State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR RULEMAKING

PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE CURRENT SPARK-IGNITION MARINE ENGINE AND BOAT REGULATIONS

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EXECUTIVE SUMMARY

The amendments proposed herein to the California emissions regulations and test procedures for new spark-ignition marine engines and boats are intended to address issues that have developed since the Air Resources Board (Board or ARB) last considered the regulations (November 2005) and to enhance alignment with other ARB and United States Environmental Protection Agency (U.S. EPA) regulations.

Staff is foremost proposing that the Board modify the existing requirements for high performance engines (sterndrive/inboard (SD/I) engines > 373 kilowatts) to address technical barriers to the use of catalytic converters on these engines by relaxing the exhaust standards in this category for small volume manufacturers. To offset the potential emissions increases, staff is proposing to require the incorporation of enhanced evaporative technology (i.e., activated carbon canisters and low permeation tanks and hoses) on all vessels in which high performance engines are used beginning in 2009. Staff proposes to retain the existing exhaust emission standards for large volume manufacturers that produce both high performance and standard performance engines (SD/I engines ≤ 373 kilowatts). Such dual category manufacturers would be able to meet the standards through averaging. Optionally, these manufacturers would be allowed to certify high performance engines to the same exhaust and evaporative standards as proposed for small volume manufacturers. They would then be required to ensure the installation of enhanced evaporative technology on a portion of the vessels in which their standard performance SD/I engines are installed. In either case, all high performance engines beginning in 2009 would be accompanied with enhanced evaporative controls. These proposed changes would result in the same total combined hydrocarbon and oxides of nitrogen emissions as retaining the existing standards.

Staff is also proposing to streamline the regulations and harmonize with U.S. EPA to the extent feasible.

Staff's other proposed amendments are of two general types, those:

Harmonizing with U.S. EPA, including

- Total Hydrocarbon Standards (all spark-ignition marine categories)
- Not-To-Exceed Limits (all spark-ignition marine, except SD/I > 373 kW)
- Revised Jet Boat Engine Standards
- Standardized Engine Rebuilding Practices (all spark-ignition marine categories)
- Revised Definitions for Outboard, Personal Watercraft, and SD/I Engines

Provisions Specific to and Retained for California, including

- Carbon Monoxide Standards (all spark-ignition marine categories)
- Revised High Performance Engine Certification Requirements (SD/I >373 kW)
- Revised On-Board Diagnostics Marine (OBD-M) Requirements (SD/I engines)
- Hardship Allowance Provisions (SD/I engines)
- Voluntary Five-Star Standards (all spark-ignition marine)
- Replacement Engine Provisions (all spark-ignition marine)

- Clarifications and Miscellaneous Requirements

A more in depth description of staff's proposal is included in Chapter 3 of this report.

Staff recommends that the Board adopt this proposal.

1. INTRODUCTION

This report describes the rationale and details of staff's proposal to amend California's existing regulations for new spark-ignition marine engines and boats. In chapter 8 of the Air Resources Board's (Board or ARB) Initial Statement of Reasons (staff report) dated September 30, 2005, staff committed to return to the Board prior to the commencement of the 2009 model year regarding the certification of, and the incorporation of catalysts on, high performance sterndrive and inboard (SD/I) engines (i.e., those with rated power greater than 373 kilowatts) for manufacturers without sufficient product volume to make use of existing fleet averaging provisions (ARB 2005a). For reasons detailed in chapter 4 of this report, several technical issues have surfaced that would make it problematic to properly engineer a three-way catalytic converter for effective use on high performance engines. Furthermore, chapter 8 of the 2005 staff report also describes staff's intent to return to the Board prior to 2009 to adopt carbon monoxide (CO) standards and evaporative requirements, and to align as appropriate with the future requirements of the United States Environmental Protection Agency (U.S. EPA) pertaining to spark-ignition marine engines and boats. The changes proposed herein are meant to address these issues and to facilitate compliance with the California regulations.

2. BACKGROUND

This section provides information on the history of emissions control for spark-ignition marine engines, California's authority to set standards for off-road mobile sources including spark-ignition marine engines and boats, the current emissions inventory for spark-ignition marine engines in California, the existing spark-ignition marine regulations, and the steps taken to make the public and stakeholders aware of staff's proposal to amend California's current regulations.

2.1. History

Only in recent years has government regulatory activity been undertaken to control exhaust emissions from spark-ignition marine engines. The U.S. EPA first promulgated exhaust emission standards to reduce emissions of hydrocarbon (HC) and oxides of nitrogen (NOx) from new outboard and personal watercraft (OB/PWC) engines in 1996 (U.S. EPA 1996). However, the benefits of the federal rulemaking were not sufficient to meet California's air quality goals and State Implementation Plan (SIP) requirements. Therefore, in 1998 ARB adopted exhaust emission regulations for spark-ignition marine engines that accelerated the 2006 federal standards to begin in 2001 in California (ARB 1998a). The regulations also set more stringent standards for these engines to be implemented in 2004 and 2008. As of this current year 2008, personal watercraft and outboard engines in California will meet exhaust emission standards that are numerically 65 percent less (i.e., more stringent) than existing federal exhaust emission standards. The Board also adopted a star rating system for these engines depicting their relative cleanliness through a visible display of one, two, or three stars, with three representing the most stringent standards in California at that time.

On July 26, 2001, the Board amended the spark-ignition marine regulations (Title 13, California Code of Regulations, section 2440 et seq.) to include new SD/I engines (ARB 2001). Although OB/PWC engines dominate the emissions inventory with respect to spark-ignition marine engines, ARB modeling showed that SD/I engines also contributed significantly to ozone-forming emissions in California.

Accordingly, manufacturers of inboard and sterndrive engines were required to demonstrate compliance with an NMHC[1]+NOx exhaust emissions standard of 16.0 grams per kilowatt-hour (g/kW-hr) beginning with the 2003 model year. This standard is roughly equivalent to California's most stringent exhaust standard for OB/PWC engines, which, for those engines, was not required until 2008.

The SD/I regulations at that time also required compliance with a more stringent NMHC+NOx standard beginning in 2007 on a portion of engines. Since inboard and sterndrive marine engines are generally similar to automobile engines, for which a number of effective emission control technologies already exist, transference of automotive control technologies (catalysts specifically) to the marine sector makes a more stringent standard feasible. In fact, the majority of SD/I engines with rated power less than 373 kW are almost exclusively General Motors truck engines that have been marinized[2] for use on lakes and the ocean. Accordingly, the Board adopted a 5.0 g/kW-hr NMHC+NOx standard for these engines, which was based on the demonstrated use of three-way catalytic converters and oxygen sensor feedback control. Engines complying with the 5.0 g/kW-hr NMHC+NOx standard were eligible for a new four-star rating on environmental labels and hang tags to visually depict the most stringent marine engine standards currently available at that time. Also required beginning in 2007 was the incorporation of on-board diagnostics for all engines required to comply with the 5.0 g/kW-hr NMHC+NOx standard.

On November 17, 2005, the Board amended the original SD/I regulations by providing engine manufacturers with an emissions neutral option to delay the introduction of engines meeting the catalyst-based second tier standards by one year in exchange for full product line compliance in 2008 and limited evaporative permeation control. The Board adopted other provisions during this rulemaking such as revised durability periods and default certification levels for high performance engines. The Board also provided a temporary reprieve for high performance engine manufacturers by delaying the second tier standard (5.0 g/kW-hr NMHC+NOx) for these engines until 2009, and by allowing them to meet the standard through averaging. Finally, the Board directed staff to investigate the incorporation of future CO standards for spark-ignition marine engines and the harmonization of requirements that were under development by U.S. EPA.

[1] The non-methane component of hydrocarbons.

[2] Marinization is the process of modifying an existing automobile engine to operate reliably in a marine environment. Some typical modifications include upgrading the composition of exhaust components to be more resistive against rust and corrosion, incorporating a water jacket within the exhaust manifolds to reduce temperatures, and providing better insulation for electrical contacts that might otherwise be exposed to corrosive sea water.

On May 18, 2007, U.S. EPA published its Notice of Proposed Rulemaking to harmonize federal exhaust standards for OB/PWC and SD/I engines with those already in effect in California (U.S. EPA 2007). Additionally, U.S. EPA proposed the adoption of CO standards, evaporative control requirements, Not-To-Exceed (NTE) standards, and other minor changes. U.S. EPA is expected to promulgate a final rulemaking in June 2008.

2.2. Authority

The Board's regulatory authority to control air pollution is set forth in Divisions 25.5 and 26 of the Health & Safety Code (H&SC), including sections 39600 and 39601. Health & Safety Code §39903 identifies ARB (the actual acronym used is CARB) as:

> "… the state agency charged with coordinating efforts to attain and maintain ambient air quality standards, to conduct research into the causes of and solutions to air pollution, and to systematically attack the serious problem caused by motor vehicles, which is the major source of air pollution in many areas of the state."

Provisions in Division 26 of the H&SC authorize CARB to control the emissions of criteria pollutants (and their precursors) from specific source categories.

In addition to more general grants of authority, the California Clean Air Act, as codified in Health and Safety Code section 43013, directs the ARB to regulate off-road mobile sources of emissions. Health and Safety Code section 43018 further mandates ARB "to achieve the maximum degree of emission reduction possible" from mobile sources of pollution in order to attain California's ambient air quality standards. These off-road mobile sources include, but are not limited to, marine vessels, locomotives, utility engines, off-road motorcycles, and off-highway vehicles. This regulation focuses on new spark-ignition (gasoline) marine engines, typically found in recreational boats such as ski boats or family fishing boats.

2.3. Existing Regulations

The existing California, federal, and international spark-ignition marine requirements are briefly discussed in this subsection.

2.3.1. California's Spark-Ignition Marine Regulations

The current spark-ignition marine regulations require that new engines comply with NMHC+NOx exhaust standards and that certification and environmental labels be attached to engines and/or boats to provide prospective engine owners, current engine owners, and enforcement personnel with information about the relative cleanliness of the engine.

The OB/PWC section of the regulations requires three phases (or tiers) of progressively more stringent exhaust standards from 2001 through 2008 culminating in a final emissions level of approximately 16 g/kW-hr NMHC+NOx for a typical 75 kW OB/PWC

engine. The test procedures for OB/PWC engines adopted by the Board were largely aligned with those already promulgated by U.S. EPA, but ARB's regulations required more stringent long term emission standards for California engines.

Table 2.1 shows the current range of standards for SD/I engines. The first tier standard of 16.0 g/kW-hr NMHC+NOx was required for all new SD/I engines with rated power less than or equal to 373 kW (500 horsepower) beginning in 2003. The second tier standard requires engines to meet a 5.0 g/kW-hr NMHC+NOx emissions level beginning on a portion of engines in 2007 and 2008, or optionally on all engines beginning in 2008 and thereafter, provided supplemental measures were taken to ensure equivalent emissions. Manufacturers choosing to wait until 2008 before introducing 5.0 g/kW-hr NMHC+NOx engines must use 15 grams per meter squared per day low-permeation fuel line supply hoses in 2007 and thereafter. SD/I engines with rated power greater than 373 kW do not have to comply with the emission standards until 2009.

The SD/I regulations also established durability periods for engines certified to the 5.0 g/kW-hr NMHC+NOx standard to ensure compliance with the standard throughout the engines' useful lives.

