Low Sulfur Gasoline Testing Project
Winter 2005-2006

Project Information:

In calendar year 2000, EPA issued regulations establishing lower sulfur content requirements for all gasoline and stricter tailpipe emissions standards for all passenger vehicles, including sport utility vehicles (SUVs), minivans, vans and pick-up trucks. The gasoline sulfur control program is needed to support the operation of the control technologies that are being used to meet the more stringent tailpipe emission standards. Reductions in gasoline sulfur content began phasing-in during 2004. Refiners are required to meet a refinery average sulfur standard of 30 ppm beginning in 2005 and a per gallon "cap" standard of 80 ppm beginning in 2006. Refiners in certain western states, including Alaska, were allowed to delay meeting this standard until January 2007. EPA's mobile source emission factor model, MOBILE6, estimates that the carbon monoxide (CO) benefits of the lower sulfur gasoline to be in the range of 15 – 20% for Fairbanks in 2007. These reductions represent the single largest source of CO reduction available to the community and are critical to projections of long-term attainment contained in the recently approved CO Maintenance Plan.

Other key assumptions employed in the attainment forecast include the continuation of the I/M Program and a slow but steady outlook for growth. Recent events, however, suggest that these assumptions may not be correct. The Department of Environmental Conservation (DEC) and the Fairbanks North Star Borough have committed to consider eliminating the I/M program later this decade. In addition, there is an increasing probability that a gas pipeline will be built later this decade in the vicinity of Fairbanks. The ability of the community to accommodate the growth associated with the pipeline, eliminate the I/M program and continue to attain the CO standard will depend on the accuracy of the MOBILE6 estimates of low sulfur gasoline benefits.

Concerns about the limitations of data used in EPA's MOBILE models (versions 5 & 6) led the DEC and the Borough to jointly construct a cold temperature testing facility in Fairbanks. Several studies (e.g., extended idle, block heaters and oxygen sensor replacement) conducted at that facility have confirmed the limitations of MOBILE to accurately represent emissions under cold temperature operating conditions in Alaska. In light of the findings of these programs and the importance of low sulfur gasoline to Fairbanks future attainment prospects, the DEC and Borough have determined that a study is needed to confirm the magnitude of the projected emission benefits during winter operation in Alaska.

Funding was secured to proceed with a study of the emission benefits of low sulfur gasoline in Fairbanks' cold climate. A contract has been put in place to conduct the testing project, with vehicle testing occurring in January – March 2006. Sierra Research, Inc. is the contractor selected to conduct the study in Fairbanks.

Testing Location: Fairbanks North Star Borough Test Facility in Fairbanks, Alaska

Prime Contractor: Sierra Research, Inc.

Contract Scope of Work:

The contract has been split into seven primary tasks as described below-

Task 1 – Quality Assurance Plan

Prepare a quality control/quality assurance plan that addresses:

1. mass emissions tests based on dilute exhaust sampling;
2. sampling and analysis of raw vehicle exhaust concentrations; and
3. ancillary measurements and calculations pertinent to the computation of vehicle emissions from test measurements.

Task 2 – Determine Gasoline Consumption Patterns

Develop, execute and analyze results from a questionnaire to collect information on gasoline purchasing behavior in Fairbanks and identifying vehicle owners willing to participate in the test program. The focus of the survey should be on vehicles owned and operated in the nonattainment area during the winter months.

Task 3 – Establish Sampling Requirements

Develop a matrix of alternative sample size choices based on relative error (i.e., precision) and confidence limits needed to quantify the carbon monoxide (CO) benefits that will accrue from the reduction in gasoline sulfur content. The sample size estimates should be stratified to account for emission control technology differences within the vehicle fleet.

Task 4 – Design a Testing Program

Use the results of the survey from Task 2 to construct a test program that captures the range of operations that occur within the non-attainment area. Some key issues to consider in the development of a testing protocol include (but are not limited to):

- Vehicle identification, procurement and screening;
- Range of ambient temperatures for testing;
- Overnight soak time;
- Range of temperature thresholds for auto start;
- Typical block heater use;
- Winter driving patterns in Fairbanks;
- Sample size considerations;
- Fuel specifications;
- Vehicle age, type and repair status; and
- Purging sulfur deposits from catalyst.

Task 5 – Vehicle Emission Testing

Procure and test emissions from a representative sample of cars and light-duty trucks to obtain at least 200 cold start tests and associated 400 hot start tests. The process should include (but is not limited to):

- A set of incentives to encourage public participation;
- Safety criteria for use in assessing whether volunteered vehicles can participate in the program;
- Insurance to cover vehicle liability, damage/repairs, etc.; and
- Lab operating procedures.

Task 6 – Quantify Emission Benefits of Low Sulfur Gasoline

Data collected in the test program must undergo quality assurance review per the plan established in Task 1. Use the results to compute total grams and gram/mile emission rates for HC, CO and NOx separately for tank fuel and for Tier 2 compliant gasoline. Calculate the difference in emission rates between the two different fuels. Vehicle specific emission rates and differences should be organized into common age and emission control categories. Fleet average values should also be computed. Confidence limits and precision levels should be computed for gasoline specific emission rates and for the differences between them. The results should be reviewed with the Project Director and the Director of the Fairbanks North Star Borough's Department of Transportation or their designee to determine if the statistical insight available from the data could be meaningfully improved with additional testing.

Task 7 – Reporting

Provide monthly status reports and document the results of each task. A draft final project report shall be provided to the contract manager for review. Revisions to the report shall be prepared that respond to comments received from the Project Director and the Director of the Fairbanks North Star Borough's Department of Transportation. The final report will then be transmitted and will include one unbound copy and four bound copies of the report, an electronic copy of the report, electronic copies of all spreadsheets used to calculate benefits, and an electronic copy of all raw data with a data definition to enable someone to identify the various data elements.

Contract Schedule of Deliverables:

Task 1 – Quality Assurance Plan due December 9, 2005.

Task 2 – Determine Gasoline Consumption Patterns by December 23, 2005.

Task 3 – Establish Sampling Requirements by December 23, 2005

Task 4 – Testing Program Design due by December 23, 2005

Task 5 – Vehicle Emission Testing must begin no later than January 17, 2006 and must be completed no later than March 17, 2006.

Task 6 – Quantify Emission Benefits of Low Sulfur Gasoline by April 19, 2006

Task 7 – In addition to the monthly status reports to be filed with each invoice, the Draft Report is due May 1, 2006. The department will review the report and provide comments no later than June 1, 2006. The department comments will then be incorporated in the final report which is due June 30, 2006.