

and not-to-exceed requirements) to engines in the <25 hp category beginning in 2013. The supplemental test procedures and standards will apply not only to PM, but also to NMHC+NO_x. While we believe the engine technology necessary to comply with the supplemental test procedures and standards is the same as the technology necessary to comply with the 2008 standard, we are delaying the implementation of the supplemental test procedures and standards until 2013 in order to implement the supplemental requirements on the larger powered nonroad engines before the smallest power category (*see* section III.C. above). This will also provide engine manufacturers with additional time to install any emission testing equipment upgrades they may need in order to implement the new nonroad transient test cycle. Nevertheless, the technologies described above are capable of complying with both the proposed nonroad transient test cycle and the NTE standard. As just described, DOCs are capable of reducing PM emissions up to 50 percent during transient testing. With respect to feasibility under NTE testing, it has been demonstrated, as a result of a recent Agency action, that engines which rely on retarded injection timing as a primary NO_x control technology, which is also the primary technology that engines in the <25 hp category will likely use to comply with the Tier 2 NMHC+NO_x standard, are capable of complying with an NMHC+NO_x NTE standard of 1.25 x the FTP for engines with emission levels on the order of 4 g/bhp-hr NO_x. Specifically, as a result of federal consent decrees with a number of highway heavy-duty diesel engine manufactures, many highway engines certified to an FTP standard of 4 g/bhp-hr NO_x were also designed to comply with an NTE limit of 5 g/bhp-hr (*i.e.*, 1.25 x FTP standard).²¹¹ The Tier 2 NMHC+NO_x standard for engines <25hp is 5.6 g/bhp-hr, therefore, in 2013 the proposed NTE standard is 7.0 g/bhp-hr NMHC+NO_x. Based on the experience which a number of highway diesel engine companies, we project that the proposed NTE standard for engines <25 hp can be achieved by 2013.

As discussed in section III.B, we have also proposed a minor change in the CO standard for the <11 hp engines, in order to align those standards with the

standards for the 11–25 hp engines. As discussed in section III.B., the small change in the CO standard is intended to simplify EPA's regulations as part of our decision to propose a reduction in the number of engine power categories for Tier 4. The current CO standard for this category is 6.0 g/bhp-hr, and the proposed standard is 4.9 g/bhp-hr (*i.e.*, the current standard for engines in the 11–25 hp range). The model year 2002 certification data shows that more than 90 percent of the engine families in this power category meet the proposed standards today. In addition, DOCs typically reduce CO emissions on the order of 50 percent or more during both transient and steady-state operation.²¹² Given that more than 90 percent of the engines in this category meet the proposed standard today, and the ready availability of technology which can easily achieve the proposed standard, we project this CO standard will be achievable by model year 2008.

Based on the existence of a number of engine families which already comply with the proposed Tier 4 PM standard (and the 2008 NMHC+NO_x standard), and the availability of PM reduction technologies such as improved fuel systems, combustion chamber improvements, and in particular diesel oxidation catalysts, we project the proposed 0.30 g/bhp-hr PM standards is technologically feasible by model year 2008. All of these are conventional technologies which have been used on both highway and nonroad diesel engines in the past. As such, we do not expect there to be any negative impacts with respect to noise or safety. In addition, PM reduction technologies such as improved combustion through the use of higher pressure fuel injection systems as well as DOCs are not predicted to have any substantial impact on fuel efficiency.

d. Why has EPA not Proposed More Stringent PM or NO_x Standards for Engines <25 hp?

Section III.E.4 contains a detailed discussion of why we don't believe it is appropriate at this time to revise the NO_x standards based on NO_x absorber technology for engines between 25 and 75 hp. These same arguments apply for engines below 25 hp. In addition, we have not proposed to revise the NO_x standard for <25 hp engines in this

action, nor do we believe PM standards based on particulate filters are appropriate for this power category based on a number of factors, as discussed below.

In EPA's recent Staff Technical Paper regarding the feasibility of the Tier 3 NMHC+NO_x standards for engines greater than 50 hp, we projected that a number of engine technologies can be used to meet the Tier 3 standards, including cooled EGR or hot EGR, both with advanced electronic fuel systems, as well as with internal combustion techniques using advanced electronic fuel systems, advanced turbocharging systems (*e.g.*, waste-gated or variable geometry turbochargers), and possibly variable valve actuation.²¹³ In addition, we presumed the use of charge-air cooling. In order to set more stringent NO_x standards for <25 hp engines without increasing PM emissions, the most logical list of technologies is turbocharging, electronically controlled hot or cooled EGR, an electronic fuel system, and possibly charge-air-cooling. No nonroad diesel engine <25 hp uses any combination of these technologies today. While we are able to postulate that some of this technology could be applied to the <25 hp engines, the application of some of the technology (such as turbocharging) is technologically uncertain. It is the combination of these two issues (the traditional NO_x-PM trade-off and the difficulties with turbocharging 1 and 2 cylinder engines) which is the primary reason we are not proposing to revise the NO_x standard for engines in this size range. NO_x reduction control technologies such as advancing fuel injection timing or using EGR will increase PM emissions. In order to reduce NO_x emissions and reduce or maintain current PM levels additional technologies must be used. Fundamental among these is the need to increase oxygen content, which can be achieved principally with turbocharging. However, turbocharging systems do not lend themselves to 1 and 2 cylinder products, which are approximately 50 percent of the engines in this power category. In addition, even if these technologies could be applied to engines in the < 25 hp category, the costs would be substantial relative to both the base engine cost and to the cost of the nonroad equipment itself. Therefore, for the reasons discussed above, we have not proposed to revise the NO_x standard for these engines at

²¹¹ EPA Memorandum "Summary of Model Year 1999 and 2000 Federal On-highway Heavy-duty Diesel Engine Families Certified as Compliant with Not-to-Exceed Requirements, Euro-3 Steady State Requirements, and Maximum Allowable Emission Limits Requirements", copy available in EPA Air Docket A-2001-28.

²¹² "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1—Oxidation Catalyst Technology, and "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts", P. Zelenka *et al.*, Society of Automotive Engineers paper 902111, October 1990.

²¹³ *See* section 2.3.1 through 2.3.3 of "Nonroad Diesel Emission Standards—Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.