**WRITTEN COMMENTS OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON BUREAU OF OCEAN ENERGY MANAGEMENT PROPOSED RULE ON AIR
QUALITY CONTROL, REPORTING, AND COMPLIANCE**

June 20, 2016

The Manufacturers of Emission Controls Association (MECA) is pleased to respond to the Bureau of Ocean Energy Management's (BOEM) request for public comments on its proposed rule titled "Air Quality Control, Reporting, and Compliance."

MECA is a non-profit association of the world's leading manufacturers of emission control technology for mobile sources such as automobiles, trucks, buses, off-road equipment, as well as stationary internal combustion engines. Our members have over 40 years of experience and a proven track record in developing and manufacturing emission control technology for a wide variety of on-road and off-road vehicles and equipment, including extensive experience in developing emission controls for gasoline and diesel engines and vehicles in all world markets. Our industry has played an important role in the emission reduction success story associated with reciprocating internal combustion sources in the United States, and has continually supported efforts to develop innovative, technology-forcing, emissions programs to deal with air quality problems.

MECA commends BOEM on its efforts in developing a regulation to protect air quality during oil, gas, and sulfur operations on the Outer Continental Shelf, including the area offshore the North Slope Borough of the State of Alaska. MECA agrees with the many research studies that have concluded that black carbon (BC) has negative impacts on human health and contributes to climate change. These studies conclude that cutting emissions of short-lived climate pollutants like BC provides a significant pathway for slowing the impacts of climate change. In addition, reducing black carbon emissions from both mobile and stationary sources results in important health-related co-benefits of reduced exposure to particulate matter (PM) emissions. The emission control technologies that reduce PM and BC emissions are commercially available and proven technologies that are currently utilized as retrofits on existing engines and by engine manufacturers to meet federal and state standards for new engines. The US Environmental Protection Agency (EPA) has a long history of setting stringent PM mass emission standards for new vehicles and engines, including stationary engines. In addition, California's Air Resources Board (ARB) sets standards for new vehicles and engines but also has implemented emission reduction requirements for existing mobile and stationary diesel engines. These federal and state regulations will continue to result in reductions in PM and BC emissions from mobile and stationary light-duty and heavy-duty engines. However, more can be done to reduce BC emissions from the oil and gas sector, especially from existing high PM-emitting engines, and MECA's comments will focus on these additional opportunities.

BC particles are often composed of long chains of nanoparticles that grow to 0.1 to 1 micrometer in diameter. BC particles of this size can remain in the atmosphere for days to weeks and absorb solar radiation very efficiently, which contributes to atmospheric warming. When these particles are removed from the atmosphere through precipitation and settling, they can deposit on ice and snow in the Arctic. A National Academy of Sciences paper (http://www.pnas.org/content/106/52/22114.full) found that minimal BC concentrations on snow (10 nanograms BC per gram of snow) can significantly alter the reflectivity of that snow, which results in 10-100% increase in visible light absorption. Furthermore, as the snow and ice melt, the BC particles tend to be retained, causing an increase in the surface concentration of BC, which results in even more light absorption and ensuing melting. To provide context, a typical stand-by generator engine of about 1000 horsepower certified to 0.15 g/bhp-hr operating for 100 hours per year will emit 15,000 grams of soot annually. This amount of soot has the potential to significantly increase the light absorption of roughly 60 million cubic feet of glacial ice and snow (Note: assuming a glacial ice density of 900 kg/m^3).

BC emissions from diesel engines that power vehicles and equipment can be significantly reduced through emission control technology that is already commercially available. High efficiency diesel particulate filters (DPFs) installed on new and existing diesel engines provide nearly 99.9% reductions of BC emissions. As has been shown in the heavy-duty highway sector, DPFs are extremely efficient at reducing particulate emissions over a wide range of particle sizes, including reducing emissions of the smallest, ultrafine particles emitted by a diesel engine. In the highway, heavy-duty sector, DPF-equipped engines are routinely being certified at PM emissions levels that are 90% or more below the 0.01 g/bhp-hr 2010 EPA PM heavy-duty highway diesel engine standard. The “bonus” PM reductions provided by DPFs in the highway sector result in significantly more public health benefits than estimated by EPA in their final 2007-2010 heavy-duty highway regulation. In addition to “bonus” public health benefits afforded by DPFs, DPFs have also provided important co-benefits on climate change due to the large reductions in BC emissions that result from the use of high efficiency DPFs. Both EPA and ARB have released information that highlights the significant impact of reducing black carbon emissions from diesel engines on climate change.

