NAVSEA Philadelphia
Naval Surface Warfare Center
Carderock Division
Philadelphia, PA 19112-5083

NSWCCD-98-TR–2004/22 May 2007
Machinery Research and Silencing Division
Technical Report

Single Naval Fuel At-Sea Diesel Engine Impact Study

by

David P. Guimond
Energy Conversion R& D Branch, Code 9850

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14. ABSTRACT
The objective of this investigation was to identify and document potential performance, maintenance and cost impacts on diesel engine operation when using JP-5. Based on the data and information gathered during this investigation and detailed in this report, the adoption of JP-5 as the single naval fuel at-sea could be accomplished with no major impacts on Naval diesel engines. There are some potential issues regarding the use of JP-5 in a small number of engines. However, for the majority of Naval diesel engines the transition should be transparent. It is recommended that a minimum requirement for cetane number and lubricity potentially be incorporated into the JP-5 specification to insure compatibility with current and future technology diesel engines. As new engines are introduced, they will incorporate new technologies such as high-pressure common rail fuel injection. These engines are being designed to produce lower exhaust emissions and could possibly have new fuel requirements (higher cetane number). Also, new ship designs, such as LCS, may require engines to be operated at more severe duty cycles and spend more time at full power than is the current practice. The effects of JP-5 fuel properties (lubricity, cetane number, ignition delay, etc.) on these advanced technology engines need to be investigated.

15. SUBJECT TERMS
JP-5, Diesel Engines, lubricity, cetane number, sulfur, fuel consumption

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BACKGROUND

The Chief of Naval Operations, Code N420 tasked NAVAIR 4.4.5 to study the feasibility of converting to a single naval fuel at-sea. This single fuel would be used in all propulsion systems for aircraft, ships and USMC ground equipment as well as in electrical power generation systems. Currently, the primary shipboard propulsion fuel is Naval Distillate Fuel procured to MIL-PRF-16884 (NATO F-76). The Navy's aviation turbine fuel, JP-5 per MIL-DTL-5624 (NATO F-44), was selected as the single naval battlefield fuel. This choice was made for two reasons. First, naval aircraft have the most stringent fuel requirements of all naval fuel users. Secondly, JP-5 is an approved alternate to both F-76 and JP-8 and is the only fuel that can be used by all of the services for bulk fuel requirements. A Phase One study that investigated significant availability or cost issues involved with the switch to JP-5 as the single fuel was completed [1]. Positive findings from this study led to the authorization of a multifaceted Phase two study. One facet of the Phase Two study is to investigate the potential operational impact on shipboard Hull Mechanical & Electrical (HM&E) equipment when using JP-5 and to perform a more extensive cost/benefit analysis.

OBJECTIVE

The objective of this investigation was to identify and document potential performance, maintenance and cost impacts on diesel engine operation when using JP-5.

APPROACH

The approach for this Phase Two diesel engine study was to:

- Quantify the number, type and application of Naval marine diesel engines.
- Quantify fleet diesel engine maintenance costs and project any differences (plus or minus) associated with converting to JP-5 as the primary shipboard propulsion fuel.
- Perform a literature search for previously published studies, reports and papers relating to operation of diesel engines with aviation-type fuels (JP-5, JP-8).
- Contact diesel engine Original Equipment Manufacturers to document their experiences and recommendations when operating with JP-5/JP-8.
- Contact Navy Diesel Engine Inspectors (DEI) to ask about their experiences with operating Navy diesel engines on JP-5.
- Survey United States Coast Guard personnel to determine the extent of JP-5 usage in their vessels and related operational experience with regards to diesel engines.

CONCLUSIONS

Based on the data and information gathered during this investigation and detailed in this report, the adoption of JP-5 as the single naval fuel at-sea could be accomplished with no major impacts on Naval diesel engines. There are some potential issues regarding the use of JP-5 in a small number of engines equipped with rotary-type fuel injection pumps (mostly SPECWAR boats). However, for the majority of Naval diesel engines the transition should be transparent.

Lubricity

There is no indication of lubricity-related problems with the bulk of Navy diesel engines when operated on JP-5. There are some isolated problems identified with a few specific engines (for example some SPECWAR engines) that will have to be addressed. Worldwide regulation of emissions from diesel engines is driving the legislated reduction of sulfur in middle distillate (diesel) fuel. Lower fuel sulfur content, which can be directly attributed to the severity of hydrotreatment, raises concerns regarding lubricity characteristics. Thus, diesel engine manufacturers are pursuing commercial fuel specifications that include a minimum lubricity requirement. There is currently no minimum lubricity specification for any Navy fuel. However, the Naval Fuels and Lubricants Integrated Product Team has embarked on a low-lubricity fuel program to determine if there is a fuel lubricity problem with shipboard diesel engines when using Ultra-Low Sulfur Diesel (ULSD) and JP-5-type fuels and if so, what level and types of fuel additives or material hardware changes to the affected fuel injection systems may correct the problems. The program also seeks to establish a minimum fuel lubricity level that would be added to all Navy fuel specifications.

Cetane Number/Cetane Index

Cetane number is a measure of the ignition quality of a fuel and effects engine startability and acceleration capability under load. There have been no reports of cetane-related problems with Navy diesel engines when operated on JP-5. There was one incident of starting problems and abnormal combustion identified with a diesel engine in an AAAV. The problem occurred during trials when the vehicle was fueled with JP-8 that had a low cetane number value (35). Again, diesel engine manufacturers are pursuing commercial fuel specifications that include a minimum cetane number requirement to ensure proper engine operation. There is currently no cetane number/index specification requirement for JP-5.

Power

Although laboratory testing has shown reductions in rated power with JP-5, the effects vary greatly with the type of engine and engine-mounted fuel injection system. In reality, due to operational procedures, the Navy rarely operates MPDE or SSDG engines at full-power. Also, there is no data to show that any Navy shipboard diesel engine could not attain full power when operating on JP-5.

Fuel Consumption

Laboratory testing and manufacturer data indicate an increase in fuel consumption will occur when JP-5 is utilized instead of F-76, but during an extensive Army field evaluation there was no statistical difference in fuel procurement cost and consumption when using JP-8 in place of diesel fuel. There is no Navy documentation of the fuel consumption of shipboard diesel engines run with JP-5. It is therefore unknown if this projected increase in fuel consumption will be seen under actual shipboard engine operating scenarios. The various variables associated with real world ship operations as well as variations in actual fuel properties (energy content and density) between fuel batches could make these small differences unnoticeable.

Maintenance

Previous studies and experience from the U.S. Army and NATO countries have indicated potential maintenance benefits when using aviation fuels in diesel engines. However, during the Army long-term field evaluation there was no documentation of differences in oil changes, fuel-wetted component replacements or wear metals. Also, a study conducted by JJMA on Navy diesel engines has shown that fuel injection system-related maintenance costs are a minor part of overall diesel engine maintenance costs and that there was no available Navy data to indicate any difference in these costs when using JP-5 versus F-76.

RECOMMENDATIONS

- This report focused on diesel engines that are currently in the fleet. As new engines are introduced, they will incorporate new technologies such as high-pressure common rail fuel injection. These engines are being designed to produce lower exhaust emissions and could possibly have new fuel requirements (higher cetane number/cetane index). Also, new ship designs, such as LCS, may require engines to be operated at more severe duty cycles and spend more time at full power than is the current practice. The effects of JP-5 fuel properties (lubricity, cetane number, ignition delay, etc.) on these advanced technology engines need to be investigated.
- It is recommended that a minimum requirement for cetane number/cetane index and lubricity potentially be incorporated into the JP-5 specification to insure compatibility with current and future technology diesel engines.
- In order to investigate the reality/magnitude of a fuel consumption penalty for Navy diesel engines when using JP-5, it is recommended that several long-term shipboard "at-sea" evaluations be performed. These evaluations should involve main propulsion and ship service generator engines. The evaluations should be as "controlled" as possible to minimize variations in ship operation, sea conditions, engine build or wear-out condition, etc. The ideal situation would be two identical engines on the same ship operating on the same duty cycle; one using JP-5 the other using F-76. These evaluations would require adding instrumentation over-and-above what is normally onboard as well as periodic visits by technical personnel to inspect/calibrate the instrumentation and retrieve collected data. Fuel samples (JP-5/F-76) would have to be obtained regularly during these evaluations. The fuel samples would be analyzed to assist in determining any operational differences. In addition to the fuel consumption/power issues, these evaluations would provide information regarding differences in required maintenance actions.

ADMINISTRATIVE INFORMATION

The work described in this report was performed by the Machinery Research Division (Code 98) of the Machinery and Engineering Directorate at the Naval Surface Warfare Center, Carderock Division (NSWCCD). The work was funded and sponsored by the Naval Air Systems Command, Fuels & Lubricants Division (AIR 4.4.5) Robert M. Giannini as part of the Shipboard Mobility Fuels Task (Program Element 0603724N). AIR 4.4.5 is a member of the Naval Fuels and Lubricants Integrated Product Team (Naval F&L IPT).

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The author would also like to thank George Campbell and Phil Jung, also from Code 9324, for providing their technical expertise during the course of this effort.

LIST OF ACRONYMS/ABBREVIATIONS

AAV	Amphibious Assault Vehicle
AAAV	Advanced Amphibious Assault Vehicle
ABS	American Bureau of Shipping
bbls	Barrels
BHP	Brake Horsepower
BTU	British Thermal Unit
C	Celsius
Ca	Calcium
CI	Corrosion Inhibitor
cSt	centistokes
CV	Multi-Purpose Aircraft Carrier
CVN	Multi-Purpose Aircraft Carrier (Nuclear-Propulsion)
CY	Calendar Year
DD or DDC	Detroit Diesel Corporation
DEI	Diesel Engine Inspector
DFM	Diesel Fuel Marine
DOD	Department of Defense
EDG	Emergency Diesel Generator
EMD	Electro-Motive Division
E.P.	End Point
F	Fahrenheit
F-76	MIL-PRF-16884 (NATO symbol F-76)
FM	Fairbanks Morse
ft	Foot
FQP	Fuels Qualification Procedure
gal	Gallon
HM&E	Hull Mechanical & Electrical
I-F	Isotta Franchini
JJMA	John J. McMullen Associates
JP-5	MIL-DTL-5624 (NATO symbol F-44)

JP-8	MIL-DTL-83133 (NATO Symbol F-34)
K	Potassium
kg	kilogram
KW	Kilowatt
L	Liter
lbs/hp-hr	Pounds (of fuel burned) per horsepower per hour
LCDR	Lieutenant Commander
LCP	Landing Craft Personnel
LCS	Littoral Combat Ship
LHA	Amphibious Assault Ship (General- Purpose)
LHD	Amphibious Assault Ship (Multi-Purpose)
MAX	Maximum
Mfr	Manufacturer
mg KOH/g	Milligrams of sodium hydroxide per gram
MGO	Marine Gas Oil
MIN	Minimum
MILSPEC	Military Specification
MJ/kg	Megajoules per kilogram
MLC	Maintenance Logistics Center
mm^2/second	Millimeters squared per second
MPDE	Main Propulsion Diesel Engine
MSC	Military Sealift Command
MTU	Motoren und Turbinen Union
N	Nitrogen
NA	Naturally Aspirated
Na	Sodium
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
Naval F&L IPT	Naval Fuels and Lubricants Integrated Product Team
No.	Number
NR	No Requirement
NSWCCD	Naval Surface Warfare Center Carderock Division
NVR	Naval Vessel Rules

O	Oxygen
OARS	Open Architecture Retrieval System
OEM	Original Equipment Manufacturer
PB	Patrol Boat
Pb	Lead
PBR	Patrol Boat River
%	Percent
ppm	Parts per million
RIB	Rigid Inflatable Boat
S	Sulfur
SDA	Static Dissipater Additive
SFC	Specific Fuel Consumption
SOC	Special Operations Craft
SOC-R	Special Operations Craft-Riverine
SPECWAR	Special Warfare
SSDG	Ship Service Diesel Generator
SUC-R	Small Unit Riverine Craft
SwRI	Southwest Research Institute
TOC	Total Ownership Cost
ULSD	Ultra-Low Sulfur Diesel
USMC	United States Marine Corps
V	Vanadium
vol	Volume
wt	Weight

BACKGROUND

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NAVY DIESEL ENGINE SURVEY

John J. McMullen Associates, Inc. (JJMA) was contracted to quantify and list various aspects of fleet diesel engines and rank them according to annual fuel consumption and critical application. The results of this effort were documented in a report, attached as Appendix A.

This report focused on diesel engines that are used for main propulsion, ship service diesel generators or emergency diesel generators onboard Navy ships, craft, small boats and SPECWAR boats. A table or matrix was developed for each category listing the vessel, engine model, engine use, quantity, vintage, fuel system-type, fuel pump-type, estimated annual fuel consumption and projected year of decommissioning. The engine model, operating hours and fuel consumption data used for this study was for the year 2002. A table of miscellaneous diesel engines that are used to power various pieces of shipboard equipment was also generated along with summary tables that sort the engines by different criteria and consolidate the information from all of the tables. The following tables are excerpted from reference 1.

Table 1 summarizes the number of engines on ships, craft, boats and SPECWAR craft. Miscellaneous engines are not included. There are 69 diesel engine models in use produced by 18 different manufacturers for a total of 3,677 engines.

Table 1. Navy Diesel Engine Summary

Vessel Type	Total No. of Engines	No. of Engine Manufacturers(1)	No. of Engine Models(1)	2002 Fuel Consumption (Gallons)
Ships	806	10	27	58,258,562
Craft	211	3	14	12,791,955
Boats	2,404	7	28	19,050,795
SPECWAR craft	256	4	4	2,733,513
Totals	3,677	18	69	92,834,825

Note (1) Totals for No. of Manufacturers and No. of Models are not a summation of total number of different OEMs or engine models because some OEMs and engine models may be repeated for each vesseltype.

(2) Although part of the Small Boat Matrix, USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV) were not included as part of this comparison.

Table 2 is an all-inclusive list of the 18 manufacturers of the marine diesel engines used on Navy ships, craft, and boats. Also shown are the number of engines and engine models.

Table 2. Navy Marine Diesels

OEM	Number of Engines	Number of Models
Alco	26	1
Caterpillar	293	8
Colt-Pielstick	96	1
Cummins	734	8
Detroit Diesel	1,559	26
Electro Motive Division (EMD)	47	4
Fairbanks Morse	188	9
Gray Marine	20	1
Isotta-Fraschini (I-F)	144	2
Iveco	1	1
MTU	40	1
Northern Lights	20	1
Onan	64	1
Paxman	52	1
Volvo Penta	346	2
Waukesha	14	1
Westerbeke	13	1
Yanmar	40	1
Total (Ships, boats, and craft)	3,697	69

Table 3 provides a summary of annual fuel consumption by OEM versus total annual fuel consumption.

Table 3. Fuel Consumption by Engine Manufacturer

OEM	Annual Fuel Consumption by OEM (Gallons)	% of Total Annual Fuel Consumption by OEM
Alco	238,938	0.26
Caterpillar	9,293,661	9.99
Colt-Pielstick	29,347,296	31.56
Cummins	4,719,944	5.08
Detroit Diesel	32,393,306	34.84
EMD	907,453	0.98
Fairbanks Morse	11,030,087	11.86
Gray Marine	8,640	0.01
Isotta-Fraschini	1,969,848	2.12
Iveco	2,376	0.00
MTU	1,646,064	1.77
Northern Lights	44,846	0.05
Onan	36,864	0.04
Paxman	305,032	0.33
Volvo Penta	787,824	0.85
Waukesha	91,726	0.10
Westerbeke	10,920	0.01
Yanmar	150,120	0.16
Total by All OEMs	92,984,945	100%

By examining Table 3 it can be seen that 4 engine manufactures stand out from the rest in regards to annual fuel consumption. In fact these four, out of the total of eighteen, engine manufacturers account for over 88% of all the fuel consumed by Navy diesel engines as shown in Table 4.

Table 4. Engines with the Greatest Fuel Consumption

OEM	No. of Engines	% of Engines	% of Fuel Consumed
Detroit Diesel	1,549	42.1	34.84
Colt-Pielstick	96	2.6	31.56
Fairbanks Morse	188	5.1	11.86
Caterpillar	293	8.0	9.99
Total	2,216	57.8%	88.25%

Once the individual engine tables for Navy ships, craft, small boats and SPECWAR boats were populated with the required information of fuel consumption, engine types, application, etc., a weighting system was applied to sort the engines using factors that would identify high-profile engines to assist in determining the impacts in converting to JP-5. The three factors used to determine a rating for an engine were application, combat criticality and annual fuel consumption. Each engine received a numerical score for each of the three factors with the overall rating being tabulated by summing the scores of the three individual weighting factors. The following factors and scores were used:

<u>Engine Application:</u>	
MPDE – Planing Hull (High)	20
MPDE – Displacement Hull (Medium)	10
SSDG (Low)	5
EDG (Low)	5
<u>Combat Criticality:</u>	
Combatant (High)	10
Combat Support (Medium)	5
Noncombatant (Low)	2
<u>Annual Fuel Consumption:</u>	
High	6
Medium	4
Low	2

For ships, the factors were based on the following annual fuel consumption rates:

High	Greater than 500,000 gal/year (11,905 bbls/year)
Medium	100,000 – 500,000 gal/year (11,905 – 2,380 bbls/year)
Low	Less than 100,000 gal/year (2,380 bbls/year)

For service craft, small boats, and SPECWAR boats the factors were base on the following annual fuel consumption rates:

High	Greater than 30,000 gal/year (714 bbls/year)
Medium	10,000 – 30,000 gal/year (714 – 238 bbls/year)
Low	Less than 10,000 gal/year (238 bbls/year)

The engines that scored the highest overall ratings with regards to use, fuel consumed and criticality are shown in Table 5. Three of these engines are used in Special Warfare applications. One engine is used to propel a landing craft and the other two are utilized in patrol boats.

Table 5. Highest Rated Engines (30 and above)

Engine	No. of Engines	Rating	Vessel	No. of Vessels
MTU 12V-396 TE94	40	36	SPECWAR MkV SOC	20
Caterpillar 3126TA	156	32	SPECWAR 11M RIB	78
Yanmar 6LY2-STE	40	32	SPECWAR SOC-R	20
DD 8V-71 7082-3000	77	32	36-ft LCP(L)	77
DD 8V-71 TI	64	32	65-ft PB	64
DD 6V-53	23	32	31-ft PBR	23
Totals	400			282

JP-5 FUEL PROPERTIES

Currently, the preferred fuel for all Navy combustion equipment (gas turbines/boilers/diesel engines) is Naval distillate fuel, NATO Symbol F-76. This fuel is procured under MIL-PRF-16884K. It was formerly known as Diesel Fuel, Marine (DFM).

JP-5 is a high-flash point, kerosene-type aviation fuel, used primarily for fueling aircraft on Naval ships. It is procured under MIL-DTL-5624U, NATO Symbol F-44. JP-5 is an acceptable substitute for use on a continuous basis for diesel engines and is the second fuel, after F-76, in the hierarchy of fuels authorized for use onboard Naval ships [2]. JP-5 is also the preferred cold-weather fuel. Table 6 compares selected specification requirements between F-76 and JP-5. Also included are selected specification requirements for JP-8, MIL-DTL-83133 (NATO Symbol F-34), an aviation fuel similar to JP-5. It should be noted, however, that JP-8 cannot be used onboard ship in place of F-76 or JP-5, because the minimum flash point of JP-8, 38 °C, is too low.

As part of the overall Single Naval Fuel at-Sea Phase Two Study, Southwest Research Institute (SwRI) was tasked to perform a fuel property survey for F-76 and JP-5 fuels used by the Navy. This data was compiled in a report [3] along with information gathered from a survey of diesel engine manufacturers. For the fuel property survey SwRI analyzed JP-5 and F-76 data for the years 1999 to 2003. The fuel data was obtained from the Petroleum Quality Information System database maintained by the Defense Energy Support Center. The properties chosen for analysis were aromatics content, cetane index, density, distillation, energy content/heat of combustion, sulfur content and viscosity. These specification properties were selected for analysis as being the most relevant to the use of JP-5 in diesel engines. The specification requirements and fuel analysis data were compared for F-76 and JP-5. There are some characteristics/properties of JP-5 that have the potential to negatively impact performance and durability and should be of concern with regards to the operation of diesel engines.

