Report of the Small Business Advocacy Review Panel

On

Emissions Standards for New Compression-ignition and Spark-ignition Recreational Marine Engines

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Table of Contents

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1. Introduction

This report is presented by the Small Business Advocacy Review Panel (SBAR Panel or Panel) convened for the proposed rulemaking on emissions standards for new compression-ignition and spark-ignition recreational marine engines that is currently being developed by the Environmental Protection Agency (EPA). On June 7, 1999, EPA's Small Business Advocacy Chairperson convened the Panel under section 609(b) of the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). Section 609(b) requires convening a review Panel prior to publication of the initial regulatory flexibility analysis that an agency may be required to prepare under the RFA. In addition to the chairperson, the Panel consists of the Director of the Engine Programs and Compliance Division of the Office of Mobile Sources, the Administrator of the Office of Information and Regulatory Affairs within the Office of Management and Budget, and the Chief Counsel for Advocacy of the Small Business Administration.

This report provides background information on the proposed rule being developed and the types of small entities that would be subject to the proposed rule, describes the efforts to obtain the advice and recommendations of representatives of those small entities, summarizes the comments that have been received to date from those representatives, and presents the findings and recommendations of the Panel. The complete written comments of the small entity representatives (SERs) are attached to this report.

Section 609(b) of the RFA directs the review Panel to report on the comments of small entity representatives and make findings as to issues related to identified elements of an initial regulatory flexibility analysis (IRFA) under section 603 of the RFA. Those elements of an IRFA are:

- A description of, and where feasible, an estimate of the number of small entities to which the proposed rule will apply;
- A description of projected reporting, record keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirements and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant Federal rules which may duplicate, overlap, or conflict with the proposed rule; and

- A description of any significant alternative to the proposed rule which accomplishes the stated objectives of applicable statutes and which minimizes any significant economic impact of the proposed rule on small entities.

Once completed, the Panel report is provided to the agency issuing the proposed rule and included in the rulemaking record. In light of the Panel report, and where appropriate, the agency is to make changes to the draft proposed rule, the IRFA for the proposed rule, or the decision on whether an IRFA is required.

It is important to note that the Panel's findings and discussion are based on the information available at the time this report was drafted. EPA is continuing to conduct analyses relevant to the proposed rule, and additional information may be developed or obtained during the remainder of the rule development process. The Panel makes its report at a preliminary stage of rule development and its report should be considered in that light. At the same time, the report provides the Panel and the Agency with an opportunity to identify and explore potential ways of shaping the proposed rule to minimize the burden of the rule on small entities while achieving the rule's purposes. Any options identified by the Panel for reducing the rule's regulatory impact on small entities may require further analysis and/or data collection to ensure that the options are practicable, enforceable, environmentally sound and consistent with the statute authorizing the proposal.

2. Background

2.1 Nonroad Study

Section 213(a) of the Clean Air Act (CAA) directs EPA to: (1) conduct a study of emissions from nonroad engines and vehicles; (2) determine whether emissions of carbon monoxide (CO), oxides of nitrogen (NOx), and volatile organic compounds (VOCs, including hydrocarbons (HC)) from nonroad engines and vehicles are significant contributors to ozone or CO in more than one area which has failed to attain the national ambient air quality standards (NAAQS) for ozone or CO; and (3) if nonroad emissions are determined to be significant, set appropriate emissions standards for those categories or classes of new nonroad engines and vehicles determined to cause or contribute to such air pollution.

The Nonroad Engine and Vehicle Emission Study required by section 213(a)(1) was completed in November 1991. The determination of the significance of emissions from nonroad engines and vehicles in more than one NAAQS nonattainment area was published on June 17, 1994. At the same time, the first set of regulations for new land-based nonroad compression-ignition (CI) engines at or above 37 kW was promulgated. These are often referred to as the

nonroad Tier 1 standards for large CI engines. EPA has also issued proposed or final rules for other categories of nonroad engines, including spark-ignition[1] (SI) engines less than 19 kW, spark-ignition marine engines (outboards and personal watercraft), land based and marine compression-ignition engines less than 37kW, and locomotives.

2.2 Emission Control Program for Compression-ignition Marine Engines

On December 11, 1998 (63 FR 68508), the Agency published a notice of proposed rulemaking for an emission control program for new commercial compression-ignition marine engines at or above 37kW. Emission standards for CI marine engines were initially proposed in 1994 as part of the proposed rule for control of emissions from new spark-ignition and compression-ignition marine engines. In 1994, EPA had a limited understanding of the CI marine industry and, relying on the similarities between land based and marine CI engines, proposed to apply the same emission levels as those in the then just-developed land-based rule. As EPA learned more about the industry, it decided to separate commercial marine from this rulemaking . In the 1998 proposal , EPA stated that it was deferring setting emissions standards for recreational CI marine engines until a later rulemaking.

The engines covered by the December 11, 1998 commercial marine CI proposal are very diverse, in terms of engine size, emission technology, control hardware, and costs associated with reducing emissions so EPA did not propose one set of emission levels for all CI marine engines. Because of the differences among engines, emissions standards that are reasonable and feasible for a 37 kW engine used on an 18-foot boat may not be reasonable or feasible for a 1500 kW engine installed on a tug or a 20,000 kW engine installed on an ocean-going container ship. Similarly, emission limits that are appropriate for very large engines may be too lenient for smaller engines, leaving them virtually unregulated. Therefore, the EPA proposal includes different standards for different sizes of CI marine engines. EPA plans to finalize this regulation later in 1999.

2.3 History of SD/I Regulation

In November 1994, EPA proposed emission standards for all marine SI engines. EPA proposed to regulate all marine spark-ignition engines as one "class or category"of new nonroad engines, covering outboard, personal watercraft, and jetboat (OB/PWC) engines as well as SD/I engines. This proposal included SD/I engine emission limits of 8 g/kW-hr HC and 6.5 g/kW-hr NOx. These standards were intended to be met with engine calibration only, and EPA expected

[1]Spark-ignition (SI) engines, also known as Otto-cycle engines, use a spark plug to initiate combustion. The vast majority of marine SI engines are gasoline fueled. Compression-ignition (CI) engines, also known as Diesel-cycle engines, use the heat generated from compression of the air in the cylinder to ignite the fuel. The vast majority of marine CI engines are diesel fueled.

that the standards would reduce NOx about 10%. EPA also asked for comment on reducing the NOx standard to 3.9 g/kW-hr. EPA stated that it considered SD/I engines to be a cleaner technology than controlled OB/PWC engines and encouraged their use for applications where they could be used in place of OB/PWC engines. However, EPA recognized that such substitution could only be possible for limited applications.

After receiving comment from the SD/I industry, EPA published a supplemental proposal in February, 1996. EPA proposed a HC+NOx cap for SD/I engines equal to 2/3 of the standard for OB/PWC (about 30 g/kW-hr). This would have reduced costs for SD/I manufacturers as compared with the 1994 proposal since they would not have needed to apply new technology. EPA was also concerned that, because of the number of small businesses involved in marinizing SD/I engines, compliance testing would be very burdensome. Because baseline emissions were believed to be 14-16 g/kW-hr HC+NOx, EPA believed that it would be safe for SD/I manufacturers to certify their engines without having to perform any emission testing. Therefore, EPA proposed that SD/I manufacturers would only have to send in a one-page submittal and EPA would issue an expedient issuance of a Certificate of Conformity.

EPA issued a final rule for OB/PWC on October 4, 1996 (61 FR 52087). The standards require a very large reduction in HC emissions on a brake-specific basis with only a slight increase in NOx emissions. The standards require increasingly stringent HC control over the course of a nine-year phase-in period beginning in model year 1998. By the end of the phase-in, each manufacturer must meet an HC+NOx emission standard on a corporate average basis that represents a 75 percent reduction in HC compared to unregulated levels. SD/I engine standards were not set in this rule. At the time, even without emission standards, EPA believed that emission reductions would be gained from limited substitution of OB/PWC with lower cost SD/Is. EPA also believed that emissions from SD/I engines were going to be reduced in the future, without regulation, through the use of electronic fuel injection.

EPA is now developing a proposal that would include standards for SD/I engines. This proposal is motivated by many factors:

- CAA §213(a) requires greatest degree of emission reduction, achievable through technology which EPA determines will be available, considering costs, lead time, noise, energy, and safety.

- EPA believes that SD/I engines have high per engine emissions compared to levels they could achieve using technology demonstrated in other sectors and which can be applied to this sector.

- EPA understands that baseline SD/I NOx emissions have increased in some instances when electronic fuel injection was applied because EFI systems have been calibrated for

lean operation.

-EPA does not believe there will be significant substitution of outboard engines for sterndrive engines as a result of the 1996 rule.

- EPA believes meaningful and cost-effective emission reductions can be achieved from SD/I engines.

- EPA believes that technology has advanced since the 1996 final rule; catalysts are more feasible and electronic control is widely available.

- EPA understands that there would be possible inequity between diesel and gasoline engine manufacturers if diesels are regulated alone.

- EPA is concerned that boat builders utilizing either gasoline or diesel engines should be impacted similarly by EPA emission regulations.

- The California Air Resources Board is also in the process of developing technology-forcing standards for SD/I.

In developing the 1994 proposal, EPA considered large catalysts that could achieve reductions of 65-75%. A large catalyst would be difficult to package in an SD/I engine because of its size and because it must be upstream of where the water and exhaust mix. For the current proposal, EPA is considering small catalysts that could be packaged in the exhaust manifolds. EPA believes this design would achieve 35-45% reductions while significantly reducing the costs compared with the systems previously considered. Also, in the earlier proposal, EPA was concerned that operation at wide open throttle would result in high temperatures that could quickly thermally degrade the catalyst. Since that time, EPA believes catalysts have been designed that operate well at sustained temperatures above 1100☜C. EPA's understanding is that marine engine exhaust generally has a maximum temperature of 750-850☜C at the exhaust ports.