Table 2.1 - SD/I Exhaust Standards and Permeation Requirements

MODEL YEAR	RATED POWER	COMPLIANCE OPTION[1]	DURABILITY	EXHAUST STANDARD		SUPPLEMENTAL MEASURE[4]
				NMHC[2]+NOx	TYPE[3]	
	[kilowatts]		[hours / years]	[grams per kilowatt-hour]		
2003 - 2006	kW ≤ 373	N/A	N/A	16.0	AVE	None
2007	kW ≤ 373	OPT 1	N/A	16.0 (55%)	AVE	None
			480 / 10	5.0 (45%)	FIXED	
		OPT 2	N/A	14.0	FIXED	Low-Permeation Fuel Line Hoses
2008	kW ≤ 373	OPT 1	N/A	16.0 (25%)	AVE	None
			480 / 10	5.0 (75%)	FIXED	
		OPT 2	480 / 10	5.0	FIXED	Low-Permeation Fuel Line Hoses
2009 and later	kW ≤ 373	N/A	480 / 10	5.0[6]	FIXED	Carryover[7]
	373 < kW ≤ 485		150[5] / 3	5.0[6]	AVE	
	kW > 485		50[5] / 1	5.0[6]	AVE	

Notes:
1. Once a manufacturer has chosen an option, that option must continue to be used exclusively across product lines
2. The non-methane component of hydrocarbon
3. Corporate averaging (AVE) may be used to demonstrate compliance with the exhaust emission standard, except where a FIXED standard is required
4. Supplemental measures may be different than shown, but must provide equal and verifiable emission reductions to those indicated
5. For the purpose of durability testing, engine components that have been approved with an hourly warranty period shorter than the full hourly durability period per § 2445.1 (c)(3)(C)4. may be replaced at the specified warranty interval
6. All engines ≤ 373 kW must meet a 5.0 g/kW-hr NMHC+NOx capping standard. For engines > 373 kW, the standard may be met by sales-averaging with engines equal to or less than 373 kW
7. The same or better supplemental emission control hardware used to meet the standard in 2007 must be used every model year thereafter

Additionally, the regulations require manufacturers to employ on-board diagnostics marine (OBD-M) on SD/I engines and boats complying with the 5.0 g/kW-hr NMHC+NOx standard to continuously monitor emission control components for proper performance and to alert the vessel operator via a dashboard light or audio alert device after a malfunction has been identified. The OBD-M system makes consumers aware when a component or system fails anytime in-use, which in turn provides incentive for the consumer to have the problem corrected in a timely manner especially should the malfunction occur during the warranty period. Furthermore, OBD-M facilitates the repair of the malfunctioning component by providing a detailed description of the problem to the service technician via a generic scan tool, and a confirmation that the repair has been performed correctly.

The spark-ignition marine regulations also provide selective enforcement auditing, in-use compliance testing, consumer labeling to identify emissions performance relative to other spark-ignition marine engines, and a defects warranty program to protect

consumers against poor quality products and to ensure that engines continue to perform as designed throughout their entire useful lives.

2.3.2. Federal Regulations

On May 18, 2007, U.S. EPA published a Notice of Proposed Rulemaking (NPRM) in the Federal Register for nonroad spark-ignition engines and equipment that would generally harmonize federal and California exhaust standards for OB/PWC and SD/I engines (U.S. EPA 2007). The NPRM also proposed the adoption of CO standards and evaporative control requirements for OB/PWC and SD/I engines and boats. Furthermore, the NPRM proposed to include the methane component of hydrocarbon in the federal certification standard for gasoline fueled engines and to incorporate compliance facilitation provisions for unforeseen technical and economic hardships that may befall engine or equipment manufacturers. Although on-board diagnostics for SD/I engines were proposed in the NPRM, they were far less comprehensive and rigorous that the OBD-M requirements already in effect for California.

2.4. Emissions Inventory

Table 2.2 shows the statewide baseline inventories for the reactive organic gas (ROG) component of hydrocarbons, NOx, and CO from spark-ignition marine engines in 2009, 2010, and 2020. These baseline estimates are annual averages and include the effects of all currently adopted State and federally promulgated regulations, including the 5.0 g/kW-hr NMHC+NOx standard for high performance SD/I engines schedule to begin in 2009. All emissions estimates are from the ARB's off-road emissions inventory database as of May 2008.

Table 2.2 - Baseline Spark-Ignition Marine Exhaust Emission Inventories Statewide Annual Averages

ENGINE TYPE		POLLUTANT	EMISSIONS INVENTORY (tons per day)		
			2009	2010	2020
OUTBOARD		ROG	42.6	40.0	20.4
		NOx	3.6	3.6	3.3
		CO	85.6	80.8	45.3
PERSONAL WATERCRAFT		ROG	25.3	24.2	22.4
		NOx	4.0	4.2	7.4
		CO	43.9	42.3	40.1
STERNDRIVE / INBOARD	≤ 373 KW	ROG	19.0	18.7	17.3
		NOx	24.1	23.8	22.3
		CO	538.3	541.8	629.3
	> 373 KW	ROG	0.9	0.9	0.7
		NOx	0.3	0.3	0.2
		CO	18.9	19.6	27.5

As shown in the table, ozone precursors from these engines are projected to decrease over time as a result of the Board's previous actions. Between 2009 and 2020, ROG+NOx[3] emissions are projected to decrease by 22 tons per day for OB/PWC engines and about 3.8 tons per day for SD/I engines. Although not currently regulated, CO emissions for outboard engines and personal watercraft are also projected to decrease over time as a corollary effect of the Board's previous actions to control ozone precursors. Paradoxically, total estimated CO emissions for sterndrive and inboard engines continue to increase despite the incorporation of CO reducing three-way catalytic converters on these engines in 2007 and 2008. Although the catalytic converters reduce engine-out CO by 40 - 60 percent, the increasing population of engines appears to cancel out these gains resulting in a net loss over time[4].

Table 2.2 only shows half the story, however. To provide the complete picture, Table 2.3 illustrates the emissions inventories for the same categories of spark-ignition marine engines during summer weekends. Boats with spark-ignition marine engines are used most frequently on summer weekends when the temperature is hot and smog levels are high. Exhaust emission levels associated with summer weekend operation are approximately 143[3] percent higher than corresponding annual average levels due to increased boating activity during the summer months. This is especially relevant since the potential for ozone formation is highest during the summer months.

Table 2.3 - Baseline Spark-Ignition Marine Exhaust Emission Inventories Statewide Summer Weekend

ENGINE TYPE		POLLUTANT	EMISSIONS INVENTORY (tons per day)		
			2009	2010	2020
OUTBOARD		ROG	103.5	97.1	49.6
		NOx	8.8	8.9	8.1
		CO	208.1	196.4	110.1
PERSONAL WATERCRAFT		ROG	61.4	58.9	54.4
		NOx	9.7	10.2	18.1
		CO	106.8	102.7	97.3
STERNDRIVE / INBOARD	≤ 373 KW	ROG	46.3	45.4	41.9
		NOx	58.6	57.9	54.2
		CO	1308.0	1316.6	1529.1
	> 373 KW	ROG	2.1	2.1	1.6
		NOx	0.7	0.7	0.6
		CO	46.0	47.7	66.8

[3] Estimated 2020 benefits are based on May 2008 off-road emissions inventory data, and differ somewhat from earlier calculations due to modeling refinements after the 2001 adoption of the existing regulation.
[4] The CO emissions inventory estimate is not as fully developed as that for ozone precursors. As more data become available with certification, the emissions inventory will be improved.

This table shows that ROG+NOx emissions are projected to decrease by about 53 tons per day for OB/PWC engines and about 9.4 tons per day for SD/I engines between 2009 and 2020 due to the Board's previous actions. CO emissions are also projected to decrease for OB/PWC engines and to increase for SD/I engines accordingly.

2.5. Public Process

In developing its proposal, staff has remained in close contact with the regulated marine industry in order to follow industry's progress regarding the spark-ignition marine engine and boat regulations and to be kept apprised of any issues that might delay compliance efforts. A list of specific outreach efforts is provided in Appendix A at the end of this report.

3. SUMMARY OF PROPOSED REGULATIONS

The amendments herein proposed address issues that have developed since 2005, when the Board last considered the regulations, and are meant to enhance alignment with other ARB and U.S. EPA regulations by harmonizing requirements where possible and by streamlining certification requirements. Staff is also proposing to revise the exhaust standard for high performance SD/I engines certified by small volume manufacturers to a level that would no longer be based on the use of three-way catalytic converters. Additionally, to make up for lost emission benefits resulting from this proposed relaxation of the standards, all high performance SD/I engine manufacturers would be required to ensure the proper installation of canister-based evaporative emission controls on all vessels using high performance engines in order to preserve the overall benefit of the existing 5.0 g/kW-hr HC+NOx exhaust standard. This amendment is necessary because using catalytic converters on high performance engines has turned out to be a difficult challenge.

Staff's other proposed amendments include the adoption of CO standards and Not-To-Exceed (NTE) limits for all categories of spark-ignition marine engines, the incorporation of general and hardship related compliance facilitation provisions for all engines, modifications to OBD-M and replacement engine requirements for SD/I engines, and the adoption of voluntary standards allowing manufacturers the option of a new five-star certification rating for any spark-ignition marine engine. Staff is also proposing to harmonize several existing and new definitions with those proposed by U.S. EPA and to align with U.S. EPA regarding the assignment of total hydrocarbons, rather than non-methane hydrocarbons, for its exhaust standards for all categories of spark-ignition marine engines. Staff is proposing other non-substantial modifications to the regulations and test procedures to correct grammatical and typographical errors, to correct references and citations, and to improve clarity. The following subsections describe the major provisions of staff's proposals in greater detail.

3.1. Definitions

Staff intends to revise or adopt definitions for the following terms to enhance harmonization with the requirements proposed by U.S. EPA in its May 18, 2007, NPRM and Regulatory Impact Analysis (RIA) documents:

- “High Performance Engine”
- “Jet boat”
- “Large Volume Dual Category Manufacturer”
- “Marinize”
- “Maximum Engine Power”
- “Maximum Test Speed”
- “New Propulsion Marine Engine” or “New Engine”
- “Nontrailerable Boat”
- “Outboard Engine”
- “Personal Watercraft”
- “Personal Watercraft Engine”
- “Spark-ignition”
- “Sterndrive/Inboard Engine” or “Sterndrive/Inboard Marine Engine”

These terms are defined in § 2441 of the proposed regulation order in Attachment A.

3.2. Emission Standards

3.2.1. Total Hydrocarbon plus Oxides of Nitrogen (HC+NOx) Standards

Title 13 of the California Code of Regulations (CCR), Section 2442(b) (13 CCR 2442(b)), requires spark-ignition marine engines to comply with NMHC+NOx standards as a condition of certification and sale in California. Only the non-methane component of hydrocarbon was included in those standards because the intent of the regulation was to control ozone and methane does not contribute to ozone formation in the atmosphere. However, methane has been identified as one of the greenhouse gases responsible for manmade global warming; therefore, staff intends to propose that all future marine standards reflect the total hydrocarbon species. Additionally, such action would harmonize the form of California’s spark-ignition marine standards with that proposed by U.S. EPA for gasoline fuel certification. However, in practice this requirement is not expected to have a significant impact on compliance or change the projected reductions of ozone precursors in California. Virtually all currently regulated spark-ignition marine manufacturers in California already voluntarily submit total hydrocarbon measurements in their certification applications to eliminate having to speciate emission samples. Furthermore, the methane component is only about one percent of the total hydrocarbon species for gasoline and would not constitute much of a change in ozone precursor reductions regardless. From this point forward, all references in this staff report to combined hydrocarbons and oxides of nitrogen (HC+NOx) should be read to include methane.