Table 6. Comparison of Selected Fuel Specification Requirements

Specification Requirements			
Property	JP-5	JP-8	F-76
Ash, wt %	not required	not required	0.005, max
Calculated Cetane Index	Report	Report	43, min
Carbon Residue, wt %	not required	not required	0.20, max
Cloud Point, °C	not required	not required	-1, max
Density, kg/L	0.788 - 0.845	0.775 – 0.840	0.876, max
Distillation Temperature, °C	10%: 205, max 20%: Report 50%: Report 90%: Report E. P: 300, max	10%: 205, max 20%: Report 50%: Report 90%: Report E. P: 300, max	10%: Report 20%: NR 50%: Report 90%: 357, max E. P: 385, max
Flash Point, °C	60, min	38, min	60, min
Freezing Point, °C	-46, max	-47, max	not required
Heat of Combustion, MJ/kg	42.6, min	42.8, min	not required
Hydrogen Content, wt %	13.4, min	13.4, min	12.5, min
Pour Point, °C	not required	not required	-6, max
Total Acid Number, mg KOH/g	0.015, max	0.015, max	0.30, max
Total Aromatics, vol %	25.0, max	25.0, max	not required
Total Sulfur, wt %	0.30, max	0.30, max	1.0, max
Trace Metals, ppm	not required	not required	Ca: 1.0, max Pb: 0.5, max Na + K: 1.0, max V: 0.5, max
Viscosity, mm^2/second	8.5 @ -20°C, max	8.0 @ -20°C, max	1.7 - 4.3 @ 40°C

Aromatics

There is no requirement in the F-76 specification for total aromatics. The JP-5 specification has a requirement of 25 vol %, maximum. All of the JP-5 fuels analyzed met this specification with the majority being below 20 vol %. While fuel aromatic content may not have a direct effect on diesel engine performance, there is published data that correlates diesel fuel aromatic content with the production of particulate (smoke) emissions in diesel engines [4]. Lowering the total aromatic content of the fuel, and in particular polyaromatic content, will result in reduced exhaust particulate emissions.

Cetane Index/Number

Cetane index is a calculated estimate of the cetane number of the fuel based on density and distillation data. Cetane number is a measure of the ignition quality of the fuel. The specification for F-76 requires a minimum cetane index of 43 whereas for JP-5 there is only a requirement to report the number with no minimum specified. Analysis of the JP-5 cetane index data, as shown in Figure 1, revealed that approximately 21% of the fuel purchased by the Navy during the time period analyzed had a cetane index below the 43 minimum specified for F-76. Of these fuels, 10% had a cetane index between 40 and 43 but there were some data as low as 33. The cetane index data for F-76 is shown in Figure 2.

Cetane number has a significant effect on diesel engine starting and proper operation during engine warm-up. Diesel engine manufacturers specify a minimum fuel cetane number for their engines but there is no minimum cetane requirement in the JP-5 specification. JP-5 is the preferred cold-weather fuel in place of F-76 due to its superior cold flow properties and lower viscosity at low temperatures than F-76. However, using a JP-5 fuel that has a low cetane index (for example ~33) could possibly lead to hard starting and improper operation due to the excessive ignition delay period.

Engine Durability

Cetane number effects ignition delay along with the rate of cylinder pressure rise and peak pressure that occurs in the combustion chamber. Lower cetane numbers will result in higher ignition delay values. With a longer ignition delay, a greater amount of fuel is burned under the premixed mode of combustion. This results in an increased rate of pressure rise and higher peak cylinder pressures. The increased stress resulting from higher peak pressures could affect the reliability and durability of components such as pistons and bearings.

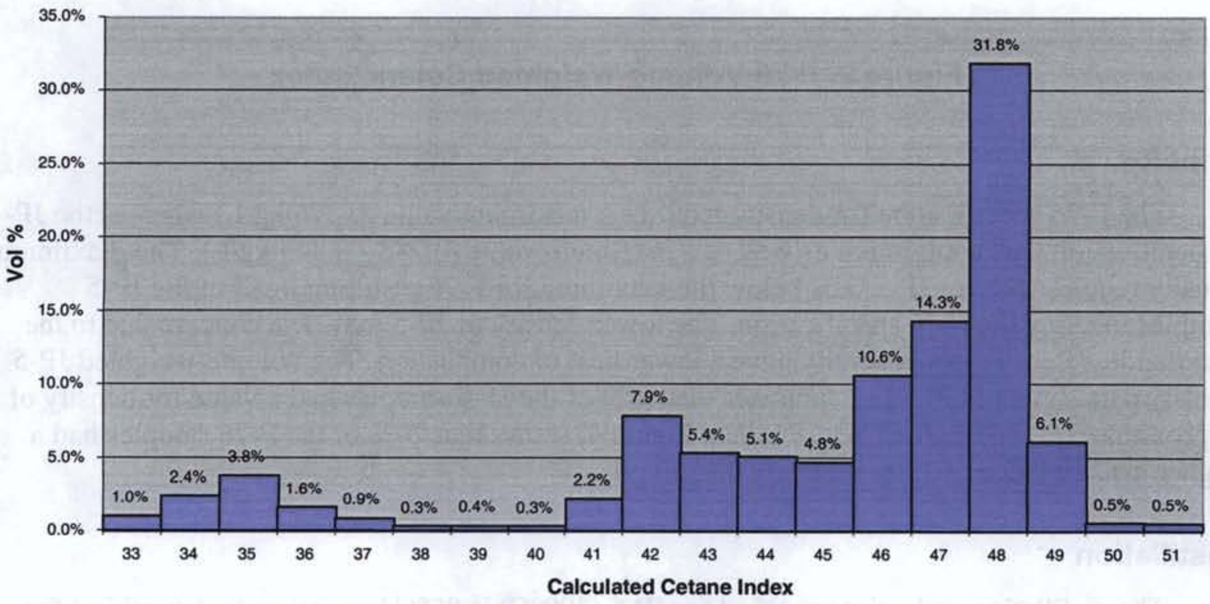

Figure 1. JP-5 Volume-Weighted Cetane Index

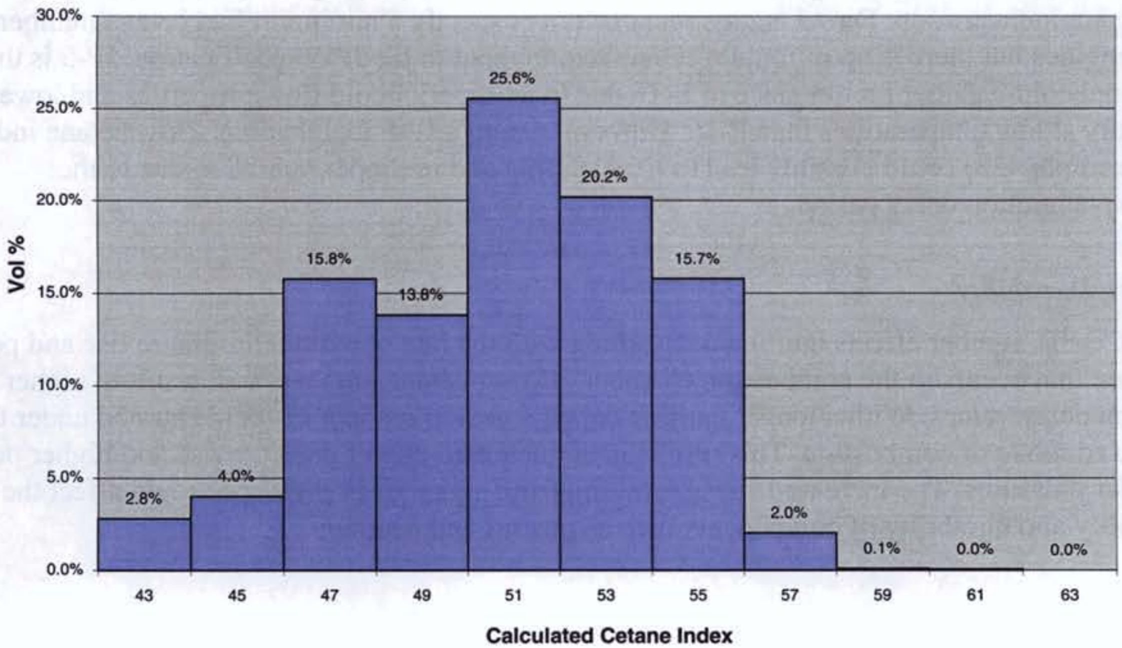

Figure 2. F-76 Volume-Weighted Cetane Index

Density

The F-76 specification for density requires a maximum value (0.876 kg/L) whereas the JP-5 specification lists a minimum as well as a maximum value (0.788 - 0.845 kg/L). The maximum density requirement for JP-5 falls below the maximum for F-76 resulting in all of the JP-5 samples meeting the F-76 specification. The lower density of JP-5 may be a concern due to the fact that less dense fuels generally have a lower heat of combustion. The volume-weighted JP-5 density data shown in Figure 3 indicates that 70% of the JP-5 samples had a value for density of approximately 0.805 kg/L. The F-76 data, Figure 4, shows that 70% of the F-76 samples had a higher density value of approximately 0.835 kg/L.

Distillation

The distillation end point specified for JP-5 (300°C) is 85°C lower than that specified for F-76 (385°C) ensuring that all JP-5 fuels would meet the F-76 specification. With a significantly lower end point, JP-5 will typically be a lighter, cleaner-burning fuel than F-76.

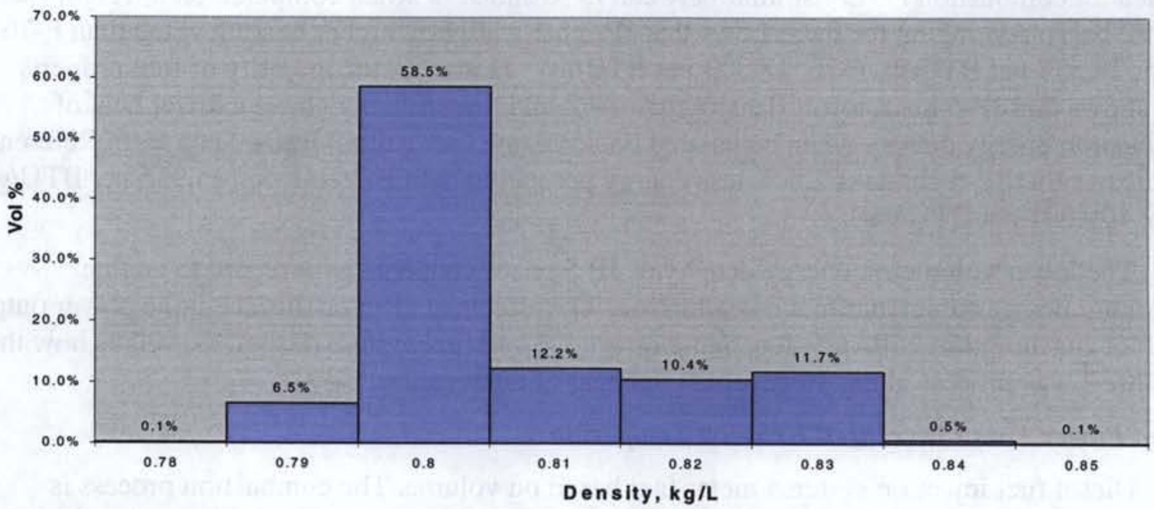

Figure 3. Volume-Weighted JP-5 Density at 15°C

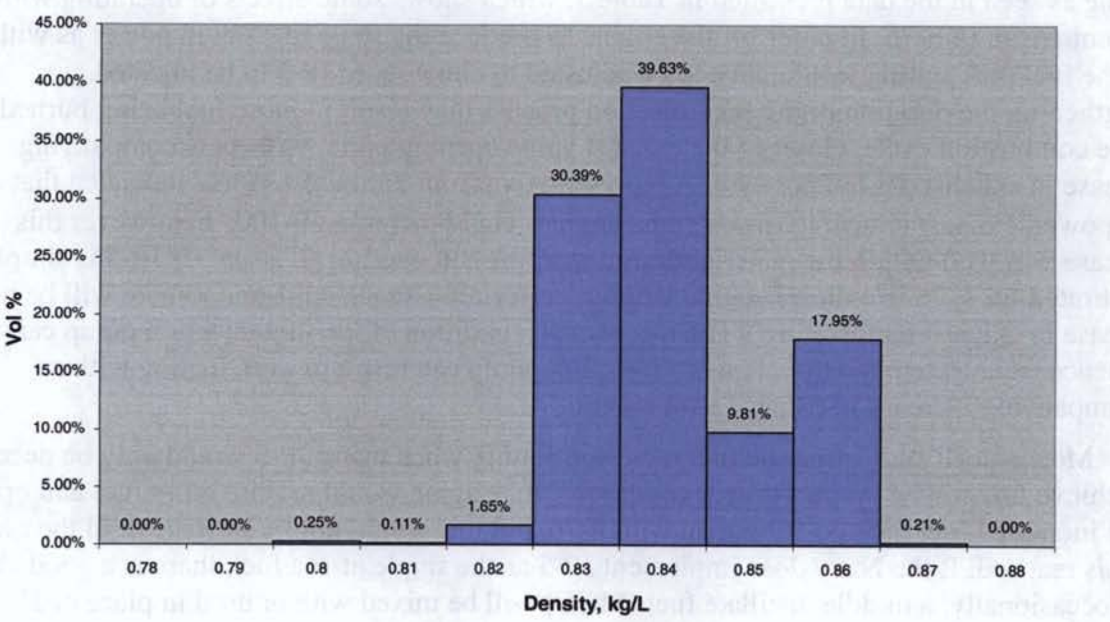

Figure 4. Volume-Weighted F-76 Density at 15°C

Energy Content / Heat of Combustion (Net)

The net heat of combustion or energy content of a fuel influences the power output and fuel consumption of an internal combustion engine. Data from various sources [1,3] indicates that the net heat of combustion is very similar between F-76 and JP-5 when compared on a weight (per pound) basis. Averaging the data shows that JP-5 has a slightly higher heating value than F-76 (JP-5; 18,577 net BTU/lb, F-76; 18,303 net BTU/lb)[1]. However, the majority of fuel property data shows that JP-5 has a lower density than F-76 and therefore may have a lower heat of combustion/energy density when calculated on a volume (per gallon) basis. Data from Reference 1 indicates that JP-5 contains 2.6 % less energy per gallon than F-76 (JP-5; 125,956 net BTU/gal, F-76; 129,291 net BTU/gal).

The lower volumetric energy density of JP-5 raises concerns with regard to engine maximum power output and fuel consumption. The effects of JP-5 on diesel engine power output and fuel consumption will vary depending on engine and fuel system design, as well as how the JP-5 itself was processed and its resultant net heat of combustion.

Rated Power Loss / Increased Exhaust Temperature

Diesel fuel injection systems meter fuel based on volume. The combustion process is controlled by the mass of fuel injected. Fuel density influences engine performance by changing the mass of fuel delivered during the fuel metering and injection stroke. For the same effective metering and injection stroke, less mass of JP-5 will be injected than F-76 because JP-5 is less dense. The lower injected fuel mass can be decreased further by fuel injection system internal leakage due to the lower viscosity of JP-5. Therefore, for the same fuel rack setting, less power will be produced when burning JP-5. The amount of the power loss varies with the particular engine as seen in the data presented in Table 7, which shows some effects of operating with JP-5 in comparison to F-76. In order for the engine to produce the same maximum power as with F-76, the fuel rack setting would have to be adjusted to allow more JP-5 to be injected. Lengthening the duration of the fuel injection process may result in more fuel being burned later in the combustion cycle, closer to the exhaust valve opening point, with an accompanying increase in exhaust gas temperature. A representative from Fairbanks Morse indicated that at full-power, exhaust temperatures on some engines could increase 50-100 °F, however this increase was well within the material/design margins and was not an issue[2]. If JP-5 is simply substituted for F-76 in a diesel engine without performing a rack adjustment there will be no increase in exhaust temperature[3]. The mechanical condition of the fuel injection pump can also influence exhaust temperature. A worn injection pump can result in over-fueling with an accompanying increase in exhaust temperature.

Mechanically adjusting the fuel rack stop setting when using JP-5 would only be necessary to achieve full power. At part-power conditions, the engine would require more fuel and operate at an increased fuel rack position than with F-76, but this would not be an issue until the rack stop is reached. If the Navy does implement JP-5 as the single at-sea fuel, there is a good chance that occasionally, a middle distillate fuel (MGO) will be mixed with or used in place of JP-5

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[1] Email from Robert Giannini to Abe Boughner, December 2, 2003.

[2] Phone conversation with Neil Blythe Fairbanks Morse, October 15, 2003.

[3] Email from Doug Yost, SwRI to Bob Giannini, March 10, 2004

propulsion fuel due to unavailability of JP-5. In these cases, an engine might switch from operating on JP-5, to a mix, or to MGO, and then back again to JP-5. If the engine fuel injection system has been adjusted to achieve rated maximum power using 100% JP-5, an over-fueling condition might occur if this same setting is used with fuel containing a high percentage or 100% MGO. This could result in excess smoke and increased exhaust and engine temperatures. The safest approach would be to not adjust an engine's fuel rack when using JP-5 and accept a slightly reduced maximum power output.

Increased Fuel Consumption

For engines in general, specific fuel consumption (SFC) is usually expressed in pounds of fuel burned per horsepower per hour (lbs/hp-hr). Since the heat of combustion for F-76 and JP-5 are similar on a per pound basis, there will be only slight differences in SFC values when comparing diesel engine operation on JP-5 and F-76. For example, for the LPD-17 Qualification test of the Colt-Pielstick 16PC2.5 engine, a JP-5 fuel consumption comparison test was performed [5]. The Lower Heating Values of the test fuels were very close (18,165 BTU/lb for F-76 and 18,182 BTU/lb for JP-5) and the resultant SFC values obtained at rated power were identical (0.337 lbs/hp-hr). However, fuel is purchased and stored in volumetric units (gallons). When fuel consumption values are converted to a gallon basis, there is a significant difference due to the difference in fuel density between F-76 and JP-5. For the 16PC2.5 engine, the fuel consumption increases by 4.6% when compared on a volume (gallon) basis due to the lower density of JP-5.

Accumulated test data from Navy diesel engines, shown in Table 7, illustrates some of the effects of operating with JP-5 fuel in comparison to F-76. This data was provided to NAVAIR Fuels and Lubricants Division in an email from NSWCCD Philadelphia[4].

Table 7. JP-5 Diesel Engine Performance Impact

Diesel Engine OEM and Model	Performance Characteristics			
	Rated Power Loss (%)	Fuel Consumption Increase (%)	Increase in Maximum Rate of Cylinder Pressure Rise (%)	Increase in Ignition Delay (%)
DDC 4-71N[a]	4.1	3.0	20.0	24.0
Westerbeke 4-108[b]	20.6	5.5	---	---
DDC 6V-53N[a]	6.3	5.3	22.6	13.0
DDC 8V-149TI[c]	2.2	3.4	12.6	20.0
MTU 16V396TB94[d]	9.6	---	---	---
Pielstick16PC2.5[e]	---	4.6	---	---

[a] Two cycle, naturally aspirated, unit injectors, direct injection; Navy FQP test; test date-1987
[b] Four cycle, naturally aspirated, rotary injector pump/nozzles, pre-chamber; Navy FQP test; test date-1987
[c] Two cycle, turbocharged, unit injectors, direct injection; Navy FQP test; test date-1987
[d] Four cycle, turbocharged, inline injection pump/nozzles, direct injection; Navy Qualification test; test date-1989
[e] Four cycle, turbocharged, individual pumps/nozzles, direct injection; LPD-17 Qualification test; test date-2000

[4] Email from NSWCCD Philadelphia to NAVAIR 4.4.5 Subj.: JP-5 Single Fuel Study, author P.K. Jung.

Lubricity

Lubricity describes the ability of a fluid to minimize friction between, and damage to, surfaces in relative motion. The lubricity of the fuel is important factor in the proper operation and durability of diesel fuel system components such as the fuel injection pump and the fuel - wetted components within the injector itself. Lubricity concerns are heightened when using JP-5 instead of F-76 in diesel engines because the sulfur content and viscosity of JP-5 is often much lower than that of F-76.

