STATEMENT
OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON THE
U.S. ENVIRONMENTAL PROTECTION AGENCY'S
CONTROL OF EMISSIONS OF AIR POLLUTION FROM NEW LOCOMOTIVE ENGINES AND NEW MARINE COMPRESSION-IGNITION ENGINES LESS THAN 30 LITERS PER CYLINDER NOTICE OF PROPOSED RULEMAKING

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Good morning. My name is Dr. Joseph Kubsh. I am the Executive Director of the Manufacturers of Emission Controls Association (MECA). MECA is pleased to present testimony in support of EPA's proposals covering future emission standards for locomotive and marine diesel engines. We believe an important opportunity exists to significantly reduce emissions from new locomotive engines and new marine compression-ignition engines less than 30 liters per cylinder by utilizing an engineered systems approach that incorporates and combines advanced engine designs, advanced emission control technology, and ultra-low sulfur diesel fuel.

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 diesel engines used in nonroad applications. Our members are partnering with vehicle and engine manufacturers to make "clean diesel" cars and trucks a reality here in North America. A recent survey of MECA's members revealed that our industry has invested more than $2 billion in R & D and capital expenditures to develop, optimize, and commercialize advanced emission control technology to substantially reduce emissions from on-road and off-road diesel engines.

Technologies to reduce diesel emissions, such as diesel particulate filters (DPFs), diesel oxidation catalysts (DOCs), and selective catalytic reduction (SCR) systems, are commercially available today. These emission control technologies have already been installed on millions of new light-duty and heavy-duty vehicles and equipment and as retrofit technology on hundreds of thousands of existing on-road and off-road diesel engines worldwide to provide significant reductions in diesel particulate matter (PM) and NOx emissions, as well as reductions in hydrocarbon (including toxic hydrocarbons like poly-aromatic hydrocarbons) and CO emissions from diesel engines. There is already growing experience with these "clean diesel" emission control technologies on marine and locomotive diesel engines. These marine and locomotive diesel engine applications pose unique operating environments and challenging packaging envelopes for emission control technologies but over the past 30 years our industry has accepted and met every challenge in the design and optimization of emission control systems used on mobile source engines that range from small handheld equipment to large off-road equipment.

MECA strongly believes that many of the emission control technologies and strategies that are either already in commercial use or nearing commercial practice for light-duty diesel vehicles meeting EPA's Tier 2 standards, commercialized or under development to meet EPA's 2007-2010 heavy-duty highway diesel engine standards, and under development to meet EPA's Tier 4 nonroad diesel engine standards will be applicable to locomotive and marine diesel engines in the 2015 timeframe to meet their proposed Tier 4 locomotive and marine diesel emission standards.

I would like to provide some more specific comments to the experience base with diesel particulate filters and SCR catalysts since these emission control technologies were cited by EPA in their technology feasibility analysis for their potential in achieving the proposed Tier 4 locomotive and marine diesel standards.

Diesel Particulate Filters (DPFs) – Diesel particulate filters are commercially available today, with over 200,000 on-road heavy-duty vehicles worldwide retrofitted with high efficiency DPFs and over four million new diesel passenger cars in Europe equipped with this technology since 2000. Starting this year here in the U.S., all new heavy-duty diesel highway engines are equipped with diesel particulate filters to achieve EPA's 2007 0.01 g/bhp-hr PM highway diesel standard. New "clean diesel" light-duty vehicles that are entering the U.S. market will also be equipped with DPFs to achieve compliance with EPA's light-duty Tier 2 PM emission regulations. These successful on-road DPF applications are generally employing durable ceramic wall-flow filters to achieve in excess of 90% reduction in engine-out PM levels over years of operation. Light-duty and heavy-duty new vehicle applications of DPFs rely on combinations of both passive and active regeneration strategies for periodic combustion of soot that accumulates on the filter. In many cases catalysts displayed directly on the filter substrate and/or located upstream of the filter element have been used to facilitate soot oxidation under normal exhaust temperatures. Similar to the highway and off-road diesel application areas, EPA has already put regulations in place requiring the use of ultra-low sulfur diesel fuel in locomotive and marine diesel engines (starting in 2012), an important enabler for the use of catalyst-based PM control technologies.

In the nonroad diesel engine application area, DPFs have been successfully installed and used on thousands of mining, construction, and materials handling equipment where vehicle integration has been challenging. Particulate filters, many employing active regeneration strategies such as fuel burners or electrical resistance heaters, have also been used on over 200 locomotives in Europe since the mid-1990s providing in excess of an 85 percent reduction in particulate matter emissions. Some of these systems have been operating effectively for over 650,000 kilometers. A limited number of these active DPF systems have also been safely equipped on marine vessels in Europe to control PM.

Several demonstration projects have been, or are being conducted in the U.S. to evaluate the feasibility of equipping locomotive and marine engines with DPFs. In 2006, a U.S. Navy work boat/barge was retrofitted with an active DPF system. Emissions testing results show that the DPF, along with engine modifications, achieved an 85 percent reduction in PM and a 74 percent reduction in NOx emissions relative to the original engine configuration. Active DPF systems, similar to those equipped on European locomotives, have been retrofit on two 1500 hp switcher locomotives. These two switchers are now operating in rail yards in southern California as part of an industry demonstration program. In another California demonstration project, DPFs will be demonstrated on two commuter rail locomotives operating between

Oakland and Sacramento.

