-HC concentrations. For 100% alcohol fuels, the value of RHC is small and due to experimental variations, it may be measured as positive or negative but can best be assumed to be zero.
- c A value cannot be calculated because the parameters required for calculation are not available.
- d A value of coefficient variance (CV%) is not meaningful because the average value is too small or not available. A significant coefficient of variance may exist for PM from CNG vehicles, where the PM is at very low levels. Note that CNG PM is more than an order of magnitude less than PM usually measured from diesel vehicles. Similarly some modern diesel vehicles will yield very low hydrocarbon emissions.

Component codes used in the short report data table:

CO:	Carbon monoxide in grams/mile
CO₂:	Carbon dioxide in grams/mile
NO_x:	Oxides of nitrogen in grams/mile
FIDHC:	Total hydrocarbon measured by HFID in grams/mile. For CNG and LNG vehicle test, unburned methane is included and no HFID response factor was corrected.
PM:	Particulate matter in grams/mile
CH₄:	Unburned methane emissions in grams/mile
NMHC:	Non-methane hydrocarbon in grams/mile
mile/gal:	Calculated fuel economy in mile/gallon. For NG fueled vehicles, MPG means miles per equivalent gallon diesel. In this table, 137 cubic feet CNG at standard temperature and pressure (STP) is equivalent to 1 gallon of #1 diesel.
BTU/mile:	Calculated fuel energy used by the vehicle, in BTU/mile.
Miles:	Total actual driving distance for a test run

All short reports for RDC trucks are included in this report.

Test Sequence Number: 1046

WVU Test Reference Number: WVU-TEDDY2-D2-5MILES

Fleet Owner Full Name West Virginia University
Fleet Address MAE Dept., P. O. Box 6106
Fleet Address (City, State, Zip) Morgantown, WV 26506

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1FUPYSYB7FH258124
Vehicle Manufacturer Freightliner
Vehicle Model Year 1985
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 12000
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 748400
Transmission Type Manual
Transmission Configuration 9-Speed
Number of Axles 3

Engine Type Caterpillar 3406B
Engine ID Number 7FB30060
Engine Displacement (Liter) 14
Number of Cylinders 6
Engine Rated Power (hp) 350

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 2/18/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq No	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1046-3	15.4	30.1	3.53	3.17	2166	4.62	28128	5.00
1046-4	17.1	29.3	5.04	3.98	2118	4.71	27605	5.00
1046-5	13.8	30.1	2.68	2.34	2120	4.73	27470	5.01
1046-6	16.2	29.9	4.71	3.64	2133	4.68	27767	5.00
1046 Average	15.6	29.8	3.99	3.28	2134	4.69	27742	5.00
Std. Dev.	1.4	0.4	1.09	0.71	22	0.05	284	0.00
CV%	9.1	1.3	27.3	21.6	1.0	1.0	1.0	0.0

Test Purpose:

Measurement of exhaust constituents from WVU Transportable Heavy Duty Emissions Laboratory-2 control vehicle for comparison of emissions on the same vehicle at different locations.

Special Procedures:

The vehicle was serviced 3000 miles prior to this test.

Observations:

HC and PM emissions were very high compared to emissions measured previously from this vehicle at other test sites.

Test Sequence Number: 1047

WVU Test Reference Number: RDC-1501-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X0VR745373
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 16520
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 37200
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34845353
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/19/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1047-2	11.0	3.71	83.5	75.7	0.70	0.13	1916	3.58	35850	5.01
1047-3	10.9	3.68	92.3	83.8	0.66	0.11	1970	3.48	36925	5.02
1047-4	9.8	3.83	76.0	69.0	0.64	0.09	1925	3.60	35730	5.00
1047-5	14.7	5.66	167.4	152.5	0.76	0.12	2022	3.25	39492	5.01
1047-6	13.9	3.59	129.5	117.8	0.79	0.17	1995	3.35	38355	5.00
1047 Average	12.0	4.09	109.8	99.7	0.71	0.13	1966	3.45	37270	5.01
Std. Dev.	2.1	0.88	38.2	35.0	0.07	0.03	45	0.15	1629	0.01
CV%	17.5	21.5	34.8	35.0	9.3	22.9	2.3	4.3	4.4	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Special Procedures:

Dilute bag was replaced with a new one the day before the test. It rained heavily during the test. This vehicle was re-tested in test number 1058. See comments in test sequence number 1058.