3.2.2. Carbon Monoxide Standards

The CO standards proposed in this report are intended to lower the risk of asphyxiation during boating activities such as wakeboarding and teak surfing where boaters may be in close or direct proximity to a vessel’s exhaust, but also to protect vessel occupants exposed to lesser concentrations that can cause diminished cerebral capacity leading to

accidents as a result. The California Department of Boating and Waterways reports ten deaths between 2001 and 2006 in California directly attributable to the inhalation of carbon monoxide during recreational boating activities[5]. Other fatalities or injuries not quantified in this tally may have occurred indirectly (e.g., drowning or loss of balance).

The proposed CO standards would apply separately to OB/PWC and SD/I engines and would essentially cap CO emissions at current measured levels; therefore, compliance with the proposed standards should not require the incorporation of any additional technology not already required by existing California regulation. Staff does, however, recognize that more stringent standards will likely be necessary to better protect the health of boaters in the future, and is committed to developing such standards (see subsection 5.3), but for now believes it important to ensure that CO levels not be allowed to increase above current levels. The proposed California standards differ slightly from the proposed federal standards for OB/PWC and SD/I engines in that the California standards would apply discretely to each engine family whereas the proposed federal standards could be met using averaging. As such, some manufacturers may need to adjust engine calibrations on some applications to comply with the proposed California standards, but such modifications are expected to be rare and minor. Staff's proposal does not provide for CO averaging in California because of the immediate risk from CO poisoning that higher emitting engines would pose to vessel occupants, not to mention the added complexity that would be added to the State's enforcement efforts should multiple emissions configurations become applicable (via averaging) to engines whose final point-of-sale destinations are not always predictable.

Staff is also proposing an optional CO standard and alternate certification cycle for larger displacement standard performance SD/I engines to facilitate compliance. For SD/I engines greater than or equal to 6.0 liters in displacement, but less than 373 kW maximum power, staff is proposing an optional CO standard of 25 g/kW-hr that would only use the weighted emission measurements from modes 2 through 5 of the E4 test cycle[6]. This standard discounts CO emissions at wide open throttle (Mode 1) where the risk of CO exposure from large displacement boats is expected to be low due to the unlikelihood of tow sports or other near-exhaust proximity activities such as wakeboarding and teak surfing being performed at maximum engine speeds and accelerations. Staff is not proposing to extend this alternate CO standard to high performance engines because the proposed standard for these engines is not expected to result in any compliance issues.

U.S. EPA had considered the promulgation of an identical standard in Chapter 4 of its Regulatory Impact Analysis (RIA 2007), but has not yet decided whether to include it in the final rulemaking since the proposed federal rule would permit CO averaging, which

[5] Annual safety reports are found collectively at http://www.dbw.ca.gov/Reports/SafetyReports.aspx

[6] Universally accepted 5-mode steady-state test cycle for spark-ignition marine engines defined in the International Organization for Standardization document "(ISO) 8178-4. Reciprocating Internal Combustion Engines, Exhaust Emissions Measurement, Part 4: Test Cycles for Different Engine Applications. Test cycle E4—Spark-ignited pleasure-craft less than 24 m length." Originally developed by the International Committee of Marine Industry Associations (ICOMIA Standard 36, 1988)

industry believes is sufficient to account for the few SD/I engine families that are expected to exceed the proposed 75.0 g/kW-hr CO standard.

Table 3.1, below, summarizes staff's proposed CO standards.

Table 3.1 - Proposed CO Standards for OB/PWC & SD/I Engines

ENGINE CATEGORY	MODEL YEAR	MAXIMUM POWER[a] *[kilowatts]*	CO STANDARD[b] *[grams per kilowatt-hour]*
OB/PWC	2009 and later	kW ≤ 40	500 – 5 x P[c]
		kW > 40	300.0
SD/I	2009 and later	kW ≤ 373	75.0[d]
		kW > 373	350.0

a Maximum Power may be interpreted as maximum rated power prior to 2010, but must be interpreted as maximum engine power for 2010 models and thereafter.
b All standards are fixed.
c P is defined as Maximum Engine Power in kilowatts (kW).
d An alternative standard of 25 g/kW-hr over modes 2 - 5 of the E4 cycle is provided for engines ≥ 6.0 L displacement.

3.2.3. High Performance (> 373 kW) SD/I Engine Standards

California's existing spark-ignition marine regulations require high performance SD/I engines to comply with a 5.0 g/kW-hr HC+NOx exhaust standard in 2009. The existing regulation allows standard performance (i.e., ≤ 373 kW) and high performance engine family emission levels to be averaged within a manufacturer's product line as a means to facilitate compliance.

However, due to technical obstacles regarding the effective use of catalytic converters on high performance engines and the competitive disadvantage that averaging would place on small volume manufacturers without enough standard performance engines to generate offsets (discussed in detail in Section 4.1, below), staff believes that sufficient reason exists for the Board to modify the high performance engine requirements.

Staff proposes that the Board relax the 2009 and later HC+NOx exhaust standard for small volume manufacturers of high performance engines from 5.0 g/kW-hr HC+NOx to the levels shown in Table 3.2 below. Any large volume dual category manufacturer (i.e., a manufacturer that produces both high performance and standard performance engines in California in combined quantities greater than 75 units annually)[7] would continue to be required to meet the existing 5.0 g/kW-hr HC+NOx exhaust standard, and could also avail themselves of averaging, if they so choose, beginning in 2009.

[7] Currently, only one large volume manufacturer of high performance and standard performance engines is know to exist (Mercury Marine).

Table 3.2
Proposed Exhaust Standards for SD/I engines

MODEL YEAR	MAXIMUM[a] POWER *[kilowatts]*	HC+NOx STANDARD *[grams per kilowatt-hour]*		CO STANDARD *[grams per kilowatt-hour]*
		Small Volume Single/Dual Category or Large Volume Single Category Manufacturer[b]	Large Volume Dual Category Manufacturer	
2009 - 2010	kW ≤ 373	5.0	5.0[b]	75.0[c]
	373 < kW ≤ 485	16.0	5.0[d]	350.0
	kW > 485	25.0		
2011 and later	kW ≤ 373	5.0	5.0[b]	75.0[c]
	373 < kW ≤ 485	16.0	5.0[d]	350.0
	kW > 485	22.0		

a Maximum Power may be interpreted as maximum rated power prior to 2010, but must be interpreted as maximum engine power for 2010 models and thereafter.
b These standards are fixed except for engines certified under the discontinuation allowance in subsection 3.4.1.
c Standard performance engines ≥ 6.0 liter displacement may alternatively meet a 25 g/kW-hr standard based on Modes 2-5 of the E4 test cycle.
d This standard may be met using averaging within the high performance category and/or between standard performance and high performance categories. Alternatively, manufacturers may instead comply with the exhaust standards for single category manufacturers provided a sufficient number of vessels with standard performance engines are equipped with carbon canister based evaporative systems.

To compensate for the shortfall in emission benefits from the change in exhaust standards, the staff proposal would also require all boats using 2009 and later high performance SD/I engines (regardless of whether the engine is produced by a small or large volume manufacturer) to incorporate enhanced evaporative controls, including evaporative control canisters (i.e., activated carbon canisters) and low permeation fuel tanks and hoses. The proposed evaporative requirements are based on national data compiled by U.S. EPA and rely in part on the analyses presented in the May 18, 2007, NPRM and its incorporated Regulatory Impact Analysis (RIA 2007). The proposed U.S. EPA standards are included in Table 3.3 below as guidance for industry. Staff is at this time proposing only a design-based requirement, not testing of individual evaporative control configurations. ARB staff is in the process of developing more comprehensive evaporative standards and test procedures specific to California's spark-ignition marine engines; therefore, the currently proposed evaporative requirements will be updated when staff's independent development work is complete and more comprehensive standards are considered for adoption in California.

Table 3.3
Proposed 2009 and Later Evaporative Control Design Specifications / Proposed U.S. EPA Standards

PERMEATION STANDARDS *[grams per square meter per day]*		DIURNAL STANDARD[a] *[grams per gallon per day]*
Hose[b]	Tank[c]	
15.0	1.5	0.40[d]

a Diurnal testing requires fuel with 9 pounds per square inch (psi) Reid Vapor Pressure volatility and a 24 hour fuel temperature cycle of 27.6 º to 30.2 º Celsius.
b Fuel line permeation testing requires gasoline fuel with 10% ethanol content and must be performed at a test temperature of 23 ± 2 º Celsius.
c Fuel tank permeation testing requires gasoline fuel with 10% ethanol content and must be performed at a test temperature of 28 ± 2 º Celsius.
d This standard is for trailerable boats; non-trailerable boats must meet a 0.16 grams per gallon per day diurnal standard over a fuel temperature cycle of 25.6 º to 32.2 º Celsius.

Staff additionally proposes that any large volume dual category manufacturer be given an option to certify high performance engines to the less stringent 16.0 g/kW-hr HC+NOx standard, but be required to recover the lost emission benefits by expanding the use of evaporative controls on standard performance engines. This option is explained in further detail in subsection 4.1.

The proposal would not change the levels associated with the required environmental labels. High performance engines achieving the existing 5.0 g/kW-hr standard without averaging would receive a four-star rating on environmental labels and hang tags. High performance engines certified to the 16.0 g/kW-hr HC+NOx standard and possessing enhanced evaporative controls would receive a three-star rating on environmental labels and hang tags, and high performance engines certified to either the 25.0 g/kW-hr or 22.0 g/kW-hr HC+NOx standards would receive a two-star rating.

3.2.4. Optional Test Cycle for High Performance Engines

Staff is also proposing an optional certification test cycle for all high performance SD/I engines. The optional cycle would be similar to the currently required E4 steady-state test cycle, but instead of measuring emissions at “no load” idle, manufacturers would test at 15 percent load. Staff has learned that high performance engines typically operate at loaded idle since much of their operation occurs while going through numerous zones near docks and swimming areas with five mile per hour “no wake” speed limits. Loaded idle operation is therefore more representative of high performance engine operation than “no load” idle operation and should be reflected in the certification test cycle.

3.2.5. Not-To-Exceed Limits

Staff proposes that the Board harmonize with federal NTE requirements for OB/PWC engines and SD/I engines with rated power less than or equal to 373 kW. The NTE

requirements would ensure emissions control in modes of engine operation that are not fully represented by the certification test cycle. No additional testing beyond that required by the federal requirements would be required; however, engine manufacturers would be required to certify separately in California and would be subject to all applicable State provisions pertaining to in-use compliance and enforcement.