More recently metal substrate filter designs have been developed and introduced for PM control of diesel engines. These designs combine more tortuous flow paths with sintered metal filter elements to achieve intermediate PM filtering efficiencies that can range from 30 to 70% depending on engine operating conditions and the soluble content of the diesel particulate matter emitted by the engine. Like ceramic wall-flow filters, these metal filter designs can be catalyzed directly or used with an upstream catalyst to facilitate regeneration of soot captured by the substrate. These metal substrate filter designs have been verified by the California Air Resources Board as a Level 2 retrofit device (50-85% PM reduction) on a range of highway diesel engines, used by one engine manufacturer in Europe for complying with Euro 4 heavy-duty diesel PM limits, and are available in Europe as a retrofit PM technology for light-duty diesel vehicles. Due to their more open designs, these metal substrate filter designs can operate over very long timeframes without the need for cleaning the substrate of trapped lubricant oil ash.

Selective Catalytic Reduction (SCR) Technology – SCR technology is a proven NOx control strategy. SCR has been used to control NOx emissions from stationary sources for over 20 years. More recently, SCR system has been applied to mobile sources including trucks, off-road equipment, and marine vessels. Applying SCR to diesel-powered engines provides simultaneous reductions of NOx, PM, and HC emissions. Open loop SCR systems can reduce NOx emissions from 75 to 90 percent. Closed loop systems on stationary engines have achieved NOx reductions of greater than 95 percent. Modern SCR system designs have been detailed for mobile source applications that combine highly controlled reductant injection hardware, flow mixing devices for effective distribution of the reductant across the available catalyst cross-section, durable SCR catalyst formulations, and ammonia slip clean-up catalysts that are capable of achieving and maintaining high NOx conversion efficiencies with extremely low levels of exhaust outlet ammonia concentrations over thousands of hours of operation.

The majority of heavy-duty engine manufacturers are offering urea-SCR systems in highway truck applications to comply with Euro IV and V emission regulations with more than 100 thousand of these SCR-equipped trucks already in service. Engine manufacturers here in North America are also seriously considering combined DPF+SCR system designs for complying with EPA’s 2010 heavy-duty highway emission standards. A number of combined DPF+SCR system demonstration projections have been completed or are still underway on highway trucks both here in the U.S. and Europe. DOC+SCR systems are also being used commercially in Japan for new diesel trucks by several engine manufacturers to comply with Japan’s 2005 standards for new diesel trucks. Several technology providers are developing and demonstrating retrofit SCR systems for both on-road trucks and off-road equipment.

Since the mid-1990s, SCR technology using a urea-based reductant has been safely installed on a variety of marine applications in Europe, including auto ferries, cargo vessels, military ships, and tugboats with over 200 systems installed on engines ranging from approximately 450 to over 10,000 kW. The Port Authority of New York and New Jersey has recently conducted an innovative pilot project to demonstrate diesel emissions reduction technologies on a Staten Island ferry. The ferry was retrofitted with DOC+SCR systems on its two main, four-stroke propulsion engines. Emissions testing observed on the ferry showed NOx reductions that typically exceeded 94% during ferry cruise modes. This ferry project along with other operational, marine SCR installations provides firm evidence that SCR systems can be engineered to meet rigorous marine industry safety standards. Some of these marine SCR systems have been operating since the 1990s with no reported safety-related issues.

As discussed in the EPA technical feasibility document, SCR catalysts formulations based on vanadia-titania and base metal-containing zeolites have been commercialized for both stationary and mobile source applications. The maximum NOx conversion window for SCR catalysts is a function of composition. Base metal zeolite SCR catalysts, in particular, have been selected, and are continuing their development, for applications that require NOx performance and durability under higher exhaust operating temperatures that may be encountered in some mobile source applications. Recent results published by Ford Motor Co. engineers at the 2007 Society of Automotive Engineers International Congress held in Detroit last month detail performance characteristics of base metal zeolite SCR catalysts under consideration for mobile source applications on cars and trucks. The zeolite SCR catalysts in this study maintained peak NOx conversion efficiencies of more than 90% over a broad inlet exhaust gas temperature window after hydrothermal aging in a simulated diesel exhaust for 64 hours at 670^{o}C. For low temperature NOx conversion efficiency, emission control system design engineers have a number of options available including the composition of the SCR catalyst itself, control of the ratio of NO_2 to NO present at the inlet of the catalyst, and improving the urea decomposition process at low exhaust temperatures.

CONCLUSION

While we recognize that the proposed new Tier 4 locomotive and marine 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 the further evolution of locomotive and marine diesel engine designs, the use of advanced emission control technology, such as diesel particulate filters and SCR catalyst systems, the use of ultra-low sulfur diesel fuel, and the use of low ash and sulfur-containing lubricants. MECA has reviewed EPA's Tier 4 technical feasibility discussion presented in their NPRM and agrees with EPA's technical assessments. MECA and its member companies firmly believe that high efficiency and durable diesel particulate filter and SCR catalysts meeting the EPA staff technical assumptions for their proposed Tier 4 standards on locomotive and marine diesel engines will be available in the 2015 timeframe. MECA member companies stand ready to work with locomotive and marine engine manufacturers on understanding current diesel PM and NOx catalyst performance and durability levels, and to begin the development process for future locomotive and marine diesel exhaust emission control systems.

Our industry is convinced that advanced exhaust emission controls that have already begun to usher in the new generation of clean diesel engines used in cars and trucks in the U.S., Europe, and Japan, will also allow for significant reductions in both NOx and diesel particulate emissions from locomotive and marine diesel engines in the next decade.

Thank you