Also, in the June 1996 Regulatory Impact Analysis, EPA did not consider the NOx reductions that could be achieved through exhaust gas recirculation. EPA's current estimates are that NOx could be reduced 40-50% over the marine E4 duty cycle by using EGR. Also, the wide spread use of electronic fuel injection offers manufacturers greater flexibility in calibrating their engines for low emissions.

2.4 Cost

Section 213(a)(3) of the Clean Air Act (CAA) requires EPA to "achieve the greatest degree of emission reduction achievable through the application of technology...giving

appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology."

The Panel received information about costs of compliance with emission standards from a variety of sources. The Panel provided SERs with preliminary estimates of the cost of implementing various emissions reduction technologies, and SERs commented that these estimates underestimated the expected costs of applying the technologies to their engines. The Panel also received comments about other compliance costs, such as testing of engines. In addition, SERs expressed concern that the emission reductions likely to be achieved by the rule would be small.

Because SERs had raised the issue of cost, the Panel felt motivated to consider this issue carefully in its deliberations. Accordingly, one Panel member, with consultation, prepared preliminary analyses of cost effectiveness and cost per engine. That analysis is presented in Appendix H of this report. The reader should note that the estimates in Appendix H are preliminary and that EPA has not independently confirmed the information underlying those estimates. The Panel expects that EPA will produce more refined cost and related estimates, which will supersede the preliminary estimates in Appendix H, as EPA develops more robust information during the course of its rulemaking.

The Panel recognizes that cost is an important factor for EPA to consider in setting standards under section 213(a), and carefully considered all of the information presented to it on the question of cost. Although the information and analysis presented in Appendix H was considered by the Panel, the Panel members did not reach a common view on the usefulness and appropriateness of that information as a way to determine and address this issue for small marinizers. (Nevertheless, in the interest of transparency and full disclosure, the Panel agreed to present this information in Appendix H.)

Also, based upon the preliminary information used in these analyses and other information before the Panel, particular concern was raised within the Panel with respect to small diesel engine marinizers in the lowest power grouping (37 to 225 kW). Cost per engine provides a measure of the differential impact of recreational marine engine regulations of small and large entities. The small firms could spend from approximately two to five times more per engine than large firms. Although the cost estimates and other factors impacting these analyses are preliminary, the Panel agrees that, in particular, it is important for EPA to evaluate, as it develops its proposed rule, whether small marinizers in this engine grouping would have inappropriately high cost impacts under the regulatory alternatives EPA plans to consider.

The Panel recognizes that EPA has not decided what technology will be an appropriate basis for an emissions standard for each engine grouping. In addition, the various burden

reduction measures discussed in the report would affect the cost impact on small marinizers of any proposed emission standard. The Panel agrees that in evaluating these and other issues relevant to setting a standard for this rule, it is important that EPA consider, for each engine grouping, whether small marinizers would be subject to inappropriately high cost impacts.

2.5 Emissions Levels for Other Mobile Source Categories

Table 1 presents EPA estimates of NOx, HC, and PM mobile source inventories in calendar year 2000. According to these EPA figures, recreational CI marine and SD/I SI marine combined make up about 0.5% of the HC+NOx and 0.1% of the PM emissions from mobile sources nationally. Note that these estimates for recreational marine engines (as well as for other sources) may be updated as EPA receives new information or improves on its analyses of existing information. Also note that EPA believes that these recreational marine engines could represent more significant portions of the inventory in specific geographic areas where they tend to operate such as port cities.

Table 1: 2000 Annual Emissions Levels for Mobile Source Categories (thousand short tons)

Category	NOx		HC		PM		Source
	thousand short tons	percent	thousand short tons	percent	thousand short tons	percent	
Nonroad SI > 19 kW	227	1.7%	57	0.8%	3	0.4%	a
Recreational Equipment	25	0.2%	1,100	15%	16	2%	a
Nonroad SI < 19 kW	82	0.7%	623	8%	14	2%	a
Marine SI OB/PWC	7	0.1%	559	7%	not reported	--	b
Marine SI SD/I	41	0.3%	26	0.3%		--	b
Nonroad CI	2,900	24%	350	5%	292	43%	c
Marine CI commercial	975	8%	30	0.4%	41	6%	d
Marine CI recreational	30	0.2%	1	0.0%	1	0.1%	d
Locomotive	1,190	10%	47	0.6%	30	4%	e
Aircraft	178	1.5%	183	2%	39	6%	f
Total Nonroad	5,655	47%	2,975	40%	436	65%	--
Total Highway	6,397	53%	4,482	60%	238	35%	f
Mobile Source	12,052	100%	7,457	100%	674	100%	--

a. Notice of Proposed Finding, "Control of Emissions From New Nonroad Spark-Ignition Engines Rated Above 19 Kilowatts and New Land-Based Recreational Spark-Ignition Engines," Federal Register, p. 6008, February 8, 1999.
b. Regulatory Impact Analysis, "Control of Air Pollution Emission Standards for New Nonroad Spark-Ignition Marine Engines," June 1996.
c. Regulatory Impact Analysis, "Control of Emissions from Nonroad Diesel Engines," August 1998.
d. Draft Regulatory Impact Analysis, "Control of Emissions from Compression-Ignition Marine Engines," November 1998.
e. Regulatory Support Document, "Locomotive Emission Standards," April 1998.
f. "National Air Pollutant Emission Trends, 1900-1996," December 1997.

3. Overview of Proposed Program Under Consideration

3.1 Program Likely to be Proposed

EPA intends to propose emission standards for new recreational compression-ignition marine engines ≤ 37 kW and new sterndrive/inboard spark-ignition marine engines. In developing these standards, EPA is considering not only the potential emission reductions which are technologically feasible, but also the effects that these standards would have on cost, safety, noise, and energy. Because of the important role of small businesses in the recreational marine industry, EPA believes that it is critical that small business concerns be addressed in this rulemaking.

3.1.1 Compression-Ignition Engines

EPA plans to propose emissions standards for recreational compression-ignition engines by November 23, 1999 and to finalize the requirements by October 31, 2000. The following is a list of emission control technology that EPA believes can be used to control emissions from compression-ignition marine engines. EPA believes that at least three of these technologies are used on many recreational diesel marine engines today. Therefore, at the time this information was supplied to the Panel, EPA considered the costs of electronic fuel management and high pressure fuel injection as the only incremental technology costs attributable to this anticipated rulemaking.

- timing retard
- turbocharging
- raw-water/separate circuit aftercooling
- electronic fuel management
- high pressure fuel injection

EPA recognizes that recreational marine engines are used differently from commercial marine engines. This is especially true for planing versus displacement hull applications. Recreational marine engines are generally designed for a high power-to-weight ratio while commercial marine engines sacrifice power to gain longevity. Based on the differences in use, EPA estimates that brake-specific HC+NOx from a recreational marine engine is generally 10-15% higher than from a commercial marine engine. This will likely be reflected in the proposed standards.

In considering emission standards for recreational CI marine engines, EPA also estimatedthe baseline emission levels. These baseline emission levels were developed from the data that EPA presented to the SERs. EPA used data on several marine engines (almost all commercial) tested on both the E3 (commercial) and E5 (recreational) test cycles to determine the recreational CI marine engine HC+NOx baseline. Using the data on each of these two test

cycles, EPA determined that engines on the recreational test cycles would on average produce emissions that are 14% higher than those when tested on the commercial engine test cycle. Therefore, EPA adjusted the commercial engine HC+NOx baseline up 14% to reflect recreational applications. These data include engines mostly built from 1994 to 1999, and do not necessarily reflect the baseline emission levels at the time that the proposed rule would go into effect. These test engines may or may not represent engines typical of those currently produced by the industry.

3.1.2 Spark-Ignition Engines

EPA also plans to include sterndrive and inboard SI marine engines in this rulemaking. SD/I engine marinizers are beginning to make widespread use of electronic fuel injection to optimize performance and fuel consumption. This technology can also be used to reduce emissions. In addition, EPA believes that exhaust gas recirculation can reduce NOx emissions by about 50% in SD/I engines. EPA is also considering the benefits of placing a small three-way catalyst into the exhaust manifold prior to where the water and exhaust mix (Figure 1). Catalyst manufacturers have indicated that a catalyst could be provided for this application which would withstand the thermal and mechanical stresses and would result in a 30-50% reduction in HC, NOx, and CO. EPA will be working with CARB, engine manufacturers, catalyst manufacturers, and other stakeholders to evaluate the emissions performance of potential emission control equipment including catalysts. This analysis will consider impacts on performance, safety, and related issues.

In considering emission standards for SD/I marine engines EPA also looked at emission data. These estimates of baseline emission levels were developed from the data on 8 engines built from 1992 to 1995 that EPA presented to the SERs. This data was consistent with test data submitted confidentially to EPA on several other SD/I engines. The test engines covered a wide range of technology including carburetion, throttle-body fuel injection, multi-port fuel injection, and included baseline and low HC/CO calibrations for the BSO standards. The test engines may or may not represent engines typical of those currently produced by the industry.

