**WRITTEN STATEMENT OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION TO THE
OZONE TRANSPORT COMMISSION'S SECOND DRAFT MODEL RULE TO
CONTROL NOX FROM NATURAL GAS COMPRESSOR FUEL-FIRED PRIME
MOVERS**

February 28, 2012

The Manufacturers of Emission Controls Association (MECA) is pleased to provide comments to the Ozone Transport Commission's proposed 2016 Model Rule for the Control of NOx Emissions from Natural Gas Pipeline Compressor Fuel-Fired Prime Movers. MECA believes that the 90 percent reduction targets outlined in the model rule are a good first step to reducing NOx from some categories of engines; however we believe that the emission limits do not go far enough and don't represent the current capabilities of technologies that are available today. Furthermore, the emission limits specified in the rule, leave significant NOx emission reductions on the table because they don't represent the capabilities of even the most cost effective technologies such as NSCR for rich-burn natural gas engines.

MECA is a non-profit association made up of the world's leading manufacturers of emission control technology for mobile and stationary internal combustion engines. MECA member companies have over 35 years of experience and a proven track record in developing and commercializing exhaust emission control technologies for a wide range of engines of all sizes including both rich and lean-burn, stationary, spark ignited natural gas engines. MECA member companies have commercialized the necessary emission control technologies to achieve greater than 90% NOx reduction from spark-ignited natural gas compressor engines covered by this model rule. We provide the following comments to support further tightening of the emission rates of the specific engine categories so that they are closer to those achievable by today's exhaust control technologies.

Definition of Engines Covered Under the Rule

MECA recommends that the OTC clarify the engines that are covered under this model rule as there appears to be confusion among stakeholders as to what types of engines are proposed to be regulated. The title of the rule states that natural gas-fired prime movers are to be impacted; however definition # 2.8 broadly defines a prime mover as any spark-ignited reciprocating internal combustion engine (RICE). Furthermore, the applicability, in section 3.0 implies that all SI RICE engines ≥ 200 hp are covered.

MECA members that sell emission control technologies into the natural gas transmission sector have found that the majority of prime movers are the large ≥ 2000 hp, two-stroke, lean-burn engines. In fact, comments provided by the Interstate Natural Gas Association of America (INGAA) regarding the capabilities and experience of retrofit exhaust control technologies appear to address these largest two stroke prime mover engines. MECA member experience has found that by number, the prime movers represent the minority of engines used in the natural gas infrastructure and that many more smaller, diesel and natural gas four stroke engines are used in well head operations for drilling and feeding gas under pressure to gas processing plants and into the major transmission pipelines. We support the expansion of the model rule to include this category of drilling and compressor feeder engines that contribute to the emissions inventory from the natural gas infrastructure and for which exhaust emission control technologies have been demonstrated and commercialized.

Two-Stroke Lean Burn Engines

MECA believes that exhaust controls could be used to achieve further reductions in NOx emissions from these large prime mover engines; however, there are limited examples of SCR technologies being retrofitted on these types of engines. Furthermore the limited demonstration test programs that have been completed have never been published at the request of the supporters of these projects. There have been several demonstrations conducted by independent laboratories where SCR was retrofitted on such two-stroke, lean-burn natural gas prime mover engines that achieved >90% reduction in NOx. An emission rate around 0.5 g/bhp-hr would more closely represent that achievable with a 90% reduction in NOx emissions using SCR on these types of engines. There were challenges in retrofitting SCR to these engines because of the relatively low exhaust temperatures on some older 2-stroke engines, however today's SCR systems operate over a much broader operating range. Some of our members have formulated catalysts specifically for these large two-stroke engines and demonstrated their effectiveness down to exhaust temperatures as low as 250^{o}C and as high as 550^{o}C.

