STATEMENT
OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON THE AIR RESOURCES BOARD'S
PROPOSED OFF-ROAD EMISSION REGULATION FOR
COMPRESSION-IGNITION ENGINES AND EQUIPMENT

December 9, 2004

MECA is pleased to provide testimony in support of ARB's proposed nonroad diesel engine standards that harmonize ARB's emission standards for these nonroad diesel engines with the U.S. EPA's Tier 4 nonroad diesel emission limits. MECA believes an important opportunity exists to significantly reduce emissions from nonroad diesel engines by utilizing an engineered systems approach that incorporates and combines advanced engine designs, advanced emission control technology, and very low sulfur diesel fuel. If the ARB program is finalized, it will result in substantial, cost-effective emission reductions over the next several decades for the people of California and provide an important backstop to the federal nonroad diesel program.

MECA is a non-profit association made up of the world's leading manufacturers of mobile source emission controls. MECA member companies have over 30 years of experience and a proven track record in developing and commercializing exhaust emission control technologies. A number of our members have extensive experience in the development, manufacture, and commercial application of emission control technologies for diesel engines, including engines used in nonroad applications. These companies are committed to make the necessary investments to ensure that the diesel emission control technology is available to comply with ARB's proposed nonroad diesel emissions program. A recent survey of MECA's members revealed that our industry is investing over $1.5 billion in R & D and capital expenditures to develop, optimize, and commercialize advanced emission control technology to substantially reduce emissions from on-road and nonroad diesel engines.

TECHNOLOGICAL FEASIBILITY OF THE PROPOSED DIESEL NONROAD STANDARDS

Overview

MECA believes the proposed exhaust and crankcase emission standards for nonroad diesel engines can be achieved in a cost-effective manner within the lead-time provided. ARB has already required the use of ultra-low sulfur diesel fuel for these nonroad engines, ensuring that an important component of the required systems approach will be available when these proposed regulations would be implemented.

Technologies to reduce diesel PM, such as diesel particulate filters and diesel oxidation catalysts, are commercially available today. In fact, the use of exhaust emission control technology for nonroad diesel engines is not new. For over thirty-five years, nonroad diesel engines used in the construction, mining, and materials handling industries have been equipped with exhaust emission control technology – initially with diesel oxidation catalysts (DOCs) and followed later by diesel particulate filters (DPFs). These systems have been installed on vehicles and equipment both as original equipment and as retrofit technology on over 250,000 nonroad engines worldwide.

Technologies such as DPFs and NOx adsorbers, as well as the integration strategies being developed to meet the 2007 and 2010 heavy-duty on-road diesel engine standards, generally can be applied to nonroad diesel engines and vehicles. Also, SCR, which has been widely used on stationary engines and in some mobile source applications on a limited basis, is another possible NOx control option. Exhaust gas recirculation (EGR) technology, which is being used on highway HDEs and is being evaluated on nonroad engines as a retrofit option, will also be an available option to help meet the proposed standards. Finally, lean-NOx catalyst technology, which is an available retrofit technology for on-road HDEs, is a strategy that could be used to help meet the proposed less stringent NOx standards proposed for several of the smaller engine categories of nonroad diesel engines. A comprehensive list of references discussing the considerable progress in developing, optimizing, and applying advanced emission control technologies and strategies for reducing emissions from diesel engines can be found in *Diesel Emission Control: 2001 in Review*, SAE Paper No. 2002-01-0285 (2002 SAE Congress, Detroit), *Diesel Emission Control: 2002 in Review*, SAE Paper No. 2003-01-0039 (2003 SAE Congress, Detroit), and Diesel Emission Control: 2003 Technology Review, SAE Paper No. 2004-01-0070 (2004 SAE Congress, Detroit).

PM, Toxic HC, NOx Emission Control Technology Capability and Experience

MECA concurs with EPA's and ARB's conclusion that, while important differences exist, nonroad diesel engines operate fundamentally like on-road diesel HDEs. With the availability of 15 ppm sulfur fuel and adequate leadtime, MECA believes that nonroad diesel engines can be successfully designed to utilize the advanced emission control technology that will be employed to meet the on-road HDE standards, which take effect beginning in 2007 and will be fully implemented by 2010.

MECA supports ARB's conclusion that filter technology with PM control efficiencies of up to 90 percent or more can be cost-effectively employed on nonroad diesel engines from 25 hp to >750 hp and that advanced, high efficiency NOx control technologies, such as NOx adsorbers or SCR, will be available for nonroad engines ranging from 75 hp to >750 hp. For nonroad diesel engines <25 hp, MECA believes that DOC technology is readily available to significantly reduce PM, CO, and HC emissions, including those HC species identified as air toxics.