Since DPFs accumulate soot over time, they must be cleaned out, or “regenerated,” intermittently. There are a variety of regeneration strategies available in order to match the operating characteristics of the engine. Many engines can utilize a DPF with a passive regeneration strategy, which uses the heat of the engine to clean out the soot, while DPFs on some engines must be actively regenerated through the addition of energy such as heat. Due to the variety of DPFs and DPF regeneration strategies, DPFs can be installed on nearly all diesel engines.

In 2011, California set in-use standards for stationary and portable engines in order to reduce PM emissions. Fleet owners can comply with these standards by retrofitting their stationary diesel engines with DPFs. Several MECA member companies have experience with the application of DPFs to existing stationary diesel engines, such as those used in oil and gas operations. For example, DPFs have been successfully applied to stationary engines as small as 20 kW to very large installations on emergency back-up or prime power generators rated at several megawatts of power. This experience base includes both passively regenerated DPF systems and actively regenerated DPF systems, as well as fuel-borne catalyst regenerated DPF systems. A variety of retrofit DPF systems are currently verified by both EPA and ARB, and these could be installed on engines used for oil and gas operations.

The most comprehensive information on the application of PM exhaust emission control technology to in-use stationary diesel engines can be found in ARB's September 2003 Staff Report in support of its airborne toxic control measure for stationary compression-ignition engines. In the report, ARB provides a thorough list of in-use emergency standby engines and prime stationary engines using emission control systems (mostly DPFs) in California. The retrofit devices were installed on stationary engines ranging from model years 1993 to 2002. The list shows numerous DPF installations on large engines rated above 600 kW, including Caterpillar 3516 engines rated in the 1490-2120 kW range. Operating experience with these large engine DPF systems has been excellent, with DPFs providing 85 percent or more reductions in particulate matter compared to uncontrolled levels.

A survey of MECA members estimates that there are over 800 stationary diesel engines in the U.S. that currently use DPFs. The vast majority (90%) of these engines are in-use emergency standby engines, with the rest being prime stationary genset engines. Some states with ozone nonattainment areas require DPF's to be installed on engines as a result of New Source Review (NSR) or Best Available Control Technology (BACT)/Lowest Achievable Emission Rate (LAER) analysis. In those cases, DPFs along with SCR have been required on emergency diesel engines. Furthermore, many states require emergency diesel engines, that are also used in demand response programs for power peak shaving, to install DPF as well as SCR control devices.

There are at least five MECA member companies that have experience with the installation of DPF retrofits on emergency standby diesel engines. One MECA member company has had extensive experience with the retrofit of stationary diesel engines in Taiwan. Power outages are frequent in Taiwan, so standby generators used for emergency back-up power are an important part of the country's infrastructure. DPFs have been successfully installed on these generators. For example, Taiwan Semiconductor Manufacturing installed DPFs on 14 emergency standby generators (2 MW engines) in 2001, which has resulted in a greater than 90 percent reduction in PM.

Highlighted below are specific examples of emission control systems installed on existing stationary diesel engines by MECA member companies:

- In July 2005, the California Energy Commission published a report, *Air Quality Implications of Backup Generators In California*, detailing the emission performance of back-up diesel generators with a variety of power ratings equipped with exhaust emission controls, including DOCs, passive DPFs, and active DPFs (a copy of this report is available at: www.energy.ca.gov/2005publications/CEC-500-2005-049/CEC-500-2005-049.PDF). The DPFs evaluated in this program were found to be effective in reducing PM emissions by more than 85 percent compared to uncontrolled baseline levels. The results of the demonstration program showed successful application of DPFs, DOCs, and emulsified fuels on engines ranging in age from two to 18 years old. Durability testing of the DPF and DOC systems for intermittent cold start and extended high load operation indicates that these technologies are effective for generator applications and may be effective for other steady-state stationary engine applications as well.

