

advanced technologies. We will then be best situated to make a technology-based decision that maximizes emission reductions from these engines, taking into consideration cost and other appropriate factors.

While deferring adoption of the Tier 2 standards to a future rulemaking is appropriate for the reasons described above, an additional reason supporting this approach is to pursue further negotiations in the international arena to achieve more stringent global emission standards for marine diesel engines. As discussed below, adopting appropriate international standards has the potential to maximize the control of emissions from U.S. and foreign vessels.

The near-term Tier 1 standards we are adopting are equivalent to the internationally negotiated NO<sub>x</sub> standards established by the International Maritime Organization (IMO) in Annex VI to the International Convention on the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto (more commonly referred to as MARPOL or MARPOL 73/78; the standards are referred to as the Annex VI NO<sub>x</sub> standards).<sup>6</sup> As explained in Section III below and in the Final Regulatory Support Document, these standards are achievable almost immediately, with less than one year of lead time, because manufacturers are already achieving and certifying to these standards under our Voluntary Statement of Compliance program for Annex VI. These near-term standards are being achieved through the application of currently available technology, including optimized turbocharging, higher compression ratios, and optimized fuel injection. The certification and compliance program we are adopting is similar to the internationally negotiated program, but contains additional provisions reflecting certain Clean Air Act-specific compliance provisions and the related need to adopt test procedures designed to achieve the emission reductions called for under Clean Air Act section 213. These certification requirements are described in Section V of this preamble. These Tier 1 standards are expected to result in negligible costs because engine manufacturers are already producing engines that meet the MARPOL Annex VI NO<sub>x</sub> limits. Engine

manufacturers should not have to engage in additional research and development to achieve these standards. Recognizing that some additional lead time is needed for manufacturers in some cases, we are including an interim provision that will allow manufacturers to use their Annex VI test data to show compliance with the Tier 1 standards.

We considered, but rejected, setting near-term Tier 1 standards that would require a level of emission control greater than that necessary to meet the MARPOL Annex VI NO<sub>x</sub> limits, for a combination of reasons. We concluded that setting more stringent near-term Tier 1 standards would likely delay achieving greater environmental benefits in the longer term. The additional lead time that would be necessary to set a Tier 1 standard based on further use and optimization of in-cylinder control would lead to two separate—and possibly conflicting—design steps, one for Tier 1 and a second for Tier 2. Dividing manufacturers' resources this way has the potential to delay the Tier 2 standards. For example, manufacturers would potentially need to make initial changes to in-cylinder designs, then pursue an additional development program to optimize the in-cylinder technologies for controlling emissions in conjunction with advanced technologies. We believe the best route to achieving the maximum reductions from Category 3 marine engines is a near-term Tier 1 standard based on the use of existing technologies, followed by a Tier 2 rulemaking in the next few years that focuses on designing the optimum combination of in-cylinder and advanced technology to reduce emissions from these engines.

The second phase of our emission-control program for Category 3 marine diesel engines will consist of more stringent standards that reflect the application of advanced emission-control technologies and further optimization of in-cylinder controls. We understand that further use and optimization of in-cylinder control can achieve emission reductions beyond the levels needed to meet the Tier 1 standards. As discussed in the Final Regulatory Support Document, we believe that manufacturers can, with additional lead time, make greater use and optimization of in-cylinder controls to reduce emissions at least 10 to 15 percent below Tier 1 levels. It is not clear at this time that in-cylinder controls alone could reduce emissions 30 percent below Tier 1 levels. However, in combination with advanced technologies, emission reductions should be greater than 30 percent below Tier 1 levels. In the Tier

2 rulemaking, we therefore expect to focus on standards that would be based on achieving greater emission reductions through optimizing in-cylinder controls and incorporating advanced technologies such as SCR or water. As discussed above, adopting Tier 2 standards at this time based only on in-cylinder controls could lead to two separate and possibly conflicting design steps, potentially delaying introduction of advanced emission-control technologies and their anticipated emission reductions.

At this time, however, there are still several outstanding technical issues involving the use of these advanced emission-control technologies. For example, there are technical issues concerning the impacts of fuel sulfur levels on emissions, the ability of these technologies to achieve emission reductions at low engine loads, and their impacts on PM emissions. With regard to fuel-sulfur content, most of the demonstration engines that currently use these technologies are operated on fuel with a sulfur content ranging from 5,000 to 10,000 ppm. However, the average sulfur content of fuel used by Category 3 marine diesel engines is 27,000 ppm, and it can be as high as 45,000 ppm. At this time, it is not clear how engines will perform with this higher sulfur fuel and what types of adjustments will need to be made to accommodate the higher sulfur. Also, it may be the case that this technology will perform well with fuel at 15,000 ppm, which is the maximum sulfur content allowable for ships operating in SO<sub>x</sub> Emission Control Areas pursuant to Annex VI. With regard to emissions at low load, some studies suggest that advanced technologies may not perform as well when the engine is not operating at its optimal fuel-consumption rate. This is important because engines typically operate at low load in port. Once we understand this dynamic better we will be able to evaluate the extent to which it can be addressed technically. With regard to PM emissions, some concerns have been raised that using these advanced technologies to control NO<sub>x</sub> emissions may raise PM emissions. Again, once we understand this dynamic better we will be able to evaluate the extent to which it can be addressed technically. Part of this analysis will entail developing a method to measure PM emissions from these very large engines. Each of these issues is discussed in greater detail in Section IV and in the Final Regulatory Support Document.

Engine manufacturers are currently working on many of these issues. Water emulsification has been applied for

<sup>6</sup> Annex VI was adopted by a Conference of the Parties to MARPOL on September 26, 1997, but has not yet entered into force. Copies of the conference versions of the Annex and the NO<sub>x</sub> Technical Code can be found in Docket A-97-50, Document II-B-01. Copies of updated versions can be obtained from the International Maritime Organization (<http://www.imo.org>).