Four-Stroke Lean Burn Internal Combustion Engines

For this category of engines, MECA supports the tighter 90% NOx reduction limit proposed by OTC in the latest draft of this model rule. However, by not also tightening the corresponding emission rate of 1.5 to 2.0 g/bhp-hr, the OTC is missing a significant opportunity to achieve further NOx reductions. SCR has long been the technology of choice for NOx emission reduction in industrial processes and stationary power generation applications. The commercial use of SCR systems for the control of NOx from lean-burn stationary engines has been around since the mid-1980s in Europe and since the early 1990s in the U.S. Since 1995, one MECA member company specifically has installed over 400 SCR systems worldwide for stationary engines with varying fuel combinations including dozens of natural gas powered compressor engines at sites in the U.S. These four-stroke, lean-burn, gas compressor engines, equipped with urea-SCR achieve in excess of 90% reduction in NOx with as little as 2-3 ppm ammonia emissions. On an emissions rate basis that would correspond to approximately 0.2 to 0.5 g/bhp-hr. This represents the capabilities of today's SCR systems. The emission rates in the latest draft of the model rule can be easily achieved by retrofitting engines with combustion controls and are not representative of Best Available Control Technology (BACT) such as SCR.

In their comments, the natural gas industry has argued that SCR technology is not suitable for the types of cyclic load operations experienced by gas- compressor engines. While this may have been true 10-20 years ago, cyclic load profiles for engine are now readily accommodated with the latest engine load profiles and urea injection control technology. There are few engine load profiles more cyclic in nature than in mobile, on-highway trucks and vehicles. As of 2005 in Europe and 2010 in the U.S., all on-highway lean-burn engines are equipped with SCR technology to achieve at least 0.2 g/bhp-hr NOx emissions from the tailpipe. The same control and injection strategies used on these mobile applications can be readily applied to handle the somewhat less cyclic nature of gas engines operating in gas compression applications.

Urea injection is typically controlled in two ways: Open-Loop Control whereby the urea injection system is mapped to the load signal of the engine, thus as the engine load changes, urea injection is modified to fit the load profile. This strategy has been used for many years, and has demonstrated reliable results of up to 90% NOx reduction, even in cyclic load profiles such as those observed in peak-shaving operations in diesel or natural gas-fueled reciprocating engines driving an electrical generator. When more NOx reduction is required, manufacturers rely on Closed-Loop Control, where a NOx sensor is installed at the exit point of the SCR System to continuously monitor NOx levels. The signal is then sent to the urea injection controller, which refines the amount of urea injected to achieve very high levels of NOx reduction (as high as 98%) with very low ammonia slip levels (below 10ppm is common). Alternatively to NOx sensors, some manufacturers add a rapid-response NOx analyzer system in line with the post-SCR exhaust stream to directly measure post-SCR NOx concentrations.

Although the above control methods are effective at minimizing ammonia slip through the SCR catalyst, to protect against periodic higher levels under highly transient operation, every on-road SCR system is equipped with an ammonia slip catalyst. These catalysts are formulated to have a high selectivity for converting ammonia to nitrogen rather than NO, NO_2 or N_2O. Mobile SCR systems deliver less than 10 ppm ammonia slip even under highly transient operation. One MECA member has successfully incorporated urea-SCR emission control technologies into a four stroke lean burn natural gas drilling rig engine in the remote gas fields of Wyoming. The drilling operation exhibited highly transient operation ranging between 20 to 80% of full load. By implementing state of the art catalysts and urea injection controls, the units exceeded their design goals of 90% NOx reduction and less than 10 ppm ammonia slip. The real world performance of the SCR system was 91-99% NOx reduction and 2-3 ppm ammonia slip.

Four-Stroke Rich-Burn engines

MECA supports the 90% NOx reduction limits being proposed for this category of gas compressor engines. For this application class of four-stroke, rich-burn engines, the NOx emission limits, being proposed, can be easily achieved by applying, closed loop, non-selective catalytic reduction (NSCR) technologies. The use of NSCR technology is a very cost-effective way to reduce NOx emissions from existing stationary rich-burn engines. The emission rates proposed in the draft model rule do not represent the capabilities of today’s NSCR catalysts combined with air fuel ratio controls (AFCR). For rich burn engines, we believe that a NOx standard of 2.0 g/hp-hr can be achieved relatively easily using standard NSCR technology (catalyst +AFRC) on a retrofit basis using a "site specific source testing" approach. By "site specific source testing" we mean the NSCR is specifically calibrated in the field on an individual engine basis and source tested on a quarterly or yearly basis at full load or normal load conditions. This site specific approach is commonly followed in many jurisdictions in the US and Europe with successful results. Today’s commercial NSCR technology can easily achieve 0.5 g/bhp-hr and even 0.2 g/bhp-hr. One company has demonstrated a state of the art control system combined with an NSCR catalyst installed on a rich-burn stationary natural gas engine that achieved 23.2 ppm NOx, 0.3 ppm CO and 1 ppm VOC which represent a 99% reduction from the engine out levels for all three pollutants.