Currently, the Navy does not have a minimum fuel lubricity level in any of its fuel specifications to protect its shipboard propulsion gas turbine or diesel engines, nor does the Navy know the level of protection these engines require. It is thought the most affected engines would be the fleet's diesel engines.

The JP-5 specification does not specifically have a minimum lubricity level but does require a minimum level of corrosion inhibitor-type additives. These additives provide the required lubricity level for aircraft airframe fuel pumps. The amount of corrosion inhibitor (CI) to be added to the fuel (per the specification) controls the minimum lubricity requirement for these pumps. The corrosion inhibitor acts as a fuel lubricity enhancer and is not used to "inhibit corrosion" per se. The CI is added as a matter of course to JP-5 but the lubricity level provided by the additives may not be at a sufficient level to protect diesel engine fuel injection systems.

Therefore, the Naval Fuels and Lubricants Integrated Product Team (Naval F&L IPT) has embarked on a program to determine if there are fuel lubricity problems with existing shipboard diesel engines when using Ultra-Low Sulfur Diesel (ULSD) and JP-5-type fuels [6]. If problems are encountered, then it will be determined which types of commercial lubricity additives, along with their corresponding dosages, are required to alleviate the problem. Additionally, material hardware changes to the affected fuel injection systems may also correct the problems. The program also seeks to establish a minimum fuel lubricity level that would be added to all Navy fuel specifications.

The low-lubricity fuel program is concentrating on the most likely/susceptible Naval shipboard diesel engine components to evaluate, determined through discussions with OEM's, the fuel injection system design, the ship platform it is on, the engines' function/importance, the number of engines in the fleet, the amount of fuel consumed, etc. The program is currently well along, having established the engine fuel injection systems to evaluate, the test fuels, and the test plan sequence. The engines range from small, high-speed engines used by special operations forces, to medium-speed engines used for ships' main propulsion and emergency electrical power generating sources, to slow-speed main propulsion engines. The slow-speed engine that was chosen is not used in the Navy, but instead is used by the Coast Guard, and MSC. The program will be completed by April 2006.

Sulfur

The sulfur limit for JP-5 (0.3 mass %) is less than that specified for F-76 (1.0 mass %) so that all JP-5 samples analyzed met the F-76 requirement. Fuel sulfur levels can sometimes be, but not necessarily are, an indication of fuel lubricity characteristics. Fuels with sulfur levels below 0.05 mass % (500 ppm) may have unsatisfactory lubricity when used in diesel engine fuel injection equipment. As shown in Figure 5, approximately 40% of the JP-5 fuel samples had sulfur levels below 500 ppm with 25% being below 50 ppm. The total sulfur mass data for the F-76 samples is shown in Figure 6.

Middle distillate (diesel) fuel lubricity is largely provided by trace levels of naturally occurring surface-active polar compounds [7]. These act by forming a protective layer on the metal surface to improve boundary lubrication. The most active polar materials in fuels are hetero-compounds containing nitrogen (N) and/or oxygen (O). Sulfur compounds themselves do not provide this protection. However, the process of hydrotreating to reduce sulfur levels is not selective and removes N and O as well as S. The removal of N and O from the hetero-compounds destroys their ability to perform as lubricity agents. Ultimately, crude oil source, processing, blending and/or additive use affect fuel lubricity. Although lower sulfur content does not necessarily equate to lower fuel lubricity, it raises the concern that the fuel may have been hydrotreated. On the positive side, reduced sulfur levels will result in reduced diesel engine exhaust particulate emissions [4].

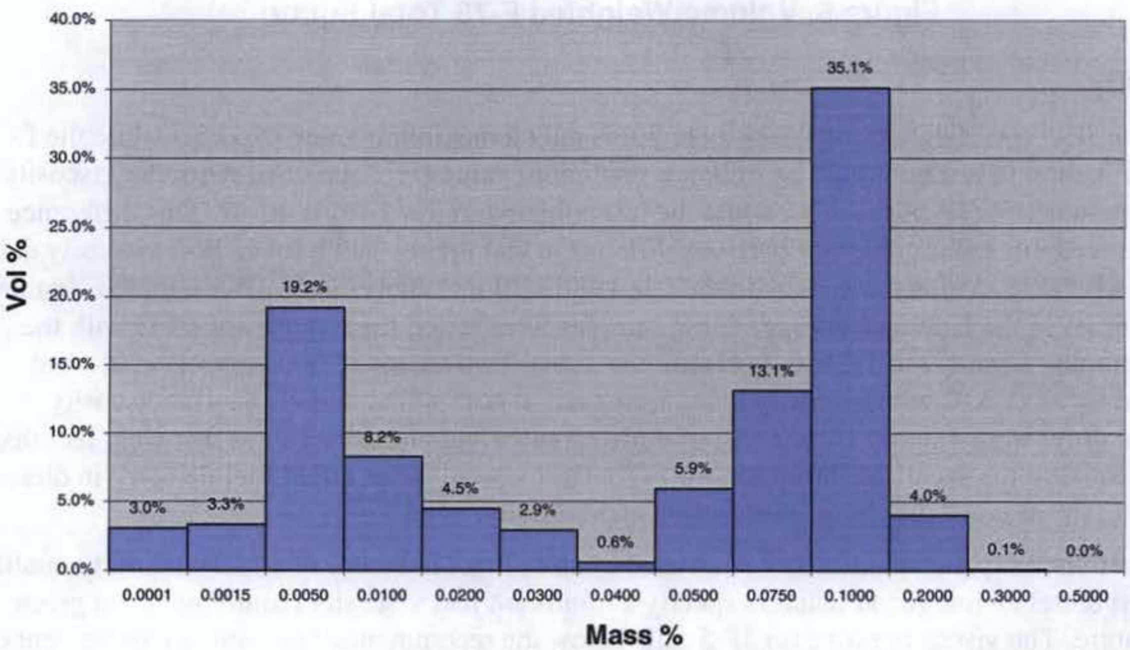

Figure 5. Volume-Weighted JP-5 Total Sulfur

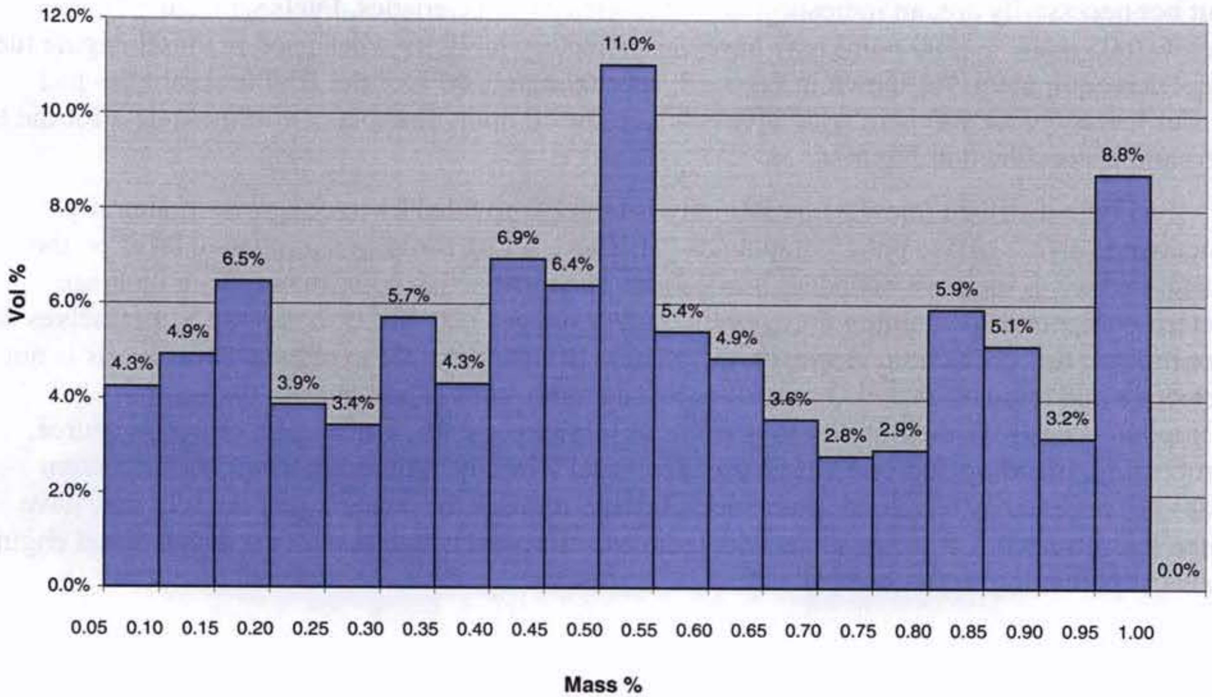

Figure 6. Volume-Weighted F-76 Total Sulfur

Viscosity

The JP-5 specification for viscosity requires only a maximum value (8.5 cSt) while the F-76 specification lists a minimum as well as a maximum value (1.7 - 4.3 cSt). Also, the viscosity test temperature for JP-5 is -20 °C, while the test temperature for F-76 is 40 °C. This difference in test procedures makes data comparisons difficult in that there is not a lot of JP-5 viscosity data at 40°C available. A study was done in the late 1980's [8] that analyzed 63 JP-5 samples obtained from sources in the U.S. and Europe. These samples were tested for viscosity at 40°C with the results ranging from 1.3 to 1.7 mm^2/s ($1mm^2/s$ = 1cSt). Two recent JP-5 samples [9, 10] were analyzed by NAVAIR with viscosity being measured at both -20°C and 40°C. The viscosity values at 40°C were 1.3 and 1.4 cSt. All of these samples had viscosity values that were less than or only equal to the specified minimum for F-76. Fuel viscosity can effect fuel delivery in diesel engines in the areas of pumping, atomization and lubricity.

Fuel viscosity has traditionally been used as an indirect indicator of a fuel's lubricity quality and most diesel engine manufacturers specify a minimum fuel viscosity requirement at a given temperature. The viscosity range for JP-5 falls below the recommended minimum requirement of all the Navy's diesel engine manufacturers. Lower viscosity can contribute to lower lubricity because a less viscous fuel will more easily leak past close tolerance injector/pump components and seals, which could lead to contact between components and increased wear. Lower viscosity also decreases hydrodynamic film thickness in fuel lubricated journal bearings used in some injection pumps. Increases in fuel temperature for a given fuel have the same effect as using a fuel with a lower viscosity.

ENGINE MANUFACTURER SURVEYS

In addition to quantifying and identifying the various diesel engines utilized by the Navy, JJMA was also tasked to determine the impact on maintenance when using JP-5 instead of F-76. This work was documented in a report, attached as Appendix B. As part of this effort, JJMA surveyed Navy diesel engine OEMs for information on operational experience or recommended guidelines regarding the use of JP-5 in their engines. SwRI also gathered information from OEMs as part of their fuel properties report [3]. The responses received from engine manufacturers to these inquiries are as follows.

Caterpillar

Navy Engines:

• 3126 • 3208 • 3306 • 3408 • 3412 • 3512 • 3516 • 3608 • D334 • D349 • D398 • D399

Caterpillar states that JP-5 fuel is an acceptable fuel for their engines if it complies with Caterpillar distillate fuel requirements [11].

Rated power loss of 11-12% is possible when JP-5 fuel is used (without adjusting the governor or fuel injection system). Fuel consumption could slightly increase.

Caterpillar recommends that JP-5 have a minimum cetane number of 40, and a minimum viscosity of 1.4 cSt @ 100 °F (37.8 °C) at the fuel injection pump.

Caterpillar has not conducted engine component testing. Caterpillar recommends that JP-5 should be tested for lubricity using either ASTM D6078 Scuffing Load Wear Test (SBOCLE) or ASTM D6079 High Frequency Reciprocating Rig (HFRR) method. For the SBOCLE test, Caterpillar requires a 3100 g minimum. The maximum allowable wear scar for the HFRR test is 450 microns

Cummins

Navy Engines:

• 4B3.9M • 6BT5.9M • KTA-50M • VTA28 • VT400 • VT525

JP-5 is an acceptable fuel for Navy Cummins engines.

Detroit Diesel Corporation (DDC)

Navy Engines:

• 53 Series • 71 Series • 92 Series • 149 Series (Stewart & Stevenson) • 64HN9 (Gray Marine)

JP-5 fuel is considered to be an acceptable fuel for use in Navy DDC engines.

DDC recommends a minimum Cetane number of 40.

The DDC 149 series engine used JP-5 fuel for extensive periods of time (as SSDGs onboard FFG 7 Class ships) with no loss of performance or engine degradation. FFG 7s used nothing but JP-5 when they were first commissioned in the late 1970's and early 1980's. Fuel consumption measurements were not taken or recorded. An increase in fuel consumption may be realized when operating on JP-5.

Electro-Motive Division (EMD)

Navy Engines:

• 567 • 645

JP-5 fuel was used for each engine above during Navy acceptance tests in accordance with MIL-E-23457. No engine performance or degradation problems were discovered during or after the test.

JP-5 fuel is an acceptable fuel for Navy EMD engines.

Fairbanks Morse (FM)

Navy Engines:

• FM 38F 5 1/4 • FM 38 ND 8 1/8 • Pielstick PC 2.5 • Pielstick PC 4.2 (MSC)

• Pielstick PA6 • FM/Alco 251C

JP-5 fuel was used for each engine above during Navy acceptance tests in accordance with MIL-E-23457. No engine performance or degradation problems were discovered during or after the test. No lubricity measurements were taken during the tests. FM conducted a 1000-hour test on their PC 2.5 fuel injection pump. They motored the pump while pumping JP-5 fuel. No lubricity or wear problems were evident.

FM did notice slight cavitation/erosion on fuel injector barrels and plungers on their PC 4.2 onboard MSC ships when continually going from F-76 to JP-5 and back again. This cavitation/erosion on the fuel injector parts was not considered to be a serious problem and would not reduce pump performance, or reduce pump life.

FM indicated that fuel consumption could increase if JP-5 is used due to the lower volumetric energy density relative to F-76.

FM states that no modifications to their engines or components would be necessary if the Navy should switch to JP-5 fuel. FM feels confident that all of their engines are conservatively rated, and that their engines can use any fuel that the Navy wishes to use with no loss of performance, and no degradation to the engine or its parts.

Isotta-Fraschini

Navy Engines:

• 36SS6V-AM • 36SS8V-AM

JP-5 fuel is an acceptable fuel for Navy I-F engines

Motoren und Turbinen Union (MTU)

Navy Engines:

396 • MT883

All Navy MTU engines have used JP-5 while undergoing the 1000-hour MILSPEC test in accordance with MIL-E-24455 with no loss of performance or engine degradation.

JP-5 fuel is an acceptable fuel for Navy MTU engines.

Engines that MTU is currently selling to the Marine Corps (AAAV) have imbedded sensors that would have the engine automatically adjust itself to compensate for different quality fuels.

Onan Generators

Navy Engines:

• DJC-MS • DJB-MS • DJCM-MS • MDJF

JP-5 fuel is not recommended in any of the Navy Onan generator set applications due to its poor lubricity characteristics and the fuel's effect on engine fuel pumps.

Paxman

Navy Engine:

• 16RP200CM

A report, sent to SwRI, from Man B&W Diesel Ltd discusses the use of JP-5 in the Valenta 16RP200CM engine. According to the report, the engine was required to operate satisfactorily on JP-5. The manufacturer carried out a 500-hour test using JP-5 in the engine. The report contains much useful information regarding the use of JP-5 in this engine. In summary, Man B&W / Paxman are aware of the potential problems with use of JP-5 in a diesel engine. Some of the older Paxman Navy engines contained sensitive parts but these were upgraded to a newer design that is not sensitive to JP-5. The newer Valenta engines are designed and constructed so that it is not sensitive to low-viscosity, low-lubricity fuels. The manufacturer is not aware of any fuel-related problems with the use of JP-5; the engine operates satisfactorily on the fuel.

Volvo Penta

Navy Engines:

• 2003TB • AQAD-31A • AQAD-40 • AQAD-41

JP-5 may be used with no modifications to Volvo Penta engines that have in-line injection pumps. For engines that have rotary injection pumps, JP-5 should be blended with 1 to 2% low-ash lubricating oil to improve lubricity (Note: This practice is not condoned on Navy ships).

Using JP-5 fuel could result in a 6 to 8% power loss, and a slight increase in fuel consumption.

If JP-5 fuel has a lower cetane number than diesel fuel, then the engine's cold starting ability may be reduced.

Westerbeke (Northern Lights)

Navy Engines:

• 14088 • 4-107 • 4-108 • 4-230 • LB-40

Westerbeke states that JP-5 fuel should not be used in any of their engine applications. The engine that Westerbeke uses for their generator sets is the Perkins diesel engine. This engine utilizes a CAV brand fuel injection pump. Westerbeke stated that the injection pump would fail in a short period of time if JP-5 fuel were used, due to the fuels inherent low lubricity.

Westerbeke would be willing to work with the Navy to modify or redesign the injection pump to properly utilize JP-5 fuel.

Yanmar

Navy Engine:

• 6LY2-STE

The following is an excerpt from an email message sent to SwRI in response to their survey of OEMs [4]. It regards the Yanmar position on the use of JP-5 in their engines.

> "Yanmar's policy regarding the use of JP5 in our engines has not changed. The use of JP5 is not recommended. The reason is solely that of wear of fuel lubricated components within the fuel system. Failures or excess wear of fuel injection components is not covered by Yanmar's warranty. The balance of the engine is covered. The use of approved fuel additives should help reduce wear of the fuel injection components, but Yanmar has not tested this so we cannot confirm this hypothesis. The use of the approved additives, in the recommended concentrations, will not void any part of Yanmar's warranty."

Regarding the use of JP-5 with lubricity additives, Yanmar states the following:

> "Currently two additives recommended by Yanmar for help in lubricity when using jet fuels are;
>
> Stanadyne Lubricity Formula Especially formulated for use with very dry , poor quality fuels such as ultra-low sulfur, jet fuel, kerosene or #1 diesel.
>
> Hammonds LubriBor This is a Mil-Spec fuel lubricity agent. It is approved for use in military and civilian jet fuels and is approved by major aircraft and engine manufacturers. It provides effective protection of injection pumps and tips from premature failure in diesel engines being run on jet fuel."

SUMMARY OF OEM SURVEYS

In summary, of those engine manufacturers surveyed, FM, Alco, EMD, DDC, Motoren and Turbinen Union (MTU), Volvo Penta, Cummins, and Isotta Fraschini (I-F) stated that JP-5 fuel is acceptable for use in the engines they have sold to the Navy. Caterpillar and Volvo Penta stated that there could be a 6 to 12 % power loss when using JP-5 fuel if their engines are not adjusted to compensate for the fuel's lower specific gravity. Most manufacturers indicated that there could be an increase in fuel consumption due to the lower volumetric energy content of JP-

5. The OEMs that approved the use of JP-5 fuel require a minimum cetane number of 40 for engine startability and performance. Caterpillar stated that JP-5 is an acceptable fuel for their engines if it complies with their recommended fuel specifications. Volvo Penta stated that if their engines are equipped with rotary injection pumps, then JP-5 should be blended with 1- to 2-percent low-ash lubricating oil to improve lubricity. MTU uses imbedded sensors in their 883 engine to adjust its fuel combustion characteristics for the different fuels that can be used (JP-5/JP-8/F-76). Westerbeke, Onan and Yanmar do not recommend the use of JP-5 fuels in their engines due to lubricity issues with rotary fuel injection pumps.

NAVY MAINTENANCE SURVEY

JJMA was tasked to determine the impact of using JP-5 fuel instead of F-76 fuel on the maintenance and total ownership cost of U.S. Navy diesel engines. JJMA was also tasked to quantify the major portion of the fleet diesel engine maintenance costs and project potential cost savings, if any, were JP-5 to be used instead of the current fuel, F-76. This study was limited to Navy ships, boats, and craft. MSC, Coast Guard, and Marine Corps engines were not included. During the course of this study, JJMA reviewed approximately 100,000 corrective maintenance records from the Navy's 3M Open Architecture Retrieval System (OARS) covering the years 1995 to 2003. They also surveyed diesel engine OEMs and interviewed nine Navy Diesel Engine Inspectors (DEIs) and diesel technical representatives. The results of this study were documented in a final report [Appendix B]. Selected tables and excerpts from this report are included in this section.