Looking to the future we also believe that other cost-effective NOx and PM control strategies are beginning to emerge for these smaller engines, including such technologies as lean NOx catalysts (capable of reducing NOx by up to 25 percent or more) and lower efficiency DPFs (capable of reducing PM by 50-70 percent) and low-pressure EGR combined with DPFs. MECA has recommended to EPA that as part of EPA's proposed 2007 technical review of emissions standards for nonroad diesel engines <75 hp, EPA assess the availability of cost-effective PM and NOx controls and tighten the requirements if appropriate. We would recommend that ARB also consider further tightening on these smaller engines as appropriate cost effective technologies are demonstrated and become available.

Diesel Particulate Filters (DPFs) – As noted above, DPFs are commercially available today. Over 100,000 on-road heavy-duty vehicles and nearly 1,000,000 diesel passenger cars in

Europe have been equipped with this technology. For nonroad engines, DPFs have been successfully installed and used on mining, construction, and materials handling equipment. In these nonroad engine applications, DPF systems have been successfully designed to function effectively over the specific duty cycle of the engine and withstand harsh environments that some nonroad diesel engines operate in. DPF technology is projected to be utilized on highway heavy-duty diesel engines sold in the U.S. beginning with the 2007 model year. Indeed, DPFs are currently available on selected on-road diesel vehicles in the U.S. and Europe. This technology has demonstrated impressive durability characteristics in commercial operation in the U.S. and Europe and will be used across the board on diesel vehicles and engines in Japan beginning in 2005. Also, a growing number of different filter system designs and strategies – both passive and active – are emerging.

Where diesel fuel with <15 ppm sulfur is used, precious metal catalyst-based diesel particulate filters (CB-DPFs) have consistently demonstrated the capability to reduce PM emissions on a mass basis by up to 90 percent or more. In addition, this technology has proven effective in reducing the carbon-based PM by up to 99.9+ percent, while significantly reducing particle numbers over the full range of particle size, including ultra-fine particles. Finally, CB-DPF technology, has demonstrated the capability to reduce a wide range of toxic hydrocarbon species and PAHs by up to 80 percent or more.

Also, particulate filter systems are emerging that are specially designed to provide exhaust flow turbulence and increased particulate residence time, and have achieved PM reductions in the 40 to 70 percent range. One design has recently been verified as a Level 2 diesel emission control strategy by ARB for specific diesel retrofit applications. Another design will be used by a heavy-duty diesel engine manufacturer in Europe in conjunction with EGR to meet Euro 4 heavy-duty PM requirements.

NOx Adsorber Technology – NOx adsorber catalysts are one strategy that may be utilized to meet the 2007/2010 on-road HDE standards, and this strategy will also be an available NOx control strategy to help meet the NOx standards applicable to nonroad engines >75 hp. NOx adsorber catalysts are currently being used commercially in light-duty gasoline direct injection (GDI) engines. This technology continues to undergo extensive research and development in anticipation of the U.S. 2007/2010 on-road heavy-duty diesel engine regulations to help significantly reduce NOx emissions. The progress in developing and optimizing this technology has been extremely impressive. Indeed, EPA's Clean Diesel Independent Review Panel as well as two progess reports authored by EPA concerning the 2007-2010 highway emissions program, have concluded that NOx adsorber technology development was on track to help meet the on-road HDE standards and no technological roadblocks were identified.

The current focus of NOx adsorber technology development and optimization is on: 1) expanding the operating temperature window in which the technology will perform, 2) improving the thermal durability of the technology, 3) improving the desulfurization methods and performance, and 4) improving system packaging and integration. The progress being made in these areas continues to be impressive. In light-duty applications, several automobile manufacturers are conducting field tests with NOx adsorber/DPF systems and one manufacturer has begun to sell vehicles equipped with such a system in Japan and in Europe during 2004. While NOx adsorber catalysts are not currently available for nonroad diesel engines, we believe

NOx adsorbers and the associated engine technologies will be available for use on nonroad diesel engines within the leadtime provided in the proposal. The incorporation of on-highway type fueling systems will allow for the use of NOx adsorber technology on smaller diesel engines as well.