Observations:

Driver complained not being able to hold the speed during the test. Low fuel pressure light was on during the 5th test, even though the fuel tank was above half. HC emissions were very high and out of the analyzer range, HC dilute bag results were reported.

Test Sequence Number: 1048

WVU Test Reference Number: RDC-1502-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X2VR745374
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 16380
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 38600
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34847019
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/20/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1048-2	8.98	4.11	26.6	23.8	0.60	0.046	1793	4.00	32142	5.02
1048-4	8.72	4.56	28.6	25.6	0.61	0.047	1832	3.91	32891	5.01
1048-5	8.32	4.41	25.3	22.6	0.62	0.038	1827	3.94	32641	5.00
1048-6	7.72	5.49	21.3	18.8	0.71	0.031	1813	3.99	32201	5.00
1048 Average	8.44	4.65	25.5	22.7	0.63	0.041	1816	3.96	32469	5.01
Std. Dev.	0.55	0.60	3.1	2.9	0.05	0.008	17	0.04	359	0.01
CV%	6.5	12.8	12.1	12.6	8.3	18.8	1.0	1.1	1.1	0.2

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Special Procedures:

Background bag was replaced with a new one the day before the test.

Observations:

Driver complained that the truck was sluggish and under-powered.

Test Sequence Number: 1051

WVU Test Reference Number: RDC-1504-LNG-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X6VR745376
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 16540
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 51400
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34847352
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/23/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1051-2	8.05	4.67	22.1	19.5	0.72	0.049	1968	3.69	34848	5.00
1051-3	7.83	6.46	22.8	20.1	0.74	0.062	1908	3.80	33850	5.00
1051-5	9.45	6.95	50.5	45.4	0.85	0.061	1859	3.81	33769	4.98
1051-6	10.19	5.57	59.9	53.9	0.91	0.082	1879	3.73	34427	5.01
1051-7	8.98	5.59	44.7	40.1	0.80	0.062	1862	3.82	33679	5.01
1051 Average	8.90	5.85	40.0	35.8	0.80	0.063	1895	3.77	34115	5.00
Std. Dev.	0.98	0.88	16.9	15.4	0.08	0.012	45	0.06	504	0.01
CV%	11.0	15.1	42.3	43.1	9.7	18.7	2.4	1.5	1.5	0.2

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Special Procedures:

Cummins representative plugged his device to log data during the test simultaneously. It was rainy during test. The vehicle was re-tested in test number 1056 under sunny weather to see the effect of rainy weather on emissions.

Observations:

Driver complained about the sluggishness of the vehicle. HC was out of analyzer range at 40MPH ramp for test run number 5, 6 and 7, HC dilute bag results were reported.

Test Sequence Number: 1052

WVU Test Reference Number: RDC-1503-LNG-5MILES

Fleet Owner Full Name
Fleet Address
Fleet Address (City, State, Zip)

Raley's Distribution Center
4061 Gateway Park Blvd.
Sacramento, CA 95834

Vehicle Type
Vehicle ID Number (VIN)
Vehicle Manufacturer
Vehicle Model Year
Gross Vehicle Weight (GVW) (lb.)
Vehicle Total Curb Weight (lb.)
Vehicle Tested Weight (lb.)
Odometer Reading (mile)
Transmission Type
Transmission Configuration
Number of Axles

Tractor Truck
1XKDD59X4VR745375
Kenworth
1997
80000
16560
42000
46000
Manual
10-Speed
3

Engine Type
Engine ID Number
Engine Displacement (Liter)
Number of Cylinders
Engine Rated Power (hp)

Cummins GL-10-300E
34847353
10
6
300

Primary Fuel
Test Cycle
Test Date

LNG
5 Mile Route
2/24/98

Engineer
Driver

W. Xie
B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1052-3	7.80	7.04	15.7	13.7	0.68	0.048	1670	4.36	29495	5.00
1052-5	7.99	7.85	15.5	c	c	0.043	1644	4.42	29047	5.01
1052-6	8.17	8.62	16.1	14.2	0.55	0.046	1592	4.56	28198	5.00
1052-7	7.82	8.21	17.3	15.2	0.56	0.052	1626	4.46	28823	5.01
1052 Average	7.95	7.93	16.1	14.4	0.60	0.047	1633	4.45	28891	5.00
Std. Dev.	0.17	0.67	0.8	0.8	0.07	0.004	33	0.08	540	0.01
CV%	2.2	8.5	4.9	5.5	12.0	7.9	2.0	1.9	1.9	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Observations:

Fuel tanking was leaking the day before the test when it was put on the test bed because it was too full. The leaking stopped before the test.