3.2.6. Voluntary Standards

Staff is proposing a fifth tier of voluntary emission standards for spark-ignition marine engines. Engines certified to these voluntary requirements would be eligible for a new five-star emissions rating. Although intended for SD/I engines primarily, the five-star rating would be available to any category of spark-ignition marine engine certified to the voluntary standards throughout its useful life. The proposed five-star label is shown below:

The proposed voluntary five-star emission levels are shown below in Table 3.4:

Table 3.4 – Five-Star Voluntary Standards

$HC+NO_X$ STANDARD *[grams per kilowatt-hour]*	CO STANDARD *[grams per kilowatt-hour]*	PERMEATION STANDARDS *[grams per square meter per day]*		DIURNAL STANDARD *[grams per gallon per day]*
		Hose	Tank	
2.50	50.0	15.0	1.5	0.4

In addition to complying with the five-star emissions levels, which represent a fifty percent decrease in exhaust emissions compared to a four-star engine family, an eligible five-star engine family would also need to possess a fully complaint OBD-M system complete with functioning misfire monitoring capability. Labels and hang-tags for engine families certified to the voluntary standards must indicate a five-star rating. Manufacturers may, however, continue to use existing stocks of labels with only four stars for engines that are not certified to the voluntary standards.

3.3. Certification Requirements for High Performance Engines

3.3.1. Portable Measurement Systems

For the certification of high performance SD/I engines manufactured in extremely low volumes, staff proposes that the Board adopt, as an option to engine dynamometer testing, the use of portable emissions measurement systems (PEMS) for measurements in the laboratory or in the field. Eligible PEMS must comply with generally the same specifications and verifications as the laboratory instrumentation described in the spark-ignition marine engine test procedures, but with added flexibility per the incorporation of the provisions for portable measurement systems from sections 1065.901 through 1065.940 of Title 40, Code of Federal Regulations. A determination of compliance for the PEMS would be based on an overall demonstration of comparable accuracy and reliability relative to laboratory measurements occurring over multiple repetitions of the certification test cycle or an equivalent manufacturer-defined duty cycle. An acceptable duty cycle must have several individual field-test intervals against which a PEMS is compared to the laboratory system. The proposed test procedure amendments also specify procedures for preparing and conducting a field test and for correcting emission analyzer drift by taking into account a number of known measurement techniques. Additional provisions and conditions would apply when using PEMS in an engine dynamometer laboratory. Staff proposes that the PEMS option be limited to manufacturers that produce no more than 75 engines per year nationally (roughly 10% of which end up in California) to ensure a reasonable mix of dynamometer and PEMS data for comparison. Such an amendment would greatly reduce the cost of compliance for the many small volume manufacturers in the high performance sector.

3.3.2. Assigned Deterioration Factors

Staff is also proposing the optional use of assigned deterioration factors for high performance engines regardless of production volumes. Emissions deterioration over a high performance engine's useful life is expected to be relatively small considering an engine's 50-hour or 150-hour rebuild frequency; therefore, the assignment of reasonable deterioration factors provides a cost effective and low-risk alternative to the traditional method of determining deterioration factors. Staff anticipates the assignment of conservative deterioration factors in the early years of implementation, most likely extrapolated from the largest standard performance engines prior to the incorporation of catalytic converters. However, as more data become available, staff intends to revise deterioration factors as necessary to better reflect real world engine performance. Manufacturers opting to certify with assigned deterioration factors would be required to indicate this in their applications for certification, and engines so certified would be subject to the same requirements, penalties, and corrective actions for in-use compliance as would be the case for engines certified using traditionally derived deterioration factors.

3.4. Compliance Assistance Provisions

Engine marinizers have requested corporate averaging as a means for addressing unforeseen circumstances, primarily the unanticipated discontinuation of engines by the base engine supplier[8] and the lack of development time necessary to develop reliable emission control systems for the engines that replace them. While staff recognizes that unforeseen circumstances beyond the control of the engine marinizer can and do occur, it does not believe that corporate averaging is the most appropriate solution for the California market. As discussed previously with respect to CO emissions, averaging does not address the immediate risk to vessel occupants from CO poisoning that engines certified to higher family emission limits would pose. Furthermore, since manufacturers are not able to guarantee the ultimate destination of their engines, they cannot guarantee that California would not receive more than its fair share of higher emitting engines should ARB agree to participate in the national averaging program. Additionally, corporate averaging would complicate ARB's ability to enforce the regulations in that compliant SD/I engines would no longer be readily distinguished from noncompliant engines in the field by ARB inspectors. Further, should ARB attempt to implement corporate averaging within State boundaries, rather than as a participant in the federal program, U.S. EPA has the right to deny federal credits for any engines certified in California, which would serve as a disincentive for manufacturers to introduce their cleanest engines in California. Consequently, ARB would have to adopt significantly more stringent standards than currently required or proposed to achieve the same air quality benefits as from fixed standards.

3.4.1. Engine Discontinuation Allowance for SD/I Engines

In lieu of providing relief through corporate averaging for SD/I engines that will no longer be produced by the base engine supplier, staff proposes to allow manufacturers to certify one engine family (or other logical grouping) per year to current emission levels. This approach, hereafter known as the engine discontinuation allowance (EDA), would require one or more of the remaining engine families in a manufacturer's SD/I product line to be certified to emission levels more stringent than the existing fixed exhaust standards to make up for the deficit of the higher emitting engine family.

In addition to the typical stipulations of an averaging program, such as calculation methodology, records keeping, and reporting requirements as documented in 13 CCR 2442(b)(2), staff intends that the following criteria also be applicable with respect to its SD/I EDA proposal:

- Only one engine family (or other approved logical grouping of engines) per year per manufacturer may be certified with emission levels less stringent than the standards;
    - The engine family may be carried over for three subsequent years;

[8] In 2006, General Motors announced the end of production runs for two of the five base engines (4.3 liter and 8.1 liter engine families) frequently marinized by standard performance SD/I manufacturers.

- Previously certified engine families may not subsequently be certified to less stringent standards; however, normal fluctuations in certification levels due to superseded component use would be permitted unless the fluctuations resulted in an exceedance of the standards to which the engine family was previously certified;

- First time certified engine families certified less stringent than the standards must still comply with applicable OBD-M requirements and evaporative control standards;

3.4.2. Hardship Compliance Assistance for All Spark-Ignition Marine Engines

Staff is also proposing a separate provision applicable to all spark-ignition marine engines granting the Executive Officer discretion to issue additional compliance assistance for matters of extreme hardship for which the engine discontinuation allowance may not be completely adequate. Such compliance assistance would not be automatically available to the manufacturer; the manufacturer would be required to show proof that the situation necessitating Executive Officer intervention was completely beyond its control, and that the manufacturer had done everything feasible to resolve the situation under existing provisions. The following would be considered by the Executive Officer in determining whether or not to grant the compliance assistance:

- Proof must be provided showing that the hardship was beyond the control of the engine or boat manufacturer;
- All existing compliance flexibility provisions have been exhausted;
- The manufacturer has a plan to make up for any lost emission benefits.

3.5. On-Board Diagnostics-Marine (OBD-M)

Staff proposes that misfire monitoring become a mandatory component of the OBD-M requirements for SD/I engines beginning in 2010. Currently misfire monitoring is only required when ARB or the certifying manufacturer determines that engine misfire would cause the catalyst to fail before the emissions durability period of the engine had elapsed (e.g., 480 hours or 10 years for standard performance engines certified with a catalyst). When the OBD-M requirements were originally adopted, industry believed that catalyst construction would have to be far more robust than that of existing automotive catalysts to meet the 5.0 g/kW-hr NMHC+NOx standard and remain durable in a water environment. By virtue of that assumption, industry contended that misfire would not be an issue regarding catalyst durability and ARB agreed to make misfire monitoring a conditional OBD-M requirement. However, now that manufacturers have begun certifying SD/I engines in California, all have voluntarily included misfire monitoring as part of their OBD-M systems, presumably, at least in part, because they have found ways to incorporate conventionally designed catalytic converters that are susceptible to damage from engine misfire. As such, and because misfire monitoring has already been introduced voluntarily, staff believes that mandatory misfire monitoring should be a requirement for all future OBD-M systems. Audio/visual alert device suppression provisions would remain in effect per existing provisions. Staff is also proposing to ease the transition to OBD-M for manufacturers of high performance

engines by extending compliance dates to allow for the deployment of more sophisticated on-board computers and/or by temporarily relaxing the requirement for audio/visual alert device (i.e., malfunction indicator light) activation.

3.6. Replacement Engine Provisions

Part I, Section 8, of the "California Exhaust Emission Standards and Test Procedures for 2001 Model Year and Later Spark-Ignition Marine Engines" currently requires new SD/I replacement engines to comply with current model year emission standards. This unintentionally necessitates that a catalyst-equipped engine be used to replace the engine in an older model boat that may not be properly designed to accommodate or support a catalyst-equipped engine (e.g., limited engine compartment space, incompatible wiring harnesses, etc.). Accordingly, staff proposes to revise this provision to require installation of the cleanest engine currently available that can be installed in a boat without unreasonable modifications when replacing an existing engine. If no cleaner engine is available or compatible with the boat, a less stringent new replacement engine would be allowed so long as its emissions performance is at least as stringent as that of the engine being replaced.

3.7. Standardized Engine Rebuilding Practices

Staff proposes the incorporation of language to standardize procedures for rebuilding spark-ignition marine engines. The proposed language is in alignment with the engine rebuilding practices for other off-road categories in California and is virtually identical to that proposed by U.S. EPA for spark-ignition marine engines (40 CFR 1068.120). The incorporation of this requirement is necessary to prevent the downgrading of emission system performance during an engine rebuild.

3.8. Hang Tag Durability Requirements

Staff proposes to add a general statement of durability regarding the construction of hang tag labels. The requirements for environmental labels in § 2443.3 mandate a non-permanent label (i.e., hang tag) to be displayed on marine engines at the time of sale, but provide no material specifications for the construction of the hang tag. To address longevity concerns raised by a California dealership, staff had considered proposing an amendment to standardize components of the hang tag's construction such as reinforced grommets and surface lamination. However, several members of the regulated industry expressed opposition to more specific requirements citing that existing hang tags were sufficiently durable and replacements were available upon request should they ever be needed. After examining samples from several engine manufacturers, staff has concluded that the reviewed hang tags appear robust enough to survive under most conditions that should be encountered in a boat show room. However, to ensure that this is always the case and for every manufacturer, staff proposes that the Executive Officer be given discretion to require a demonstration of durability for any hang tag submitted per the provisions of § 2443.3 (d) that is suspected of being too fragile to remain viable for a period of no less than two years displayed under normal conditions. Recent legislation (Assembly Bill 695) now requires hang tags be submitted to the Department of Motor Vehicles with the registration application for

new boats with SD/I engines produced on or after July 1, 2008, further illustrating the importance of hang-tag durability.

3.9. Executive Officer Discretion for Technical Changes

Staff proposes that the Board additionally delegate to the Executive Officer the discretion to make technical changes to the regulations and test procedures without the need to return to the Board. This discretion is needed to ensure harmonization with the U.S. EPA, as its program has not yet been finalized. The staff envisions these changes being on the order of modifying definitions and technical specifications, particularly with regards to the test procedures and the NTE program. In these cases, the staff proposes alignment with U.S. EPA for the benefit of industry, but the final form of the requirements is not yet determined. Without such delegation, the marine industry may be subject to differing requirements until the Board could amend the regulation itself.