Since they are located in auxiliary spaces with the JP-5 aviation fuel systems, many ship emergency diesels are fueled with JP-5 rather than F-76 [2]. Table 8 lists diesel engines on board naval ships that are currently using JP-5 fuel. These engines are from FM, Alco, and EMD. All of the engines listed are emergency diesel generator (EDG) engines on CV, CVN, LHA, and LHD class ships.

Full-power load performance tests are conducted periodically for all diesel generator sets using F-76 as well as JP-5 fuel. No corrective maintenance actions were listed to indicate that the diesel generator sets using JP-5 were unable to achieve and maintain 100-percent power. No increased wear or part change out were evident on fuel-wetted parts (pistons, rings, cylinder liners, intake and exhaust valves, cylinder heads, injectors, fuel pumps) as a result of using JP-5 fuel. It should be noted that emergency diesel generator engines average only 300 operating hours per year. Reports of leaky fuel injectors and pumps for engines using either F-76 or JP-5 fuel are due to carbon buildup (as a result of low-load operation) or poorly rebuilt components. According to the Naval Ships' Technical Manual Chapter 233 "Diesel Engines" [12], extended operation at any speed at less than 60% of full-load torque will lead to incomplete combustion and may cause heavy carbon deposits. To achieve redundancy, many Navy diesels are operated below 50% load for prolonged periods of time. Also, it was noted that some of the engines were still using old-style injectors and pumps.

Engine manufacturers have improved their component designs to reduce fuel leakage. Engine overhaul life did not appear to be affected by either fuel. Maintenance records revealed that requests for outside activities to overhaul their engines were due to the fact that the engines had surpassed, or were approaching the end of their useful prescribed overhaul life regardless of the fuel used, or as a result of a non-fuel-related casualty. No fuel oil lubricity maintenance action issues were evident using either fuel. None of the engines experienced startability problems regardless of the fuel being used. No maintenance action listed indicates any reliability problems for engines using JP-5 or F-76 fuel.

Table 8. Ship Diesel Engines Currently Using JP-5

Class Ship	Ship	Mfr	Model	No. / Ship	Application	Power (HP)	Speed (RPM)	Stroke	Naturally Aspirated (NA) or Turbo
CV-63	CV 63	FM	10-38ND 8 1/8	3	EDG	1440	720	2	NA
CV-63	CV 64	FM	10-38ND 8 1/8	3	EDG	1440	720	2	NA
CV-67	CV 67	FM	12-38D 8 1/8	2	EDG	2250	900	2	NA
CVN-65	CVN 65	EMD	16-567C	4	EDG	1490	720	2	Turbo
CVN-68	CVN 68	EMD	16-LL16-645E4	4	EDG	2700	900	2	Turbo
CVN-68	CVN 69	EMD	16-LL16-645E4	4	EDG	2700	900	2	Turbo
CVN-68	CVN 70	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 71	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 72	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 73	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 74	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 75	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 76	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
CVN-68	CVN 77	EMD	16-LL16-645E5N	4	EDG	2700	900	2	Turbo
LHA-1	LHA 1	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHA-1	LHA 2	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHA-1	LHA 3	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHA-1	LHA 4	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHA-1	LHA 5	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 1	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 2	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 3	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 4	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 5	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 6	ALCO	16-251C	2	EDG	2800	900	4	Turbo
LHD-1	LHD 7	ALCO	16-251C	2	EDG	2800	900	4	Turbo

In addition to the emergency diesel generators listed above, the DDC 16V-149TI ship service diesel generators (SSDGs) onboard early FFG-7 class ships are known to have used JP-5 exclusively when they were first commissioned. Today, FFG-7's are using F-76 with small quantities of JP-5 taken on during deployment. The number of hours that these engines were/are operated on JP-5 is not known, as this data is usually not entered when corrective action/parts requisition reports (TWO-KILO form) are submitted. Diesel Engine Inspector reports submitted on these DDC 16V-149TI engines did not indicate any abnormalities as a result of using JP-5.

The Navy is currently in the process of replacing these engines with Caterpillar 3512 engines. This conversion is being executed over several years with all active FFGs being converted by 2010.

Table 9 lists fleet MPDE, SSDG and EDG diesel engines for which FY03 corrective maintenance data was available from the OARS database. The table shows overhaul cost per engine, estimated hours between overhaul, total corrective maintenance actions and fuel related maintenance actions. Also, listed is Calendar Year (CY) 03 fuel related Total Ownership Cost (TOC) and the overall TOC. The fuel related TOC was calculated by multiplying the overall TOC by the ratio of fuel related corrective maintenance actions to the total number of maintenance actions.

As can be seen from examining Table 9, the number of fuel-related corrective maintenance actions and their corresponding fuel related TOC are small when compared to the overall numbers for corrective maintenance actions and TOC. Based on the limited available data there is no apparent correlation between fuel-type and fuel-related maintenance costs.

Table 9. Diesel Engine Maintenance Costs

U.S. NAVY MPDE/SSDG/EDG MAINTENANCE POOL										
Equipment Type/Application	**Unit Rating (KW/BHP)**	**No./ Ship**	**No. of Ships**	**Total Units**	**Overhaul Cost/ Unit($K)**	**Estimated Hours Between Overhauls**	**No. of CY 03 Corrective Maintenance Actions**	**No. of CY 03 Fuel- Related Corrective Maintenance Actions**	**CY 03 Fuel-Related TOC($K)**	**CY 03 TOC($K)**
ALCO 251/EDG	2000 KW	2	13	26	1,000	16,000	47	6	38.80	304
CAT 399/SSDG	1100 BHP	1	4	4	600	12,000	12	5	85	204
CAT 3608/SSDG	3485 BHP	5	4	20	800	20,000	16	0	0	75
Coltec PC2.5V MPDE	8500 BHP	4	12	48	3,000	18,000	25	4	79.68	498
DD 16V-149TI SSDG	1000 KW	4	31	124	250	11,000	20	1	380.95	7,619
EMD 567/EDG	1500 KW	4	1	4	650	20,000	3	0	0	21
EMD 645/EDG	2000 KW	4	9	36	750	20,000	20	1	8.60	172
FM 38ND 8 1/8 SSDG	1200-2000 BHP	1/2/4	108	120	1,000	18,000	65	7	248.33	2,306
FM 38F 5 1/4/EDG	428 BHP	2	11	22	800	16,000	25	0	0	15
IF ID36SS6V-AM MPDE/SSDG	600 BHP	7	12	84	250	6,000	44	4	274	3,014
IF ID36SS8V-AM MPDE/SSDG	800 BHP	5	12	60	350	6,000	19	0	0	1,933
Paxman 16RP200CM MPDE	3350 BHP	4	13	52	450	12,000	10	0	0	1,435
Waukesha L1616DSIN MPDE/SSDG	600 BHP	7	2	14	200	6,000	13	3	507.92	2,201

SURVEY OF FLEET DIESEL ENGINE INSPECTORS

JJMA interviewed nine Navy Diesel Engine Inspectors (DEI) and diesel technical representatives as part of their Navy maintenance survey task. Selected responses are included in this section. All of the responses are included in the JJMA final report (Appendix B).

Dan Seagle, DEI SURFLANT

JP-5 was on the LST's (ALCO 251, EMD 645) all the time (all of the LST's have been since decommissioned). F-76 wasn't used for the first couple of years after commissioning of the USS Spartanburg. The ship didn't even know what F-76 really was. If at any time the ship got low on F-76 storage they would transfer some JP-5 from the forward helo storage to the engine storage tanks that normally held F-76.

Ray Dibiasi, DEI FTSCLANT

The FFG's (Stewart and Stevenson DDC 149TI) received a lot of JP-5 downloaded from aircraft carriers during refueling on deployments. This never posed a problem, just a little higher exhaust temperatures. JP-5 will clean the gunk out of an engine (residue) left by F-76. The lubricating qualities of JP are not as good as F-76, although no noticeable degradation.

As for the use of JP-5, the only things he ever saw that were different were the higher exhaust temperatures, and he oiled the injection pump racks every day on the LST. On the FFG's, he didn't conduct any additional maintenance, but he did closely monitor the exhaust temperatures.

No major issues were noticed for the ALCO 251 and EMD 645 engines onboard LSTs. He believes that exhaust temperatures were a little higher (air intake issue on LSTs added to this). These engines ran on the overheating edge due to the small lube oil and jacket water coolers. The worst thing that he found was an occasional burnt valve. He didn't see any fuel injector issues.

Wayland Porter, DEI FTSCLANT

He used JP-5 in FM 38ND 8 1/8 engines onboard submarines, and in engines onboard FFG 7 Class ships. FFGs used nothing but JP-5 when they were first commissioned. In all cases, he saw no adverse effects while using JP-5. He could take an engine, and shift it from F-76 to JP-5 and not notice any difference with the exception of longer lasting fuel filters while using JP-5.

Cary Christenson, DEI SURFLANT

He ran JP-5 on the USS Proteus, AS-19 (EMD 645's) EDGs with no problems.

Dean Meinnert, DEI FTSCLANT

He used JP-5 in everything. He was on USS Newport (LST 1179, EMD 645 diesel engines) from 1973-1976 and USS Harlan County (LST 1196, ALCO 251 diesel engines) from 1976-1979 and he ran JP-5. He also used it in the SSDG on the Knox FF-1052 16V-71 SSDGs. The FFGs originally had JP-5, but he never steamed them, just worked on them when they broke. He remembers that it just burned cleaner and was a cleaner fuel. He used it in the small boats during cold weather since the JP-5 wouldn't jell.

Rich Caccesse, PACFLT DEI Program Manager, FTSCPAC Division Director, Propulsion Division

At one time in the past, all of the Pacific fleet FFG SSDGs used JP-5 fuel with no reported problems. Since JP-5 has a lower specific gravity than F-76, some engines fuel system may have to be adjusted, or higher output fuel injectors may be needed to achieve full power. JP-5 may be the only fuel available in certain parts of the world, and is loaded onboard as the single source fuel.

SUMMARY OF NAVY MAINTENANCE SURVEY

In summary, there is no Navy data (3M (OARS), DEI reports, ships operating logs), or diesel OEM data to indicate any savings in maintenance costs if the Navy were to use JP-5 fuel as a single shipboard fuel.

The carbon buildup problems noted in Corrective Maintenance Action Reports were due to extended low-load engine operations. JP-5 fuel burns cleaner than F-76 (due to its inherent lower sulfur content and lower distillation end point) and it is possible that this would reduce the engines' carbon buildup, even though this is not indicated in the limited maintenance data that was obtained.

All of the Navy diesel engines above 100 BHP are MILSPEC qualified (MIL-E-24455 for high-speed engines and MIL-E-23457B for medium-speed engines) and as such are capable of operating on JP-5 fuel. All DDC engines, regardless of horsepower, have been MILSPEC qualified.

In the review of the OARS database, it was found that none of the Navy diesel engines that have used or, are currently using JP-5 fuel experienced any performance problems. The fuel did not interfere with the engines' ability to achieve full-rated power.

Most of the Navy's medium-speed diesel engines (FM, EMD, and Alco) have used or are currently using JP-5 fuel with no adverse effects.

The Navy FM, EMD, and Alco diesel engines that are using JP-5 are all shipboard EDGs, and as such should never require overhaul (average use is 300 hours/year). No JP-5 fuel-related corrective maintenance was evident.

The DDC 149TI prime mover for the SSDG's onboard some early FFG-7 class ships have used JP-5 in the past and some may continue to use small quantities of JP-5 when on deployment. No adverse effects have been reported.

COAST GUARD JP-5 USAGE SURVEY

JJMA was contracted to conduct a survey of the United States Coast Guard in order to assess the amount of JP-5 utilized by the Coast Guard and to gather information regarding their experience with burning JP-5 in diesel engines. During the course of this survey, JJMA personnel met with personnel from the Coast Guard Engineering Logistics Center (ELC) Baltimore, the Atlantic and Pacific Maintenance Logistics Centers (MLCs), the Joint Interagency Task Force South (JIATFS) and engineering personnel stationed at Coast Guard bases in St. Petersburg and Key West, Florida. The results of this survey are attached as Appendix C. Selected highlights from the report follow.

Logistics

- The Coast Guard has been using JP-5 as a ship propulsion plant fuel for many years. Interviews with retired Coast Guard Cutter engineering personnel confirm that the 378-ft High Endurance Cutters stationed on the West Coast were using JP-5 as early as the 1970's without reporting any operational problems.
- Cutters that take on JP-5 for propulsion fuel use it for main propulsion, ship service generators, and for miscellaneous applications such as powering portable fire pumps.
- Some Coast Guard cutters use JP-5 fuel frequently and there is no prohibition against their taking on JP-5 as a propulsion fuel. The three primary fuels used by the CG in their cutters are F-76, JP-5, and MGO.
- Cutters stationed at or calling at certain ports tend to make more use of JP-5 than others. Cutters stationed at Key West, FL use JP-5 almost exclusively as JP-5 is readily available since the Coast Guard base is co-located with a Naval Air Station. For F-76 to be used, the fuel must be trucked in from outside Key West. Mixing JP-5 with other fuels is common practice for cutters calling at Key West as well as at other ports that dispense JP-5. Cutters calling at Kodiak, AK, where JP-5 is readily available, tend to fuel with JP-5.

Performance

- In general, CG cutter engineering personnel did not report any performance, reliability or maintainability problems with the use of JP-5.
- There were few reported instances of cutters that could not make full-power or suffered endurance problems associated with the lower JP-5 heating value. The exception to this was from LCDR Novotny at MLC Atlantic who went on record as saying that the 110-ft Patrol Boats, equipped with Paxman RP200M engines, could not make full power on JP-5.
- Some cutters reported increased fuel consumption while using JP-5 fuel. However, this did not appear to be a major concern.
- It was noted that the use of JP-5 resulted in cleaner burning engines.
- Cutter personnel stated that Caterpillar engines ran hotter when using JP-5 fuel. It was also reported that the Alco model 251engines used aboard 270-ft Medium Endurance Cutters ran hotter on the JP-5. However, there was no data/documentation to determine how much hotter these engines ran on JP-5.
- The P-100 fire pumps with Yanmar engines (Model L90AE, 1 cylinder, 9 hp on the WLM) have occasionally used JP-5 fuel, but normally use F-76. No adverse effects were noticed when using JP-5 in the Yanmar pump (this pump is not normally run for long periods of time).

Maintenance

- If F-76 and JP-5 fuels are mixed, or if JP-5 is added to fuel tanks normally using F-76, cutter crews carry additional fuel filters. It was reported that any "varnish" in the tanks (associated with the F-76), is dissolved by the JP-5, acting as a solvent, and is trapped in the fuel filters. Ships force accounts for this by storing additional filters if the cutter transits to Key West.
- Cutters with Alpha Laval fuel oil purifiers have to change the purifier ring dam when operating on JP-5.
- MLC Pacific reported faster wear of fuel pumps and fuel injectors on the Fairbanks-Morse and EMD engines when using JP-5.

Summary

The Coast Guard has been using significant quantities of JP-5 fuel on many of its boats and cutters since the mid-1970's. All manufacturers' brand diesel engines on the major cutters and many of the boats in the Coast Guard fleet have utilized, and continue to use JP-5 fuel. Many of the engines utilized by the Coast Guard are the same or similar to engines used by the Navy (Alco 251, EMD 567, FM 38D 8-1/8, MTU 396, Paxman RP200 and Yanmar 6LP-STZ). The effect of JP-5 on cutter diesel engine maintenance and performance varies depending on the Coast Guard individual interviewed and little documentation is available to substantiate the claims. The wear/lubricity issue raised by MLC Pacific is currently being addressed by the Navy under the Naval F&L IPT-sponsored Low Lubricity Fuels program detailed earlier in this report. Overall, no major performance, maintenance, or reliability issues are apparent while using JP-5 fuel.

ARMY/NATO EXPERIENCE

JP-8 (NATO F-34) is a 100% kerosene blend fuel with properties very similar to JP-5 (see Table 6). The primary difference between the fuels is the minimum flash point specification and a few additives. Since safety concerns aboard Navy ships, JP-5 requires a flash point minimum of 60°C while JP-8 only requires a minimum of 38°C. JP-8 also contains a static dissipater additive (SDA) that is not in JP-5.

NATO Standardization Agreement STANAG 4362 Fuels for Future Ground Equipment Using Compression Ignition or Turbine Engines was introduced in October 1987. It declared F-34 as the primary fuel for NATO use. The United States adopted the Single Fuel on the Battlefield in March 1988 with the issuance of DOD Directive 4140.43 entitled "Fuel Standardization" that stated the primary fuel for the U.S. Army and Air Force will be JP-8.

Army

The Army conducted a comprehensive field demonstration at Ft. Bliss, Texas to resolve any user concerns and instill confidence. This demonstration involved a total conversion from diesel fuel to F-34 from October 1988 through July 1990. Over 2800 different vehicles and equipment satisfactorily used F-34 and over 4,700,000 gallons were dispensed during this period [13]. In addition to this demonstration, the Belvoir Fuels and Lubricants Research Facility at

Southwest Research Institute (SwRI) performed numerous laboratory engine evaluations. The US Army subsequently issued their Army Regulation AR 70-12 Fuels and Lubricants Standardization policy for Equipment Design, Operation and Logistical Support in November 1992, specifically calling out F-34 as the Single Fuel on the Battlefield.

The laboratory evaluations at SwRI identified several advantages and disadvantages of using JP-8 as compared to diesel fuel that were observed during their diesel engine testing [14,15,16].

Advantages

- JP-8 fueled engines place less stress on the lubricant in terms of acid levels and contaminants.
- Significantly less wear of the critical top piston ring was observed, which can prolong engine service life.
- Less combustion chamber and valve deposits are formed, prolonging engine life.
- No change to a slight reduction occurred in injector scuffing and deposits.
- An increase in thermal efficiency under some conditions for some engines. This increase in efficiency is achieved through larger amounts of constant volume combustion. The lower cetane value typical for JP-8 results in longer ignition delay periods and more premixed combustion, which generally denotes more constant volume combustion.
- The lower average sulfur content of JP-8 will have a positive effect on reducing particulate emissions.

Disadvantages

- Maximum engine power is reduced with the actual net effect being fuel injection and combustion system dependent. Engines with in-line injection pumps revealed performance decrements commensurate with the lower volumetric heating value of JP-8. Engines with rotary injection pumps displayed a performance decrement larger than expected from the difference in heating value relative to diesel fuel indicating that the rotary distributor injection pump is more sensitive to fuel viscosity than in-line units. In one particular application, severe wear problems occurred in Stanadyne rotary injection pumps used on the Army's General Motors 6.2L and 6.5L vehicle engines.
- Higher volumetric fuel consumption can be expected. However, as mentioned under advantages, some efficiency improvements have been documented that could partially offset the lower volumetric heating value and detrimental leakage associated with JP-8. The data indicates that the actual fuel consumption penalty of using JP-8 might be less severe than that expected from a strict comparison of fuel energy values.

While these advantages and disadvantages were demonstrated during the laboratory evaluation, they were not observed during the long-term field trails at Ft. Bliss. For that demonstration program, there were no major statistical differences in fuel procurement costs, vehicle and equipment fuel consumption, oil changes, fuel-wetted component replacements, or wear metals with JP-8 use [17] There was no impact on cost, performance or mission that was judged to be the result of using JP-8 fuel in diesel engines.

Studies investigating the use of aviation type fuels (JP-5, JP-8) in diesel engines have been ongoing since the laboratory evaluations performed by SwRI in the late 1980's and early 1990's. A recent (2005) experimental research effort was performed by the US Army, RDECOM National Automotive Center and the University of Michigan, Automotive Research Center [18]. The main objective of this research was to understand the effect of JP-8 fuel on combustion, performance and emissions of a modern heavy-duty diesel engine and to provide insight and explanations for the observed effects. The engine used in this study was a DDC Series 60 engine equipped with electronic unit injection, variable geometry turbocharging and cooled exhaust gas recirculation. The findings of this study are summarized below.