Some manufacturers have stated that baseline emissions have increased since this information was collected because they have been designing for low CO emissions. If engines are calibrated for low CO without consideration of NOx, then NOx emissions are likely to increase. Based on data that EPA has presented to the SERs, HC+NOx levels range from 13 to 22 g/kW-hr

with an average of 16 g/kW-hr, with CO levels that ranged from 44 to 247 g/kW-hr. The engine with the lowest CO had an HC+NOx level of less than 16 g/kW-hr. Data presented by one SER showed even lower CO with an HC+NOx level under 12 g/kW-hr. EPA's primary goal in developing this rule is the reduction of the ozone precursors HC and NOx. However, through the use of EGR and catalytic control, EPA believes that manufacturers will have more flexibility in how CO is addressed in combination with HC+NOx control if they wish to reduce CO below the baseline cap that EPA is considering. EPA will consider any other available emissions test data in determining baseline and potential emission levels.

The intent of the catalyst packaging design described in Figure 1 is to minimize costs by not requiring the manufacturer to rework the entire exhaust system and, for sterndrives, rework the lower power unit as well. While fitting a catalyst into a marine exhaust system is a relatively new idea, EPA believes it can be accomplished in a way that avoids adverse effects on engine safety, durability, and performance characteristics. EPA recognizes the importance of these factors, especially safety. A more detailed discussion of the Agency's current position on safety, durability, and performance issues can be found in Appendix A. The Panel held a technical meeting to discuss these issues in greater detail with the industry as a whole on June 30, 1999. This meeting included representatives of the catalyst manufacturers, the U.S. Coast Guard, EPA, and the marine industry. The Agency intends to continue its dialogue and data collection from interested parties including the recreational marine industry, the Coast Guard and catalyst manufacturers as it develops its proposed and final rulemakings.

Through a joint effort with CARB, Southwest Research Institute (SwRI), General Motors, Mercruiser and MECA, EPA is preparing to test a marine engine in a test cell with both EGR and catalyst technology. The goal of this testing is proof of concept. As part of this testing, temperatures and pressures relevant to safety, durability, and performance will also be measured; other testing may also be necessary to support the rule. Because of the uncertainties in applying catalyst technology to recreational marine engines, EPA has stated it plans to include in the proposal as a regulatory alternative a set of standards that do not anticipate use of catalysts.

EPA will carefully consider the impacts of its regulations on the safety, durability, and performance of marine engines.

3.2 Other Recreational Marine Standards Considered by EPA

EPA is aware of other recreational marine emission standards either in place or being developed world wide. EPA recognizes the value of harmonization of emission control programs where the standards meet the Clean Air Act requirements. The other emissions limits (shown for a 300 kW, 4-stroke engine) are described in Table 2:

Table 2: Status of Other Exhaust Emission Standards for Recreational Marine

Organization	Status	Type	HC g/kW-hr	NOx g/kW-hr	CO g/kW-hr	PM g/kW-hr
European Union	Proposed	CI	1.5	9.8	5.0	1.0
		SI	6.4	15	152	--
International Bodensee Shipping Commission	Stage 2	CI	1.2	10	20	smoke*
		SI	1.2	5.0	20	--
		both	95 g/hr	360 g/hr	1500 g/hr	
California Air Resources Board	Pre-proposal	SI	not yet proposed			

* Bosch blackening number of 3.5/2.5 for naturally aspirated/turbocharged engines

EPA understands that, for a manufacturer marketing the same basic engine design of engine in both the United States and in Europe, complying only with the EU level of stringency would likely allow for an engine and emission control system that is easier to design and less expensive to build compared to an engine and emission control system designed and constructed to meet the more stringent level of standards being considered by EPA. Furthermore, while such engine manufacturers could choose to build one version of the engine designed to meet U.S. standards and then market it in both the U.S. and Europe, if the U.S. version is most costly, this could adversely affect the competitive market position of the manufacturer when selling the engine in Europe and competing against engine designs only satisfying the EU performance requirements. Conversely, if the manufacturer chose to design a separate version targeted to EU standards, this would likely represent an increase in design cost (perhaps significant) to provide two versions of the same engine. Thus, the small engine manufacturer marketing in both areas might be reduced costs if U.S. and EU standards were harmonized.

In considering the standards proposed by the European Union, EPA is concerned that no significant emissions reduction would be achieved. These data are presented in Figures 2 and 3 for fourteen diesel (almost all commercial) marine engines tested on the recreational duty cycle and for eight gasoline SD/I marine engines. However, EPA also recognizes that the baseline estimates are subject to uncertainty because the available information from older engines is limited and will reevaluate its views if additional data becomes available. EPA believes it is unlikely that these proposed standards would attain the appropriate reductions from this category required to meet the Clean Air Act's mandate to set standards that achieve the greatest degree of emission reduction achievable considering cost, availability of technology, noise, energy, and safety.

Figure 2: Diesel Marine Engine Emissions Tested on the ISOE5 Compared to the Proposed EU Standard

Tested on the ISOE4 Compared to the Proposed EU Standard

The Bodensee emissions limits are focused on preserving water quality by achieving low hydrocarbon levels from boats operated on Lake Constance in Europe. EPA's goal is to reduce the ozone precursors HC and NOx with a focus on NOx. If EPA were to adopted the Bodensee limits, the very low HC limits would likely drive SI engines from the market while the relaxed NOx levels would not achieve the maximum achievable reductions in ozone formation. Also, the g/hr standards would essentially limit the size of engines permitted to be sold in the U.S.

EPA is working with CARB in developing this proposal for recreational marine exhaust emissions. EPA's goal is to harmonize with California to the extent practicable and appropriate under the CAA.

3.3 Overview of Burden Reduction Approaches Designed for Small Marinizers

On June 16, 1999, the EPA provided the Small Entity Representatives with an overview of some potential approaches for small marinizers and boat builders (see Appendix B). The following is a brief discussion of those approaches. Additional burden reduction approaches are also discussed below (3.3.8 - 3.3.10).

3.3.1 Broaden Engine Families

This approach would allow small marinizers to put all of their models into one engine family (or more) for certification purposes.

3.3.2 Minimize Compliance Related Requirements

This approach would waive production line and deterioration testing for small marinizers. EPA would assign a deterioration factor for use in calculating end of life emission factors for certification.

3.3.3 Expand Engine Dresser Flexibility

This approach would allow marinized versions of certified nonroad engines to be considered "dressed" engines that would not have to be recertified provided the marinization process does not change engine emissions (e.g., adding water-cooled exhaust, but matching manufacturer specifications for cooling and restriction pressure). This possibly could be expanded to include water-cooled turbochargers where the goal of the design is to match the original turbocharger performance.

3.3.4 Design Based Certification

This approach would allow small marinizers to certify to a performance standard by showing their engines meet design criteria rather than by certification testing.

3.3.5 Delay Standards for Small Businesses for Five Years

This approach would exempt small marinizers from complying with the standards for five years beyond the initial compliance date. After this time period, the proposed standards would apply.

3.3.6 Hardship Provisions

There are two parts to this approach. The first part of this approach would allow small marinizers to petition EPA for additional time to comply with the standards. These marinizers would have to make the case that the burden of compliance costs would have a major impact on the company. If a certified base engine were available, the marinizer would have to use this engine. The second part of this approach would allow small marinizers to apply for hardship relief if circumstances outside their control cause the failure to comply (e.g., if a supply contract was broken by a parts supplier) and if failure to sell the subject engines would have a major impact on the company's solvency.

3.3.7 Averaging, Banking, & Trading of Emission Credits

This approach would allow the use of credits by some engines to be offset by the generation of credits by other engines in the same regulatory program. Averaging would allow manufacturers to use positive credits from engine families below the standard to offset negative credits from engine families above the standard. Banking would allow manufacturers to save emission credits for use in the future. Trading would allow manufacturers to purchase credits from other manufacturers of similar engines to cover their own shortfalls. ABT would be allowed among gasoline SD/I engines and among recreational diesel engines, but would not be allowed between gasoline and diesel engines.

3.3.8 Exemption of Small Diesel Engines for Small Marinizers

This approach was suggested by SBA after the June 16 overview distributed to SERs for their comment. This approach would exempt small marinizers who produce the smallest class of diesel engines (37 - 225 kW diesel engines) from the proposed standards.

3.3.9 Adoption of EU or Other International Standards for Small Marinizers

This approach was suggested by SBA after the June 16 overview distributed to SERs for their comment. Under this approach, small marinizers would be subject to the EU or other international standards, as a means of harmonizing the EPA approach with other international standards. This approach would allow engine marinizers to design to both US and other international standards for one or both categories.

3.3.10 No Standard for Small Marinizers

This approach was suggested by SBA after the June 16 overview distributed to SERs for their comment. SBA suggested that, if EPA finds that there are no additional emission reductions that can reasonably be required from recreational marine engines or makes a new finding that these engines do not "cause or contribute to air pollution," he Agency could elect not to propose or promulgate regulations for one or both of these categories.

3.4 Overview of Burden Reduction Approaches Designed for Small Boat Builders

Four burden reduction approaches are being considered by the Agency for small boat builders.

1) Percentage of Production Exemption: Over a period of 5-7 years, small boat builders would be able to sell uncertified engines in boats for an amount equal to 80 percent of engine sales for one year. For example, if the small boat builder sells 100 engines per year, a total of 80 uncertified engines may be sold over the 5-7 year period.