Test Sequence Number: 1053

WVU Test Reference Number: RDC-1507-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X1VR745379
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 15585
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 46000
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34849167
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/24/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Emissions Results (g/mile)							Fuel Economy			
Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1053-1	6.72	5.38	16.7	14.8	0.51	0.027	1720	4.23	30380	5.00
1053-2	6.56	5.37	15.8	13.9	0.51	0.028	1684	4.32	29714	5.01
1053-3	6.55	5.46	15.9	14.0	0.50	0.023	1672	4.35	29508	5.01
1053-4	6.23	5.45	15.5	13.7	0.50	0.021	1675	4.35	29536	5.01
1053 Average	6.51	5.42	16.0	14.1	0.50	0.025	1688	4.32	29784	5.01
Std. Dev.	0.21	0.04	0.5	0.5	0.01	0.003	22	0.06	407	0.00
CV%	3.2	0.8	3.2	3.3	1.3	13.7	1.3	1.4	1.4	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Observations:

The Lebow on the right side of the test bed (side 2), which had a short circuit inside and lost tracking since test number 1050, started functioning during the third run of this test. It was re-calibrated before the fourth run.

Test Sequence Number: 1054

WVU Test Reference Number: RDC-1506-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59XXVR745378
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 16520
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 44700
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34849166
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/25/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1054-1	7.19	5.03	17.9	15.8	0.54	0.035	1818	4.00	32110	5.00
1054-2	7.55	4.22	19.9	17.7	0.55	0.036	1882	3.86	33320	5.00
1054-4	6.90	4.08	16.9	15.0	0.52	0.037	1843	3.95	32494	5.01
1054-5	6.59	4.90	16.0	14.1	0.54	0.042	1820	4.01	32048	5.00
1054-6	6.50	3.88	17.0	15.1	0.49	0.027	1843	3.96	32487	5.00
1054 Average	6.95	4.42	17.5	15.5	0.53	0.035	1841	3.96	32492	5.00
Std. Dev.	0.43	0.51	1.5	1.4	0.02	0.005	26	0.06	507	0.00
CV%	6.2	11.6	8.5	8.7	4.0	15.4	1.4	1.5	1.6	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Test Sequence Number: 1055

WVU Test Reference Number: RDC-1508-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X8VR745380
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 15680
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 52700
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34849165
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/25/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1055-1	7.21	4.13	20.5	18.1	0.69	0.061	1793	4.04	31805	5.00
1055-2	7.20	3.32	20.7	18.3	0.69	0.058	1773	4.08	31475	5.01
1055-3	7.02	3.85	19.8	17.4	0.69	0.050	1768	4.10	31347	5.00
1055-4	6.97	4.54	18.5	16.2	0.70	0.059	1730	4.19	30642	5.01
1055-5	6.52	2.64	18.2	16.1	0.57	0.058	1764	4.12	31193	5.01
1055-6	6.48	2.90	19.2	16.9	0.66	0.056	1756	4.13	31097	5.00
1055 Average	6.90	3.56	19.5	17.2	0.67	0.057	1764	4.11	31260	5.00
Std. Dev.	0.32	0.74	1.0	0.9	0.05	0.004	20	0.05	391	0.01
CV%	4.7	20.7	5.4	5.4	7.4	6.7	1.2	1.3	1.2	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Observations:

NO_x emissions were very low compared to other similar LNG tractors, while the variation from test run to test run was high.

Test Sequence Number: 1056

WVU Test Reference Number: RDC-1504-LNG-5MILES-R2

Fleet Owner Full Name

Fleet Address

Fleet Address (City, State, Zip)

Raley's Distribution Center

4061 Gateway Park Blvd.

Sacramento, CA 95834

Vehicle Type

Vehicle ID Number (VIN)

Vehicle Manufacturer

Vehicle Model Year

Gross Vehicle Weight (GVW) (lb.)

Vehicle Total Curb Weight (lb.)

Vehicle Tested Weight (lb.)