- Directly replacing diesel fuel with JP-8 leads to a performance reduction due to the lower density of JP-8 which results in a smaller mass of fuel injected.
- The baseline performance of the engine operating on diesel fuel can be matched by increasing the volume of JP-8 injected. At low loads this can be accomplished by matching the mass of fuel injected, however at high loads, the engine requires further increases in the amount of JP-8 injected due to increased mechanical losses in the fuel system when pumping higher volumetric flow.
- When the baseline performance of the engine on diesel is matched by increasing the volume of injected JP-8, the BSFC values are very close.
- Testing with JP-8 fuel resulted in lower NOx and PM emissions under all load conditions. The reduction of NOx is attributed to the lower aromatic content of JP-8 and resultant lower peak flame temperatures. The higher volatility and longer ignition delay associated with JP-8 leads to better fuel-air mixing and fewer rich pockets in the combustion chamber resulting in drastically reduced soot formation. The lower sulfur content of JP-8 provides for a decrease in sulfate production which also contributes to lower PM emissions.

NATO

All NATO nations have ratified and are implementing STANAG 4362. The Ground Fuels Working Party of the NATO Pipeline Committee was tasked to investigate the applicability of F-34 and F-35 (JET A-1) to land-based vehicles and equipment utilizing compression ignition engines. Nations performed extensive tests and evaluations of kerosene-type aviation fuels in diesel engines focusing on the effects on engine performance and fuel related components [17]. Also, the NATO Research and Technology Organization (RTO) Applied Vehicle Technology panel commissioned a working group to review the technical status of the Single Fuel Concept [19]. The results of these investigations have identified the main effects associated with the use of F-34 on diesel engines.

Main Effects

- Operation of the combustion process due to the different physical and chemical properties, especially the cetane number, when compared with diesel fuel.

- Operation and durability of the fuel injection system due to lower density and lubricity.
- Exhaust gas emissions.
- Maintainability and operability of engines.

The following points summarize the effects of using jet fuel in diesel engines as experienced by the numerous NATO countries contributing to the studies.

1. There is a power loss, typically up to 10%. On commercial engines, depending on the design, loss of power up to 15% may be observed due to lower viscosity (internal pump leakage) and lower volumetric heat content.
2. The specific fuel consumption is almost the same when utilizing F-34 and diesel fuel. A small increase is observed at high loads with F-34 and peak pressure is also increased.
3. The ignition delay period is longer with F-34 due to a lower cetane number value.
4. The use of F-34 produces differences and fluctuations of the residual pressure in the fuel lines as a result of the differences in physical properties (density, viscosity) between F-34 and diesel fuel.
5. The exhaust gas temperatures are similar for F-34 and diesel fuel, but at high engine speeds and loads an increase can be observed when using F-34.
6. Exhaust gas NOx emissions are similar for both F-34 and diesel fuel.
7. The CO emissions are lower when using F-34 compared to diesel fuel at low and intermediate engine speeds, but can be higher at high load conditions.
8. Hydrocarbon emissions are increased when using F-34 instead of diesel fuel.
9. Soot emissions are usually lower when using F-34.
10. When using F-34 there is a reduced tendency for injector nozzle fouling and deposit problems, reduced potential for fuel system corrosion problems and extended replacement intervals for fuel filters. JP-5 would be similar.

DISCUSSION

The Navy utilizes a large number of diesel engines in a wide variety of platforms and applications as evidenced by the engine survey conducted as part of this study [Appendix B]. There is no indication that this reliance on diesel engines will decline to any significant degree in the foreseeable future. When all the available information gathered from fuel property studies, manufacturer surveys and past Navy and worldwide experience with aviation-type fuels (JP-5, JP-8) is considered, there are some definite issues associated with the use of kerosene-based fuels in diesel engines.

The three main issues with JP-5 when used in diesel engines are cetane number/index, lubricity/viscosity and density/energy content. There is no minimum requirement for cetane index or lubricity in the current JP-5 specification, version U. There are worldwide efforts currently underway to develop and implement middle distillate/diesel fuel specifications that include a minimum lubricity requirement as well as a cetane index requirement [20, 21]. Engine and fuel injection equipment manufacturers (Engine Manufacturers Association, European

Automobile Manufacturers Association) are leading these efforts which are being driven by concerns about fuel properties associated with the legislated introduction of ultra-low sulfur (15 ppm) diesel fuels. Although kerosene-based fuels (JP-5) will not achieve this ultra-low sulfur level immediately, it is likely that some reduction in sulfur levels will occur. As the sulfur level of JP-5 continues to decrease due to increased hydrotreating, the natural lubricity of the additive-free base fuels will continue to decrease as will the ability of current lubricity additives (acidic corrosion inhibitors and esters) to impart acceptable lubricity [22]. If the available supply of kerosene fuels for JP-5 eventually reflects this level of hydrotreating, the methods currently available to restore adequate lubricity may no longer work. Cetane has a pronounced effect on lowering NOx and HC emissions [21]. The future will bring an increase in the minimum cetane requirement specified by manufacturers for new engines as they are compelled to meet ever more stringent exhaust emissions levels. Without a specified minimum cetane number/cetane index for JP-5, the discrepancy between actual JP-5 cetane levels and that required by the engine manufacturers could grow.

There is evidence to document that rotary fuel injection pumps, which depend on the fuel for lubrication of highly loaded components, are particularly sensitive to low lubricity fuels. Army/NATO experience with JP-8 has documented several failures with these type pumps. Also, the USMC had an incident with their Bridge Boats where new Perkins engines had their Bosch rotary injection pumps seize after only 40 hours of operation using JP-5. Several Navy engine manufacturers (Yanmar, Volvo-Penta, Westerbeke and Onan) do not recommend using JP-5 in their engines (with rotary pumps) without a supplemental lubricity additive. Some current state-of-the-art as well as future diesel engines are/will be utilizing high- pressure common rail fuel injection systems to improve performance and reduce exhaust emissions. These new common rail fuel pumps are highly loaded and will be more sensitive to fuel lubricity than rotary pumps [23]. This underscores the fact that fuel lubricity is not just an issue with legacy Navy diesel engines but will continue to be an issue in the future with new technology engines.

The military specifications for high-speed diesel engines (MIL-E-24455), medium-speed diesel engines (MIL-E-23457B) and the new ABS Naval Vessel Rules (NVR) diesel engine specification [24] all state that engines shall be capable of operating on F-76 or JP-5 fuels. However, there is no requirement for extended operation on JP-5 during the qualification tests. The only required operation on JP-5 is a fuel performance comparison test where fuel mass flow measurements are taken while the engine is operated at 5 test points (100, 90, 70, 50 and 30 % rated speed and 100% full-load at each speed). There are no test results to show that many engines qualified prior to 1990 ever ran on JP-5, even though it is included in the qualification specification. It is speculated that, in some cases, a letter produced by the OEM stating that their engines would run on JP-5 was accepted in place of a JP-5 engine test.[5]

Three of the highest rated Navy diesel engines in the JJMA engine survey are used in SPECWAR boats. The MTU 396 engine has been MILSPEC tested. The Yanmar 6LY2-STE and Caterpillar 3126 are commercial engines and have not been MILSPEC qualified. There has been a verbal agreement from the manufacturer to use JP-5 on a limited basis in these two engines, but with a power loss and no guaranty on engine life [6]. A similar Yanmar engine (6LY2A-STP) is used in the new Marine Corps Small Unit Riverine Craft (SUC-R). During trials, one craft was

[5] Email from George Campbell, NSWCCD Philadelphia, Code 9324, February 03, 2005.

[6] Phone conversation with Jim Stafford, NSWCCD Philadelphia, Code 9324, October 14, 2004

operated over 200 hours with JP-5 that contained an additive recommended by the engine manufacturer [7]. The additive used was Racor Diesel Conditioner Plus+. According to Racor, Diesel Conditioner Plus+ is a multi-functional diesel fuel additive that contains a cetane improver and a lubricity additive.

All engines will have a predictable variation in power output depending on the density of the fuel used. Lower density fuels will also cause an increase in fuel consumption, due to lower thermal energy content in BTU's per gallon of fuel. The density of JP-5 is generally less than F-76 as indicated in the SwRI fuel property study. In addition to power variations due to fuel density differences, there are additional changes to power output due to differences in fuel viscosity. The effect of viscosity on power output is related to the type of fuel injection system [25]. A decrease in fuel viscosity will result in high-pressure leakage of fuel past the fuel system components, with less fuel actually being injected into the cylinder resulting in a loss of power. The loss of power due to decreased fuel viscosity will be more pronounced in a rotary or distributor pump system than in an in-line or unit injector/pump system. The rotary pump system has more fuel leakage than the other systems. The effects of JP-5 on engine power output and fuel consumption have been documented by Navy laboratory testing (Table 7) and were sited by virtually all of the Navy engine manufacturers that were surveyed.

There is very little data on shipboard diesels running on straight JP-5, other than the Navy EDGs detailed previously in this report. The U.S. Special Operations Command conducted a single set of speed and range tests using a SPECWAR RIB powered by Caterpillar 3126 diesel engines using JP-5. They concluded that the speed and range may have degraded slightly using JP-5, but that the observed degradation was so slight that it could be considered to fall within the normal range of performance variations observed between different RIBs or be due to tuning variables [26]. The U.S. Coast Guard Engineering Logistics Center Baltimore has related several anecdotal instances indicating power issues with JP-5[8]. It was reported that the 110-ft Patrol Boats, powered by Paxman diesel engines, which operate out of Key West, all have problems making rated rpm when burning JP-5. Another instance involved the SENECA, a 270-ft Medium Endurance Cutter. The cutter had not completed a successful full-power trail in 4 years while operating on JP-5. When the service tanks were filled with F-76, the ALCO diesel engines were able to achieve full-power.

CONCLUSIONS

Based on the data and information gathered during this investigation and detailed in this report, the adoption of JP-5 as the single naval fuel at-sea could be accomplished with no major impacts on Naval diesel engines. There are some potential issues regarding the use of JP-5 in a small number of engines equipped with rotary-type fuel injection pumps (mostly SPECWAR boats). However, for the majority of Naval diesel engines the transition should be transparent.

[7] Phone conversation with Jason Marshall NSWCCD Det Norfolk, Code 2310, October 10, 2004

[8] Email from Tom Gahs to Robert Giannini, November 03, 2003

Lubricity

There is no indication of lubricity-related problems with the bulk of Navy diesel engines when operated on JP-5. There are some isolated problems identified with a few specific engines (for example some SPECWAR engines with rotary fuel injection pumps) that will have to be addressed. Worldwide regulation of emissions from diesel engines is driving the legislated reduction of sulfur in middle distillate (diesel) fuel. Lower fuel sulfur content, which can be directly attributed to the severity of hydrotreatment, raises concerns regarding lubricity characteristics. Thus, diesel engine manufacturers are pursuing commercial fuel specifications that include a minimum lubricity requirement.

There is currently no minimum lubricity specification for any Navy fuel. However, the Naval Fuels and Lubricants Integrated Product Team has embarked on a program to determine if there is a fuel lubricity problem with shipboard diesel engines when using ULSD and JP-5-type fuels and if so, what level and types of fuel additives or material hardware changes to the affected fuel injection systems may correct the problems. The program also seeks to establish a minimum fuel lubricity level that would be added to all Navy fuel specifications.

Cetane Number/Cetane Index

Cetane number is a measure of the ignition quality of a fuel and effects engine startability and acceleration capability under load. There have been no reports of cetane-related problems with Navy diesel engines when operated on JP-5. There was one incident of starting problems and abnormal combustion identified with a diesel engine in an AAAV. The problem occurred during trials when the vehicle was fueled with JP-8 that had a low cetane number value (35). Again, diesel engine manufacturers are pursuing commercial fuel specifications that include a minimum cetane number requirement to ensure proper engine operation. There is currently no cetane number/index specification requirement for JP-5.

Power

Although laboratory testing has shown reductions in rated power with JP-5, the effects vary greatly with the type of engine and engine-mounted fuel injection system. In reality, due to operational procedures, the Navy rarely operates MPDE or SSDG engines at full-power. Also, there is no data to show that any Navy shipboard diesel engine could not attain full power when operating on JP-5.

Fuel Consumption

Laboratory testing and manufacturer data indicate an increase in fuel consumption will occur when JP-5 is utilized instead of F-76, but during an extensive Army field evaluation there was no statistical difference in fuel procurement cost and consumption when using JP-8 in place of diesel fuel. There is no Navy documentation of the fuel consumption of shipboard diesel engines run with JP-5. It is therefore unknown if this projected increase in fuel consumption will be seen under actual shipboard engine operating scenarios. The various variables associated with real world ship operations as well as variations in actual fuel properties (energy content and density) between fuel batches could make these small differences unnoticeable.

Maintenance

Previous studies and experience from the U.S. Army and NATO countries have indicated potential maintenance benefits when using aviation fuels in diesel engines. However, during the Army long-term field evaluation there was no documentation of differences in oil changes, fuel-wetted component replacements or wear metals. Also, a study conducted by JJMA on Navy diesel engines has shown that fuel injection system-related maintenance costs are a minor part of overall diesel engine maintenance costs and that there was no available Navy data to indicate any difference in these costs when using JP-5 versus F-76.

RECOMMENDATIONS

- This report focused on diesel engines that are currently in the fleet. As new engines are introduced, they will incorporate new technologies such as high-pressure common rail fuel injection. These engines are being designed to produce lower exhaust emissions and could possibly have new fuel requirements (higher cetane number/cetane index). Also, new ship designs, such as LCS, may require engines to be operated at more severe duty cycles and spend more time at full power than is the current practice. The effects of JP-5 fuel properties (lubricity, cetane number, ignition delay, etc.) on these advanced technology engines need to be investigated.
- It is recommended that a minimum requirement for cetane number/cetane index and lubricity potentially be incorporated into the JP-5 specification to insure compatibility with current and future technology diesel engines.
- In order to investigate the reality/magnitude of a fuel consumption penalty for Navy diesel engines when using JP-5, it is recommended that several long-term shipboard "at-sea" evaluations be performed. These evaluations should involve main propulsion and ship service generator engines. The evaluations should be as "controlled" as possible to minimize variations in ship operation, sea conditions, engine build or wear-out condition, etc. The ideal situation would be two identical engines on the same ship operating on the same duty cycle; one using JP-5 the other using F-76. These evaluations would require adding instrumentation over-and-above what normally is onboard as well as periodic visits by technical personnel to inspect/calibrate the instrumentation and retrieve collected data. Fuel samples (JP-5/F-76) would have to be obtained regularly during these evaluations. The fuel samples would be analyzed to assist in determining any operational differences. In addition to the fuel consumption/power issues, these evaluations would provide information regarding differences in required maintenance actions.

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APPENDIX A

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4704-0040Rev2 Final
12 March 2007

To: Naval Surface Warfare Center, Carderock Division (Code 9823)
Attn: D. Guimond

Subj: CONTRACT N00024-99-C-4055, DELIVERY ORDER 0078, "DIESEL ENGINE ENGINEERING SUPPORT," JP-5 NAVAL SINGLE FUEL AT SEA STUDY OF IMPACTS ON DIESEL ENGINES, TASK 2.1, ENGINE MATRIX, FINAL REPORT (A002)

Ref:
(a) P. Grotsky, W. Remley, K. Fledderman, "Task 2.2 Quantify the Major Portion of Fleet Diesel Engine Maintenance Costs and Project Cost Savings if JP-5 Is Used as the Single Shipboard Fuel," Final Report, 4704-0049, 29 March 2004
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(e) W. Remley, K. Fledderman, T. Vota, "2002 Fleet Emission Inventory," JJMA, 4703-0152, July 2003.
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(g) Enclosure (1) to JJMA report 4702-0250, "Attrition Schedule," 1 October 2002
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(i) E-mail from J. DeHart, NSWC, to W. Remley, JJMA, Diesel Engine Single Fuel Task – ROM Estimate, 30 September 2003

Encl:
(1) U.S. Navy Single Fuel Ship Diesel Engine Matrix
(2) U.S. Navy Single Fuel Craft Diesel Engine Matrix
(3) U.S. Navy Single Fuel Small Boat Diesel Engine Matrix
(4) U.S. Navy Single Fuel SPECWAR Boat Diesel Engine Matrix
(5) U.S. Navy Single Fuel Miscellaneous Diesel Engine Matrix
(6) Comparison Matrix, Fuel Consumption by Engine Manufacturer
(7) Comparison Matrix, Total Number of Engines by Engine Model
(8) Comparison Matrix, Total Number of Engines by Vintage
(9) Comparison Matrix, Engine Ratings

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1. Introduction

In accordance with the subject contract, JJMA was tasked to participate in a Navy-wide effort to gather information about and assess the impact of using JP-5 as a single at-sea fuel for Navy ships, service craft, and boats. JJMA was asked to assess the impact on fleet diesel engines in particular. The effort was divided into two tasks: Task 2.1 was to quantify and list the aspects of the fleet diesels and rank them according to fuel impact; Task 2.2 was to assess the impact of converting to JP-5 fuel by determining the Navy's experience with it through interviews with Navy Diesel Engine Inspectors (DEI), Original Engine Manufacturers (OEMs) that supply Navy diesels, and a survey of ships that are using or have used JP-5 in their engines. This report presents the information that was used to quantify the Navy marine diesels in Task 2.1 of the Delivery Order (DO) and the diesel engines that have been identified as sensitive to the introduction of JP-5. In particular, DO 78 required JJMA to develop the following items:

- A table of ship diesel engines with the ship, engine models, engine use (Main Propulsion Diesel Engine (MPDE), Ship's Service Diesel Generator (SSDG) or Emergency Diesel Generator (EDG)), quantity, vintage, fuel system type, fuel pump type, estimated fuel consumption, and year of decommissioning.
- A table of service craft diesel engines with the craft type, engine models, engine use (MPDE, SSDG), quantity, vintage, fuel system type, fuel pump type, estimated annual fuel consumption, and year of decommissioning.
- A table of small boat diesel engines with the boat type, engine models, engine use (MPDE, SSDG), quantity, vintage, fuel system type, fuel pump type, estimated annual fuel consumption, and year of decommissioning.
- A table of miscellaneous engines to quantify the miscellaneous engines.
- A table of special warfare (SPECWAR) boat diesel engines with the boat type, engine models, engine use (MPDE, SSDG), quantity, vintage, fuel system type, fuel pump type, estimated annual fuel consumption, and year of decommissioning.
- A summary analysis matrix sorting the engines by different criteria and consolidating the information from the above tables.

In conjunction with this report, another task considering the impact of JP-5 on Navy diesels was conducted [Ref (a)]. The findings of this report should be considered in conjunction with the high profile engines noted in this report.

2. Discussion

Given the short timeframe in which the task had to be accomplished (the DO was authorized on 18 December 2003 and the work had to be completed by 29 March 2004) and the large amount of data that had to be obtained and correlated, a schedule was set up requiring periodic delivery of the above tables [Ref (b) and (c)]. Following this schedule ensured that the work progressed smoothly and that problems were dealt with as they arose on a timely basis. Monthly status reports were issued to inform the Navy Technical Point of Contact (TPOC) of our progress and any issues to be resolved.

The following data from the below named sources were used to develop the tables:

- Engine models with fuel system description – references (d) and (e)
- 2002 Engine Operating Hours – 3-M data obtained from the Open Architecture Retrieval System (OARS) maintained by the Naval Sea Logistics Center N60, Version 5.00
- SPECWAR boat operating hours – 11M RIB and MK V SOC (Special Operations Craft) [ref. (f)]
- 2002 Fuel Consumption data – 3-M data obtained from OARS maintained by the Naval Sea Logistics Center N60, Version 5.00
- Ship, service craft, boat, and SPECWAR boat lists and engines – Combination of Naval Vessel Register (NVR), Ship and Boat Accounting Report (SABAR), and references (d) and (f)
- Attrition data for ships and boats – Reference (g) for ships and reference (h) for boats. (Note: At the time of this report, no craft attrition data was available. The TPOC felt that this data was not critical to finishing the task and indicated it was not needed to complete the task.)

