WRITTEN COMMENTS OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S PROPOSAL
CONCERNING ATTRIBUTES OF FUTURE SCR SYSTEMS
DOCKET ID NO. EPA-HQ-OAR-2010-0444

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The Manufacturers of Emission Controls Association (MECA) is pleased to provide comments in response to the U.S. EPA's request for public comments on their proposals covering the attributes of future SCR systems used in mobile source applications (Docket ID No. EPA-HQ-OAR-2010-0444). These comments are also being provided to the California Air Resources Board (by e-mail to Ms. Kimberly Pryor) since ARB is engaged jointly with EPA on this topic. MECA attended the joint EPA/ARB workshop held in El Monte, CA on July 20, 2010. The primary focus of the July 20 workshop was on SCR applications on new engines or vehicles that are certified by EPA and ARB. MECA members have interests in SCR technology for these new engine/vehicle applications and retrofit applications of SCR technology on existing vehicles for the purpose of reducing NOx exhaust emissions. SCR has become an important NOx emission reduction technology for mobile sources in the U.S. and other world markets as evidenced by the hundreds of thousands of light-duty and heavy-duty vehicles that have been sold and operated with SCR technology over the past six years in Europe, Japan, and North America. SCR applications are expected to expand significantly in the off-road sector in the coming decade as OEMs certify new off-road, marine, and locomotive engines to comply with EPA Tier 4 emission regulations in each of these sectors. MECA understands the need to incorporate into SCR systems sufficient attributes and safeguards to ensure that these catalyst systems are operated with the specified reductant (diesel exhaust fluid, DEF) and deliver the NOx emission reductions required by EPA and ARB engine and vehicle emission regulations. As was expressed by some of the attendees at the July 20 workshop, MECA also believes that it is important that EPA and ARB have a common set of requirements and a harmonized implementation schedule for future SCR system attributes for both new engine and vehicle applications, and for SCR retrofit applications.

MECA is a non-profit association of the world's leading manufacturers of emission control technology for motor vehicles. Our members have decades of experience and a proven track record in developing and manufacturing emission control technology for a wide variety of on-road and non-road vehicles and equipment. A number of our members have extensive experience in the development, manufacture, and application of hydrocarbon, PM and NOx emission control technologies for both new and existing engines. Our members include the largest suppliers of SCR catalysts for original equipment applications in all world markets where this technology is being used for mobile source applications and companies that have or are in the process of verifying SCR systems for retrofit applications for both on-road and off-road diesel engines. MECA members are also involved in developing other types of NOx emission controls for mobile source applications on diesel engines including lean NOx adsorber catalysts, lean NOx catalysts (sometimes referred to as hydrocarbon-SCR catalysts), and combinations of these NOx catalysts with SCR catalyst. In general, MECA member companies have developed

exhaust and evaporative emission control technologies for gasoline, diesel, and alternative-fueled engines.

Many of the proposed attributes for future SCR technology discussed at the July 20, 2010 workshop deal with more rigorous and robust monitoring, warnings and inducements that limit the potential operation of SCR systems without DEF. In new engine and vehicle applications the OEM is responsible for these issues and in the best position to provide inputs to EPA and ARB on these issues. MECA is aware that many OEMs are already making use of available NOx sensors and urea quality sensors to "manage" their SCR systems and ensure the use of DEF that meets the current ASTM specifications. Urea quality detection may become more important as SCR systems are introduced in the off-road sector; especially in applications where there is a risk that agricultural-grade urea could be substituted for DEF. The use of agricultural-grade urea that does not meet the same specifications of DEF can lead to deposits on catalysts or poor urea injection system performance that will degrade NOx conversion efficiency of the SCR system. Another area of concern related to DEF quality is related to "shelf life" of DEF in on-board DEF tanks in applications that could have unusually long periods of inactivity (e.g. seasonal service fleets in either on-road or off-road applications). Available NOx sensors or urea quality sensors should be able to provide protection for this situation as well.

OEMs are also in the best position to deal with the issue of improved freeze protection for SCR systems that was discussed at the July 20, 2010 workshop. MECA would like to note, however, that highly efficient diesel fuel burners are available that could be used to accelerate the warm-up of SCR systems that operate in cold ambient conditions.

Some of the proposals presented at the workshop on more robust monitoring and driver warning issues can also be carried over to retrofit SCR operations. Retrofit SCR applications are, in general, not able to include inducements related to engine operation (e.g., engine derating, speed limiters, etc.). Also SCR retrofits on older diesel engines with mechanical controls can limit the options for SCR driver inducements compared to OEM SCR applications. However, recent EPA verifications of retrofit SCR systems have included the use of dual NOx sensor or urea quality sensor strategies that are tied to engine re-start conditions to ensure that the retrofit SCR system is functioning as verified. MECA believes that this type of "final inducement" provides an adequate safeguard for retrofit SCR system applications. MECA would like to better understand EPA and ARB's proposals as they pertain to retrofit SCR applications. A joint public workshop devoted specifically to retrofit SCR applications would be a helpful means to initiate a productive dialogue between the agencies and SCR retrofit manufacturers on how to best translate some of the future attributes for OEM SCR systems over to retrofit SCR applications.