Odometer Reading (mile)

Transmission Type

Transmission Configuration

Number of Axles

Tractor Truck

1XKDD59X6VR745376

Kenworth

1997

80000

16540

42000

51600

Manual

10-Speed

3

Engine Type

Engine ID Number

Engine Displacement (Liter)

Number of Cylinders

Engine Rated Power (hp)

Cummins GL-10-300E

34847352

10

6

300

Primary Fuel

Test Cycle

Test Date

LNG

5 Mile Route

2/26/98

Engineer

Driver

W. Xie

B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1056-1	8.45	4.27	50.1	45.1	0.79	0.055	1865	3.80	33786	4.99
1056-2	8.75	4.15	54.9	49.4	0.84	0.053	1801	3.91	32894	5.01
1056-3	8.39	5.24	33.4	29.9	0.72	0.051	1811	3.94	32581	5.00
1056-4	7.55	4.22	20.7	18.3	0.63	0.039	1811	4.00	32099	5.00
1056-5	8.19	5.06	37.2	33.3	0.74	0.048	1828	3.90	32946	5.00
1056 Average	8.27	4.59	39.3	35.2	0.74	0.049	1823	3.91	32861	5.00
Std. Dev.	0.45	0.52	13.6	12.4	0.08	0.007	25	0.07	617	0.01
CV%	5.4	11.3	34.7	35.2	10.3	13.3	1.4	1.9	1.9	0.1

Test Purpose:

Re-test vehicle 1504 under sunny weather to determine the effect of rainy weather on emissions.

Special Procedures:

Cummins representative informed us that no tune up or any service would be done on this vehicle. So this vehicle was not re-tested during this trip any more.

Observations:

Driver complained that the vehicle was rough at 40MPH. All CO, CO₂, NO_x and PM emissions dropped comparing to those in test 1051 which was tested in rain, while HC was still out of analyzer range during 40MPH ramp.

Test Sequence Number: 1057

WVU Test Reference Number: RDC-1505-LNG-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X8VR745377
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 15720
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 28800
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34849168
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/27/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1057-1	9.35	6.67	17.7	15.5	0.67	0.041	2036	3.58	35893	5.01
1057-2	10.12	7.77	18.0	15.8	0.68	0.037	2011	3.62	35507	5.00
1057-3	8.94	7.44	18.5	16.3	0.62	0.033	1959	3.71	34596	5.01
1057-4	8.70	6.55	17.4	15.2	0.68	0.036	2000	3.65	35245	5.00
1057-5	8.17	7.00	15.9	c	c	0.033	1929	3.79	33951	5.01
1057-6	8.42	7.06	17.2	15.1	0.67	0.039	1953	3.73	34419	5.01
1057 Average	8.95	7.08	17.5	15.6	0.67	0.037	1981	3.68	34935	5.01
Std. Dev.	0.70	0.46	0.9	0.5	0.03	0.003	41	0.08	734	0.01
CV%	7.9	6.5	5.1	3.1	4.0	8.9	2.1	2.1	2.1	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicles for use in comparison with similar, diesel powered vehicles.

Special Procedures:

Cummins representative informed us four days before the test that there was a regulator problem for the vehicle, which could not convert LNG to gas properly. This problem was fixed before the test.

Test Sequence Number: 1058

WVU Test Reference Number: RDC-1501-LNG-5MILES-R

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKDD59X0VR745373
Vehicle Manufacturer Kenworth
Vehicle Model Year 1997
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 16520
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 38000
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins GL-10-300E
Engine ID Number 34845353
Engine Displacement (Liter) 10
Number of Cylinders 6
Engine Rated Power (hp) 300

Primary Fuel LNG
Test Cycle 5 Mile Route
Test Date 2/28/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)								Fuel Economy		
Run/Seq. No.	CO	NO _x	FIDHC	CH ₄	NMHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1058-1	9.74	4.30	19.7	17.4	0.63	0.033	2085	3.49	36840	5.01
1058-2	8.47	3.98	19.1	16.9	0.65	0.031	2036	3.58	35933	5.01
1058-4	10.31	4.81	20.4	18.0	0.66	0.034	1985	3.65	35164	5.01
1058-5	9.46	4.77	19.7	17.3	0.66	0.034	1962	3.70	34723	5.01
1058-6	9.11	3.94	19.2	16.9	0.69	0.034	2025	3.59	35767	5.01
1058 Average	9.42	4.36	19.6	17.3	0.66	0.033	2019	3.60	35686	5.01
Std. Dev.	0.69	0.42	0.5	0.5	0.02	0.001	48	0.08	806	0.00
CV%	7.3	9.6	2.5	2.7	3.1	4.0	2.4	2.2	2.3	0.1

Test Purpose:

Collection of emissions data from LNG fueled vehicle after it has been serviced to determine the effect, if any, on emissions.