- In July 2007, Janssen Ortho, a subsidiary of Johnson & Johnson, located in Gurabo, Puerto Rico, installed DPF+SCR systems on three 2220-hp Cummins KTTA50-G2 engines (approximately 0.2 g/bhp-hr PM). The engines are used to provide emergency backup power for their pharmaceutical R&D and manufacturing facility. Despite the limited amount of space around the engines, the company and emission control technology provider worked together to arrive at a compact and efficient solution – a platform design that allowed all of the emission control equipment to be installed above the engines. The DPF+SCR systems achieve PM reductions of >90 percent and NOx reductions of 91-92 percent.
- In September 2005, J. Cloud Inc., a rock-crushing operation in El Cajon, California, installed DPF systems on their pre-1996 Caterpillar 3408 (0.2 g/bhp-hr PM) and Caterpillar 3306 (0.3 g/bhp-hr PM) engines. The 536-hp Caterpillar 3408 engine drives a hydraulic pump that powers a rock crusher and the 430-hp Caterpillar 3306 engine drives a generator that provides power for a conveyor. Each DPF system contains two filters and each was designed to match the engine size and exhaust conditions of the respective engine. The site operates eight hours a day for five days a week. The DPF systems have achieved PM reductions of 85 percent and CO reductions of 80 percent. In addition, the DPF systems run at a backpressure of approximately 15" water column at full load and have only been cleaned once at 1,200 hours to remove accumulated ash from the filters.
- In September 2003, Snow Summit Ski Resort in Big Bear Lake, California, installed DPF+SCR systems on two large stationary engines. The two engines are Cummins QSK78-G6 diesel engines (0.2 g/bhp-hr PM), which power two 2-MW generators. The generators are used to operate snow-making and other auxiliary equipment. Source test results showed PM reductions of greater than 90 percent and NOx reductions of greater than 94 percent.

DPF manufacturers have been gaining experience in the marine sector for a number of years. It should be noted that marine vessels often have multiple engines onboard, which are used for both propulsion and auxiliary power. Particulate filters have been applied to both propulsion and auxiliary engines on numerous large yachts. There have also been limited applications on harbor craft, such as tugs, ferries, pilot boats, as well as inland vessels that include barges. BOEM should require particulate filters on both propulsion (main) and auxiliary engines whenever feasible. While there is less DPF experience on larger ocean-going vessels, a number of demonstration projects have been underway for some time. Alternatively, some fleets are utilizing exhaust gas scrubbers, a proven decades-old technology, to reduce PM and other exhaust emissions from marine vessels. In 2014, Carnival Cruise Lines committed to more than doubling the number of its ships equipped with marine diesel emissions scrubbing systems, from the 32 originally planned in 2013 to 70 vessels in total. The expansion means that Carnival will invest as much as $400 million in diesel emissions scrubbing systems, covering 70% of its global fleet. More information on the scrubber technology implemented by Carnival can be found on their website at http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MjU2MTY3fENoaWxkSUQ9LTF8VHlwZT0z&t=1.

While it is likely that the majority of engines used in oil and gas operations currently run on diesel fuel, future engines may use alternative fuels such as natural gas. It is worth noting that stoichiometric, heavy-duty natural gas engines have been shown to emit large numbers of ultrafine particulates that are largely the result of the consumption of lubricant oil during the engine combustion process (Thiruvengadam et al., *Environmental Science & Technology*, 2014, *48*(14), pp 8235-8242). These stoichiometric heavy-duty engines are currently certified without particulate filters due to their low particulate mass emissions. Particulate filters on these stoichiometric natural gas engines would significantly reduce the ultrafine particle emissions from these engines and provide additional climate and public health benefits. MECA encourages BOEM to include particulate filters as BACT on all engines utilized in oil and gas operations, including stoichiometric heavy-duty natural gas engines.

In addition to PM emissions from a diesel engine's exhaust, PM emissions from the engine's crankcase can be substantial (as much as 0.7 g/bhp-hr PM during idle conditions). To control these emissions, closed crankcase ventilation (CCV) systems can be installed, which return the crankcase blow-by gases to the engine for combustion. CCV systems prevent oil-mist fouling of radiators, the engine compartment, and the general area around the engine. CCV systems virtually eliminate crankcase PM emissions (over 90 percent) during all engine-operating modes. The CCV system consists of a filter housing with a disposable filter that must be periodically replaced, a pressure regulator, a pressure release valve, and an oil check valve.

In conclusion, MECA supports BOEM's proposal to require monitoring and reduction of PM and BC emissions from oil, gas, and sulfur operations on the Outer Continental Shelf. Reductions in PM and BC emissions will result in benefits to both human health and the environment as well as reduce the human contribution to climate change. As described above, this can be done through application of best available control technology high-efficiency particulate filters to the engines used in vehicles and equipment performing this work.

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