2) Small Volume Allowance: For small boat builders with annual sales much less than those covered by example in the approach discussed above, the 80% allowance described above could be exceeded provided that the sales do not exceed the following limits in their size range:

engine type	engine size range	maximum engines exempted
spark-ignition	< 400 kW	70 in 5-7 years/20 per year
	≥ 400 kW	70 in 5-7 years/20 per year
compression-ignition	< 1.2 liters/cylinder	20 in 5-7 years/10 per year
	1.2-2.5 liters/cylinder	20 in 5-7 years/10 per year
	> 2.5 liters/cylinder	no small volume exemption

3) Existing Inventory and Replacement Engine Allowance: Small boat builders would be able to sell existing inventory after the implementation date of the new standards and would be able to sell replacement engines comparable to the original engine. However, no purposeful stockpiling of uncertified engines would be permitted.

4) Hardship Relief Provision: Small boat builders could apply for hardship relief if circumstances outside their control caused the failure to comply (i.e., supply contract broken by engine supplier) and if failure to sell the subject vessels would have a major impact on the company's solvency. This relief would allow the boat builder to use an uncertified engine and would be considered a mechanism of last resort.

4. Industries that May be Subject to the Proposed Regulation

Persons or companies potentially regulated by this action are those that manufacture or introduce into commerce new sterndrive and inboard SI marine engines and recreational compression-ignition marine engines and those that make vessels using such engines.

In general, the companies that manufacture recreational vessels would only be responsible for ensuring that the engines they install have been certified as meeting the proposed emission control requirements. They are potentially affected by the proposed rule to the extent that physical changes to the engines require changes to their vessel designs. However, by relaxing the recreational compression ignition standards compared to the proposed commercial marine engine standards, EPA believes that no significant decrease in power-to-weight ratio will result from new emission standards. Also, the technology itself should have no significant effects on the packaging of the engine in the boat. For spark-ignition engines, EPA does not believe that the technology under consideration will significantly affect the engine size, power, or weight. EPA expects to propose a rule that would not significantly affect engine size, power, or weight, although EPA is still in the process of developing the proposal.

The Agency is in the process of developing the industry characterization of the impacted entities. Identification of every small engine manufacturer and boat builder is difficult due to the complex nature of the marine industry. Mergers and buy-outs are fairly common in this industry, and many smaller engine manufacturers move in and out of the recreational segment of the

market. The Agency believes that it has identified all of the large companies and most or all of the smaller companies that manufacture or marinize marine engines.

Table 3: Primary SBA Small Business Categories Potentially Impacted by this Proposed Regulation

SIC Code	*Description*	*Size Standard*
3519	Internal Combustion Engines	1000 employees
3732	Boat Building and Repairing	500 employees

4.1 Small Diesel Engine Manufacturers

The Agency has determined that there are at least 14 companies that manufacture CI diesel engines for recreational vessels. Six of the identified companies are considered small businesses as defined by SBA SIC code 3519. Nearly 75 percent of diesel engines sales for recreational vessels in 1997 can be attributed to three large companies. Based on sales data for 1997, these six companies represent approximately 4 percent of recreational marine diesel engine sales. The remaining 21 percent of sales is spread across five companies, each which comprises between two and seven percent of sales for 1997.

4.2 Small Gasoline Engine Manufacturers

The Agency has determined that there are at least 17 companies that manufacture SD/I gasoline engines for recreational vessels. Fifteen of the identified companies are considered small businesses as defined by SBA SIC code 3519. These 15 companies represent approximately 6 percent of recreational gasoline marine engines sales for 1998. Nearly 78 percent of gasoline SD/I engines manufactured in 1998 can be attributed to one company. The next largest company is responsible for the remaining 16 percent of 1998 sales.

4.3 Small Recreational Boat Builders

The Agency has less precise information about recreational boat builders than is available about engine manufacturers. The Agency has utilized several sources, including trade associations and Internet sites when identifying entities that build and/or sell recreational boats. The Agency is also working with an independent contractor to assist in the characterization of this segment of the industry. To date, our research indicates that there are at least 165 boat builders that may install recreational gasoline and diesel engines that would be subject to the proposed

requirements outlined above. Approximately 98 % of the companies identified so far would be considered small businesses as defined by SBA SIC code 3732. The Agency continues to develop a more complete picture of this segment of the industry and will provide additional information as it becomes available.

Based on information supplied by a variety of recreational boat builders, recreational marine engines are usually purchased from factory authorized distribution centers. The boat builder provides the specifications to the distributor who helps match an engine for a particular application. It is the boat builder's responsibility to fit the engine into their vessel design. The reason for this is that sales to boat builders are a very small part of engine manufacturers' total engine sales. These engines are not generally interchangeable from one design to the next. Recreational boat builder have their own designs. In general, a boat builder will design one or two molds that are intended to last 5-8 years. Very few changes are tolerated in the molds because of the costs of building and retooling them.

5. Summary of Small Entity Outreach

5.1 Pre-Panel Outreach

Prior to convening the Panel, the Agency conducted several meetings and conference calls with entities potentially impacted by this regulation. Fact sheets and other handouts were also distributed in March of 1999 to entities potentially impacted by the regulations. Some meetings and conference calls were held in the summer of 1998 when the Agency was considering whether to include recreational marine engines in its marine CI rulemaking. During the development of the CI marine engine rulemaking, the Agency became aware of the potential small business implications for recreational boat builders and engine manufacturers and decided to address recreational marine engine emissions standards in a separate rulemaking. A briefing for Small Entity Representatives was held on May 11, 1999 at EPA's Office of Mobile Sources in Washington, DC. A summary of this meeting and the written comments received as a result of this meeting can be found in Appendix C.

5.2 Small Entity Representative Conference Calls and Meetings

On June 16, 1999, EPA distributed a package of information to the SERs for their review and comment. A list of these documents can be found in Appendix D. The SERs were asked to review the information package and to provide any additional comments to the Panel during the follow-up conference call and by submitting written comment by July 9, 1999. Written SER comments were also received after this date and are listed in Table 4. These SER written comments are summarized in section 7. The first Panel outreach meeting was held on June 29, 1999 and the second follow-up SER conference call was held on July 6, 1999. A summary of the June 29 meeting can be found in Appendix E and the summary of the July 6 conference call can be

found in Appendix F. Additionally, a site visit for the Panel was conducted on July 27, 1999 at Indmar Products, Inc. in Memphis, TN.

6. Small-Entity Representatives

EPA, in consultation with SBA, invited the following 16 SERs to participate in its SBREFA consultation process.

Bill Lawson Daytona Marine Ormond Beach, FL	Paolo Vidoli FDGM Chesapeake, VA	Dick Rowe Indmar Products Millington, TN
Dick Wlezien Volvo Penta Chesapeake, VA	Jeff Ng Westerbeke Avon, MA	Tom Fileman Flagship Marine Punta Gorda, FL
Greg Kirkland KEM Equipment, Inc Tualatin, OR	Bishop Jordan Panther Marine Engines Cocoa, FL	Tony Martens and Jim Viestanz KCS International Inc. Oconto, WI
Dennis Corbett Orca Yachts Chessapeake, VA	John Brooks and Buck Peg Chaparral Boats Nashville, GA	Stan Blair Viking Yachts New Gretna, NJ
Randy Gills Regal Marine Industries Orlando, FL	Doug McElroy Alaska Diesel Seattle, WA	Dan Springer Tiara Yachts Holland, MI

John McKnight
National Marine Manufacturers Association
Washington, DC

7. Summary of Comments from SERs

The Panel received six sets of written comments in response to the June 29, 1999 and July 6, 1999 SER outreach meetings. Table 4 provides a record of the comments and is followed by a summary of the main issues raised by the SERs in their written submittals. The complete written comments are provided in Appendix G . Also summarized are the oral comments from the two SER outreach meetings held on June 29, 1999 and July 6, 1999. Complete summaries of these meetings can be found in Appendices E and F.

Table 4: List of SER Written Comments

Name	Organization	Date Received	Number of Pages
Greg H. Kirkland	KEM Equipment, Inc	7/7/99	1
Doug McElroy	Alaska Diesel Electric	7/9/99	5
Richard C. Rowe	Indmar Products, Inc	7/9/99	26
John W. Brooks	Chaparral Boats, Inc	7/12/99	1
John McKnight	National Marine Manufacturers Association	7/12/99	41
John McKnight	National Marine Manufacturers Association	7/21/99	2
Doug McElroy	Alaska Diesel	8/3/99	2
John McKnight	National Marine Manufacturers Association	8/5/99	2

7.1 Number and Types of Entities Affected

No SER comments were received on this issue, either in writing or from the SER outreach meetings.

7.2 Potential Reporting, Record Keeping and Compliance Requirements

No SER comments were received on this issue, either in writing or from the SER outreach meetings.

7.3 Related Federal Rules

No SER comments were received on this issue, either in writing or from the SER outreach meetings.

7.4 Regulatory Alternatives

7.4.1 Burden Reduction Approaches for Small Marinizers

Sections 7.4.1.1 through 7.4.1.7 are SER responses to conceptual approaches presented to them by the Panel. Sections 7.4.1.8 through 7.4.1.10 present approaches developed in response to SER comments, although these approaches were not presented to SERs.

7.4.1.1 Broaden Engine Families

Two written SER comments were received on this issue. Neither comment expressed support for this approach. One SER commented that broadening engine families provides little or no flexibility for small marinizers. Under this approach, engine manufacturers or boat builders would have to choose a "worst case emitter" which cannot accurately be based on fuel throughput or on an accurate fail-safe test design protocol. Engine manufacturers would be certifying that their engines meet an emission standard and would face liability of unknowingly selling an engine that does not meet the standard. This is a risk that few manufacturers would be willing to take. Another SER commented that broadening engine families based on small business status would put them at a competitive disadvantage. Similar comments were received from the SERs at the outreach meetings.