3.10. Aftermarket Exemption Procedures Clarification

To correct an oversight dating back to the adoption of the SD/I regulations in 2001, staff proposes to remove the exclusion of eligibility for an aftermarket exemption for SD/I parts found in section V, subsection D, of the "Procedures for Exemption of Add-On and Modified Parts for Off-Road Categories," incorporated in § 2472 of California's aftermarket regulations (13 CCR Article 7). As such, these procedures are in conflict with the applicability section of the aftermarket regulations (13 CCR 2470), which grants exemption applicability to all off-road engines subject to California or federal emission standards. The statement excluding SD/I engines in the aftermarket procedures was added in 2000, when only OB/PWC engines were subject to California's spark-ignition marine engine emission requirements, and was meant to provide reinforcement to readers that an exemption was not needed for pre-controlled engines, specifically SD/I engines at that time. However, after emission standards were adopted for SD/I engines in 2001, a corresponding adjustment to the aftermarket exemption procedures did not occur. Nonetheless, there has been no consequence to this apparent conflict in practice since applicability to SD/I engines is provided for in the aftermarket regulations, which establish regulatory requirements while incorporated test procedures detail the more nuts and bolts of demonstrating compliance to the regulations, and the regulations take precedence over incorporated documents. Staff's proposal to include SD/I engines in the aftermarket exemption procedures would therefore be a clarification of existing requirements.

4. DISCUSSION

4.1. High Performance Engines

The high performance engine sector in California consists of a relatively small number of manufacturers that cumulatively sell between 200 - 250 new engines Statewide each year. Despite this small number of engines, the emissions contribution from this category is not trivial. Additionally, the overwhelming majority of high performance engine sales are from a single manufacturer (Mercury Marine) that also has the distinction of being the only manufacturer that produces both standard and high

performance engines. As such, this manufacturer has a significant competitive advantage under the existing regulation in that it would be the only manufacturer able to certify high performance engines at current emission levels by averaging them together with lower-emitting standard performance engines.

Furthermore, additional information has indicated that the existing 2009 and later HC+NOx standard of 5.0 g/kW-hr presents a difficult challenge for high performance engines. Unlike the standard performance engines which have successfully met the 5.0 g/kW-hr emissions standard, high performance engines are typically operated at wide-open throttle for extended periods, and as such are calibrated to run fuel-rich most of the time. This is done primarily to reduce combustion temperatures preventing exhaust valve failure due to the high temperatures and cylinder pressures generated within the engines. Conversely, three-way catalytic converters, the technology of choice utilized almost exclusively on standard performance engines to comply with the standard, only achieve optimal performance at or near stoichiometric air/fuel ratios. Three-way catalysts can be engineered to retain some oxygen for use during fuel-rich operation; however, as the Manufacturers of Emissions Controls Association (MECA) noted in a letter regarding the staff's proposal, (See Appendix B), the oxygen storage materials used in three-way catalysts need periods of lean operation in order to replenish the stored oxygen. Typical usage of high-performance marine engines would not reliably offer the necessary periods of lean operation.

A key consideration in the development of staff's proposal was the potential impact of leaving the regulation unchanged. As mentioned above, the existing regulation gives an unfair competitive advantage to the sole dual category manufacturer. As a result, this manufacturer, already the dominant provider of high performance engines, would have a virtual monopoly of the high performance market in California. This would severely impact the small, California-based high performance engine manufacturers, as California sales form a significant part of their small market share. California dealers and boat builders currently supplied by high performance engine manufacturers without compliant product for 2009 would also be adversely affected. Furthermore, staff anticipates that many affluent Californians intent on owning a high performance boat would not be deterred by the lack of product in California and could purchase and register boats out of State, but use them in California anyway, despite legislation prohibiting the practice (Chapter 609, Statutes of 2007, Assembly Bill No. 695, Vehicle Code Sections 9852.9, 9853.7, and 9853.8). Should this scenario come to fruition, the result of the existing regulation with averaging would be job loss with less than optimal emission reductions.

While the original rulemaking included standard and high performance engines together, standard performance engines have been able to meet the 5.0 g/kW-hr HC+NOx standard, so requiring further emissions reductions from manufacturers participating solely in that market to make up for relaxed standards in the high performance market would not make sense. Any emissions reductions to make up for the relaxation should reasonably come from manufacturers in the high-performance market.

However, due to the composition of the market, most manufacturers have neither any standard performance engines with which to average, nor the resources to develop a plan to make up the shortfall. Requiring these small businesses, many of which are located in California, to make up the shortfall would be tantamount to shutting them down. For these reasons, staff investigated alternatives to the existing standard that could provide equivalent emissions benefits.

After examining and rejecting various alternatives (See Section 7), staff determined that the current proposal most fairly balanced the competing issues. The staff's proposal to relax the 2009 and later HC+NOx exhaust standard for small volume manufacturers of high performance engines from 5.0 g/kW-hr HC+NOx to the levels shown in Table 3.2, combined with the requirement that any large volume dual category manufacturer be required to meet the existing 5.0 g/kW-hr HC+NOx exhaust standard beginning in 2009 (likely using averaging), and the requirement that all boats using 2009 and later high performance SD/I engines (regardless of whether the engine is produced by a small or large volume manufacturer) incorporate enhanced evaporative controls, would preserve the emissions benefits of the regulation adopted in 2001.

The presence of only a single large volume dual category manufacturer, Mercury Marine, in the market has caused staff to consider alternatives that would allow for less expensive ways to comply with the requirements. Thus, staff additionally proposes an option that a large dual category manufacturer may certify high performance engines to the same exhaust and evaporative standards as proposed for small volume manufacturers. If a manufacturer chooses that option, staff proposes that it would then be required each year to expand the use of enhanced evaporative control technology on its standard performance engines to compensate for the emissions benefit shortfall that would otherwise occur. Staff also proposes that the Executive Officer be given discretion to allow other methods for recovering lost emission benefits should such methods provide equivalent and verifiable emissions benefits as the options identified.

It could be argued that the proposal thus increases the cost of the standard performance boats that are either used to generate a lower average exhaust emissions level or equipped with enhanced evaporative controls. However, since the requirement applies only to dual category manufacturers, that manufacturer would have the option of absorbing those costs in the purchase price of the high performance engine, an option the other manufacturers would not have. Furthermore, it should be noted that any other manufacturer that offers product in both the high-performance and standard performance markets in the future would be subject to the same requirements.

4.2. Technological Feasibility

The technological feasibility of the existing spark-ignition marine regulations has already been established by staff in its reports to the Board during the 1998, 2001, and 2005 rulemakings and follow-up test programs at Southwest Research Institute (SwRI). Namely, the technologies such as four-stroke and direct injection two-stroke technologies, leaner air-fuel calibration, electronic fuel injection, oxygen sensor

feedback fuel control, catalytic converters, and on-board diagnostics have all been determined to be feasible and appropriate for marine applications.

Staff's proposal does introduce additional evaporative emission controls that were not evaluated during those rulemakings. However, controls such as evaporative carbon canisters and low-permeation hoses are well-established, and have been used successfully by the automotive industry (ARB 1998b) for many years and are currently required for use on other off-road applications including some lawnmowers (ARB 2003a). U.S. EPA has also demonstrated the feasibility of carbon canisters and low-permeation hoses in marine applications as part of its current proposed rulemaking for spark-ignition marine engines (RIA 2007). The carbon canisters and hoses suggested in this report as a means to satisfy the proposed compliance requirement for high performance SD/I engines are expected to have similar material specifications as those mentioned in the referenced studies, and are indeed the same as those on which staff's and U.S. EPA's proposals are based.

4.3. "Sterndrive/Inboard Engine" and "Jet Boat" Definitions

Staff's proposed alignment with the federal definitions for "Sterndrive/inboard engine" and "Jet boat" would require several manufacturers that currently certify jet boat engines to the OB/PWC standards to begin certifying them to the more stringent SD/I standards. Staff believes this change is appropriate since jet boats typically compete in the same market as boats with sterndrive engines, and is necessary to prevent a potential shift in the sterndrive market favoring greater production and sales of higher emitting OB/PWC engines. U.S. EPA intends to allow manufacturers of jet boats with OB/PWC engines to comply federally using banked emission credits until 2012. However, ARB regulations do not permit the banking of emission credits and thus, these manufacturers would be required to make the transition immediately in California in the absence of additional action by the Board to grant compliance assistance. Therefore, to help facilitate transitioning to the SD/I standards for manufacturers currently certifying jet boat engines to the OB/PWC standards, staff proposes the following amendments:

- Jet boat engine families previously certified to the OB/PWC standards may continue to be certified to the OB/PWC standards until 2012;

- Beginning in 2010, newly introduced jet boat engine families must comply with the SD/I requirements upon introduction, but same-year offsets from any other jet boat or OB/PWC engine family may be used to comply with the HC+NOx standards through averaging until 2012. Compliance with the proposed CO standards would need to be met without averaging. Engine families certified to the OB/PWC HC+NOx standards in prior years, but not used in jet boat applications until 2010 would be considered newly introduced jet boat families;

- Jet boat engines previously certified in the same engine family as OB/PWC engines must be certified separately and in a unique engine family beginning in 2010 if newly introduced, or in 2012 otherwise.

Additionally, OBD-M would apply to new jet boat engine families beginning in 2010 and to all jet boat engine families beginning in 2012. The engine discontinuation allowance (EDA) would apply to these engine families beginning in 2012, but only engines used in jet boat applications would be considered in determining the final EDA emissions limit (i.e., engines from the same family as a jet boat engine, but installed in a PWC, cannot generate EDA offsets).

4.4. "New Engine" Definition

Staff's proposed alignment with the federal definition for "New Propulsion Marine Engine or New Engine" is meant to ensure consistency between federal and State regulations regarding applicability to specific engine configurations. This definition also makes explicit that any engine installed for sale in a new vessel, whether the engine is rebuilt, remanufactured, or used, must comply with the emission requirements in effect for new engines at the time the engine was installed.

4.5. Safety Concerns

The marine industry has not raised any safety-related issues at this time regarding staff's proposed amendments to the regulation. The proposed diurnal and permeation standards for high performance SD/I engines are based on the use of passive purge control carbon canister systems which do not violate United States Coast Guard prohibitions against fuel storage in pressurized containers.

5. ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

The proposed amendments are intended to provide limited regulatory relief while maintaining reductions of ozone precursor emissions assumed in the current regulations. An additional consideration is the impact that the proposed amendments may have on both ambient and localized concentrations of carbon monoxide in the environment. In consideration of the data analyses performed herein, staff has determined that no significant adverse environmental impacts should occur as a result of adopting these amendments. This chapter describes the potential impacts that the proposed amendments may have on the environment.

5.1 Legal Requirements

The California Environmental Quality Act (CEQA) and CARB policy require an analysis be performed to determine the potential adverse environmental impacts of proposed regulations. In addition, ARB's regulations require Staff Reports to assess significant beneficial and adverse environmental impacts. (Title 17 California Code of Regulations, Section 60005(b).) To meet these requirements, CARB must assess the extent and severity of reasonably foreseeable environmental impacts, evaluate potential environmental benefits of both the proposed action and of alternatives, and respond (in writing) to all significant environmental issues raised in the public review period and at the Board hearing. At present, CARB's regulatory program is certified by the Secretary of Resources (cf. Public Resources Code §21080.5), which allows CARB to include an

environmental analysis in the Initial Statement of Reasons (ISOR) instead of preparing an environmental impact report or negative declaration. Written responses to significant environmental issues raised by the public will be included in the Final Statement of Reasons (FSOR) for the proposed amendments .

Public Resources Code §21159 requires that the environmental analysis prepared by CARB include analyses of the following "reasonably foreseeable" items:

- Impacts of the methods of compliance;
- Feasible mitigation measures; and
- Alternate means of compliance with the proposed amendments (see subsection 5.2.3).