Special Procedures:

One of the spark plugs was found bad and replaced after the previous test (see test number 1047). Vehicle then ran normally.

Observations:

HC and PM emissions dropped dramatically, while CO dropped slightly and CO2 stayed about the same comparing to previous test (see test number 1047).

Test Sequence Number: 1059

WVU Test Reference Number: RDC-1586-D2-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKBD99X9TS690099
Vehicle Manufacturer Kenworth
Vehicle Model Year 1995
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 14440
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 205700
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins M11-330E
Engine ID Number 34776206
Engine Displacement (Liter) 10.8
Number of Cylinders 6
Engine Rated Power (hp) 330

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 3/2/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run/Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1059-2	2.27	21.1	1.97	1.92	1689	5.99	21701	5.00
1059-3	2.22	23.2	1.89	1.69	1646	6.15	21154	5.00
1059-4	2.50	20.5	1.94	1.72	1631	6.20	20961	5.01
1059-5	2.27	17.8	1.93	1.62	1643	6.16	21116	5.01
1059-6	2.32	21.4	2.03	1.90	1663	6.08	21376	5.01
1059 Average	2.32	20.8	1.95	1.77	1654	6.12	21262	5.01
Std. Dev.	0.11	1.9	0.05	0.13	22	0.08	287	0.01
CV%	4.7	9.4	2.8	7.3	1.4	1.3	1.3	0.1

Test Purpose:

Collection of emissions data from diesel fueled vehicles for use in comparison with similar, LNG powered vehicles.

Test Sequence Number: 1060

WVU Test Reference Number: RDC-1592-D2-5MILES

Fleet Owner Full Name Raley's Distribution Center
Fleet Address 4061 Gateway Park Blvd.
Fleet Address (City, State, Zip) Sacramento, CA 95834

Vehicle Type Tractor Truck
Vehicle ID Number (VIN) 1XKBD99X2TS712783
Vehicle Manufacturer Kenworth
Vehicle Model Year 1995
Gross Vehicle Weight (GVW) (lb.) 80000
Vehicle Total Curb Weight (lb.) 14960
Vehicle Tested Weight (lb.) 42000
Odometer Reading (mile) 174000
Transmission Type Manual
Transmission Configuration 10-Speed
Number of Axles 3

Engine Type Cummins M11-330E
Engine ID Number 34786945
Engine Displacement (Liter) 10.8
Number of Cylinders 6
Engine Rated Power (hp) 330

Primary Fuel D2
Test Cycle 5 Mile Route
Test Date 3/3/98

Engineer W. Xie
Driver B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1060-1	2.11	23.7	1.64	1.19	1684	6.01	21620	4.99
1060-2	2.21	22.1	1.63	1.17	1619	6.25	20792	5.00
1060-3	2.07	18.8	1.66	1.16	1608	6.29	20654	5.00
1060-4	2.05	21.3	1.67	1.16	1624	6.23	20852	5.00
1060-5	2.35	18.4	1.63	1.16	1610	6.29	20677	5.00
1060 Average	2.16	20.9	1.65	1.17	1629	6.22	20919	5.00
Std. Dev.	0.12	2.3	0.02	0.01	31	0.12	400	0.00
CV%	5.8	10.8	1.1	1.0	1.9	1.9	1.9	0.1

Test Purpose:

Collection of emissions data from diesel fueled vehicles for use in comparison with similar, LNG powered vehicles.