7.4.1.2 Minimize Compliance Related Requirements

Three written SER comments were received on this issue. One SER comment expressed support for minimizing compliance requirements. The other two SER comments were not in support of this approach. One of these SERs commented that eliminating some of the steps in the compliance process may reduce or eliminate cost, but may also increase the liability of being out of compliance. The other SER that did not support this approach commented that minimizing compliance requirements for small businesses would put them at a competitive disadvantage. Therefore, minimizing compliance requirements may offer little or no benefit to small engine marinizers according to these two SERs. At the SER outreach meetings, no opposition was expressed to this approach.

7.4.1.3 Expand Engine Dresser Definition

Two written SER comments were received on this issue. One SER expressed support for the additional allowance of adding turbocharging. This commenter also expressed interest in discussing additional engine changes that could be made without requiring certification. The other SER commented that expanding engine dresser flexibilities based on small business status would put them at a competitive disadvantage. No opposition was expressed on this approach at the SER outreach meetings.

7.4.1.4 Design Based Certification

There were three written SER comments in support of design based certification which would eliminate certification testing of engine families by the small business. One SER commented that any regulation requiring certification, production line or in-use testing would place undue economic burden on small gasoline and diesel recreational marine marinizers because of smaller number of units over which to spread the costs of these tests.

7.4.1.5 Delay Standards for Small Businesses for Five Years

There were two written SER comments on this issues. Neither comment supported this approach. Both of these SERs commented that this approach could create a marketing disadvantage for small businesses. Larger businesses could market their engines as "clean" engines, which may be appealing to some customers. Similar concerns on this approach were also raised by two SERs at the SER outreach meetings. However, one SER indicated that although boat manufacturers wanted to be able to advertise their boats as equipped with “clean” engines, consumers would likely not be willing to pay extra for a so-called clean engine. In contrast, two other SERs suggested that a five year delay would not necessarily put their businesses at a competitive disadvantage. These two SERs specialize in high performance engines and there is currently little competition in this segment of the marine market.

7.4.1.6 Hardship Provisions

There were two written SER comments received on this issue. Both commenters expressed support for this approach for small businesses that may have difficulty complying with the regulation. Support for this approach was also expressed at the SER outreach meetings

7.4.1.7 Averaging, Banking, and Trading

One SER written comment was received on this approach. This comment stated that ABT offers little benefit to small marine engine manufacturers and will create a competitive disadvantage as they compete against larger businesses. The one written SER comment received on this approach was not in support of ABT. The commenter expressed concern that large businesses would be able to average or trade credits among engines, possibly without having to make any improvements to a family of engines. For small businesses, the amount of engine testing that would be required to effectively account for credits would be cost prohibitive, particularly for diesel engine manufacturers.

7.4.1.8 Exemption of Small Diesel Engines for Small Marinizers

No SER comments were received on this issue, either in writing or from the SER outreach meetings. This option was not presented to SERs for discussion.

7.4.1.9 Adoption of EU or Other International Standards for Small Marinizers

This option was not presented to SERs for discussion. However, SERs stated that they would prefer that EPA adopt EU standards than something more stringent. They commented that having to meet more stringent standards in the U.S. would put them at a competitive disadvantage

with foreign firms in foreign markets. They were also concerned that if unregulated foreign boats were less expensive, they would be sold illegally in the U.S which would also result in a competitive disadvantage.

7.4.1.10 No Standard for Small Marinizers

This option was not presented to SERs for discussion. SERs commented that the fraction of the pollution in the U.S. is small from their engines so they should not be regulated. However, some SERs were concerned that this would put them at a competitive disadvantage with large manufacturers who could advertize their engines as cleaner than the engines that are not designed for emission standards.

7.4.2 Burden Reduction Approaches for Small Boat Builders

Two general written SER comments were received on the burden reduction approaches for small boat builders. Both of these comments expressed support for regulations that would be transparent to boat builders due to the high cost of retooling of hull molds that may be needed to accommodate changes in engine design or size. One of these SER comments goes on to state that boat builders will soon have to meet other requirements under the Clean Air Act (e.g. resin, gel coat and application equipment) and to impose additional burden on this sector of the industry would pose an undue burden on small businesses. In addition, this SER also commented that manufacturers must be able to continue to use old engine inventories until they are depleted. The position that EPA regulations be transparent to boat builders was supported by the SERs at the outreach meetings.

Discussion of the flexibilities for small boat builders was conducted at a meeting held for the SERs on July 6, 1999. SERs were given the opportunity to comment on the potential boat builder flexibilities presented to them. There was no SER opposition to the flexibilities, although several SERs reiterated their concern that any regulations promulgated by EPA should be transparent to boat builders.

7.5 Other Issues

7.5.1 Recreational Marine Test Data

Two written SER comments were received on this issue. One of the comments stated that some of the data shown for gasoline engines are from engines that are outdated or no longer exist. This commenter suggested that the baseline for gasoline engines is close to 20 g/kW-hr HC + NOx. This comment stated that if EPA intends to use these data, it needs to consider that lowering CO levels elevates NOx levels. The commenter stated that the industry as a whole has lowered HC levels to address customer complaints of soot. This causes NOx to increase, but the visible environmental concerns of soot have already been addressed. This commenter

recommended that EPA establish a new baseline with more current data. Additionally, this commenter stated that EPA needs to consider the effect that the current trend of lowering HC and CO levels has had on NOx.

Regarding the data provided to the SERs on diesel marine engines tested on the E5 test cycle, this commenter expressed concern with EPA's endorsement of the attributes of seawater cooling and EPA's failure to consider any of the negative attributes. Both commenters stated that diesel engine manufacturers use jacket water aftercooling to cool the charge air at high load and to warm it during light load periods. This process reduces white smoke, and low load carbon deposition, and lengthens overall engine and component life expectancy. Commenters contended that regulations requiring manufacturers to change to seawater aftercooling to address NOx emissions will result in a tradeoff in quality and visible pollution; no data were provided or offered.

7.5.2 Effects of Transient Operations on Emissions from Inboard Engines

Two written SER comments were received on this issue. One commenter stated that transient testing for marine engines is not necessary, beneficial or economically feasible. This comment stated that the test cycle will not be duplicated in the real world, thereby making transient testing unnecessary. The other commenter stated that transient operation can affect diesel emissions as well because of changing temperatures. Both SERs commented that transient emissions are sensitive to the aftercooler design.

7.5.3. Cost Issues

7.5.3.1 Draft Hardware Cost Estimates for SD/I Marine Engines

Two written SER comments were received on this issue. One commenter stated that any cost estimates are hypothetical until further testing can be done on the performance of catalysts in the marine environment. The burden for R&D, retooling, custom catalysts, and marinizing all associated support equipment will fall on each individual small business, which has fewer engines over which to spread these costs.

This commenter also stated that the port fuel injection estimates need to be adjusted to reflect the General Motors price list, which supplies 98% of the marine engines and the majority of electronic fuel injection components used for sterndrive and inboard applications. The commenter stated that using these numbers, the contract cost data are underestimated by approximately 40%.

This commenter also stated that there were parts that were omitted from the contractor cost estimates (e.g., TBI adapters, TBI linkages, cool fuel systems on fuel injected engines to

prevent vapor lock, ignition control modules for carbureted engines).

This commenter also stated that the contractor has underestimated the costs of R&D and retooling incurred by GM. The commenter also stated that these costs are underestimated by a factor of 7 for engine marinizers.

The other SER comment received on this issue states that the contractor costs are underestimated for EGR, catalysts, retooling and validation testing for small businesses.

This issue was discussed at the SER outreach meeting. One commenter stated that any cost analyses conducted for this regulation are premature until impacts of safety, durability, and performance are fully considered. Another commenter echoed the written comments with regards to the hardware numbers being incorrect or underestimated. Comments at the SER outreach meetings also stated that the cost numbers presented in the information provided to the SERs only take into account larger sales volume engine families.

7.5.3.2 Incremental Cost Estimates for Marine Diesel Engine Technology Improvements

One written SER comment was received on this issue. This commenter stated that requiring seawater aftercooling to engines that are already using jacket water aftercooling would involve very high retooling and R&D costs to be spread across very low engine volumes. The commenter stated that consideration must be given to the cost of applying these technologies compared to the environmental benefit that may be gained. The commenter provided an example of one small diesel engine marinizer that would incur tooling and R&D costs of between $584 - $795 per engine to apply seawater after cooling. SER comments provided on this issue at the SER outreach meetings were similar to the written comments received.

7.5.3.3 Recreational Marine Diesel Costs

Three written SER comments were received on this issue. Two commenters stated that electronic fuel injection systems used in high speed marine diesels are a result of technology transfer from on-highway applications. Small marine diesel engine marinizers have not developed this technology and would face large research costs and would be at a technical disadvantage if EPA were to force this technology on the marine diesel industry. One of the commenters stated that small businesses do not have patents or rights to electronic fuel injection technology and recommend that EPA carefully consider electronics as a solution for NOx reductions from diesel marine engines. The third commenter stated that they could not predict the engine costs for this upcoming rule, but they believed that the commercial marine engine NPRM underestimated costs for those engines.

7.5.4 Catalyst Safety, Durability, and Performance Issues

Both industry representatives and catalyst manufacturers stated that many engineering challenges will arise in the development of a design for a safe, effective, and durable catalyst in a marine engine. SER comments focused on specific design concerns. These comments are arranged by design concern below.

Because tests have not been conducted in the marine environment, commenters suggested that EPA conduct this type of testing before moving forward with a catalyst-based emission standard. One commenter stated that segments of the industry are developing testing programs to test catalyst technology in the marine environment. This testing cannot be completed prior to the publication of the proposal and this commenter stated that putting forth a proposal that included catalyst-based technologies would be inappropriate given the lack of data.