With respect to mitigation measures, CEQA requires state agencies to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

The impact of the proposed action (i.e., the regulations as proposed here) on criteria pollutant emissions generally has been discussed above. However, both the proposed action and alternatives to it can also affect carbon monoxide emissions levels that have a more direct impact on human health and welfare near marine engines and equipment in operation; therefore, ARB must also evaluate the relative effects of the proposed action and alternatives on these more direct impacts. Staff believes that the proposed action will provide additional and direct benefits for many individuals by reducing their exposure to CO.

5.2. Projected ROG+NOx Emission Benefits

The focal point of staff's proposal is to provide industry with compliance options (explained in subsection 4.1.1) for high performance SD/I engines that preserves the emissions reduction goals of the existing regulation (I.e., is emissions-neutral with respect to the existing regulations). As shown in Table 5.1, no adverse environmental impacts are expected as a result of staff's proposal.

Table 5.1 -
Projected Emission Benefits for High Performance SD/I Engines
Statewide Summer Weekend

MODEL YEAR	POLLUTANT	EMISSION BENEFITS [tons per day]	
		Existing	Staff proposal
2009	ROG+NOx	0.19	0.19
2010	ROG+NOx	0.36	0.36
2020	ROG+NOx	2.03	2.03

5.3. Carbon Monoxide (CO)

5.3.1. Benefits of the Proposal

Although CO is not an ozone precursor, it is a criteria pollutant and has been known to cause fatalities in high concentration through asphyxiation. The United States Coast Guard and the National Institute for Occupational Safety and Health warn against the practices of wakeboarding and teak surfing because of the potential for these activities to result in serious injury or death as a result of CO inhalation from close proximity to the boat engine's exhaust. Typically, CO poisoning occurs while wakeboarders and teak surfers hold on to the back of the boat at idle or low cruising speeds. From approximately 1990-2007, there were 52 boat-related CO poisoning cases in California according to an updated Boating Accident Report from the Double Angel Foundation (DBLA 2007) using data commissioned by the United States Coast Guard. The California Department of Boating and Waterways reports 10 deaths between 2001 and 2006 in California associated with the inhalation of carbon monoxide during boating activities.

While as previously stated in subsection 3.2.2 of this report, staff's proposed CO standards would essentially cap emission levels at current levels, the incorporation of three-way catalytic converters on SD/I engines in California beginning in 2007 to reduce HC and NOx has also significantly reduced engine-out CO levels from those same engines compared to previous generations without catalytic converters. Staff estimates that reductions in CO on the order of 40 to 60 percent below previous engine-out levels have been achieved and the proposed standards will ensure the continuation of these reductions into the future. Conversely, staff's proposal to allow relaxed exhaust standards for high performance engines would result in a theoretical loss of CO benefits for those engines compared to the existing regulation, which does not mandate CO emission levels. However, the loss would be slight since the number of high performance engines in the California inventory is relatively small and, as previously mentioned, there would not be an increase in exposure risk because wakeboarding and other tow sports are not typically performed at maximum engine speeds behind high performance boats. CO reductions for OB/PWC engines have also occurred as an indirect result of the Board's previous action to control ozone precursors and will be ensured by staff's proposed CO standards.

As noted in Section 5.2.1, inhalation of CO during boating activities was associated with 10 deaths in California between 2001 and 2006. Additionally, CO may be a contributing factor in an associated with the unknown number of other marine–related deaths or injuries that are otherwise classified as being due to drunkenness or drowning.

Because of the dangers of carbon monoxide poisoning, the California Legislature made it illegal to teak surf[9]. AB 2222 (Stats. 2004, Chap. 565), effective as of January 1, 2005, imposes a fine of up to $100 on anyone who operates a vessel's engine or

[9] "Teak surfing" or "platform dragging," involves pulling a person through the boat's wake while the person holds on to the back of the boat.

generator while a person is holding on to the swim platform, swim ladder, or swim step on a boat. The passage of AB 2222, the Legislature declared its intent to, among other items:

> (c) Urge manufacturers of motorboats to invest in research and development to do both of the following:
>
> (1) Reduce the carbon monoxide emissions from their engines as soon as possible.
>
> (2) Design a motorboat that would better protect boaters from all CO emissions.

Although staff cannot quantify the impact of the CO standards in the proposed action on premature deaths and poisonings avoided, tests conducted by the National Institute for Occupational Safety and Health (NIOSH) indicate that a catalyzed SD/I system reduced CO exposures to boat occupants more than 90 percent. NIOSH concluded that "catalytic technology can greatly reduce the CO poisoning hazard to occupants of boats that have gasoline-powered engines." (NIOSH, 2007).

Because the subject marine engines are currently unregulated for CO, and because both the proposed actions and alternatives considered here all require at least some CO reduction from marine engines neither the proposed action nor the alternatives considered can be considered to cause an adverse impact. However, the proposed action would reduce continued adverse impacts on vessel operators and occupants. By contrast, the alternatives considered that would involve less stringent CO standards could result in continued adverse environmental impacts on vessel operators and occupants, and could require mitigation. Staff will continue to evaluate CO emissions and potential ways to reduce emissions further when possible.

5.3.2. Reasonably Foreseeable Feasible Mitigation Measures

Because the proposed amendments hold ozone precursor emissions constant, and because there is currently no CO standard and the proposed CO standard is set at or below current engine emissions levels, staff concludes that no significant adverse environmental impacts would occur from implementing the proposed amendments. As no adverse impacts are anticipated, no mitigation measures would be needed.

5.3.3. Reasonably Foreseeable Alternative Means of Compliance

The use of various types of emissions controls such as catalysts or evaporative controls to reduce hydrocarbon emissions constitutes the alternative means of compliance with the proposed amendments. Both technologies are well understood, and have been used successfully in other applications such as automobiles for decades. Neither technology would increase CO emissions; catalysts would decrease CO emissions.

5.4. State Implementation Plan (SIP)

The original spark-ignition marine engine regulations were adopted by the Board in 1998 for OB/PWC and in 2001 for SD/I engines and have been included as part of the

missions inventory baseline for SIP revisions since 2002. The emissions from engines in this source category are most significant during the summer ozone season. Since the proposal retains the overall ROG+NOx emissions benefits from the 2001 regulation, the changes proposed by staff should not significantly alter SIP commitments.

There is a possibility that the projected relative emission levels of HC and NOx would change due to the substitution of evaporative emissions control for exhaust control. However, as noted, the high performance engines run extremely rich, so it is likely that even if the 5.0 g/kW-hr HC+NOx standard were somehow to be met, that the majority of emissions reduced would be HC emissions. Thus, staff believes the change in relative HC and NOx reductions due to the proposal would be negligible.

5.5. Environmental Justice

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Senate Bill 115, Solis; Stats 1999, Ch. 690; Government Code § 65040.12(c)). The Board has established a framework for incorporating environmental justice into ARB's programs consistent with the directives of State law. The policies developed apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low income and minority communities, which sometimes experience higher exposures to some pollutants as a result of the cumulative impacts of air pollution from multiple mobile, commercial, industrial, area-wide, and other sources. Over the past twenty years, ARB, local air districts, and federal air pollution control programs have made substantial progress towards improving the air quality in California. However, some communities continue to experience higher exposures than others as a result of the cumulative impacts of air pollution from multiple mobile and stationary sources and thus may suffer a disproportionate level of adverse health effects. Since the same ambient air quality standards apply to all regions of the State, all communities, including environmental justice communities, will benefit from the air quality benefits associated with the proposal. As additional relevant scientific evidence becomes available, the spark-ignition SD/I marine engine standards will be reviewed again to make certain that public health is protected with an adequate margin of safety.

To ensure that everyone has had an opportunity to stay informed and participate fully in developing these proposed amendments to the spark-ignition inboard and sterndrive marine engine standards, staff has had meetings and has participated in public forums as described in Appendix A to this report.

5.6. Cost-Effectiveness

The cost-effectiveness for OB/PWC engines found in the 1998 rulemaking was $0.32 to $3.57 per pound of NMHC+NOx reduced (ARB 1998a) and for SD/I engines in the 2001 rulemaking was $2.08 to 3.39/lb NMHC+NOx reduced (ARB 2001). Staff expects no net change in cost-effectiveness from that found in the prior rulemakings, because the proposed amendments allow high performance engine manufacturers to comply with

non-catalyst based exhaust standards, and otherwise generally align with proposed federal requirements for other SD/I and OB/PWC engines.

If carbon canisters and low-permeation evaporative control hoses are utilized as a means of complying with the regulation (virtually all vessels that use high performance engines in California already possess metal, thus low permeation, tanks), the increase in costs to the manufacturer ($0.40 to $0.60 per foot hose length and $50.00 to $150.00 per carbon canister on average) would be offset by the savings resulting from the relaxation of requirements to introduce high performance engines meeting the catalyst-based 5.0 g/kW-hr HC+NOx exhaust standard in 2009 and thereafter. For comparison, in the original 2001 Initial Statement of Reasons, the incremental cost of complying with the catalyst-based standard was estimated to be $756 to $1231 per engine (ARB 2001).

6. ECONOMIC IMPACTS

The proposed regulatory amendments are not expected to result in net additional costs above the costs to comply with the existing regulation or for manufacturers to comply with federal requirements. Adoption of staff's proposal is actually expected to benefit high performance engine manufacturers by providing them with a less expensive alternative to the catalyst-based 5.0 g/kW-hr HC+NOx exhaust standard that they would not otherwise have under the existing regulation. Additionally, the proposed CO standards, NTE limits, and jet boat requirements are nearly identical to those proposed federally and would not necessitate additional costs or efforts above those required to comply with the federal requirements. Therefore, staff maintains that the proposed amendments would have no adverse impacts on business competitiveness, California employment, or on business creation, elimination, and expansion. Furthermore, if any manufacturer determines that compliance with the existing regulation is more economically advantageous than staff's proposed amendments for high performance manufacturers, that manufacturer is still able to choose to comply with the exhaust emission standards of the existing regulation. This section discusses, in greater detail, the potential cost and economic impacts of staff's proposed amendments.

6.1. Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

State agencies are required to estimate the cost or savings to any state or local agency, and school districts. The estimate is to include any nondiscretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

6.2. Affected Businesses

Staff does not expect any business to be adversely affected by the proposed amendments to the regulation, including those pertaining to farm or agriculture. Staff's amendments would provide greater flexibility for any high performance marine engine manufacturer or boat builder to comply with the regulation. Boat owners are not likely to be adversely affected because vessels with high performance engines are primarily used in recreational applications and are not typically employed to support the livelihood of California residents. The amendments are directed at manufacturers, so docks, ports, and fishing and boating stores are not expected to be adversely affected by staff's proposal; in fact, the amendments may indirectly benefit them since the amendments are meant to facilitate compliance for the marine industry.

6.2.1. Estimated Costs to Engine Manufacturers

An additional cost to the manufacturer would occur from the incorporation of carbon canisters ($50.00 to $150.00 per carbon canister on average) and low-permeation evaporative tubing ($0.40 to $0.60 per foot hose length on average). However, these incremental costs will be more than offset by the relaxation of requirements to introduce high performance engines that comply with the 5.0 g/kW-hr HC+NOx exhaust standard (i.e., most probably equipped with catalytic converters, which were estimated in the 2001 action to cost from $756 to $1231 per engine (ARB 2001)).