Our members have installed tens of thousands of these catalysts on rich-burn stationary natural gas fueled, reciprocating engines and have repeatedly demonstrated 99% NOx reduction relative to the untreated exhaust. These types of engines are used in power production, pumping or gas compression applications. NSCR for stationary engines is a proven technology based on automotive three-way catalyst that has been installed on over 300,000,000 automobiles with outstanding results. In addition, several MECA member companies have verified retrofit NSCR systems with ARB for use on large, spark-ignited off-road engines (engines 25 hp or greater) to reduce NOx, HCs, and CO. These verified systems can be used on existing stationary rich-burn engines as well. (A complete list of ARB-verified retrofit technologies for large, spark-ignited off-road engines is available at: www.arb.ca.gov/msprog/offroad/orspark/verdev.htm.).

For rich-burn engines, some operators may inadvertently meet the NOx emission standard by using a catalyst and tuning the engine overly rich. Such a condition increases greenhouse gases and other pollutants such as CO and NH_3. To ensure the engine air/fuel ratio is properly controlled and to minimize secondary emissions, we recommend the NOx emission standard be accompanied with a relatively stringent CO and VOC standard or an NSCR best practices standard such as source testing, reporting and regular engine maintenance.

Gas Turbine Engines

Some of our members supply SCR systems for installation on large gas turbine prime mover and power generating engines. These SCR exhaust systems installed at several large gas turbine facilities in the San Joaquin Valley and elsewhere in California are exceeding their target emission reductions of >90% and achieving 2 to 5 ppm NOx emissions with only 5 ppm ammonia slip.

Further General Comments and Suggestions

Because some categories of engines covered by the rule are more amenable to the use of exhaust controls, we believe that aggregating engines to meet an average area NOx limit is an effective way to provide flexibilities to end-users while achieving the emission reduction goals of the OTC. There is a large build up of natural gas pipeline infrastructure within the Marcellus shale formation with the potential of thousands of new engines being installed to move natural gas within and from the region. These new engines, although significantly cleaner than pre 2007 engines, would remain in the region for decades without the benefit of best available control technology. These newer engines are very compatible with retrofit SCR technology to achieve 90% or better NOx reduction. Some of our members are successfully installing SCR technology on four-stroke lean-burn engines certified to 0.5-1.5 g/bhp-hr to achieve an additional 90% reduction in tailpipe NOx emissions from this engine out level. We believe that emission averaging could be used to achieve the desired reduction in emissions from the overall engine population as long as emission limits and area designations are properly defined. Site limits between 25 to 50 tons per year of NOx would allow engine operators to target their emission reductions in the most cost effective and technologically feasible way while achieving the overall goal of reducing NOx emissions from natural gas operations in the OTR.

Existing Similar Regulations

A good example of what NOx limits are achievable from in-use, spark-ignited engines, including natural gas compressor engines, has been recently adopted by the Governing Board of the San Joaquin Valley Unified Air Pollution Control District (SJVAPCD) in California under Rule 4702 and The South Coast Air Quality Management District's Rule 1110.2. For some categories and applications of natural gas fueled lean and rich-burn engines both agencies have set NOx limits as low as 11 ppmvd corrected to 15% oxygen which represent over 90% NOx reduction from engine out levels. This level of NOx emissions is achievable through the use of commercially available SCR and NSCR exhaust control technologies. These rules also show how corresponding emission rate limits on CO and VOCs can be effectively used in conjunction to NOx emission limits to protect against inadvertent secondary emissions as a result of poor engine controls or absence of inexpensive oxidation catalysts. Oxidation catalysts are extremely effective in achieving greater than 90% reduction of hazardous air pollutants such as THC and CO from lean burn engines.

Conclusions

In closing, MECA recognizes the important step being taken by the OTC in addressing NOx emissions from stationary natural gas compressor engines in the OTR. As we point out in our comments, we believe that significant NOx reductions are left uncontrolled by the limited scope and high emission limits being proposed in this draft rule. Exhaust control technology such as SCR has been demonstrated and applied to new and existing lean-burn stationary engines by our members for many years. MECA and our member companies look forward to working with the OTC, the engine and equipment manufacturers, end-users, and others in ultimately achieving the goals of the final proposed model rule.

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