



This document is part of Appendix A, and includes Small Boat Engine Wet Exhaust: Marine Pollution Control Device for the “Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS),” published in April 1999. The reference number is EPA-842-R-99-001.

Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)

Small Boat Engine Wet Exhaust: Marine Pollution Control Device

April 1999

SMALL BOAT ENGINE WET EXHAUST MARINE POLLUTION CONTROL DEVICE (MPCD) ANALYSIS

Several alternatives were investigated to determine if any reasonable and practicable MPCDs exist or could be developed for controlling discharges from small boat engine wet exhaust. An MPCD is defined as any equipment or management practice, for installation or use onboard a vessel, designed to receive, retain, treat, control, or eliminate a discharge incidental to the normal operation of a vessel. Phase I of UNDS requires several factors to be considered when determining which discharges should be controlled by MPCDs. These include the practicability, operational impact, and cost of an MPCD. During Phase I of UNDS, an MPCD option was deemed reasonable and practicable even if the analysis showed it was reasonable and practicable only for a limited number of vessels or vessel classes, or only on new construction vessels. Therefore, every possible MPCD alternative was not evaluated. A more detailed evaluation of MPCD alternatives will be conducted during Phase II of UNDS when determining the performance requirements for MPCDs. This Phase II analysis will not be limited to the MPCDs described below and may consider additional MPCD options.

MPCD Options

Small boats of the armed forces are equipped with either two- or four-stroke compression ignition diesel or two-stroke spark ignition gasoline engines. During the operation of small boat engines, seawater is used to cool and quiet engine exhaust. As seawater is introduced into the engine exhaust, combustion by-products are captured by the seawater stream, and are discharged into the receiving water.

Three potential MPCD options were investigated. The purpose of these MPCDs would be to reduce or eliminate the release of hydrocarbons, oil and grease, volatile organic compounds, and semi-volatile organic compounds into the marine environment. The MPCD options were selected based on initial screenings of alternate materials and equipment, pollution prevention options, and management practices. They are listed below with brief descriptions of each:

Option 1: Employ dry exhaust systems on new boats and craft with inboard engines

-This option would require that new small boats and craft to be equipped with inboard engines to be outfitted with dry exhaust systems wherever practicable.

Option 2: Convert small boats and craft with inboard engines to a dry exhaust system - This option would involve converting small boats and craft that are currently discharging wet exhaust at or below the waterline to dry exhaust systems.

Option 3: Procure new outboard engines with reduced emissions to meet new emissions requirements being imposed in 1999 - This option would involve replacing existing outboard engines with new “low emission” outboard engines either all at once or through attrition. These new outboards would meet EPA emission requirements which will be taking effect in 1999.

MPCD Analysis Results

Table 1 shows the results of the MPCD analysis. It contains information on the elements of practicability, effect on operational and warfighting capabilities, cost, environmental effectiveness, and a final determination for each option. Based on these findings, Option 1 -- building small boats and craft with inboard engines and dry exhaust systems, and Option 3 -- procure new outboard engines with reduced emissions to meet new emissions requirements, offer the best combination of these elements and are both considered to represent a reasonable and practicable MPCD.

Table 1. MPCD Option Analysis and Determination

MPCD Option	Practicability	Effect on Operational & Warfighting Capabilities	Cost	Environmental Effectiveness	Determination
<p>Option 1. Employ dry exhaust systems on new boats and craft with inboard engines</p>	<p>This option would require a practicability study for new small boat and craft that have inboard engines.</p>	<p>Higher acoustic and thermal signatures of dry exhaust systems are anticipated and could affect selected mission/operational profiles for some large special warfare boats. A boat and craft class study would be necessary to assess operational impact.</p>	<p>Changing the existing design would impose additional design costs including engineering analysis, drawing development, and design history documentation. Costs associated with actual installation of the dry exhaust systems are limited to material costs because labor costs for installing each type of system are approximately the same.¹</p>	<p>Dry exhaust systems would eliminate the exhaust / seawater discharge on boats and crafts on which they are installed. Dry exhaust systems would disperse pollutants over a larger area reducing the potential for causing a sheen.</p>	<p>This option appears to be practicable for most new boats and craft with inboard engines. This option would eliminate the wet exhaust discharge from new small boats and craft, on which it is practicable to install a dry exhaust system.</p>
<p>Option 2. Convert small boats and craft with inboard engines to a dry exhaust system</p>	<p>Installing dry exhaust systems on existing small boats would require many modifications because of the large number of small boat configurations. Feasibility studies would be necessary for each boat class as it may not be physically possible to install a dry exhaust system on many boat classes.</p>	<p>Higher acoustic and thermal signatures of dry exhaust systems is anticipated and could affect selected mission/operational profiles for some large special warfare boats. A boat and craft class study would be necessary to assess operational impact.</p>	<p>Converting existing inboard engines would result in costs for: feasibility studies, engineering design, installation drawing development, alteration record preparation, Boat Information Book update, material, and installation. It is estimated that \$36M would be required to study, design, and install this change on small boats/craft in the Navy.¹</p>	<p>The dry exhaust system would eliminate the exhaust/seawater discharge on vessels where the installation is practicable. Dry exhaust systems would disperse pollutants over a larger area reducing the potential for causing a sheen.</p>	<p>This option does not appear to be practicable due to space and weight limitations on small vessels, and due to high cost on all boats and craft.</p>

MPCD Option	Practicability	Effect on Operational & Warfighting Capabilities	Cost	Environmental Effectiveness	Determination
<p>Option 3. Procure new outboard engines with reduced emissions to meet new emissions requirements being imposed in 1999</p>	<p>Space and volume requirements are expected to be similar to those of existing engines. In some select cases, an increase in weight may occur and therefore slightly effect the boat's trim angle. Some new engines are expected to weigh about 15% more than existing engines. Limited horsepower ranges currently available, may require two outboards where one was sufficient before.</p>	<p>This MPCD is not expected to cause any significant change in war fighting capabilities or ship mobility. Assuming that the boat is supplied with similar horsepower and other characteristics as previous engines, the operational impact will be negligible.</p>	<p>The costs associated with this option include: feasibility study, design, development, alteration record preparation, Boat Information Book update, maintenance record / preventative maintenance documentation update, material, and installation costs. Replacing all existing small boat and craft outboard engines in the Navy would cost an estimated \$9.0M. Implementing this option through attrition would impose a considerably lower annual cost of \$34,000.¹</p>	<p>New technology outboard engines will significantly reduce engine emissions.² New EPA regulations are likely to encourage the widespread use of four-stroke, fuel injection, and advanced two-stroke engines. Engine manufacturers claim a 94% reduction in hydrocarbons with four-stroke engines.</p>	<p>This MPCD appears to be practicable with the exception of converting all existing craft to reduced emission engines, as the cost of conversion often exceeds the value of the craft. The reduced emission engine, which burns fuel more completely and directly, will reduce the amount of pollution significantly.</p>

REFERENCES

¹ NSWC Comments on NOD Report Review, March 18, 1997.

² USEPA, Amendment to Emissions Requirements Applicable to New Gasoline Spark-Ignition Marine Engines, EPA Title 40 CFR Part 91, Effective April 2, 1997.