Appendix J

Control Option 23

Control Options Analysis for Rocky Mountain National Park Initiative

Proposed Implementation of Nox Controls on new and existing engines Statewide

Purpose

Purpose: In AQCC Regulation 7, the Division has proposed implementing NOx controls Statewide for new and existing natural gas fired engines greater than 100 hp. This analysis presents the pros and cons based on an EPA analysis of 1 gram per horsepower-hour for engines greater than 300 hp, and 2 grams per horsepower-hour for engines smaller than 300 hp.

Cost/Benefit

Costs: The Divison used the EPA's economic analysis for the NSPS for Internal Combustion Engines to estimate costs for implementing Statewide NOx controls for new and existing engines. This analysis was conducted using manufacturer and inventory data from the years 1998 - 2002. The proposed emission statndards are based on fuel type, meteorology, and the horsepower capacity of Reciprocating Internal Combustion Engines (RICEs). This analysis uses RICE engines ranging from 100 - 600 hp. Currently, Colorado has 50 major (>100 tpy for NOx) engine units and 280 major (Operating Permit) facilities.

Costs: Rich burn RICE are commonly controlled by a non-selective catalyst (NSCR) and an air fuel ratio controller (AFRC). NSCR typically results in NOx reduction of greater than 90% and up to 99%. NOx emissions from lean burn RICE can be controlled by a selective catalyst reduction (SCR) and also results in NOx reduction greater than 90%. Cost data is based on a 90% reduction.

Cost Discussion: Rich burn RICE exhibit typical nitrogen oxides (NOx) emission factors in the range of 10-20 grams/horsepower hour (g/hphr). Four-cycle lean burn RICE have typical NOx and CO emission factors in the range of 1-2 g/hphr. Most 2 cycle RICE operate as lean burn engines with NOx and CO emissions of approximately 2-3 g/hphr. These emission factors are based on AP-42 data.

Cost Discussion: For engines greater than 300 hp, the EPA estimates that the average cost of NSCR per ton of NOx reduced is about $98/ton (for engines up to 2000 hp). The average cost of NSCR per ton of NOx reduced on engines 100 - 300 hp is on average $153/ton. The average cost for SCR on lean burn engines greater than 300 hp is $9133/ton and for engines 100 - 300 hp is $7760/ton.

Benefits: Applying SCR and NSCR to engines will also result in similar CO reductions (average of 90% reduction).

Disadvantages: Ammonia slip is a large concern. The fuel efficiency is reduced on average by 4%. CO reudtion requires an oxidation catalyst (OC).

Implementation and Viability

The cost efficiency for lean burn engines may not be economically feasible. However, for rich burn engines, NSCR and AFRC are already widely implemented in the industry. This option is readily economically and environmentally feasible and will result in drastic NOx reductions Statewide.

Additional Details

The Division did not perform a comprehensive analysis on the number of engines currently present at the State according to horsepower range sizes due to the complexity and inconsistency of the available inventory data. To be able to analyze engines based on horsepower data, inventory information would have to be reconfigured or an extensive amount of time spent on sorting the available data.

However, in 2003, an analysis was conducted to examine RICE controls in the EAC area. This analysis found that all EAC area RICE emitted about 13,000 tons per year. With rich burn Retrofit Controls (for this area), it was found that NOx would be reduced to 44 tons/year wtih NSCR and AFCR controls. This is a preliminary number to exemplify the effects of a RICE control implementation.