6.2.2. Potential Impacts on Business

Staff does not expect any business to be adversely affected by the proposed amendments to the regulation. The evaporative control technology to be incorporated is readily available, generally inexpensive compared to catalytic converters, and would not require special expertise. The proposed amendments are likely to benefit manufacturers because they generally facilitate compliance and are a potentially less expensive alternative for complying with the regulation. High performance marine engines are primarily used in recreational applications and do not typically support the livelihood of California residents. As mentioned above, the amendments are directed at manufacturers, so docks, ports, and fishing and boating stores are not expected to be adversely affected by staff's proposal. Staff's proposal to adopt CO standards and NTE limits is the same as the federal proposal. For all these reasons, no adverse effect on businesses would occur.

6.2.3. Potential Impact on Business Competitiveness

The proposed amendments are not expected to have a significant impact on the ability of California businesses to compete with businesses in other states since any engine produced in, or imported into, the State must comply with the proposed requirements. Furthermore, the recent enactment of AB 695 by the California Department of Motor Vehicles to modify the boat registration process in California promotes a level playing field for California dealerships by denying the registration of boats purchased outside the State with engines not certified for sale in California. Staff does not expect that any business will suffer a competitive disadvantage from the proposed amendments. The

evaporative control technologies are readily available and/or easily implementable, comparatively inexpensive, and would not require special expertise. High performance marine engines are primarily used in recreational applications and do not typically support the livelihood of California residents. As noted previously, docks, ports, and fishing and boating stores are not expected to be adversely affected by staff's proposal, since the amendments are directed at manufacturers. To the extent that the amendments reduce compliance costs to the marine industry, the docks, ports, and fishing and boating stores could also benefit.

6.2.4. Potential Impact on Employment

The proposed amendments are not expected to cause a noticeable change in California employment. In fact, they could help preserve California jobs to some extent, by making it easier for small California business to continue to compete in the high performance SD/I market. The evaporative control technologies and supplemental measures required are readily available and/or easily implementable, comparatively inexpensive, and would not require special expertise. The adoption of staff's proposal is expected to benefit manufacturers who would otherwise have to comply with a more expensive option or stop selling engines in California.

6.2.5. Potential Impact on Business Creation, Elimination or Expansion

The proposed amendments are not expected to have a noticeable impact on the status of California business creation, elimination, or expansion. The evaporative control technologies and supplemental measures required are readily available and/or easily implementable, comparatively inexpensive, and would not require special expertise.

6.2.6. Potential Impact on Small Businesses

The proposed amendments are not expected to have a noticeable impact on the status of California businesses including small businesses; however, adherence to the existing requirements for high performance engines with averaging could result in severe financial hardship for some small businesses (see subsection 4.1). The evaporative control technologies and supplemental measures required are readily available and/or easily implementable, comparatively inexpensive, and would not require special expertise.

6.3. Potential Costs to Local and State Agencies

Staff believes the proposed requirements are the most cost-effective means of achieving emission reductions of the same magnitude as the existing regulation. Staff is proposing amendments that would allow greater flexibility for businesses (high performance engine manufacturers specifically) to comply with the regulation at reduced cost and without a reduction in emission benefits as required by the existing regulation. The only costs to State government as a result of the proposed amendments would be to ARB for implementing the new regulatory requirements and possibly for additional staff time to evaluate aftermarket replacement parts for SD/I marine engines. We anticipate that the implementation costs could be absorbed within the existing ARB

budget for the current fiscal year 2008/2009; however, an additional 1¼ to 1½ PY could be needed for future fiscal years 2009/2010 and 2010/2011 to address a potential increase in the number of new applications to be reviewed. This would result in an estimated range of $150K to $180K using the current basis of $120K per PY. Although ARB is already responsible for verifying the implementation of the existing regulations for spark-ignition marine engines, an undetermined number of additional manufacturers will begin complying for the first time in 2009; thus, the hiring of additional staff could be necessary if significant increases to workload occur as a result of staff's proposed compliance flexibility option and alignment with new U.S. EPA requirements. The proposed amendments are not expected to result in an overall increase in costs for local agencies.

7. REGULATORY ALTERNATIVES

The staff evaluated various alternatives to the current proposal. A brief description of the alternatives and staff's rationale for finding them unsuitable follows below.

7.1. Preserve Existing High Performance Engine Requirements

The first alternative to this proposal would be to not modify the existing California spark-ignition marine engine regulations. As noted in Section 4.1.1., the existing regulation contains an averaging provision that unintentionally puts small volume high performance engine manufacturers at a competitive disadvantage that could result in their businesses closing. Therefore, staff rejected this alternative.

7.2. Wait for the Adoption of Federal Regulations

Although U.S. EPA has published a Notice of Proposed Rulemaking for inboard and sterndrive engine standards, including CO standards and NTE limits, the federal requirements are not expected to be implemented until 2010 at the earliest. Furthermore, the emission requirements being considered federally for high performance engines would be less stringent than those already adopted by California or the alternatives proposed in this staff report. Considering that California has had regulations for high performance engines in place since 2001, and that staff's proposed amendments preserve the emission benefits of those requirements in the absence of a federal requirement (at least through 2010), postponing these amendments would only serve to deny reasonable compliance flexibility to the regulated industry.

The advantage of a national regulation is harmonization. Manufacturers would have to comply with only one set of regulations for all nationwide sales. The disadvantage of relying on the federal rulemaking is largely one of uncertainty and timing with the likelihood of lost benefits in the high performance engine sector. Staff fully intends to continue working with U.S. EPA in its development of a federal rule to ensure consistency of standards and other requirements to the extent feasible and appropriate. However, delaying action until the federal regulation is finalized would unnecessarily burden the marine industry by requiring it to comply with a California standard for high performance engines for the 2009 model year that, by and large, the marine industry appears unable to meet. Conversely, if the action was to repeal the existing standards

and rely on U.S. EPA, the result would be a loss of emission benefits. Therefore, staff rejected this alternative.

7.3. Exempt Small Volume High Performance Engine Manufacturers

Although relatively few in number, high performance engines have high exhaust rates and their impact on air quality in California is not trivial, especially during the summer season. Since the overwhelming majority of these engines are produced by a single manufacturer, staff considered an option to exempt the remaining small volume manufacturers from compliance with the 5.0 g/kW-hr HC+NOx standard while continuing to require the single large volume manufacturer to meet the standard in 2009. While this would address any issues of a competitive disadvantage for the small volume manufacturers, it would not fully constitute an emissions neutral solution compared to the existing requirements. Furthermore, U.S. EPA has not proposed to exempt small volume manufacturers from complying with the federal standards in part because high performance engines are discretionary products and already expensive to purchase, making the cost of emissions control more absorbable and easier to pass on to the customer (albeit U.S. EPA is not likely to require catalyst-based standards for these engines). Therefore, staff rejected this alternative.

7.4. Require All High-Performance SD/I Manufacturers to Make up Emissions Shortfall

Staff considered proposing changes that would have allowed all high-performance SD/I manufacturers to meet relaxed HC+NOx emissions standards, equip high-performance boats with enhanced evaporative controls, and also require the individual manufacturers to submit plans for making up the remaining emissions shortfall with supplemental measures. Upon review, staff determined that although this alternative would theoretically be emissions-neutral, implementation would be overly burdensome. Without clarity on exactly what measures would be needed and acceptable to the Executive Officer, manufacturers could have spent an enormous amount of resources developing measures only to have them rejected. In the case of the small-volume manufacturers who participate only in the high-performance market, their alternatives for achieving additional emissions reductions would be severely constrained, placing them at a competitive disadvantage with the dual-category manufacturer. Furthermore, even the dual-category manufacturer would be subject to uncertainty regarding product planning. Therefore, staff rejected this alternative

8. CONCLUSIONS AND RECOMMENDATIONS

Staff's objectives in recommending the revisions proposed herein to California's spark-ignition marine regulations and test procedures are to provide harmonization with proposed federal requirements, and to provide another compliance path for larger, high performance engines that avoids a potential technical barrier in using catalysts, and avoids an unanticipated competitive disadvantage to small volume manufacturers of these engines. The cost-effectiveness of the changes remains positive, and manufacturers will be required to offset the small loss of emission reductions resulting from the revised tailpipe standards. A new CO standard applicable to both inboard and outboard recreational marine engines will help assure no individual engine will expose wakeboarders to excess concentrations of CO.

No alternative considered by the agency would be more effective in carrying out the purpose for which the amended regulation is proposed, or would be as effective as, or less burdensome, to affected private persons than the proposed regulation. Therefore, staff recommends that the Board accepts staff's proposed adoption of amendments to sections 2111, 2112, and Appendix A, within Chapter 2, Article 2.1, Title 13, California Code of Regulations (13 CCR); section 2139 within Chapter 2, Article 2.3, 13 CCR, section 2147 within Chapter 2, Article 2.4, 13 CCR; sections 2440, 2441, 2442, 2443.1, 2443.2, 2443.3, 2444.1, 2444.2, and 2445, and proposed repeal of Section 2448, within Chapter 9, Article 4.7, 13 CCR; and proposed adoption of amendments to the following documents incorporated by reference in Section 2447, 13 CCR: "California Exhaust Emission Standards and Test Procedures for 2001 Model Year and Later Spark-Ignition Marine Engines," as last amended September 22, 2006, and in Section 2474, 13 CCR: "Procedures for Exemption of Add-On and Modified Parts for Off-Road Categories," as adopted July 14, 2000.

9. REFERENCES

ARB 1998a: California Air Resources Board, Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2001 and Later Model Year Spark-Ignition Marine Engines, October 23, 1998 (Staff Report).

ARB 1998b: California Air Resources Board, Proposed Amendments to California Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, September 18, 1998 (Staff Report).

ARB 2001: California Air Resources Board, Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2003 and Later Spark-Ignition Inboard and Sterndrive Marine Engines, June 8, 2001 (Staff Report).

ARB 2003a: California Air Resources Board, Public Hearing to Consider the Adoption of Exhaust and Evaporative Emission Control Requirements for Small Off-Road Equipment and Engines Less Than or Equal To 19 kW, August 8, 2003 (Staff Report).

ARB 2003b: California Air Resources Board, Public Hearing to Consider Adoption of the Heavy-Duty Diesel Engine Software Upgrade Regulation (Chip Reflash), September 5, 2003 (Staff Report).

ARB 2005a: California Air Resources Board, Public Hearing to Consider Amendments to the Current Inboard and Sterndrive Boat Regulations, September 30, 2005 (Staff Report).

ARB 2005b: California Air Resources Board, Notice of Public Hearing to Consider Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008, September 1, 2005 (Staff Report).

Assembly Bill 695: California Statutes of 2007, Chapter 609, Adds Sections 9852.9, 9853.7, and 9853.8 to the VC, Karnette, Betty, 54th District, October 13, 2007

DBLA 2007: Double Angel Foundation, Boat-Related Carbon Monoxide (CO) Poisonings, Updated: April 2007.

ISO 8178-4: International Organization for Standardization, Reciprocating Internal Combustion Engines, Exhaust Emissions Measurement, Part 4: Test Cycles for Different Engine Applications.

NIOSH 2007: National Institute for Occupational Safety and Health, Report EPHB 289-12a, Evaluation of Carbon Monoxide Concentration With and Without Catalytic Emission Controls From Gasoline Propulsion Engines, April 2007

RIA 2007: United States Environmental Protection Agency, Control of Emissions from Marine SI and Small SI Engines, Vessels, and Equipment, Draft Regulatory Impact Analysis, April 2007.

