

cell technology for ship service power requirements for surface combatants in 1997. In early 2000, the U.S. Navy sponsored an effort to continue the development of the molten carbonate fuel cell for marine use. The Society of Naval Architects and Marine Engineers released the technical report "An Evaluation of Fuel Cells for Commercial Ship Applications." The report examines fuel cells for application in commercial ships of all types for electricity generation for ship services and for propulsion.

Fuel cell research is currently supported by several sources including the U.S. Maritime Administration (MARAD) and the state of California's Fuel Cell Partnership. MARAD's Division of Advanced Technology has also included the topic of fuel cells as a low air emission technology that should be demonstrated. California's Fuel Cell Partnership seeks to achieve four main goals which include (1) demonstrate vehicle technology by operating and testing the vehicles under real-world conditions in California; (2) demonstrate the viability of alternative fuel infrastructure technology, including hydrogen and methanol stations; (3) explore the path to commercialization, from identifying potential problems to developing solutions; and (4) increase public awareness and enhance opinion about fuel cell electric vehicles, preparing the market for commercialization. At this time, we consider fuel cell technology still be in the early stages of development. Because a mature fuel cell system could have significant environmental benefits, we will consider fuel cells in the future rulemaking.

4. Will the International Community Also Consider More Stringent Standards?

At the time the Annex VI NO_x limits were adopted in September 1997, several Member States expressed concern that the NO_x limits were not stringent enough and would not result in the emission reductions they were intended to achieve. Due to the efforts of these Member States, the Conference of the Parties adopted a resolution that provides for review of the emission limits with the aim of adopting more stringent limits, taking into account the adverse effects of such emissions on the environment and any technological developments in marine engines. This review is to occur at a minimum of five-year intervals after entry into force of the Annex, with amended NO_x limits to reflect more stringent controls if appropriate.

In March 2000, the United States requested the Marine Environment Protection Committee (MEPC) to begin consideration of more stringent emission limits for marine diesel engines.³¹ EPA's analysis of emission-control technology for our 1999 rulemaking indicated that more stringent standards are feasible for all Category 1 and Category 2 marine diesel engines. Engine manufacturers were also beginning to apply these emission-control strategies to Category 3 marine diesel engines, as well as more advanced strategies such as water emulsification and selective catalytic reduction. Reflecting the potential emission reductions that could be obtained from applying these strategies to all marine diesel engines, the United States recommended Annex VI Tier 2 NO_x limits be set at 25 to 30 percent below the existing Annex VI NO_x limits for all engines subject to the regulation (engines above 130 kW), to go into effect in 2007. This would allow a seven-year period of stability for the Annex VI NO_x limits, permit engine manufacturers to adjust their engine designs to include new emission-control technologies, and allow manufacturers of marine diesel engines at or above 30 liters per cylinder to develop emission-control strategies for those large engines. This recommendation was discussed at the 44th session of the MEPC (London, March 3–16, 2000), but the committee took no action.

The United States will continue to promote more stringent standards at IMO and encourage MEPC to adopt a second tier of emission limits that will reflect available technology and reduce the impact of marine diesel engines on the world's air quality. Technology has continued to advance since we made our request for review in 2000. EPA now believes that Member States of the IMO should consider further reductions of significantly more than 30 percent from the NO_x limits currently stipulated under Regulation 13 of the Annex, to be applicable to engines installed on vessels constructed on or after a date to be determined. Consideration should be given to use of emission-control systems that include a combination of optimized in-cylinder controls and advanced technologies such as selective catalytic reduction and water-based control technologies.

³¹ MEPC 44/11/7, Prevention of Pollution from Ships, Revision of the NO_x Technical Code, Tier 2 Emission Limits for Marine Diesel Engines at or Above 130 kW, submitted by the United States. This document is available at Docket A-2001-11, Document No. II-A-16.

B. Fuel Controls

The majority of Category 3 engines are designed to run on residual fuel. This fuel is made from the very end products of the oil refining process, formulated from residues remaining after the primary distilling stages of the refining process. It has higher contents of ash, metals, and nitrogen that may increase emissions of exhaust pollutants. Residual fuel also has sulfur content up to 45,000 ppm; the global average sulfur concentration is currently about 27,000 ppm, though fuel sold in the United States has sulfur levels somewhat above the average.³² Operating on fuels with such high sulfur contents results in high SO_x and direct sulfate PM emissions.

Using a residual fuel with a lower sulfur content would reduce the fraction of PM emissions from ash and metals. Using distillate fuel instead of residual fuel could result in even lower emissions. The simpler molecular structure of distillate fuel may result in more complete combustion with reduced levels of carbonaceous PM. Operation on distillate fuel would also reduce NO_x emissions because distillate fuel generally contains less nitrogen and has better ignition qualities. In general, engines that are designed to operate on residual fuel are capable of operating on distillate fuel. For example, if the engine is to be shut down for maintenance, distillate fuel is often used to flush out the fuel system. However, there are several complications associated with using distillate fuel to reduce emissions. Switching to distillate fuel requires 20 to 60 minutes, depending on how slowly the operator wants to cool the fuel temperatures. According to engine manufacturers, switching from a heated residual fuel to an unheated distillate fuel too quickly could cause damage to fuel pumps. There could also be fuel pump durability problems if the engine is operated on distillate fuel for more than a few days. For continued operation on distillate, ships would need to have separate (or modified) pumps and lines. In addition, modification to the fuel tanks may be necessary to ensure sufficient capacity for lower-sulfur fuel.

1. Is EPA Adopting Fuel Requirements?

In our proposal, we requested comment on whether we should set standards for the fuel that ships use and, if so, what form the standards should take. After reviewing the comments and

³² Sulphur Monitoring 2002. Report to Marine Environmental Protection Committee, 47th Session. MEPC 47/INF.2, August 28, 2001. A copy of this document can be found in Docket A-2001-11, Document No. II-E-9.