The tables once populated with the required information of fuel consumption, engine types, etc., were completed using a weighting system to sort the engines using factors that would identify high profile engines for the conversion to JP-5. This was done using a template supplied in reference (i). The following factors were used:

Engine Application:	
MPDE – Planing Hull (High)	20
MPDE – Displacement Hull (Medium)	10
SSDG (Low)	5
EDG (Low)	5
Combat Criticality:	
Combatant (High)	10
Combat Support (Medium)	5
Noncombatant (Low)	2
Annual Fuel Consumption:	
High	6
Medium	4
Low	2

For ships, the factors were based on the following annual fuel consumption rates:

High	Greater than 500,000 gal/year (11,905 bbls/year)
Medium	100,000 – 500,000 gal/year (11,905 – 2,380 bbls/year)
Low	Less than 100,000 gal/year (2,380 bbls/year)

For service craft, small boats, and SPECWAR boats the factors were base on the following annual fuel consumption rates:

High	Greater than 30,000 gal/year (714 bbls/year)
Medium	10,000 – 30,000 gal/year (714 – 238 bbls/year)
Low	Less than 10,000 gal/year (238 bbls/year)

Due to the variety and large number of miscellaneous engines, and the time it would take to obtain data for calculating their fuel consumption, fuel consumption rates were not listed for these engines.

It is estimated that the JP-5 conversion will take 5 to10 years to accomplish, all ships, craft, and boats currently operating regardless of their decommissioning schedule were listed in the tables. For planning purposes the tables are arranged to show attrition by decommissioning dates for 2003 to 2008 (5-year decommissioning) and 2009 to 2013 (10-year decommissioning).

3. Major Findings

There are a large number of diesel engines on board Navy ships, service craft, and boats. They are used for main propulsion, ship service generators, emergency generator sets, and for miscellaneous applications such as powering fire pumps. Table 1 summarizes the number of engines on the ships, craft, boats, and SPECWAR boats; the OEMs represented; and the various engine models as well as their fuel consumption for 2002. From the studies we conducted, we found that a total of 3,677 diesel engines are used by the Navy for these vessels. There are 806 diesel engines on ships, 211 on service craft, 2,404 on boats, and 256 on SPECWAR boats. In addition, there are 940 smaller miscellaneous shipboard engines used to power fire pumps, deck cranes, etc. The attached matrices (enclosures 1 through 5) list the engines for the ships, craft, boats, SPECWAR boats and the miscellaneous shipboard engines. These comprehensive tables were developed as input to the comparison tables (enclosures 6 through 9) and to show predicted engine attrition over the next 5 to10 years. Miscellaneous engine fuel consumption was not estimated.

Table 1. Navy Diesel Engine Summary (Miscellaneous Engines Not Included)

Vessel Type	Total No. of Engines	No. of Engine Manufacturers(1)	No. of Engine Models(1)	2002 Fuel Consumption (Gallons)
Ships	806	10	27	58,258,562
Craft	211	3	14	12,791,955
Boats	2,404	7	28	19,050,795
SPECWAR craft	256	4	4	2,833,633
Totals	3,677	18	69	92,984,945

Notes (1) Totals for No. of Engine Manufacturers and No. of Engine Models are not a summation of total number of different OEMs or engine models because some OEMs and engine models may be repeated for each vessel type.

(2) Although part of the small boat matrix, USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV) were not included in as part of this comparison.

Table 2 is an all-inclusive list of the manufacturers of the marine diesel engines used on Navy ships, craft, and boats.

Table 2. Navy Marine Diesels

OEM	Number of Engines	Number of Models
Alco	26	1
Caterpillar	283	7
Colt-Pielstick	96	1
Cummins	734	8
Detroit Diesel	1,549	26
Electro Motive Division (EMD)	47	4
Fairbanks Morse	188	9
Gray Marine	20	1
Isotta-Fraschini (I-F)	144	2
Iveco	1	1
MTU	40	1
Northern Lights	20	1
Onan	64	1
Paxman	52	1
Volvo Penta	346	2
Waukesha	14	1
Westerbeke	13	1
Yanmar	40	1
Total (Ships, boats, and craft)	3,677	69

Some ship engine types as well as some engine models by certain OEMs will disappear in the future. Table 3 shows this trend in Navy diesel engines on ships by OEM. Diesel engines on boats and craft were not included in Table 3 because the attrition data was not as complete as for ships.

Table 3. Trend in Ship Diesel Engines by Manufacturer

	OEM	Current Number of Diesel Engines	Current Number of Models	Number of Engines after 5 Years (1)	Number of Engines after 10 Years (1)
1	Alco (2)	26	1	24	20
2	Caterpillar	127	6	101	101
3	Colt – Pielstick	96	1	96	96
4	Cummins	1	1	1	0
5	Detroit Diesel	12	2	6	4
6	Electro Motive Division (EMD)	47	4	44	44
7	Fairbanks-Morse	155	7	132	113
8	Isotta-Fraschini (I-F)	144	2	144	144
9	Paxman	52	1	0	0
10	Detroit Diesel (Stewart & Stevenson)	132	1	120	80
11	Waukesha	14	1	14	14
	Totals	806	27	682	616

Note: (1) Ship attrition data from OPNAVs (OP-801) latest decommissioning schedule [Ref. (g)]
(2) Alco is now Fairbanks Morse.

Table 3 shows that the Paxman and Cummins engines will be phased out of shipboard use, reducing the number of OEMs and engine models. The table also shows that the Navy will be using marine diesels engines in substantial quantities into the foreseeable future and the impact of the conversion to JP-5 on these engines is a high priority.

The boat attrition rates [ref. (h)] are suspect in that the rule-of-thumb attrition rates based on hull material do not agree with the actual data, which shows boats still in the inventory that are well past their predicted decommissioning dates. The rule-of-thumb service life for a commercial off the shelf (COTS) glass reinforced plastic (GRP) hull is 7-10 years and for a COTS metal hull is 12-15 years. For example, using the boat attrition rates a 33-foot PE boat on CV 63 with a GRP hull built in 1967 has a decommissioning date of 1977 yet this same boat is still operational. The boats attrition rates need to be revisited and readjusted.

Table 4 shows the distribution of vintages by OEM. During the 1980's and 1990's there was an increase in the percentage of diesels in the fleet. There are several factors that may contribute to this,

- For larger engines (MPDE and SSDG) on ships, the Navy has gone away from conventional steam-powered ships toward gas turbine and diesel-powered ships,
- In the mid 80's and early 90's, the Navy began to purchase new boats (RIB) in order to phase out the older utility and personnel boats,
- SPECWAR, which consists of high performance diesel-powered boats, was added to the fleet.

Table 4. Current Engine Vintage by OEM

OEM	Engine Vintage							Total
	1940's	1950's	1960's	1970's	1980's	1990's	2000's	
Alco				0.27%	0.05%	0.27%	0.11%	0.70%
Caterpillar	0.11%(1)				0.76%	5.09%	1.74%	7.70%
Colt-Pielstick					0.87%	0.44%	1.31%	2.62%
Cummins			0.05%	0.19%	0.27%	7.72%	11.72%	19.95%
Detroit Diesel	0.16%	0.54%	3.34%	6.94%	11.75%	19.01%	0.38%	42.13%
EMD			0.19%	0.22%	0.33%	0.33%	0.22%	1.29%
Fairbanks Morse			1.36%	0.63%	1.96%	1.14%	0.03%	5.12%
Gray Marine						0.54%		0.54%
Isotta-Fraschini					0.95%	2.96%		3.91%
Iveco							0.03%	0.03%
MTU						1.09%		1.09%
Northern Lights						0.54%		0.54%
Onan				1.74%				1.74%
Paxman						1.41%		1.41%
Volvo Penta					5.71%	2.69%	1.01%	9.41%
Waukesha					0.38%			0.38%
Westerbeke						0.35%		0.35%
Yanmar							1.09%	1.09%
Totals by Decade	0.27%	0.54%	4.95%	9.98%	23.03%	43.60%	17.62%	100%

Note: (1) Percentages were calculated by dividing the number of OEM engines of a certain vintage by the total number of engines. [i.e. There are 4 Caterpillar engines from the 1940's still in use. To determine the percentage of the total engine population, divide 4 by 3,677 (total number of engines) x 100 (to convert into a percentage) = 0.11%]

3.1 Discussion of Enclosures

- Enclosure (1) provides a listing of all diesel engines on active and future U.S. Navy ships. Details such as OEM, engine models, engine use (MPDE, SSDG, or EDG), quantity, vintage, fuel system type, fuel pump type, estimated fuel consumption, and year of decommissioning are included.
- Enclosure (2) provides a listing of all diesel engines on active U.S. Navy craft. Details such as OEM, engine models, engine use (MPDE, SSDG), quantity, vintage, fuel system type, fuel pump type, estimated fuel consumption are included. Attrition data for the craft was unavailable and was therefore not included in the table.
- Enclosure (3) provides a listing of all diesel engines on active U.S. Navy boats. Details such as OEM, engine models, engine use (MPDE, SSDG), quantity, vintage, fuel system type, fuel pump type, estimated fuel consumption, and year of decommissioning are included. Attrition data for boats was suspect due to the number of boats still in service, but based on the "planned service life" [ref. (h)] should have been decommissioned.

- Enclosure (4) provides a listing of all diesel engines on active U.S. Navy SPECWAR boats. Details such as OEM, engine models, engine use (MPDE, SSDG), quantity, vintage, fuel system type, fuel pump type, estimated fuel consumption, and year of decommissioning are included.
- Enclosure (5) provides a listing of U.S. Navy miscellaneous engines. Details such as OEM, engine models, engine use, quantity, vintage, fuel system type, and fuel pump type are included. Due to the variety and large number of miscellaneous engines, fuel consumption rates were not listed for these engines.
- Enclosure (6) provides a summary of fuel consumption by OEM vs. total fuel consumption. The ship, boat, craft and SPECWAR boat tables were compiled for this summary. Referring to enclosure (6), 4 out of 18 engine manufacturers consume over 88 percent of the fuel as shown in Table 5.

Table 5. Engines with the Greatest Fuel Consumption

OEM	No. of Engines	% of Engines	% of Fuel Consumed
Detroit Diesel	1,549	42.1%	34.84%
Colt-Pielstick	96	2.6%	31.56%
Fairbanks Morse	188	5.1%	11.86%
Caterpillar	283	7.7%	9.99%
Total	2,116	57.5%	88.25%

- Enclosure (7) provides a summary of engine models by OEM and each models percentage of the total number of engines. The ship, boat, craft and SPECWAR boat tables were compiled for this summary. The two engine models that make up the greatest percentage of the total engines are the Cummins 6BT5.9M found on RIBs and RXs and the Detroit Diesel 6-71 1062-5000 found on workboats.
- Enclosure (8) provides a summary of engines by vintage. The ship, boat, craft and SPECWAR boat tables were compiled for this summary. Table 4 also shows the distribution of vintages by engine model.
- Enclosure (9) provides a summary of engine rating by engines model. Details on the rating system can be found on pages 3 and 4 of this report. The ship, boat, craft and SPECWAR boat tables were compiled for this summary. The characteristics that accounted for high overall ratings are a combat criticality rating of 10 and that they are MPDEs on planning vessels. Table 6 summarizes the results of some of the highest rated engines.

Table 6. Highest Rated Engines (30 and above)

Engine	No. of Engines	Rating	Vessel	No. of Vessels
MTU 12V-396 TE94	40	36	SPECWAR MkV SOC	20
Caterpillar 3126TA	156	32	SPECWAR 11M RIB	78
Yanmar 6LY2-STE	40	32	SPECWAR SOC-R	20
DD 8V-71 7082-3000	77	32	36' LCP(L)	77
DD 8V-71 TI	64	32	65' PB	64
DD 6V-53	23	32	31' PBR	23
DD 6088M	2	32	33' PB	2
Totals	402			284

4. Recommendations

JJMA recommends the following:

- Obtain new boat and craft construction information, i.e., contracts awarded and planned new procurements to better predict 5-year and 10-year attrition and trends in engine suppliers.
- Expand diesel engine database by obtaining information on Coast Guard marine diesels and their experience with JP-5 usage.
- Refine fuel consumption tables to show JP-5 and F-76 fuel usage.
- Include Military Sealift Command (MSC) diesel engines and any unique problems they may encounter.

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ENCLOSURE (1)

U.S. NAVY SINGLE FUEL SHIP DIESEL ENGINE MATRIX

U.S. NAVY SINGLE FUEL SHIPS DIESEL ENGINE MATRIX, SHIPS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Class Ship	Ship	# of Ships	Hull Type	Model	# / Ship	Total # of Eng	Model Year	Power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Applic Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/eng	Annual Fuel Cons gal	Fuel Cons Rating	Proposed Decomm Year
22	Paxman	PC-1	PC 10	1	D	16RP200CM	4	4	1994	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 11	1	D	16RP200CM	4	4	1994	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 12	1	D	16RP200CM	4	4	1994	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 13	1	D	16RP200CM	4	4	1995	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 14	1	D	16RP200CM	4	4	1999	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 2	1	D	16RP200CM	4	4	1992	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 3	1	D	16RP200CM	4	4	1992	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 4	1	D	16RP200CM	4	4	1992	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 5	1	D	16RP200CM	4	4	1993	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 6	1	D	16RP200CM	4	4	1993	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 7	1	D	16RP200CM	4	4	1993	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 8	1	D	16RP200CM	4	4	1993	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
22	Paxman	PC-1	PC 9	1	D	16RP200CM	4	4	1994	3350 HP	1500	4	Turbo	Direct Injection	Lucas Bryce HP Distributor Pump	MPDE	10	C	10	5,866	23,464	2	2004
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 12	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2003
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 14	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2003
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 15	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2004
17	Caterpillar	PC-1	PC 10	1	D	3306B DITA	2	2	1994	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 11	1	D	3306B DITA	2	2	1994	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 12	1	D	3306B DITA	2	2	1994	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 13	1	D	3306B DITA	2	2	1995	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 14	1	D	3306B DITA	2	2	1999	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 2	1	D	3306B DITA	2	2	1992	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 3	1	D	3306B DITA	2	2	1992	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 4	1	D	3306B DITA	2	2	1992	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 5	1	D	3306B DITA	2	2	1993	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 6	1	D	3306B DITA	2	2	1993	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 7	1	D	3306B DITA	2	2	1993	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 8	1	D	3306B DITA	2	2	1993	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Caterpillar	PC-1	PC 9	1	D	3306B DITA	2	2	1994	150 kW	1800	4	Turbo	Direct Injection	HP Distributor Pump	SSDG	5	C	10	9,153	18,306	2	2004
17	Fairbanks Morse	CV-63	CV 64	1	D	10-38ND 8 1/8	3	3	1960	1440 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	6,298	18,894	2	2003
17	Fairbanks Morse	CV-63	CV 63	1	D	10-38ND 8 1/8	3	3	1960	1440 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	6,298	18,894	2	2008
17	Fairbanks Morse	SSBN-726	SSBN 726	1	D	12-38ND 8 1/8	1	1	1979	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2003
17	Fairbanks Morse	SSBN-726	SSBN 728	1	D	12-38ND 8 1/8	1	1	1981	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2003
17	Fairbanks Morse	SSBN-726	SSBN 727	1	D	12-38ND 8 1/8	1	1	1980	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2004
17	Fairbanks Morse	SSBN-726	SSBN 729	1	D	12-38ND 8 1/8	1	1	1982	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2004
17	Fairbanks Morse	SSN-688	SSN 698	1	D	8-38ND 8 1/8	1	1	1978	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2004
17	Fairbanks Morse	SSN-688	SSN 707	1	D	8-38ND 8 1/8	1	1	1982	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2005
12	Alco	LHA-1	LHA 3	1	D	16-251C	2	2	1977	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,353	18,706	2	2007
12	Detroit Diesel	LSD-36	LSD 36	1	D	12V-71	2	2	1968	300 BHP	1800	2	Blower	Unit Injection	Transfer Pump	EDG	5	S	5	1,022	2,044	2	2003
12	Detroit Diesel	LSD-36	LSD 37	1	D	12V-71	2	2	1969	300 BHP	1800	2	Blower	Unit Injection	Transfer Pump	EDG	5	S	5	1,022	2,044	2	2003
12	Detroit Diesel	LSD-36	LSD 39	1	D	12V-71	2	2	1971	300 BHP	1800	2	Blower	Unit Injection	Transfer Pump	EDG	5	S	5	1,022	2,044	2	2003
12	EMD	AOE-1	AOE 4	1	D	12-645E2	1	1	1969	1420 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	S	5	3,311	3,311	2	2006
12	EMD	AOE-1	AOE 1	1	D	16-567C	1	1	1963	1400 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	S	5	5,115	5,115	2	2007
12	EMD	AOE-1	AOE 2	1	D	16-567C	1	1	1965	1400 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	S	5	5,115	5,115	2	2007
12	Fairbanks Morse	LPD-4	LPD 5	1	D	6-38F 5 1/4	2	2	1964	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,600	3,200	2	2005
12	Fairbanks Morse	LPD-4	LPD 4	1	D	6-38F 5 1/4	2	2	1964	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,600	3,200	2	2006
12	Fairbanks Morse	LPD-4	LPD 6	1	D	6-38F 5 1/4	2	2	1965	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,600	3,200	2	2008
12	Fairbanks Morse	LPD-4	LPD 12	1	D	6-38F 5 1/4	2	2	1966	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,273	2,546	2	2007
12	Fairbanks Morse	LPD-4	LPD 10	1	D	6-38F 5 1/4	2	2	1966	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,273	2,546	2	2008
12	Fairbanks Morse	AOE-1	AOE 3	1	D	8-38D8-1/8	1	1	1968	1390 HP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	8,013	8,013	2	2006

U.S. NAVY SINGLE FUEL SHIPS DIESEL ENGINE MATRIX, SHIPS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2009 AND 2013

Overall Rating	Manufacturer	Class Ship	Ship	# of Ships	Hull Type	Model	# / Ship	Total # of Eng	Model Year	Power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Applic Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/eng	Annual Fuel Cons gal	Fuel Cons Rating	Proposed Decomm Year
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 8	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2010
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 28	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2012
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 29	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2012
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 32	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 33	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 36	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 37	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 39	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 42	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 60	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2013
17	Fairbanks Morse	CV-67	CV 67	1	D	12-38D 8 1/8	2	2	1967	2250 HP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	14,550	29,100	2	2013
17	Fairbanks Morse	SSN-688	SSN 688	1	D	8-38ND 8 1/8	1	1	1974	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2010
17	Fairbanks Morse	SSN-688	SSN 690	1	D	8-38ND 8 1/8	1	1	1974	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2011
17	Fairbanks Morse	SSN-688	SSN 691	1	D	8-38ND 8 1/8	1	1	1976	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2011
17	Fairbanks Morse	SSN-688	SSN 771	1	D	8-38ND 8 1/8	1	1	1994	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2012
17	Fairbanks Morse	SSN-688	SSN 714	1	D	8-38ND 8 1/8	1	1	1981	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2013
12	Alco	LHA-1	LHA 1	1	D	16-251C	2	2	1973	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,353	18,706	2	2012
12	Alco	LHA-1	LHA 2	1	D	16-251C	2	2	1974	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,353	18,706	2	2012
12	Detroit Diesel	LPD-4	LPD 14	1	D	12V-71T	2	2	1968	300 BHP	1800	2	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,062	2,124	2	2012
12	Fairbanks Morse	LCC-19	LCC 19	1	D	6-38D 8 1/8	2	2	1969	1059 HP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	3,813	7,626	2	2011
12	Fairbanks Morse	LPD-4	LPD 7	1	D	6-38F 5 1/4	2	2	1966	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,273	2,546	2	2009
12	Fairbanks Morse	LPD-4	LPD 8	1	D	6-38F 5 1/4	2	2	1966	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,273	2,546	2	2010
12	Fairbanks Morse	LPD-4	LPD 9	1	D	6-38F 5 1/4	2	2	1965	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,273	2,546	2	2012
9	Cummins	ARDM-4	ARDM 4	1	D	KTA-2300G	1	1	1977	1025 HP	1800	4	Turbo	Injection Nozzle	Cummins HP Injection Pump	EDG	5	N	2	1,000	1,000	2	2010
9	Fairbanks Morse	AGF-3	AGF 3	1	D	6-38F 5 1/4	2	2	1963	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	N	2	1,127	2,254	2	2010
9	Fairbanks Morse	AGF-11	AGF 11	1	D	6-38F 5 1/4	2	2	1966	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	N	2	771	1,542	2	2011