Heat Exposure

Marinizers commented that they will not be able to control the temperature of a catalyst by varying the distance of the catalyst from the engine as in automotive applications. Under this scenario, EPA estimates that the catalyst would have to be near the exhaust ports and thus exposed to temperatures as high as 850°C. Marinizers were concerned that catalysts would deteriorate at these temperatures. The catalyst manufacturers replied that new catalyst designs remain effective at temperatures above 1100°C.

Heat Added to Engine Compartment

Vapor-Lock

Some industry representatives indicated that for SD/I engines using electronic fuel injection, designing to avoid vapor-lock is already a problem. They commented that this problem stems from fuel lines being heated to a temperature where the fuel begins to vaporize. As a result, the engine will not start. The primary source of this heat is from the engine, especially after shut-down when the cooling water is no longer flowing. Manufacturers indicated that this is made worse by the engines operating in small, poorly ventilated compartments. Some manufacturers have indicated that they use small coolers to keep the fuel line temperatures down. One industry representative suggested that vapor lock is really more an issue of what fuel the customer uses than it is of engine temperature. Industry representatives have stated that a hot catalyst can add to this problem since the exhaust system in which it is installed would not be water-cooled after the engine was turned off, thereby introducing more heat to the engine compartment.

Manufacturers stated that many engine designs already have border line borderline vapor-lock problems. Therefore, they are concerned that any heat added to the engine

compartment from a catalyst would increase vapor-lock. Catalyst manufacturers stated that, even for a perfect catalyst with 100% conversion efficiency, the exhaust temperatures at full power would not increase more that 100°C, and they stated that for the low efficiency designs considered by EPA, the exhaust stream temperature increase would be much less. They implied that any increase in exhaust system operating temperature would be slight, adding little to the thermal loading after engine shut off. Catalyst manufacturers stated that the actual heat load could be calculated. Marinizers indicated that testing would need to be performed on prototype engines to assess the magnitude of the vapor lock problem.

Surface Temperature

Marinizers also stated that they must meet surface temperature requirements on the engine and in the engine compartment. They expressed concern that large temperature increases, either during operation or right after engine shut down, could result in users being burned if they touch the engine or even in a risk of fire. They commented that they are especially concerned that if a catalyst were to melt down due to misfire or other some mechanism, that this would pose a safety risk. The commenters noted that the U.S. Coast Guard also stated that they would not accept a design that resulted in these sort of safety risks.

Exhaust Leaks

The commenters noted that the US Coast Guard has also expressed concern that if additional equipment and connections were needed to install catalysts, then more areas for potential exhaust leaks would be introduced. If such leaks were to develop, they would lead to increased carbon monoxide emissions aboard the vessel, and could pose potential harm to passengers. Although the catalyst design considered for the proposal does not require additional connections, manufacturers commented on one area of potential leaks. They stated that the two pieces of the manifold are joined where the catalyst would be placed. They commented that if the catalyst were not insulated well enough, the high temperatures could melt the seal between the manifold sections which could result in an exhaust leak.

Back Pressure

Manufacturers also expressed concern that placing a catalyst in the exhaust manifold would increase the back pressure in the exhaust. They stated that a back pressure increase would decrease engine power. Also they commented that they are limited by the size of their exhaust manifolds. They commented that they could not increase the size of the manifolds to accommodate larger catalysts and flow areas without causing changes in at least some boat designs. Specifically, they stated that some engine compartments would have to be made larger because some current designs allow just enough space to fit the engines. Manufacturers stated that an engine should be fit with a catalyst and the impacts of the catalyst on back pressure and

power should be observed.

Vibration

Industry representatives have stated that in the marine environment, the catalyst cannot be isolated from engine vibration because they would be mounted in the exhaust manifold. Industry representatives expressed concern that modern catalysts may not be able to withstand the large g-forces found in the exhaust manifold. The catalyst manufacturers stated that vibration would not be an issue for catalyst durability because the catalyst can be mounted in such a way as to separate it from engine vibration. The catalyst manufacturers cited successes with similar situations in motorcycles and chainsaws. Also, in-manifold catalysts are used in some automotive applications.

Water Ingestion to the Catalyst

Marinizers commented that a catalyst in the exhaust manifold would be subject to water ingestion, usually in the form of a mist. As described by the marinizers, this would occur since pressure pulses in the exhaust system would draw some water back towards the engine. They indicated that this is most severe when the engine is brought back to idle after operating at full power or when it is shut down. Marinizers stated that they have had designs where water has actually flowed back to the exhaust valves, but too much water flowing back through the exhaust manifold would have severe engine durability impacts. Also, they commented that water can back flow into the manifold due to user error such as immersing the lower end of the unit while putting the boat in the water.

Thermal Shock

Industry representatives questioned whether modern catalysts experience thermal shock as a result of cooling water coming into contact with a hot catalyst. Catalyst manufacturers indicated that there would be no long-term effects upon catalyst effectiveness due to thermal shock. One catalyst manufacturer described a test in which a ceramic catalyst heated to over 900°C was dropped into a bucket of water and there were no adverse effects on the catalyst's durability. The catalyst manufacturers indicated that even though the catalyst would not be active if it was cooled to far from quenching, that it would heat up quickly and would not be damaged when it was reactivated. Marine industry representatives commented that testing should be performed to determine the impact of thermal shock upon catalyst efficiency, and to develop a design whereby such impacts are minimized.

Salt Deposition

Industry representatives questioned whether modern catalysts and oxygen sensors could

withstand salt contamination by seawater coming into contact with the catalyst. Both industry representatives and catalyst manufacturers agree that modern catalysts cannot be effective if they are subject to an accumulation of salt, which can be caused by contact with salt water. Manufacturers cited SAE paper 951814, where researchers who immersed a catalyst in salt water found that the conversion efficiency dropped from 74% to 22% conversion efficiency. When a catalyst was immersed in fresh water, the efficiency did not suffer.

The catalyst manufacturers stated that salt deposition is worrisome to catalyst performance, but that salt could be washed off a catalyst. Industry representatives indicated that there would be no continuous washing of the catalyst with water but there would instead be a light trickle or spray of salt water. They commented that this would be enough salt water contacting the catalyst to lead to an accumulation of salt deposits but not a large enough volume of water to wash the salt off of the catalyst. Industry representatives indicated that they believe that only marine testing could determine the extent to which catalysts are adversely affected by salt deposition.

7.5.5 Recreational Marine Emission Reductions per Engine

Two written SER comments were received on this issue. One of the commenters stated that many recreational diesel engines are already using the EPA proposed technology to meet performance requirements. This commenter also stated that the emissions inventory used by EPA is flawed with regards to the hours of operation assumed for recreational marine diesel engines. The commenter stated that EPA's assumption that recreational marine diesel boats are operated between 175 and 500 hours is an overestimate. The commenter stated that recreational marine engines consumed approximately 4.0% of the fuel being consumed by all high speed CI marine engines in 1991. No SER comments were provided on this issue at the SER outreach meetings.

SERs also provided comment on the use of EGR in the marine environment. They commented that they did not think that large NOx reductions could be achieved over the E4 test procedure by using EGR technology because of the weight of idle and wide open throttle on the E4 cycle heavily influences the total emissions, but the EGR is not very effective during these modes. Also, one SER commented on the durability of EGR stating that if a boat sits unused for a long period of time, water could condense on the EGR valve causing it to corrode.

7.5.6 Other Recreational Marine Rules Considered by EPA

One written SER comment was received on this issue. This commenter stated that it has worked closely with EPA, the European Union (EU), the International Maritime Organization (IMO), and the Department of Commerce's Trans Atlantic Business Dialogue (TABD). The purpose of the commenter’s involvement with these entities is to ensure a level playing field for U.S. manufacturers and to work with these entities to set reasonable emissions standards. The

commenter stated that international trade harmonization is necessary for efficient regulation of private industry. In the era of transnational corporations and global economic integration, nation-based regulations are no longer rational or efficient and can create trade barriers.

This commenter also stated that, through the TABD process, the US has worked with the EU to adopt the functional equivalent of the EPA emissions standards for outboards and personal watercraft (OB/PWC). For recreational marine diesel emissions standards, the EU has adopted the functional equivalent of IMO standards. The commenter stated that, in order for the U.S. recreational marine industry to remain a world leader, it must be able to manufacturer, test, and certify an engine under one emission standard and be able to sell it anywhere in the world. Without this ability, U.S. boat builders and engine manufacturers will be at a competitive disadvantage and small businesses with limited resources will also be in jeopardy. Similar comments on this issue were also raised by several SERs at the SER outreach meetings.

7.5.7 Certification Costs for Varying Engine Family Size

One written SER comment was received on this issue. This commenter stated that the cost estimates need to be adjusted to better reflect actual costs incurred by marinizers. For example, the commenter states that EPA's estimate of the cost of the test needs to be adjusted to reflect the actual cost of the test described in the information provided to the SERs. Because there are changes made to the calibration during dynamometer testing, the engine also would need to be reevaluated in a boat. The commenter states that this is not accounted for in EPA's cost estimates. Additional examples are provided by the commenter of other costs it believed to be erroneous. The commenter also provided a table, which the commenter developed, of certification costs that the commenter believes more accurately represent the costs that would be incurred by small businesses. The commenter pointed out that certification costs for small engine families would be spread out across fewer engine sales and would therefore result in higher costs per engine.