The workshop covered a few SCR catalyst specific issues that MECA would like to comment on:

1. Ammonia slip – Both EPA and ARB indicated that future SCR systems should limit ammonia slip to below 10 ppm on average over the appropriate test cycles for the regulatory defined useful life of the emission system. This is consistent with the Euro VI heavy-duty requirements. MECA supports this position and believes that both original equipment and retrofit SCR systems are technically capable of complying

with this limit on ammonia slip. There are already examples of both OEM and retrofit SCR systems that are achieving ammonia slip emissions below this average 10 ppm limit.

2. N_2O emissions – During the workshop a commenter raised the issue of N_2O emissions from SCR systems. This issue has been included in the development efforts with respect to both SCR catalyst formulations and ammonia slip catalysts. SCR catalyst formulations and ammonia slip catalyst formulations have been developed recently with improved selectivity for producing the desired product of N_2 and reduced selectivity in producing N_2O compared to earlier catalyst compositions. An example of reduced N_2O emissions from SCR catalysts that employ an ammonia slip catalyst was presented at the September 2007 SAE Heavy-duty Diesel Symposium held in Gothenburg, Sweden (see presentation by G. Smedler of Johnson Matthey). Efforts similar to the results presented by Smedler et al. have continued at the major manufacturers of SCR catalysts and ammonia slip catalysts in advance of the commercial launch of DPF+SCR systems for both light-duty and heavy-duty vehicle applications in the U.S. It should be noted that, in addition to the selectivity of SCR and ammonia slip catalysts to produce the desired N_2 reaction product rather than N_2O, other SCR system variables such as the urea injection strategy and the volume of SCR catalyst also have impacts on the level of N_2O emissions that are emitted from SCR systems.

   MECA believes that EPA should consider appropriate N_2O caps for heavy-duty vehicles as part of its pending proposal on greenhouse emissions from this sector. EPA and ARB have already dealt with N_2O emissions from light-duty vehicles in the final national light-duty greenhouse gas emission regulation. In the light-duty sector EPA has set a cap on N_2O emissions over the FTP cycle but allowed OEMs the flexibility to include measured N_2O emissions in an overall CO_2-equivalent emission calculation (i.e., one can essentially trade-off higher N_2O emissions vs. CO_2 emissions). A similar regulatory strategy for heavy-duty vehicles would be appropriate.

3. Dioxin/furan emissions – MECA has partnered with EPA on the SCR dioxin test program that is nearing an end at EPA's Ann Arbor laboratory. As EPA indicated in their straw man proposal issued prior to the July 20 workshop, testing to date has shown no evidence for dioxin production over a Cu-zeolite SCR catalyst. The complete test matrix for this program is expected to be finished by the end of this year. If the results continue to show no evidence for any dioxin or furan formation over Cu-zeolite SCR catalysts, MECA believes that OEM or retrofit SCR systems that utilize Cu-zeolite catalysts in configurations similar to the configurations tested by EPA should be certified or verified without the need for the manufacturer to submit any additional test data.

4. Vanadia SCR catalysts – Vanadia SCR catalysts have already seen wide scale commercial use for controlling NOx emissions from stationary sources. MECA understands the issues related to the thermal stability of these catalysts and the

potential sublimation of vanadium-containing species from vanadia-based SCR catalysts that are operated at elevated temperatures. MECA, manufacturers of SCR catalysts, and SCR catalyst raw material suppliers have already initiated a dialogue with EPA on defining a suitable test method for determining the sublimation temperature of vanadium-containing species from these catalysts. MECA is committed to work with EPA and ARB on reaching an agreement on a test method that can be used to define the thermal stability of these catalysts. Establishing any requirements on thermal limits from these catalyst requires an understanding of what vanadium-containing species may be sublimation products, the potential that these species will exit the tailpipe (rather than condense elsewhere in the exhaust system), and the health risks associated with the emission of any of these species in the exhaust.

In addition to these comments specific to urea-SCR catalyst systems, MECA would also like to note that development efforts are continuing on alternative mobile source NOx emission reduction technologies that do not employ the use of an on-board source of a liquid urea-based reductant (e.g., hydrocarbon-SCR catalysts that employ diesel fuel or E85 as a reductant or combinations of lean NOx adsorber catalysts and SCR catalysts that generate ammonia during lean NOx adsorber regeneration and subsequently store this ammonia on a downstream SCR catalyst for use in NOx reduction). There are also examples of SCR systems that employ a solid reductant that can be used to generate the ammonia rather than the current DEF liquid. These alternative NOx reduction technologies, in some cases, offer the potential for more robust or "secure" real world operation but will need to compete with current urea-SCR systems in terms of performance and cost in the market. Some of these alternative technologies will also need the development of an appropriate reductant infrastructure to ensure wide scale reductant availability.

Conclusion

MECA members continue to devote significant resources to the development of NOx reduction technologies for both original equipment and retrofit mobile source applications in the U.S. and other world markets. SCR is a proven, durable NOx reduction technology for mobile sources, however, appropriate safeguards and operator inducements are necessary to ensure that these systems are used with the specified DEF. It is important for EPA and ARB to have a common set of requirements and implementation dates for the attributes of future SCR systems for both original equipment and retrofit applications. MECA encourages both agencies to hold additional workshops on SCR system attributes for the full range of mobile source NOx reduction applications to allow for a constructive dialogue with manufacturers and ensure that manufacturers have a common understanding of what is needed for future engine/vehicle certifications or retrofit verifications. MECA also believes it is important for both agencies to complement the discussion on system attributes with a strong enforcement program to make sure that future SCR systems (or other NOx reduction technologies) are used as designed and provide significant NOx reduction benefits consistent with certification and verification test procedures.

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