Test Sequence Number: 1061

WVU Test Reference Number: RDC-1593-D2-5MILES

Fleet Owner Full Name
Fleet Address
Fleet Address (City, State, Zip)

Raley's Distribution Center
4061 Gateway Park Blvd.
Sacramento, CA 95834

Vehicle Type
Vehicle ID Number (VIN)
Vehicle Manufacturer
Vehicle Model Year
Gross Vehicle Weight (GVW) (lb.)
Vehicle Total Curb Weight (lb.)
Vehicle Tested Weight (lb.)
Odometer Reading (mile)
Transmission Type
Transmission Configuration
Number of Axles

Tractor Truck
1XKBD99X4TS712784
Kenworth
1995
80000
14960
42000
209200
Manual
10-Speed
3

Engine Type
Engine ID Number
Engine Displacement (Liter)
Number of Cylinders
Engine Rated Power (hp)

Cummins M11-330E
34787997
10.8
6
330

Primary Fuel
Test Cycle
Test Date

D2
5 Mile Route
3/4/98

Engineer
Driver

W. Xie
B. Davis

Emissions Results (g/mile)

Fuel Economy

Run Seq. No.	CO	NO _x	FIDHC	PM	CO ₂	mile/gal	BTU/mile	Miles
1061-3	2.15	18.6	1.46	0.74	1668	6.07	21412	5.02
1061-4	2.55	15.7	1.51	0.72	1702	5.95	21850	5.00
1061-5	2.14	18.7	1.48	0.70	1725	5.87	22138	5.01
1061-6	2.24	16.3	1.55	0.70	1704	5.94	21883	5.01
1061-7	2.41	16.4	1.50	0.73	1659	6.10	21305	5.01
1061 Average	2.30	17.1	1.50	0.72	1692	5.99	21718	5.01
Std. Dev.	0.18	1.4	0.03	0.02	27	0.10	348	0.00
CV%	7.7	8.2	2.2	2.6	1.6	1.6	1.6	0.1

Test Purpose:

Collection of emissions data from diesel fueled vehicles for use in comparison with similar, LNG powered vehicles.

Table 1: Comparison of Emissions from Sacramento LNG and Diesel Fueled Tractors

Emission Summary for LNG Powered Tractors in Sacramento, CA

Test ID	WVU Ref Num	Cycle ID	Test Date	Mileage	CO	NOx	HC	PM	CO2	MPG	BTU	CH4	NMHC
1058	RDC-1501-LNG-5MILES-R	5 Mile Route	2/28/98	38000	9.42	4.36	19.63	0.033	2019	3.60	35686	17.31	0.66
1048	RDC-1502-LNG-5MILES	5 Mile Route	2/20/98	38600	8.44	4.65	25.49	0.041	1816	3.96	32469	22.69	0.63
1052	RDC-1503-LNG-5MILES	5 Mile Route	2/24/98	46000	7.95	7.93	16.14	0.047	1633	4.45	28891	14.36	0.60
1056	RDC-1504-LNG-5MILES-R2	5 Mile Route	2/26/98	51600	8.27	4.59	39.27	0.049	1823	3.91	32861	35.20	0.74
1057	RDC-1505-LNG-5MILES	5 Mile Route	2/27/98	28800	8.95	7.08	17.47	0.037	1981	3.68	34935	15.60	0.67
1054	RDC-1506-LNG-5MILES	5 Mile Route	2/25/98	44700	6.95	4.42	17.54	0.035	1841	3.96	32492	15.53	0.53
1053	RDC-1507-LNG-5MILES	5 Mile Route	2/24/98	46000	6.51	5.42	15.97	0.025	1688	4.32	29784	14.12	0.50
1055	RDC-1508-LNG-5MILES	5 Mile Route	2/25/98	52700	6.90	3.56	19.48	0.057	1764	4.11	31260	17.16	0.67
Average:				43300	7.92	5.25	21.37	0.040	1821	4.00	32297	19.00	0.62

Emission Summary for Diesel Powered Tractors in Sacramento, CA

Test ID	WVU Ref Num	Cycle ID	Test Date	Mileage	CO	NOx	HC	PM	CO2	MPG	BTU
1059	RDC-1586-D2-5MILES	5 Mile Route	3/2/98	205700	2.32	20.79	1.95	1.77	1654	6.12	21262
1060	RDC-1592-D2-5MILES	5 Mile Route	3/3/98	174000	2.16	20.85	1.65	1.17	1629	6.22	20919
1061	RDC-1593-D2-5MILES	5 Mile Route	3/4/98	209200	2.30	17.14	1.50	0.72	1692	5.99	21718
Average:				196300	2.26	19.59	1.70	1.22	1658	6.11	21299