7.5.8 Additional Comments Received

One written SER comment was received on the issue of efforts of the California Air Resources Board to accelerate the implementation of the EPA's onboard and personal watercraft (OB/PWC) emission requirements through a three-tiered program. The commenter stated that the third tier of the CARB standards require OB/PWC manufacturers to meet a very low emission requirement in 2008 that will require OB/PWC manufacturers to develop a marine emission capture technology, which at present appears to be catalyst technology. The commenter states that the EPA is considering a proposal that will require catalyst technology on SD/Is in 2005, well before CARB's requirements. The commenter stated EPA would be placing undue burden on small manufacturers, dependent on technology transfer, if they are forced to bear the brunt of developing technology to meet SD/I standards now being considered when larger companies in

the OB/PWC market will eventually have to develop such technology .

8. Panel Findings and Discussion

8.1 Number and Types of Small Entities

For a complete description and estimate of the small entities to which the proposed rule will likely apply, see Section 4. Marine engine manufacturers will be directly regulated under this proposal. It is unclear at this time whether or not boat builders will be directly regulated under this program. For this reason, the Panel recommends that flexibility concepts aimed at both engine marinizers and boat builders be considered.

8.2 Potential Reporting, Record Keeping, and Compliance Requirements

For any emission control program, EPA must have assurances that the regulated engines will meet the standards. Historically, EPA programs have included provisions placing manufacturers responsible for providing these assurances. The program that EPA is considering for marinizers would likely include testing, reporting, and record keeping requirements. Testing requirements for marinizers would likely include certification, production line, and deterioration testing. Reporting requirements would likely include test data and technical data on the engines including defect reporting. Manufacturers would have to keep records of this information.

8.3 Relevance of Other Federal Rules

The Panel is not aware of any other Federal rules that may duplicate, overlap, or conflict with the proposed rule.

8.4 Other Regulatory Alternatives

8.4.1 Burden Reduction Approaches Designed for Small Marinizers

8.4.1.1 Broaden Engine Families

This approach would allow small marinizers to put all of their models into one engine family (or more) for certification purposes. Marinizers would then certify their engines using the "worst case" configuration. Several SERs expressed concern at a meeting held on June 29, 1999 and in writing regarding this approach. SERs were concerned that, while this would reduce some of the certification testing, it would require manufacturers to identify and test a "worst case" engine configuration. The manufacturers would still have to perform some testing and would be responsible if they chose the "wrong" engine, which is a risk that most small manufacturers would

not be willing to take.

The Panel believes that this approach has historically reduced the burden in other regulated industries, but agrees that it might not be as useful in the marine industry due to the cost that would be incurred for testing even one engine and the potential liability faced by manufacturers. The Panel appreciates the concerns of the SERs that this approach provides limited value for this industry. However, EPA believes that this approach could help small marinizers that were not involved in this process. The Panel recommends that EPA request comment on this approach to allow for more wide spread public comment.

8.4.1.2 Minimize Compliance Requirements

This approach would waive deterioration testing during certification and production line testing for small marinizers. Deterioration testing could be replaced with either engineering judgment or an assigned deterioration factor by EPA. This issue was also discussed and written comments were received. One SER expressed written support for this approach. The two other written comments received on this issue were opposed to this approach. Commenters stated that eliminating some of the steps in the compliance process may reduce or eliminate cost, but may also increase the risk of being out of compliance. Therefore, minimizing compliance requirements offers little or no benefit to small engine marinizers. The other SER commented that minimizing compliance requirements for small businesses would put them at a competitive disadvantage.

The Panel believes the SER comments indicate that the manufacturer would be using certification testing (and perhaps production line testing) as an important part of its internal development and emissions performance assessment program. SERs commented that eliminating a requirement that manufacturers collect emission performance confirmatory data for this compliance program would also mean that the manufacturer would, for its own purposes, have insufficient data to allow it to determine the emission performance of its production. EPA generally believes that a manufacturer would fully develop its engines and emission control program prior to certification and thus would have already established for itself the expected emission performance of its engines. The subsequent compliance testing during certification and at the end of the production line then serves the purpose of demonstrating to EPA's satisfaction the emission performance of these engines. Reducing the amount of compliance demonstration testing should not substantially impact the manufacturer's own expectations for satisfactory emissions performance of these engines. At the same time, reducing these testing requirements should reduce cost to the manufacturer. For these reasons, the Panel recommends EPA propose reduced compliance testing requirements for small manufacturers.

8.4.1.3 Expand Engine Dresser Flexibility

The engine dresser approach allows marinized versions of certified nonroad engines to be

considered “dressed” engines and does not require further certification provided that the marinization process does not include changes expected to increase emissions. This concept would expand the definition of engine dressing used in the commercial marine NPRM to include other marinization changes, such as water-cooled turbocharging, provided that the goal is to match the original engine performance. This issue was discussed at the June 29, 1999 and several written comments were received. SERs provided support for this approach and stated that other marine technology may appropriately be included. The Panel recommends that this approach be proposed by the Agency with the approach expanded to include water-cooled turbochargers because, while we believe there is a risk of increased emissions, the benefit of this approach for small business outweighs this risk. The Panel also recommends that the Agency consider other recommendations that it may receive to expand this approach as appropriate during the rulemaking process.

8.4.1.4 Design Based Certification

This approach would allow small marinizers to certify to a performance standard by demonstrating that their engines meet design criteria rather than by emission testing. This issue was discussed at the June 29, 1999 meeting and written comments were also received. SERs expressed general support for this approach. Written comments stated that this approach addressed a primary concern of small businesses which would otherwise have to conduct costly certification and deterioration testing programs. However, written comments also stated that a design based certification requirement requiring catalyst technology concerns SERs because of the lack of data of catalyst durability and performance in the marine environment. EPA recognizes that a design based certification requirement has the potential to substantially reduce the fixed costs for small businesses.

For SD/Is, an example of a design-based certification requirement would be that the engine employs electronic fuel injection, EGR, and a catalyst in the exhaust manifold. It would be important that the A/F ratio and spark-timing were calibrated to ensure proper catalyst operation. Certain flow rates of EGR would be required at different engine speeds. Also catalyst specifications would have to be included such as, catalyst volume, cell density, washcoat formulation, and overall efficiency. The Panel recommends that EPA work with engine and catalyst manufacturers and with small gasoline engine marine marinizers to define these specifications and include them in the proposal for comment.

For recreational diesel engines, design-based certification requirements are less clear. The emission reduction strategies rely heavily on in-cylinder calibrations. Timing retard and charge air cooling are the primary NOx reduction strategies. Fuel injection strategy and turbocharging are the primary HC and PM reduction tools. It may not be feasible to specify criteria for ignition timing, charge air temperatures, and injection pressures that would ensure emission reductions from every engine. However, the Panel recommends that EPA work with small diesel engine

marinizers to try to develop meaningful design criteria for diesel engines and include them in the proposal, if possible.

8.4.1.5 Small Volume Exemptions

The Panel recommends that EPA request comment on the need for a 10 year exemption for a portion of the product line produced by small manufacturers of recreational marine engines considering that the approach discussed in section 8.4.1.6. may also be an option. This exemption would allow any small manufacturer to exempt 250 SD/I engines per year of their choice from having to comply with this rule for a period of up to 10 years. The Panel recognizes the difficulty the smallest manufacturers may have in redesigning their engines to meet these standards. Further, this delay in standards implementation will allow them additional time to redesign engines for niche market applications. The Panel points out that the total number of engines exempted via this provision would be less than an estimated 5% of gasoline recreational engines. One Panel member also notes that recreational marine engines eligible for this exemption contribute an estimated 0.02% of national NOx and HC emissions . Similarly, for small manufacturers of CI marine engines, the Panel recommends this exemption would be for 50 engines. However, the Panel recommends that these small volume exemptions would only be permitted if consistent with the requirements of section 213(a) to achieve the maximum emissions reductions consistent with costs and other relevant factors.

8.4.1.6 Delay Standards for Small Business for Five Years

This approach would exempt small marinizers from complying with the standards for a significant period of time, e.g. 5 years beyond the initial compliance date. After this time period, the standards would apply. This issue was discussed at the June 29, 1999 SER meeting. At this meeting two SERs expressed support for this approach. For these two SERs this approach makes sense for them because they would be able to delay development expenditures and spread this work out over a longer period of time. It was noted that these companies specialize in high performance engines, which is a segment of the marine engine market that would not be highly competitive with regards to emissions. Several other SERs expressed concern about this approach at the June 29 meeting and in their written comments. These SERs commented that it would create a marketing advantage for larger or more competitive segments of the industry by allowing them to market “clean” engines which may alter the purchasing decisions of consumers. However, SERs also have indicated that the potential cost increases required to meet stringent emission standards would also hurt sales. Presumably, during a five year delay these costs would be forgone, and therefore, during this time, putting the small volume manufacturer using this provision would avoid being placed at a cost and pricing advantage compared with other engine manufacturers. Also, the small engine manufacturer would likely benefit from technology advances adopted by other manufacturers, lowering their research and development and warranty costs.

Under this approach, manufacturers would be able to apply this delay to all or just a portion of their production. This way, they could still sell "clean" engines when possible on some product lines while delaying introduction of emission control technology on other product lines if necessary.

NMMA commented that OB/PWC manufacturers will need to develop catalyst technology for marine applications for 2008 to meet CARB requirements. They commented that if the standards were delayed beyond this date, the small businesses would benefit from the R&D work performed by the larger engine manufacturers. The 5-year delay for small businesses would have the advantage of fulfilling this request.

Given the difference in opinion regarding this approach, and the uncertainty surrounding its sales impact, the Panel recommends that EPA propose this approach in order to benefit from additional comments that may be submitted by the entire marine industry, including additional small businesses that were not directly involved in the SBAR Panel process.