U.S. NAVY SINGLE FUEL SHIPS DIESEL ENGINE MATRIX, SHIPS SCHEDULED TO BE DECOMMISSIONED AFTER 2013																								
Overall Rating	Manufacturer	Class Ship	Ship	# of Ships	Hull Type	Model	# / Ship	Total # of Eng	Model Year	Power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Applic Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/eng	Annual Fuel Cons gal	Fuel Cons Rating	Proposed Decomm Year
21	Colt-Pielstick	LSD-41	LSD 41	1	D	16-PC2.5V-RR1	4	4	1983	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Transfer Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 42	1	D	16-PC2.5V-RR1	4	4	1984	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 43	1	D	16-PC2.5V-RR1	4	4	1986	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 44	1	D	16-PC2.5V-RR1	4	4	1987	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 45	1	D	16-PC2.5V-RR1	4	4	1988	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 46	1	D	16-PC2.5V-RR1	4	4	1988	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 47	1	D	16-PC2.5V-RR1	4	4	1989	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-41	LSD 48	1	D	16-PC2.5V-RR1	4	4	1989	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	264,781	1,059,124	6	>2020
21	Colt-Pielstick	LSD-49	LSD 49	1	D	16-PC2.5V-RR1	4	4	1993	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LSD-49	LSD 50	1	D	16-PC2.5V-RR1	4	4	1993	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LSD-49	LSD 51	1	D	16-PC2.5V-RR1	4	4	1994	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LSD-49	LSD 52	1	D	16-PC2.5V-RR1	4	4	1996	8500 HP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 17	1	D	PC2.5 STC	4	4	UC	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 18	1	D	PC2.5 STC	4	4	UC	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 19	1	D	PC2.5 STC	4	4	UC	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 20	1	D	PC2.5 STC	4	4	UC	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 21	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 22	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 23	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 24	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 25	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 26	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 27	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
21	Colt-Pielstick	LPD-17	LPD 28	1	D	PC2.5 STC	4	4	AU	10400 BHP	520	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	MPDE	10	S	5	326,161	1,304,644	6	>2020
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 38	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 40	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 41	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 43	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 45	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 46	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 47	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 49	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 61	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2014
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 51	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2015
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 55	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2015
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 56	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2016
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 48	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2017
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 50	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2017
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 52	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2017
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 53	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2017
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 54	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2017
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 57	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2018
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 58	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2018
19	Detroit Diesel (Stewart & Stevenson)	FFG-7	FFG 59	1	D	16V-149TI	4	4	1976-1988	1600 BHP	1800	2	Turbo	Unit Injection	Transfer Pump	SSDG	5	C	10	83,062	332,248	4	2018
17	Caterpillar	SSN-774	SSN 774	1	D	3512B DITA	1	1	UC	1000 ekW	1800	4	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Caterpillar	SSN-774	SSN 775	1	D	3512B DITA	1	1	UC	1000 ekW	1800	4	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Caterpillar	SSN-774	SSN 776	1	D	3512B DITA	1	1	UC	1000 ekW	1800	4	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Caterpillar	SSN-774	SSN 777	1	D	3512B DITA	1	1	UC	1000 ekW	1800	4	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	EMD	CVN-65	CVN 65	1	D	16-567C	4	4	1960	1490 HP	720	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	11,828	47,312	2	2014
17	EMD	CVN-68	CVN 68	1	D	16-LL16-645E4	4	4	1972	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	2020
17	EMD	CVN-68	CVN 69	1	D	16-LL16-645E4	4	4	1975	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 70	1	D	16-LL16-645E5N	4	4	1980	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 71	1	D	16-LL16-645E5N	4	4	1984	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 72	1	D	16-LL16-645E5N	4	4	1988	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 73	1	D	16-LL16-645E5N	4	4	1990	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 74	1	D	16-LL16-645E5N	4	4	1993	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 75	1	D	16-LL16-645E5N	4	4	1996	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 76	1	D	16-LL16-645E5N	4	4	2001	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020
17	EMD	CVN-68	CVN 77	1	D	16-LL16-645E5N	4	4	2003	2700 HP	900	2	Turbo	Unit Injection	Transfer Pump	EDG	5	C	10	21,165	84,660	2	>2020

U.S. NAVY SINGLE FUEL SHIPS DIESEL ENGINE MATRIX, SHIPS SCHEDULED TO BE DECOMMISSIONED AFTER 2013

Overall Rating	Manufacturer	Class Ship	Ship	# of Ships	Hull Type	Model	# / Ship	Total # of Eng	Model Year	Power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Applic Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/eng	Annual Fuel Cons gal	Fuel Cons Rating	Proposed Decomm Year
17	Fairbanks Morse	SSBN-726	SSBN 730	1	D	12-38ND 8 1/8	1	1	1983	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2014
17	Fairbanks Morse	SSBN-726	SSBN 731	1	D	12-38ND 8 1/8	1	1	1984	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2015
17	Fairbanks Morse	SSBN-726	SSBN 732	1	D	12-38ND 8 1/8	1	1	1985	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2016
17	Fairbanks Morse	SSBN-726	SSBN 733	1	D	12-38ND 8 1/8	1	1	1985	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2016
17	Fairbanks Morse	SSBN-726	SSBN 734	1	D	12-38ND 8 1/8	1	1	1986	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2019
17	Fairbanks Morse	SSBN-726	SSBN 735	1	D	12-38ND 8 1/8	1	1	1988	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2019
17	Fairbanks Morse	SSBN-726	SSBN 736	1	D	12-38ND 8 1/8	1	1	1989	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	2020
17	Fairbanks Morse	SSBN-726	SSBN 737	1	D	12-38ND 8 1/8	1	1	1990	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSBN-726	SSBN 738	1	D	12-38ND 8 1/8	1	1	1991	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSBN-726	SSBN 739	1	D	12-38ND 8 1/8	1	1	1992	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSBN-726	SSBN 740	1	D	12-38ND 8 1/8	1	1	1993	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSBN-726	SSBN 741	1	D	12-38ND 8 1/8	1	1	1994	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSBN-726	SSBN 742	1	D	12-38ND 8 1/8	1	1	1995	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSBN-726	SSBN 743	1	D	12-38ND 8 1/8	1	1	1996	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	12,600	12,600	2	>2020
17	Fairbanks Morse	SSN-688	SSN 708	1	D	8-38ND 8 1/8	1	1	1983	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2014
17	Fairbanks Morse	SSN-688	SSN 709	1	D	8-38ND 8 1/8	1	1	1983	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2014
17	Fairbanks Morse	SSN-688	SSN 716	1	D	8-38ND 8 1/8	1	1	1982	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2014
17	Fairbanks Morse	SSN-688	SSN 700	1	D	8-38ND 8 1/8	1	1	1979	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2015
17	Fairbanks Morse	SSN-688	SSN 710	1	D	8-38ND 8 1/8	1	1	1984	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2015
17	Fairbanks Morse	SSN-688	SSN 717	1	D	8-38ND 8 1/8	1	1	1983	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2015
17	Fairbanks Morse	SSN-688	SSN 718	1	D	8-38ND 8 1/8	1	1	1983	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2015
17	Fairbanks Morse	SSN-688	SSN 719	1	D	8-38ND 8 1/8	1	1	1984	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2015
17	Fairbanks Morse	SSN-688	SSN 720	1	D	8-38ND 8 1/8	1	1	1984	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2016
17	Fairbanks Morse	SSN-688	SSN 721	1	D	8-38ND 8 1/8	1	1	1984	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2016
17	Fairbanks Morse	SSN-688	SSN 722	1	D	8-38ND 8 1/8	1	1	1985	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2017
17	Fairbanks Morse	SSN-688	SSN 724	1	D	8-38ND 8 1/8	1	1	1985	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2017
17	Fairbanks Morse	SSN-688	SSN 725	1	D	8-38ND 8 1/8	1	1	1986	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2017
17	Fairbanks Morse	SSN-688	SSN 723	1	D	8-38ND 8 1/8	1	1	1985	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2018
17	Fairbanks Morse	SSN-688	SSN 751	1	D	8-38ND 8 1/8	1	1	1986	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2018
17	Fairbanks Morse	SSN-688	SSN 750	1	D	8-38ND 8 1/8	1	1	1986	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2019
17	Fairbanks Morse	SSN-688	SSN 752	1	D	8-38ND 8 1/8	1	1	1987	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2019
17	Fairbanks Morse	SSN-688	SSN 754	1	D	8-38ND 8 1/8	1	1	1988	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2019
17	Fairbanks Morse	SSN-688	SSN 711	1	D	8-38ND 8 1/8	1	1	1979	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2020
17	Fairbanks Morse	SSN-688	SSN 753	1	D	8-38ND 8 1/8	1	1	1987	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2020
17	Fairbanks Morse	SSN-688	SSN 755	1	D	8-38ND 8 1/8	1	1	1988	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	2020
17	Fairbanks Morse	SSN-688	SSN 699	1	D	8-38ND 8 1/8	1	1	1978	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 701	1	D	8-38ND 8 1/8	1	1	1979	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 705	1	D	8-38ND 8 1/8	1	1	1981	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 706	1	D	8-38ND 8 1/8	1	1	1982	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 713	1	D	8-38ND 8 1/8	1	1	1981	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 715	1	D	8-38ND 8 1/8	1	1	1982	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 756	1	D	8-38ND 8 1/8	1	1	1989	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 757	1	D	8-38ND 8 1/8	1	1	1990	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 758	1	D	8-38ND 8 1/8	1	1	1990	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 759	1	D	8-38ND 8 1/8	1	1	1990	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 760	1	D	8-38ND 8 1/8	1	1	1991	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 761	1	D	8-38ND 8 1/8	1	1	1992	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 762	1	D	8-38ND 8 1/8	1	1	1992	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 763	1	D	8-38ND 8 1/8	1	1	1992	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 764	1	D	8-38ND 8 1/8	1	1	1991	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 765	1	D	8-38ND 8 1/8	1	1	1991	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 766	1	D	8-38ND 8 1/8	1	1	1992	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 767	1	D	8-38ND 8 1/8	1	1	1992	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 768	1	D	8-38ND 8 1/8	1	1	1993	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 769	1	D	8-38ND 8 1/8	1	1	1993	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 770	1	D	8-38ND 8 1/8	1	1	1994	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 772	1	D	8-38ND 8 1/8	1	1	1994	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-688	SSN 773	1	D	8-38ND 8 1/8	1	1	1995	1207 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	8,460	8,460	2	>2020
17	Fairbanks Morse	SSN-21	SSN 21	1	D	8-38ND8-1/8	1	1	1995	1407 BHP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	14,550	14,550	2	>2020
17	Fairbanks Morse	SSN-21	SSN 22	1	D	8-38ND8-1/8	1	1	1997	1407 BHP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	14,550	14,550	2	>2020
17	Fairbanks Morse	SSN-21	SSN 23	1	D	8-38ND8-1/8	1	1	UC	1407 BHP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	C	10	14,550	14,550	2	>2020

U.S. NAVY SINGLE FUEL SHIPS DIESEL ENGINE MATRIX, SHIPS SCHEDULED TO BE DECOMMISSIONED AFTER 2013

Overall Rating	Manufacturer	Class Ship	Ship	# of Ships	Hull Type	Model	# / Ship	Total # of Eng	Model Year	Power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Applic Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/eng	Annual Fuel Cons gal	Fuel Cons Rating	Proposed Decomm Year
17	Isotta-Fraschini	MCM-1	MCM 10	1	D	36SS6V-AM	4	4	1990	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 11	1	D	36SS6V-AM	4	4	1991	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 12	1	D	36SS6V-AM	4	4	1991	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 13	1	D	36SS6V-AM	4	4	1992	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 14	1	D	36SS6V-AM	4	4	1993	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 4	1	D	36SS6V-AM	4	4	1989	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 7	1	D	36SS6V-AM	4	4	1990	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 8	1	D	36SS6V-AM	4	4	1989	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 9	1	D	36SS6V-AM	4	4	1990	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	>2020
17	Isotta-Fraschini	MCM-1	MCM 3	1	D	36SS6V-AM	4	4	1986	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	2018
17	Isotta-Fraschini	MCM-1	MCM 5	1	D	36SS6V-AM	4	4	1987	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	2020
17	Isotta-Fraschini	MCM-1	MCM 6	1	D	36SS6V-AM	4	4	1988	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	13,419	53,676	2	2020
17	Isotta-Fraschini	MHC-51	MHC 51	1	D	36SS8V-AM	2	2	1991	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 52	1	D	36SS8V-AM	2	2	1992	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 53	1	D	36SS8V-AM	2	2	1993	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 54	1	D	36SS8V-AM	2	2	1993	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 55	1	D	36SS8V-AM	2	2	1993	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 56	1	D	36SS8V-AM	2	2	1994	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 57	1	D	36SS8V-AM	2	2	1995	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 58	1	D	36SS8V-AM	2	2	1994	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 59	1	D	36SS8V-AM	2	2	1995	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 60	1	D	36SS8V-AM	2	2	1996	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 61	1	D	36SS8V-AM	2	2	1996	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Isotta-Fraschini	MHC-51	MHC 62	1	D	36SS8V-AM	2	2	1997	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	MPDE	10	S	5	15,456	30,912	2	>2020
17	Waukesha	MCM-1	MCM 1	1	D	L1616DSIN	4	4	1985	600 BHP	2000	4	Turbo	Unit Injection	Transfer Pump	MPDE	10	S	5	5,774	23,096	2	2017
17	Waukesha	MCM-1	MCM 2	1	D	L1616DSIN	4	4	1987	600 BHP	2000	4	Turbo	Unit Injection	Transfer Pump	MPDE	10	S	5	5,774	23,096	2	2019
16	Caterpillar	LPD-17	LPD 17	1	D	3608 DITA	5	5	UC	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 18	1	D	3608 DITA	5	5	UC	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 19	1	D	3608 DITA	5	5	UC	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 20	1	D	3608 DITA	5	5	UC	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 21	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 22	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 23	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 24	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 25	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 26	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 27	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	LPD-17	LPD 28	1	D	3608 DITA	5	5	AU	2500 ekW	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	104,721	523,605	6	>2020
16	Caterpillar	ARS-50	ARS 50	1	D	D-399B-TA	4	4	1983	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	MPDE	10	N	2	44,880	179,520	4	>2020
16	Caterpillar	ARS-50	ARS 51	1	D	D-399B-TA	4	4	1984	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	MPDE	10	N	2	44,880	179,520	4	>2020
16	Caterpillar	ARS-50	ARS 52	1	D	D-399B-TA	4	4	1984	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	MPDE	10	N	2	44,880	179,520	4	>2020
16	Caterpillar	ARS-50	ARS 53	1	D	D-399B-TA	4	4	1984	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	MPDE	10	N	2	44,880	179,520	4	>2020
14	Caterpillar	AOE-6	AOE 10	1	D	3606	5	5	1996	3485 HP	900	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	94,268	471,340	4	>2020
14	Detroit Diesel	AGSS-555	AGSS 555	1	D	12V-71	2	2	1968	380 BHP	2100	2	Blower	Unit Injection	Transfer Pump	MPDE	10	N	2	44,880	89,760	2	>2020
14	Fairbanks Morse	LSD-41	LSD 41	1	D	12-38ND 8 1/8	4	4	1983	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 42	1	D	12-38ND 8 1/8	4	4	1984	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 43	1	D	12-38ND 8 1/8	4	4	1986	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 44	1	D	12-38ND 8 1/8	4	4	1987	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 45	1	D	12-38ND 8 1/8	4	4	1988	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 46	1	D	12-38ND 8 1/8	4	4	1988	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 47	1	D	12-38ND 8 1/8	4	4	1989	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-41	LSD 48	1	D	12-38ND 8 1/8	4	4	1989	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	104,721	418,884	4	>2020
14	Fairbanks Morse	LSD-49	LSD 49	1	D	12-38ND 8 1/8	4	4	1993	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	119,380	477,520	4	>2020
14	Fairbanks Morse	LSD-49	LSD 50	1	D	12-38ND 8 1/8	4	4	1993	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	119,380	477,520	4	>2020
14	Fairbanks Morse	LSD-49	LSD 51	1	D	12-38ND 8 1/8	4	4	1994	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	119,380	477,520	4	>2020
14	Fairbanks Morse	LSD-49	LSD 52	1	D	12-38ND 8 1/8	4	4	1996	1837 HP	720	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	119,380	477,520	4	>2020
12	Alco	LHA-1	LHA 4	1	D	16-251C	2	2	1978	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,353	18,706	2	2014
12	Alco	LHA-1	LHA 5	1	D	16-251C	2	2	1978	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,353	18,706	2	2015
12	Alco	LHD-1	LHD 1	1	D	16-251C	2	2	1987	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 2	1	D	16-251C	2	2	1991	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 3	1	D	16-251C	2	2	1992	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 4	1	D	16-251C	2	2	1993	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 5	1	D	16-251C	2	2	1996	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 6	1	D	16-251C	2	2	1997	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 7	1	D	16-251C	2	2	2001	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020
12	Alco	LHD-1	LHD 8	1	D	16-251C	2	2	UC	2800 HP	900	4	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	9,088	18,176	2	>2020

U.S. NAVY SINGLE FUEL SHIPS DIESEL ENGINE MATRIX, SHIPS SCHEDULED TO BE DECOMMISSIONED AFTER 2013

Overall Rating	Manufacturer	Class Ship	Ship	# of Ships	Hull Type	Model	# / Ship	Total # of Eng	Model Year	Power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Applic Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/eng	Annual Fuel Cons gal	Fuel Cons Rating	Proposed Decomm Year
12	Detroit Diesel	LPD-4	LPD 15	1	D	12V-71T	2	2	1970	300 BHP	1800	2	Turbo	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,062	2,124	2	2014
12	Fairbanks Morse	LCC-19	LCC 20	1	D	6-38D 8 1/8	2	2	1970	1059 HP	900	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	SSDG	5	S	5	3,813	7,626	2	2015
12	Fairbanks Morse	LPD-4	LPD 13	1	D	6-38F 5 1/4	2	2	1967	428 HP	1200	2	Blower	Jerk Type Injection Nozzle	Bosch Ape Pump	EDG	5	S	5	1,273	2,546	2	2014
12	Isotta-Fraschini	MCM-1	MCM 10	1	D	36SS6V-AM	3	3	1990	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 11	1	D	36SS6V-AM	3	3	1991	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 12	1	D	36SS6V-AM	3	3	1991	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 13	1	D	36SS6V-AM	3	3	1992	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 14	1	D	36SS6V-AM	3	3	1993	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 4	1	D	36SS6V-AM	3	3	1989	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 7	1	D	36SS6V-AM	3	3	1990	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 8	1	D	36SS6V-AM	3	3	1989	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 9	1	D	36SS6V-AM	3	3	1990	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	>2020
12	Isotta-Fraschini	MCM-1	MCM 3	1	D	36SS6V-AM	3	3	1986	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	2018
12	Isotta-Fraschini	MCM-1	MCM 5	1	D	36SS6V-AM	3	3	1987	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	2020
12	Isotta-Fraschini	MCM-1	MCM 6	1	D	36SS6V-AM	3	3	1988	600 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	17,061	51,183	2	2020
12	Isotta-Fraschini	MHC-51	MHC 51	1	D	36SS8V-AM	3	3	1991	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 52	1	D	36SS8V-AM	3	3	1992	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 53	1	D	36SS8V-AM	3	3	1993	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 54	1	D	36SS8V-AM	3	3	1993	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 55	1	D	36SS8V-AM	3	3	1993	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 56	1	D	36SS8V-AM	3	3	1994	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 57	1	D	36SS8V-AM	3	3	1995	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 58	1	D	36SS8V-AM	3	3	1994	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 59	1	D	36SS8V-AM	3	3	1995	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 60	1	D	36SS8V-AM	3	3	1996	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 61	1	D	36SS8V-AM	3	3	1996	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Isotta-Fraschini	MHC-51	MHC 62	1	D	36SS8V-AM	3	3	1997	800 BHP	1800	4	Turbo	Direct Injection	Bosh HP Distributor Pump	SSDG	5	S	5	9,461	28,383	2	>2020
12	Waukesha	MCM-1	MCM 1	1	D	L1616DSIN	3	3	1985	600 BHP	2000	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	7,589	22,767	2	2017
12	Waukesha	MCM-1	MCM 2	1	D	L1616DSIN	3	3	1987	600 BHP	2000	4	Turbo	Unit Injection	Transfer Pump	SSDG	5	S	5	7,589	22,767	2	2019
11	Caterpillar	ARS-50	ARS 50	1	D	D-399B-TA	3	3	1983	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	SSDG	5	N	2	41,880	125,640	4	>2020
11	Caterpillar	ARS-50	ARS 51	1	D	D-399B-TA	3	3	1984	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	SSDG	5	N	2	41,880	125,640	4	>2020
11	Caterpillar	ARS-50	ARS 52	1	D	D-399B-TA	3	3	1984	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	SSDG	5	N	2	41,880	125,640	4	>2020
11	Caterpillar	ARS-50	ARS 53	1	D	D-399B-TA	3	3	1984	1125 BHP	1225	4	Turbo	INDirect Injection	Individual Type Pump	SSDG	5	N	2	41,880	125,640	4	>2020
9	Caterpillar	AFDM-10	AFDM 10	1	D	D-399	4	4	1945	1100 BHP	1200	4	NA	INDirect Injection	Individual Type Pump	EDG	5	N	2	1,000	4,000	2	>2020

Total Annual Fuel Consumption: 58,258,562
Total Annual Fuel Consumption (ships scheduled to be decommissioned between 2003 and 2008): 1,705,946
Total Annual Fuel Consumption (ships scheduled to be decommissioned between 2009 and 2013): 3,453,476
Total Annual Fuel Consumption (ships scheduled to be decommissioned after 2013): 53,099,140

The following variables make up the overall rating.

