

While the resulting PM emission levels for nonroad diesel engines are similar to the levels for highway diesel engines, the challenge of ensuring soot regeneration of the CDPF may be more difficult for some nonroad equipment types. As explained earlier, effective regeneration occurs when the aggregate soot rate into the CDPF over an extended period is less than or equal to the soot oxidation rate over the same period. Because the baseline PM soot rate into the CDPF level may be higher for some nonroad engines and because the average exhaust temperature may be lower for some operating cycles, additional engine and aftertreatment system development will be needed for some nonroad engines. These additional developments include improved thermal management and improved active back-up systems which can periodically raise exhaust temperatures in order to initiate regeneration. We expect these systems to be evolutionary advancements based primarily on the core technologies used by nonroad manufacturers to comply with the Tier 3 emission standards with enhancements from the highway technologies developed to comply with the HD2007 standards. The implementation dates for the standards proposed today were selected in part based upon the time we believe will be necessary to transfer and further develop these highway technologies to nonroad diesel engines and equipment.

We are proposing a NO_x standard of 0.3 g/bhp-hr for engines in this category based upon the emission reductions possible from the application of NO_x adsorber catalysts and the expected emission levels for Tier 3 compliant engines which form the baseline technology for Tier 4 engines. The Tier 3 emission standards are a combined NO_x+NMHC standard of 3.0 g/bhp-hr for engines greater than 100 hp and less than 750 horsepower. For engines less than 100 hp but greater than 50 horsepower the Tier 3 NO_x+NMHC emission standard is 3.5 g/bhp-hr. For engines greater than 750 horsepower there is no Tier 3 NO_x+NMHC standard. We believe that in the time-frame of the Tier 4 emission standards proposed today, all engines of 75 horsepower or higher can be developed to control NO_x emissions to engine-out levels of 3.0 g/bhp-hr or lower. This means that all engines will need to apply Tier 3 emission control technologies (*i.e.*, turbochargers, charge-air-coolers, electronic fuel systems, and for some manufacturers EGR systems) to get to this baseline level, even those engines without a Tier 3 standard (*i.e.*, >750hp

engines). As discussed in more detail in the draft RIA, our analysis of the NRTC and the ISO C1 cycles indicates that the NO_x adsorber catalyst can provide a 90 percent or greater NO_x reduction level on the cycles. The proposed standard of 0.3 g/bhp-hr reflects a baseline emissions level of 3.0 g/bhp-hr and a 90 percent or greater reduction of NO_x emissions through the application of the NO_x adsorber catalyst. The additional lead time available to nonroad engine manufacturers and the substantial learning that will be realized from the introduction of these same technologies to highway diesel engines, plus the lack of any fundamental technical impediment, makes us confident that the proposed NO_x standards can be met.

The proposed standard is 50 percent higher than the corresponding HD2007 standard of 0.2 g/bhp-hr because of the higher baseline NO_x emissions for Tier 3 engines. The higher baseline (engine-out) NO_x level is due primarily to a lack of ram-air for improved charge-air cooling for nonroad diesel engines when compared to highway diesel engines compliant with the 2004 highway emission standards. Although nonroad engine manufacturers may be able to lower engine-out NO_x emissions below the levels required for Tier 3, we continue to expect that the lack of ram air will limit nonroad engine-out NO_x performance, and therefore we have accounted for that difference by proposing this higher NO_x emissions level.

We believe that the NO_x adsorber technology developed for highway engines can be applied with equal effectiveness to nonroad diesel engines with additional developments in engine thermal management (as discussed in section III.E.2 above) to address the more widely varied nonroad operating cycles. In fact, as discussed previously, the NO_x adsorber catalyst temperature window is particularly well matched to transient operating conditions as typified by the NRTC.

Compliance with the NTE provisions proposed today will be challenging for the nonroad engine industry due to the diversity of nonroad products and operating cycles. However, the technical challenge is reduced somewhat by the 1.5 multiplier used to calculate the NTE standard. Controlling NO_x emissions under NTE conditions is fundamentally similar for both highway and nonroad engines. The range of control is the same and the amount of reduction required is also the same. We know of no technical impediment that would prevent achieving the NTE standard under the full range of operating conditions.

The proposed NO_x standard is phased in over a number of years in a manner similar to the HD2007 NO_x phase-in. In the early years of the program half of the engines produced by a manufacturer must be certified to the new emission standard while the remaining engines can continue to be sold at the previous standard. We provided this phase-in period for highway engines in the HD2007 rulemaking to allow manufacturers to focus resources on the portion of their products best suited to NO_x catalysts first and then to apply the learning to the remainder of their products three years later.¹⁸⁰ Provisions of the averaging program in the HD2007 rulemaking allow manufacturers to alternatively comply with some engine families at an "averaged" standard that is approximately halfway between the old and new NO_x standards. In fact, we have learned from a number of engine manufacturers that they are likely to employ this strategy for some fraction of their new highway engines in 2007. The averaging provisions that we have proposed today for Tier 4 would also allow for compliance with the proposed Tier 4 NO_x standard with a single engine product during the transitional NO_x phase-in period. This provision allows manufacturers to transfer the same highway NO_x technologies to nonroad engines and to comply with an appropriately stringent standard. We believe as with the HD2007 rule that this provision is necessary in order to manage resource requirements to develop the necessary technologies and that this provision provides significant additional flexibility for manufacturers to comply with the proposed NO_x standards. Similarly, we have proposed a modified phase-in schedule for the greater than 750 horsepower engines in part because of the lack of a Tier 3 standard for those engine and the extra work required to develop a full Tier 4 emission control system from a Tier 2 baseline.

Meeting the proposed NMHC standard under the lean operating conditions typical of the biggest portion of NO_x adsorber operation should not present any special challenges to nonroad diesel engine manufacturers. Since CDPFs and NO_x adsorbers contain platinum and other precious metals to oxidize NO to NO₂, they are also very efficient oxidizers of hydrocarbons. NMHC reductions of greater than 95 percent have been shown over transient

¹⁸⁰ Control of Air Pollution from New Motor Vehicles: Heavy-duty Engine and Vehicle Standards and Highway Diesel Sulfur Control Requirements; Final Rule, 66 FR 5002, January 18, 2001.