8.4.1.7 Hardship Provisions

There are two parts to this approach. The first part of this approach would allow small marinizers to petition EPA for additional time to comply with the standards. These marinizers would have to make the case that the burden of compliance costs would have a significant impact on the company's solvency. Also, if a certified base engine were available, the marinizer would have to use this engine. The second part of this approach would allow small marinizers to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e. supply contract broken by parts supplier) and if failure to sell the subject engines would have a major impact on the company's solvency. There was no SER opposition to this approach, either in writing or at the June 29, 1999 meeting. The Panel recommends that the Agency propose this approach.

8.4.1.8 Averaging, Banking and Trading of Emission Credits

This approach would allow the use of credits by some engines to be offset by the generation of credits by other engines in the same regulatory program. Averaging would allow manufacturers to use positive credits from engine families below the standard to offset negative credits from engine families performing above the standard. Banking would allow manufacturers to save emission credits for use in the future. Trading would allow manufacturers to purchase credits from other manufacturers of similar engines to cover their own shortfalls. ABT would be allowed among gasoline SD/I engines and among recreational diesel engines, but would not be allowed between gasoline and diesel engines. EPA believes that trading between gasoline and diesel could provide manufacturers who produce both a competitive advantage over those who

produce only gasoline or only diesel engines. There were no SER responses to this approach at the June 29 meeting. The one written SER comment received on this approach was not in support of ABT. The commenter expressed concern that large businesses would be able to average or trade credits among engines, possibly without having to make any improvements to a family of engines. According to this SER, for small businesses, the amount of engine testing that would be required to account effectively for credits would be cost prohibitive, particularly for diesel engine manufacturers, but less so for gasoline engine manufacturers.

Although commenters were not interested in a full ABT program for this rule, the Panel believes that it would be useful for small businesses to be able to purchase credits under the design based certification approach. Normally, with a design based certification requirement, the manufacturer's emission performance for purposes of certification is determined on the basis of design features rather than emission test results. Thus the emission performance of the manufacturer's product would not be quantified, rather certification would be a "pass/fail" decision based upon predetermined design criteria. However, without quantified emission performance it would not be possible for a manufacturer to participate in a traditional Averaging, Banking and Trading (ABT) certification program. The Panel recognizes the technical difficulty in trying to quantify individual engine family emission performance solely on the basis of design specifications. Nevertheless, the Panel believes there is potential benefit from ABT programs for small manufacturers in allowing them the same opportunity to minimize cost and maximize production flexibility through averaging. Therefore, the Panel recommends EPA propose a limited ABT program for small manufacturers taking advantage of the potential design based certification requirement. The purchasing manufacturer could use these credits to offset higher emissions in an engine family. The level of credits necessary to offset would be conservatively based to maximize assurance of compliance. For example, if the design based certification requirement required the use of a catalyst with a minimum conversion efficiency of 35%, the manufacturer could instead of installing a catalyst certify using credits substantially greater than 35 % of the standard, for example, 45%. EPA would have to assign a conservative family emission limit (FEL) to this engine.

The Panel also discussed the question of whether recreational marine marinizers should be able to purchase credits from other sectors such as land based nonroad engines. One panel member argued that they should. Another Panel member argued that, under this limited ABT program, the participating manufacturer should only be able to buy credits offered for sale by recreational marine engine manufacturers certifying on the basis of emission tests (i.e., not certifying using the design based certification requirement). That Panel member is concerned among other reasons that cross trading would be inappropriate outside of SI marine because it could prevent emission reductions from being achieved in areas where boats are primarily operated. In light of the points raised on both sides of this issue, the Panel recommends that EPA take comment on this approach in the proposal.

8.4.1.9 Level of the Standard for Small Diesel Engines for Small Marinizers

SERs are concerned that the level of the standard currently under consideration would have inappropriately high cost impacts on small marinizers in light of the emissions reductions. In order to be responsive to these comments, EPA agreed to consider less stringent requirements for small marinizers of 37-225kW engines if appropriate and if meeting the requirements of the CAA. While one Panel member suggested that the preliminary information could support a proposal for no emission reductions for these engines, the Panel recognizes that, at this time, EPA has not completed its analysis of technology and costs. However, the Panel further understands that EPA believes the facts currently available support the level of the standard under consideration and would not result in a proposal for no emission reductions for these engines produced by small marinizers. Nevertheless, as new information comes available, EPA will consider its impact in determining the appropriate level of standards for this category of engines. The Panel recommends that EPA continue to evaluate the emissions control technologies potentially feasible for these engines and their cost impacts for small marinizers in this engine grouping.

8.4.1.10 Adoption of EU or Other International Standards For Small Marinizers

One Panel member recommends that, if upon further analysis, EPA finds that the baseline emissions for either diesel or gasoline engines are higher than the current data suggests, EPA should consider the appropriateness of other international standards as an option, as long as it is consistent with the requirements of CAA section 213(a).

That Panel member expressed concern that the baseline emissions levels provided by EPA may be too low based on manufacturer comments that today's engine designs have higher emissions than a few years ago when the EPA data was collected. However, another Panel member suggested that the potential increasing baseline emissions would add to the benefits of the rule. That Panel member further argued that if lower emissions have been achieved in the past without the use of new emission control technology, then these same lower emission levels can be achieved in the future at minimal cost. Finally, that Panel member believes that EPA has sufficient information to determine that the EU standards are not consistent with the requirements of CAA section 213(a). The Panel recommends that EPA consider any further data that it receives germane to this issue.

8.4.1.11 No Standard for Small Marinizers

One Panel member recommends that, if upon further analysis, EPA finds that there are no additional emissions reductions that can reasonably be required from recreational marine engines, or makes a new finding that these engines do not “cause or contribute” to air pollution, then EPA should consider the appropriateness of no standards as an option, as long as it is consistent with the requirements of CAA section 213(a).

The Panel recognizes that EPA may adopt a no standard approach for small marinizers only if it is consistent with the requirements of the Clean Air Act, including the obligations associated with the cause or contribute determination and the standard setting criteria under CAA section 213(a)(3). At this time, however, one Panel member believes EPA does not have a basis either to reconsider its prior final determination that new marine SI engines do meet the cause or contribute threshold, or to revise its prior proposal that new marine CI engines also meet this threshold. That Panel member also does not believe it is appropriate to consider recreational marine engines as a separate category for purposes of this determination. That Panel member also does not believe that EPA has a basis at this time to find that setting no standard would satisfy section 213's standard setting criteria for recreational marine engines as a group, the underlying premise of this recommendation. As such, EPA could not rely on this premise as a basis to set no standard for small marinizers of recreational marine engines. The Panel recommends that EPA consider new information that becomes available that is relevant to these issues.

8.4.2 Burden Reduction Approaches Designed for Small Boat Builders

EPA outlined a series of potential flexibilities for small boat builders. It is EPA's intent that these regulations will not affect boat design in ways that could add significant cost or impact the performance of the boat. The Panel is concerned that significant changes in external dimensions or performance of an engine could require some boat builders to make significant design changes to their boats at great expense. Such a high cost would be especially burdensome for small builders. The Panel believes it is appropriate to consider small business flexibilities for boat builders at this time. (EPA is still developing the proposal.) These concepts would allow engine marinizers to sell small boat builders a limited number of uncertified engines for 5-7 years if boat builders determine that no satisfactory, complying engine is available (more detail on these burden reduction approaches can be found in Appendix B).

The Panel recommends EPA propose approaches for an engine manufacturer to continue producing uncertified engines if a small boat builder provides information to EPA demonstrating that no complying engine is available which reasonably satisfies the needs of a boat builder. This approach should extend for a sufficient period of time to allow the boat builder to incorporate design changes necessary to accommodate complying engines. One Panel member further recommends that EPA develop a proposal with full transparency to boat builders.

8.5 Additional Recommendations

8.5.1 Safety, Durability, and Performance

The engineering challenges that may be encountered in the development of a design for a safe, effective, and durable catalyst in a marine engine has been a point of discussion throughout

the Panel process. EPA intends to carefully consider the impacts of its regulations on the safety, durability, and performance of marine engines during the development of this rulemaking. This will include but not be limited to evaluation of salt on emission performance and durability, which may or may not be performed in the marine environment. EPA is considering its testing options.

One Panel member expressed concern that EPA not propose standards until such time that sufficient data has been gathered to support its position that safety, durability, and performance will not be adversely impacted as a result of this regulation. Additionally, the Panel recommends that EPA have sufficient consultation with the Coast Guard regarding safety issues such that these issues can be properly identified and addressed in the preamble to the proposed regulations. EPA has indicated that it plans to propose two sets of standards-- a set of standards that would not require the use of catalysts and an alternative set of more stringent standards that anticipate the use of catalysts. The Panel agrees.

9. Appendices

Appendix A - Summary of EPA's Position on Safety, Durability, and Performance Issues.

Appendix B - Overview of Burden Reduction Approaches for Small Marinizers and Small Boat Builders

Appendix C - Summary of Small Entity Representative Conference Call on Recreational Marine Engines - May 11, 1999

Appendix D - List of Items Distributed to Small Entity Representatives on June 16, 1999

Appendix E - Summary of Small Entity Representative Conference Call on Recreational Marine Engines - June 29, 1999

Appendix F - Summary of Small Entity Representative Conference Call on Recreational Marine Engines - July 6, 1999

Appendix G - Written Comments Received from Small Entity Representatives

Appendix H - Cost Effectiveness and Cost per Engine Analyses