U.S. EPA 1996: United States Environmental Protection Agency, Control of Air Pollution; Final Rule for New Gasoline Spark-Ignition Marine Engines, Exemptions for New Nonroad Compression-Ignition Engines at or Above 37 Kilowatts and New Nonroad Spark-Ignition Engines at or Below 19 Kilowatts; Final Rule, 61 Federal Register 52088-52169, October 4, 1996.

U.S. EPA 2007: United States Environmental Protection Agency, Control of Emissions from Nonroad Spark-Ignition Engines and Equipment; Proposed Rule, 72 Federal Register 28098-28393, May 18, 2007.

APPENDIX A: SPECIFIC OUTREACH AND PUBLIC PROCESS REGARDING THE DEVELOPMENT OF STAFF'S PROPOSAL TO AMEND THE SPARK-IGNITION MARINE REGULATIONS

The following is a chronological listing of meetings and other instances of dialog with the public, regulated industries, and associated organizations:

2005 Public Board Hearing

On November 17, 2005, staff proposed and the Board adopted amendments to the spark-ignition marine regulations for SD/I engines and boats. Included in those amendments was a provision allowing engine manufacturers to certify high performance engines through corporate averaging with standard performance engines. Representatives from the National Marine Manufacturer's Association (NMMA) commented at that time that corporate averaging in itself might not be sufficient for all high performance engine manufacturers since many of them only produce high performance engines and therefore do not have standard performance engines to average. Staff had previously acknowledged this potential deficiency in the staff report for the November 17, 2005, rulemaking, and indicated its commitment to develop a long-term solution prior to the commencement of emission requirements for these engines in 2009.

Meeting with Southern California Marine Dealers Association (SCMA)

On January 16, 2007, staff met with the Board of Directors of SCMA to discuss how ARB's recreational marine regulations could affect California dealerships. SCMA was concerned that the addition of catalysts and sophisticated electronic controls on SD/I engines could cause California boats so equipped to significantly increase in price compared to similar out-of-State boats without catalysts. In response, staff identified several major marketing incentives for buying a California certified inboard or sterndrive marine engine despite the prospect of a price increase. The incentives were that the catalyzed California engine is covered by mandatory warranty and durability by the manufacturer, it must incorporate on-board diagnostics that quickly and accurately identify malfunctions and facilitate repairs, it must have a four-star label that lake authorities could use to restrict the use of boats in the future, has an environmentally friendly engine that appeals to many Californians like hybrid electric cars have, and is safer to operate because of reduced carbon monoxide emissions.

Participation in the Development of Assembly Bill No. 695 (AB 695)

AB 695 was legislation authored by State Assemblywoman Betty Karnette, 54th District, and sponsored by SCMA, to protect California marine dealers from unfair competition due to the higher cost of California boats equipped with catalytic converters versus similar out-of-State boats without them. AB 695 proposed to add §§ 9852.9, 9853.7, and 9853.8 to the California Vehicle Code (VC) to make it generally illegal for a person to purchase a marine vessel outside of California for use in California without a valid California-certified engine. AB 695 was signed into law on October 13, 2007, and as of July 1, 2008, new boat owners are required to submit proof that their boats contain a California-certified engine when applying for registration and a vessel identification

number. AB 695 was amended several times since its introduction in February 2007, and ARB staff routinely provided input throughout the various stages of its development.

2007 Los Angeles Boat Show

On February 7, 2007, staff attended the 51st Annual Los Angeles Boat Show. The show is presented each year by SCMA and staff attended by invitation of Ilmor Marine Engines, LLC, a manufacturer of high performance marine engines, and was provided complimentary passes by SCMA. The purpose of the visit was to converse with the represented boat dealers, educate them on the benefits of California engines versus federal engines, and to get a first hand look at some of the new recreational marine offerings for 2007. In particular, staff focused its attention on dealers selling boats with high performance engines since these engines will be regulated for the first time beginning with the 2009 model year.

Meetings with High Performance Marine Engine Manufacturers

In addition to frequent conference calls and meetings with NMMA and SCMA to discuss high performance related issues, staff met individually with representatives from Mercury Marine and Ilmor Marine Engines, LLC, several times between February 2007 and April 2008. During each of those meetings staff heard the manufacturer's concerns regarding compliance with the existing catalyst-based standards (5.0 g/kW-hr NMHC+NOx) set to begin with the introduction of 2009 model year engines. These meetings were informative and helped guide the development of staff's proposed amendments to the existing regulations for high performance engines.

Certification and Enforcement Guidance Meetings

On March 14, 2007, staff from ARB's regulatory, certification, legal, and enforcement groups met with NMMA collectively and individually to discuss the legality of business practices related to in-State and out-of-State engine and boat sales and distribution, engine vs. boat manufacturer liability issues, the expectations and time constraints of the certification process for catalyst equipped engines and on-board diagnostics, and to hear industry's concerns regarding new replacement engines, which according to existing regulation are required to comply with current year exhaust emission standards. Several member companies made presentations on the unique elements of its business practices.

Meeting with SCMA on High Performance Engines

On September 11, 2007, SCMA leadership and several member companies that exclusively manufacture high performance engines met with ARB staff to lobby for a relaxation of the 5.0 g/kW-hr NMHC+NOx catalyst-based standard scheduled to begin in 2009. SCMA asked for a relaxation of the exhaust standard for high performance engines and a component-based approach to emissions control rather than the traditional performance-based approach. Staff replied that it was open to both concepts, but that any lost emissions would need to be made up via other means.

Conference Calls with U.S. EPA

On October 30, 2007, and throughout the development of the proposals in this staff report, ARB staff conferred with U.S. EPA staff regarding changes to, and alignment with, the federal proposal for spark-ignition marine engines and boats. Included among the discussion topics were high performance engine standards, production line testing, OBD-M, NTE standards, and the extension of catalyst-based standards to jet boat applications.

Meeting with NMMA

On December 17-18, 2007, staff met with NMMA management and several member companies to discuss high performance engine standards and remediation methods for any loss of benefits resulting from a relaxed exhaust standard. Some of the remediation methods discussed included an early introduction of evaporative standards proposed by U.S. EPA for high performance engines and the in-use replacement of fuel hoses with low-permeation hoses. Also discussed was the lifecycle extension of the base 4.3 liter engine by General Motors.

Workshop Notice

On February 21, 2008, ARB emailed listserv subscribers and posted a document on its website at http://www.arb.ca.gov/msprog/mailouts/msc0803/msc0803.pdf announcing that a public workshop had been scheduled for March 18, 2008, to discuss proposed changes to the spark-ignition marine engine and boat regulations. The document went into some detail regarding the changes being considered by staff and provided the logistics for the meeting and outlined the processes for commenting on staff's proposal.

Meetings with Jet Boat Manufacturers

In separate meetings on March 11, 2008, staff spoke with representatives from Bombardier and Yamaha to discuss proposed changes to California's spark-ignition marine engine and boat regulations that would require jet boat engines previously certified to the applicable OB/PWC standards to be certified to the significantly more stringent SD/I standards.

NMMA Pre-Workshop Conference Call

On March 13, 2008, staff received verbal feedback from NMMA regarding the regulatory revisions proposed by staff in the February 21, 2008, workshop notice. Staff used this information to fine tune its proposal prior to the workshop.

2008 Public Workshop (Webcast)

On March 18, 2008, staff held a public workshop to discuss modifications to California's existing spark-ignition marine engine and boat regulations. The workshop was webcast to reach a wider audience than was able to attend in person. The discussion included a presentation by staff of proposed changes to the exhaust standards for high performance engines, an early introduction of evaporative control requirements for high performance engines, the incorporation of CO standards and NTE limits, adoption of general and hardship compliance assitance provisions, revised new replacement engine provisions, and more. Additional presentations were made by both the manufacturer

and supplier of carbon canisters that could be made available to the industry in the timeframe required for compliance with staff's new proposals. A copy of staff's presentation may be found at http://www.arb.ca.gov/msprog/offroad/recmarine/si_marine_workshop_03182008.pdf.

Certification Outreach Meeting

On April 22, 2008, ARB staff held a meeting to educate manufacturers of high performance engines on the various aspects of certifying their engines for the 2009 model year and beyond. The majority of high performance engine manufacturers are small business operations that sell less than fifty engines per year in California and have no previous experience with the certification process. Since many of these manufacturers do not have the resources to hire dedicated certification staff, ARB staff felt it warranted to provide outreach to this segment of the industry to facilitate compliance with the certification process.

APPENDIX B: LETTER FROM THE MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION REGARDING HIGH PERFORMANCE ENGINES

Manufacturers of Emission Controls Association

1730 M Street, NW
Suite 206
Washington, DC 20036-5603
(202) 296-4797 FAX: (202) 331-1388

May 16, 2008

Scott Rowland
Mobile Source Control Division
California Air Resources Board
9528 Telstar Ave.
El Monte, CA 91731

Dear Mr. Rowland:

This letter is in response to your request regarding ARB's proposed emission regulations for new spark-ignited marine engines and boats that were presented at the March 18th workshop. MECA has reviewed the latest proposal and participated in the March workshop. MECA supports ARB's approach to harmonize California's spark-ignition marine standards with those proposed by U.S. EPA for gasoline certification of THC + NOx. We also believe that the proposed CO limits for stern drive and inboard (SD/I) engines above and below 373 kW are reasonable and can be met with the same three-way catalyst (TWC) converters already used on California engines.

With respect to high performance engines (> 373 kW), we agree with staffs proposed approach to relax the 5.0 g/kW-hr exhaust standard for NMHC + NOx in exchange for the incorporation of evaporative control systems on vessels equipped with high performance engines beginning in 2009. Evaporative control technology has been successfully incorporated on passenger vehicles for over 30 years and has advanced to allow automobiles to meet the zero evaporative emissions required by California's LEV II PZEV emission limits. We see no reason why these performance marine vessels can not benefit from the same technology as other SI vehicles and engines to achieve ultra low evaporative emissions.

MECA agrees with Staff's conclusion that the operating conditions of these high performance engines are not ideal for optimal performance of three-way catalysts. TWC catalysts are designed for peak conversion efficiencies of all three major criteria pollutants (HC, CO and NOx) at or near the stoichiometric air/fuel ration of 14.65. Although advances in catalyst technologies designed with improved oxygen storage capacity have facilitated the broadening of this high conversion window, the range for > 90% conversion efficiencies remains between an air/fuel ratio of 14.5 to 14.7. Automotive engine combustion control has also advanced to control air/fuel operation within this narrow range. The wide-open throttle and high speed operation of high performance marine engines has required engine calibrations in the fuel-rich side of the stoichiometric air/fuel ratio. Although this is ideal for the reduction of NOx with a TWC, the oxidation of HC and CO is likely to be compromised making it difficult to meet the proposed HC + NOx combined target. Furthermore, the oxygen storage materials used in TWCs require periods of lean A/F operation in order to allow the oxygen storage function to regenerate. Long term operation on either side of the stoichiometric A/F ratio provides challenges for high TWC conversion of all three criteria pollutants. We believe that the proposed trade-off of exhaust emissions in exchange for equal reductions of evaporative emissions for this specialized class of marine vessels is a good approach that MECA and our members support.

We hope this information is helpful and please feel free to contact me if we can be of further assistance.

Best regards,

Dr. Rasto Brezny
Deputy Director