Selective Catalytic Reduction (SCR) Technology – SCR technology is another NOx control strategy that could be utilized to help meet the proposed nonroad diesel emission standards. SCR has been used to control NOx emissions from stationary sources for over 15 years. More recently, it has been applied to select mobile sources including trucks, marine vessels, and locomotives. In 2005, SCR is expected to be introduced on on-road diesel HDE engines to help meet both the Euro 4 emission standards and Japan's 2005 heavy-duty emission standards. Applying SCR to diesel-powered engines provides simultaneous reductions of NOx, PM, and HC emissions. Beginning in the mid-1990s, SCR technology has been installed a variety of marine applications in Europe including ferries, cargo vessels, and tugboats. The capacity of the engines equipped with SCR ranged from 450 to over 10,000 kW.

Crankcase Emission Controls – EPA's Tier 4 nonroad emissions program includes the control of crankcase emissions from turbocharged nonroad diesel engines. Currently on diesel engines, a rudimentary filter may be installed on the crankcase breather (the vent for the oil reservoir), but a substantial amount of particulate matter is released to the atmosphere. For diesel engines used in motor vehicle applications, emissions through the breather may exceed 0.7 g/bhp-hr during idle conditions on recent model year engines.

One solution to this emissions problem is the use of a multi-stage filter designed to collect, coalesce, and return the emitted lube oil to the engine's sump. Filtered gases are returned to the intake system, balancing the differential pressures involved. Typical systems consist of a filter housing, a pressure regulator, a pressure relief valve and an oil check valve. These systems have the capability to virtually eliminate crankcase emissions. This technology is currently being used in Europe and will be used on highway diesel heavy-duty engines in the U.S. beginning in 2007.

Emission Control Technology Can and Has Been Applied to Nonroad Engines

Proper integration of emission control technology on nonroad vehicles and equipment is important for three reasons: 1) to ensure the system is installed at the appropriate place in the exhaust system to enable the control device to function at optimum effectiveness, 2) to ensure the system physically fits in the available space, and 3) to ensure safety. Over 25 years of experience in integrating emission control technologies on a variety of diesel and SI nonroad vehicles and equipment ranging from <25 hp to over 750 hp provides a clear indication that emission control technology can be successfully integrated on a wide range of nonroad vehicles to meet EPA's proposed standards. This experience has also demonstrated that, by taking a systems approach, exhaust technology can be applied to achieve required emission reductions without compromising engine performance, engine durability, or safety. For example, both DOCs and DPFs have been successfully integrated on nonroad diesel engines ranging from >75 hp (e.g., materials handling equipment) to over 750 hp (e.g., mining equipment, locomotives and stationary engines).

Two examples of integrating emission control technologies on very small engines (25 hp or less) include: 1) the successful design and installation of over 15 million catalysts worldwide on small motorcycles and mopeds, and 2) the installation of over one million catalyst devices on a variety of lawn and garden equipment including chainsaws, trimmers, and lawn mowers in the U.S. and Europe. The same type of innovations in design and packaging can be applied to even the smallest-sized nonroad diesel engines.

Experience with over 250,000 nonroad diesel engines and millions of small SI engines has also shown that emission control systems can be successfully integrated to ensure the safety of the vehicle operator and others. In addition, exhaust emission control technology can be and has been designed for and integrated on to vehicles to address special operating concerns and environments. For example, where equipment is used in explosive operating environments, such as underground coal mines, emission control technology has been designed to meet special surface temperature requirements. Finally, exhaust emission control technologies can be and have been installed on vehicles so as not to impair operator visibility.

Some varieties of nonroad equipment operate in rigorous environments and/or experience significant engine vibration. Therefore, an important aspect of vehicle integration is to ensure that emission control technology can withstand the vibration and or extreme operating conditions associated with the operation of certain nonroad vehicles. Emission control technology can be designed, installed, and operated to provide effective, reliable, and durable performance under these extreme conditions. This fact is demonstrated by the systems that have been used in underground mining applications for years – DOCs having been in service for the life of the vehicle and DPFs having been installed on equipment that has operated for over 15,000 hours in rugged work environments and still provided effective emission reduction performance. Finally, the fact that exhaust emission control technologies have been used for many years in nonroad applications and proven to be durable attests to the fact the technologies can withstand the dust and moisture associated with many of the nonroad environments where the technologies have been used.

CONCLUSION

While we recognize that the proposed nonroad diesel engine standards present engineering challenges, we also believe those challenges can and will be met. The key will be to employ the systems approach identified in EPA's proposal consisting of advanced engine designs, advanced emission control technology, and low sulfur diesel fuel. We look forward to working with EPA, the engine and equipment manufacturers, the end users, and others. Our industry is committed to do its part to ensure that, if the proposed nonroad diesel standards and diesel sulfur limits are adopted, the desired emission reductions will be achieved at a reasonable cost and with very good performance and fuel economy.