Engine Application

If the engine application is MPDE for a planing vessel it scores 20 and for a displacement vessel it scored 10.
If the engine application is either SSDG or EDG it scored 5,

Combat Criticality

If the vessel is a combatant it scored 10,
If the vessel is combatant support it scored 5,
If the vessel is a noncombatant it scored 2.

Annual Fuel Consumption

If the vessel's annual fuel consumption is greater than 500,000 it scored 6,
If the vessel's annual fuel consumption is between 100,000 and 500,000 it scored 4,
If the vessel's annual fuel consumption is less than 100,000 gallons it scored 2.

ENCLOSURE (2)

U.S. NAVY SINGLE FUEL CRAFT DIESEL ENGINE MATRIX

Overall Rating	Manufacturer	Class	Craft	# of Craft	Hull Type	Hull Material	Model	# Eng / Craft	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA/Turb/Blower Scavenged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
21	Cummins	YTT 9	YTT 10	1	D	Metal	KTA50-M	1	1	1989	1250 HP	1800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	61,652	123,305	6	TBD
21	Cummins	YTT 9	YTT 11	1	D	Metal	KTA50-M	1	1	1989	1250 HP	1800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	61,652	123,305	6	TBD
19	Detroit Diesel	YP 676	YP 680	1	D	Wood	12V-71 7122-3001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 681	1	D	Wood	12V-71 7122-3001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 682	1	D	Wood	12V-71 7122-3001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 683	1	D	Wood	12V-71 7122-3001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 684	1	D	Wood	12V-71 7122-3001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 685	1	D	Wood	12V-71 7122-3001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 686	1	D	Wood	12V-71 7122-3001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 687	1	D	Wood	12V-71 7122-3001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 688	1	D	Wood	12V-71 7122-3001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 689	1	D	Wood	12V-71 7122-3001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 690	1	D	Wood	12V-71 7122-3001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 691	1	D	Wood	12V-71 7122-3001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 692	1	D	Wood	12V-71 7122-3001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 694	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 695	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 697	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 698	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 700	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 701	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 654	YP 663	1	D	Wood	12V-71 7122-7000	2	2	1957	340 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	54,356	4	TBD
19	Detroit Diesel	YP 654	YP 665	1	D	Wood	12V-71 7122-7000	2	2	1959	340 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	54,356	4	TBD
19	Detroit Diesel	YP 676	YP 680	1	D	Wood	12V-71 7122-7001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 681	1	D	Wood	12V-71 7122-7001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 682	1	D	Wood	12V-71 7122-7001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 683	1	D	Wood	12V-71 7122-7001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 684	1	D	Wood	12V-71 7122-7001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 685	1	D	Wood	12V-71 7122-7001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 686	1	D	Wood	12V-71 7122-7001	1	1	1985	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 687	1	D	Wood	12V-71 7122-7001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 688	1	D	Wood	12V-71 7122-7001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 689	1	D	Wood	12V-71 7122-7001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 690	1	D	Wood	12V-71 7122-7001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 691	1	D	Wood	12V-71 7122-7001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 692	1	D	Wood	12V-71 7122-7001	1	1	1986	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 694	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 695	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 697	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 698	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 700	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
19	Detroit Diesel	YP 676	YP 701	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	27,178	27,178	4	TBD
18	Detroit Diesel	YFB 92	YFB 92	1	D	Metal	12V-71	2	2	1994	350 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	62,700	250,800	6	TBD
18	Detroit Diesel	YFB 92	YFB 93	1	D	Metal	12V-71	2	2	1994	350 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	62,700	250,800	6	TBD
18	Detroit Diesel	IX 533	IX 533 (EX YD 222)	1	D	Metal	12V-71 7122-3000	2	2	1954	400 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	50,490	201,960	6	TBD
18	Fairbanks Morse	YTB 760	YTB 763	1	D	Metal	38D8-1/8	1	1	1962	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	278,400	6	TBD
18	Fairbanks Morse	YTB 760	YTB 771	1	D	Metal	38D8-1/8	1	1	1963	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	55,680	6	TBD
18	Fairbanks Morse	YTB 760	YTB 779	1	D	Metal	38D8-1/8	1	1	1964	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	167,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 781	1	D	Metal	38D8-1/8	1	1	1964	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	167,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 782	1	D	Metal	38D8-1/8	1	1	1965	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	278,400	6	TBD
18	Fairbanks Morse	YTB 760	YTB 787	1	D	Metal	38D8-1/8	1	1	1965	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	278,400	6	TBD
18	Fairbanks Morse	YTB 760	YTB 789	1	D	Metal	38D8-1/8	1	1	1966	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 796	1	D	Metal	38D8-1/8	1	1	1968	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	111,360	6	TBD
18	Fairbanks Morse	YTB 760	YTB 797	1	D	Metal	38D8-1/8	1	1	1968	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	111,360	6	TBD
18	Fairbanks Morse	YTB 760	YTB 798	1	D	Metal	38D8-1/8	1	1	1968	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	278,400	6	TBD
18	Fairbanks Morse	YTB 760	YTB 806	1	D	Metal	38D8-1/8	1	1	1969	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	167,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 807	1	D	Metal	38D8-1/8	1	1	1969	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	278,400	6	TBD
18	Fairbanks Morse	YTB 760	YTB 808	1	D	Metal	38D8-1/8	1	1	1969	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	167,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 812	1	D	Metal	38D8-1/8	1	1	1971	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	167,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 813	1	D	Metal	38D8-1/8	1	1	1971	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	55,680	167,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 814	1	D	Metal	38D8-1/8	1	1	1971	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	119,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 815	1	D	Metal	38D8-1/8	1	1	1971	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	119,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 820	1	D	Metal	38D8-1/8	1	1	1972	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 823	1	D	Metal	38D8-1/8	1	1	1973	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 824	1	D	Metal	38D8-1/8	1	1	1973	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 828	1	D	Metal	38D8-1/8	1	1	1973	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 831	1	D	Metal	38D8-1/8	1	1	1974	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 834	1	D	Metal	38D8-1/8	1	1	1974	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	119,040	6	TBD
18	Fairbanks Morse	YTB 760	YTB 835	1	D	Metal	38D8-1/8	1	1	1974	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
18	Fairbanks Morse	YTB 760	YTB 836	1	D	Metal	38D8-1/8	1	1	1974	2000 HP	850	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	59,520	238,080	6	TBD
16	Cummins	YTT 9	YTT 10	1	D	Metal	VTA28	3	3	1989	805 HP	1800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	SSDG	5	S	5	40,537	243,223	6	TBD
16	Cummins	YTT 9	YTT 11	1	D	Metal	VTA28	3	3	1989	805 HP	1800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	SSDG	5	S	5	40,537	243,223	6	TBD
16	Detroit Diesel	YDT 17	YDT 17	1	D	Metal	12V-71	2	2	1998	450 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	20,520	82,080	4	TBD
16	Detroit Diesel	YDT 17	YDT 18	1	D	Metal	12V-71	2	2	1998	450 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	20,520	82,080	4	TBD
16	Detroit Diesel	IX 531	IX 531 (EX YP 679)	1	D	Wood	12V-71 7122-3001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	25,536	51,072	4	TBD
16	Detroit Diesel	IX 531	IX 531 (EX YP 679)	1	D	Wood	12V-71 7122-7001	1	1	1984	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	25,536	51,072	4	TBD
16	Detroit Diesel	IX 514	IX 514 (EX YFU 79)	1	D	Metal	6-71	2	2	1967	174 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	10,010	20,021	4	TBD
16	Detroit Diesel	YFU 71	YFU 81	1	D	Metal	6-71	2	2	1968	174 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	MPDE	10	N	2	10,010	20,021	4	TBD
14	Detroit Diesel	YP 676	YP 702	1	D	Wood	12V-71 7122-3001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	5	S	5	25,536	153,216	4	TBD
14	Detroit Diesel	YP 676	YP 702	1	D	Wood	12V-71 7122-7001	1	1	1987	437 HP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	5	S	5	25,536	153,216	4	TBD
14	Detroit Diesel	YP 654	YP 663	1	D	Wood	3-71	1	1	1957	40 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	SSDG	5	S	5	27,178	27,178	4	TBD
14	Detroit Diesel	YP 654	YP 665	1	D	Wood	3-71	1	1	1959	40 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	SSDG	5	S	5	27,178	27,178	4	TBD
14	Fairbanks Morse	IX 517	IX 517 (EX AGOR 9)	1	D	Metal	38D8-1/8	2	2	1963	526 HP	600	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	2,400	4,800	2	TBD
14	Fairbanks Morse	IX 529	IX 529	1	D	Metal	38D8-1/8	2	2	1982	562 HP	600	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	MPDE	10	N	2	2,400	4,800	2	TBD
12	Detroit Diesel	YP 676	YP 680	1	D	Wood	3-71	2	2	1984	67 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	11,492	2	TBD
12	Detroit Diesel	YP 676	YP 681	1	D	Wood	3-71	2	2	1984	67 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	11,492	2	TBD
12	Detroit Diesel	YP 676	YP 682	1	D	Wood	3-71	2	2	1984	67 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 683	1	D	Wood	3-71	2	2	1985	67 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	11,492	2	TBD

U.S. Navy Single Fuel Craft Diesel Engine Matrix

Overall Rating	Manufacturer	Class	Craft	# of Craft	Hull Type	Hull Material	Model	# Eng / Craft	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA/Turb/Blower Scavenged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
12	Detroit Diesel	YP 676	YP 684	1	D	Wood	3-71	2	2	1965	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	11,492	2	TBD
12	Detroit Diesel	YP 676	YP 685	1	D	Wood	3-71	2	2	1965	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	11,492	2	TBD
12	Detroit Diesel	YP 676	YP 686	1	D	Wood	3-71	2	2	1965	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	11,492	2	TBD
12	Detroit Diesel	YP 676	YP 687	1	D	Wood	3-71	2	2	1966	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 688	1	D	Wood	3-71	2	2	1966	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 689	1	D	Wood	3-71	2	2	1966	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 690	1	D	Wood	3-71	2	2	1966	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 691	1	D	Wood	3-71	2	2	1966	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 692	1	D	Wood	3-71	2	2	1966	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 694	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 695	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 697	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	22,982	2	TBD
12	Detroit Diesel	YP 676	YP 698	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 700	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	218,333	2	TBD
12	Detroit Diesel	YP 676	YP 701	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	22,982	2	TBD
12	Detroit Diesel	YP 676	YP 702	1	D	Wood	3-71	2	2	1967	67 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	S	5	5,746	34,474	2	TBD
11	Detroit Diesel	IX 533	IX 533 (EX YD 222)	1	D	Metal	2-71 P2 2055	4	4	1954	67 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	15,840	126,720	4	TBD
11	Detroit Diesel	YFB 92	YFB 92	1	D	Metal	4-71	2	2	1994	100 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	25,080	100,320	4	TBD
11	Detroit Diesel	YFB 92	YFB 93	1	D	Metal	4-71	2	2	1994	100 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	25,080	100,320	4	TBD
11	Detroit Diesel	YTB 760	YTB 763	1	D	Metal	6-71	2	2	1962	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	111,360	4	TBD
11	Detroit Diesel	YTB 760	YTB 771	1	D	Metal	6-71	2	2	1963	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	22,272	4	TBD
11	Detroit Diesel	YTB 760	YTB 779	1	D	Metal	6-71	2	2	1964	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	66,816	4	TBD
11	Detroit Diesel	YTB 760	YTB 781	1	D	Metal	6-71	2	2	1964	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	66,816	4	TBD
11	Detroit Diesel	YTB 760	YTB 782	1	D	Metal	6-71	2	2	1965	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	111,360	4	TBD
11	Detroit Diesel	YTB 760	YTB 787	1	D	Metal	6-71	2	2	1965	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	111,360	4	TBD
11	Detroit Diesel	YTB 760	YTB 796	1	D	Metal	6-71	2	2	1968	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	44,544	4	TBD
11	Detroit Diesel	YTB 760	YTB 797	1	D	Metal	6-71	2	2	1968	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	44,544	4	TBD
11	Detroit Diesel	YTB 760	YTB 798	1	D	Metal	6-71	2	2	1968	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	111,360	4	TBD
11	Detroit Diesel	YTB 760	YTB 806	1	D	Metal	6-71	2	2	1969	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	66,816	4	TBD
11	Detroit Diesel	YTB 760	YTB 807	1	D	Metal	6-71	2	2	1969	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	111,360	4	TBD
11	Detroit Diesel	YTB 760	YTB 808	1	D	Metal	6-71	2	2	1969	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	66,816	4	TBD
11	Detroit Diesel	YTB 760	YTB 812	1	D	Metal	6-71	2	2	1971	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	66,816	4	TBD
11	Detroit Diesel	YTB 760	YTB 813	1	D	Metal	6-71	2	2	1971	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	11,136	66,816	4	TBD
9	Detroit Diesel	IX 531	IX 531 (EX YP 679)	1	D	Wood	3-71	2	2	1964	67 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	5,746	11,491	2	TBD
9	Detroit Diesel	IX 514	IX 514 (EX YFU 79)	1	D	Metal	3-71RC 1033-7005	2	2	1967	54 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	5,263	10,526	2	TBD
9	Detroit Diesel	YFU 71	YFU 81	1	D	Metal	3-71RC 1033-7005	2	2	1968	54 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	5,263	10,526	2	TBD
9	Detroit Diesel	YTB 760	YTB 789	1	D	Metal	4-71	2	2	1966	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 814	1	D	Metal	4-71	2	2	1971	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	29,760	2	TBD
9	Detroit Diesel	YTB 760	YTB 815	1	D	Metal	4-71	2	2	1971	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	29,760	2	TBD
9	Detroit Diesel	YTB 760	YTB 820	1	D	Metal	4-71	2	2	1972	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 823	1	D	Metal	4-71	2	2	1973	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 824	1	D	Metal	4-71	2	2	1973	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 828	1	D	Metal	4-71	2	2	1973	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 831	1	D	Metal	4-71	2	2	1974	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 834	1	D	Metal	4-71	2	2	1974	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	29,760	2	TBD
9	Detroit Diesel	YTB 760	YTB 835	1	D	Metal	4-71	2	2	1974	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YTB 760	YTB 836	1	D	Metal	4-71	2	2	1974	80 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	SSDG	5	N	2	7,440	59,520	2	TBD
9	Detroit Diesel	YDT 17	YDT 17	1	D	Metal	6-71	2	2	1998	134 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	6,635	26,539	2	TBD
9	Detroit Diesel	YDT 17	YDT 18	1	D	Metal	6-71	2	2	1998	134 HP	1800	2	Blower Scavenged	Unit Injection	Transfer pump	SSDG	5	N	2	6,635	26,539	2	TBD
9	Fairbanks Morse	IX 517	IX 517 (EX AGOR 9)	1	D	Metal	38F5-1/4	2	2	1963	402 HP	1200	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	SSDG	5	N	2	1,050	2,100	2	TBD
9	Fairbanks Morse	IX 529	IX 529	1	D	Metal	38F5-1/4	2	2	1962	402 HP	1200	2	Blower Scavenged	Jerk Type Injection Nozzle	Bosch APE Pump	SSDG	5	N	2	1,050	2,100	2	TBD
				139					211															

Total Annual Fuel Consumption (Gallons):	12,791,955
Total Annual Fuel Consumption (craft scheduled to be decommissioned between 2003 and 2008):	TBD
Total Annual Fuel Consumption (craft scheduled to be decommissioned between 2009 and 2013):	TBD
Total Annual Fuel Consumption (craft scheduled to be decommissioned after 2013):	TBD

The following variables make up the overall rating.

Engine Application

If the engine application is MPDE for a planing vessel it scores 20 and for a displacement vessel it scored 10.

If the engine application is either SSDG or EDG it scored 5,

Combat Criticality

If the vessel is a combatant it scored 10,

If the vessel is combatant support it scored 5,

If the vessel is a noncombatant it scored 2.

Annual Fuel Consumption

If the vessel's annual fuel consumption is greater than 30,000 gallons it scored 6,

If the vessel's annual fuel consumption is between 10,000 and 30,000 gallons it scored 4,

If the vessel's annual fuel consumption is less than 10,000 gallons it scored 2.

ENCLOSURE (3)

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat Is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavanged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
32	Detroit Diesel	33' PB	Metal		2	P	6088M	1	2	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,378	8,756	2	2006
32	Detroit Diesel	31' PBR	GRP		23	P	6V-53	1	23	1970	220 BHP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	6,144	141,312	2	1980
32	Detroit Diesel	36' LCP(L)	GRP	LCC 19	2	P	8V-71 7082-3000	1	2	1967	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1977
32	Detroit Diesel	36' LCP(L)	GRP	LPD 10	2	P	8V-71 7082-3000	1	2	1981	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1991
32	Detroit Diesel	36' LCP(L)	GRP	LHA 3	1	P	8V-71 7082-3000	1	1	1984	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1994
32	Detroit Diesel	36' LCP(L)	GRP	LPD 5	1	P	8V-71 7082-3000	1	1	1984	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1994
32	Detroit Diesel	36' LCP(L)	GRP	LPD 9	2	P	8V-71 7082-3000	1	2	1984	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1994
32	Detroit Diesel	36' LCP(L)	GRP	LSD 39	1	P	8V-71 7082-3000	1	1	1984	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1994
32	Detroit Diesel	36' LCP(L)	GRP	LHA 1	2	P	8V-71 7082-3000	1	2	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LHA 2	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LHA 3	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LHA 4	2	P	8V-71 7082-3000	1	2	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LHA 5	2	P	8V-71 7082-3000	1	2	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LHD 1	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LPD 15	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LPD 6	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LPD 7	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LPD 8	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LPD 8	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LSD 42	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LSD 43	1	P	8V-71 7082-3000	1	1	1985	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1995
32	Detroit Diesel	36' LCP(L)	GRP	LCC 20	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LHA 2	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 12	2	P	8V-71 7082-3000	1	2	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 14	2	P	8V-71 7082-3000	1	2	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 15	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 5	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 6	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 7	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 8	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LPD 8	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LSD 39	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LSD 42	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LSD 43	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LSD 47	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LSD 48	1	P	8V-71 7082-3000	1	1	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LSD 51	2	P	8V-71 7082-3000	1	2	1986	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1996
32	Detroit Diesel	36' LCP(L)	GRP	LHD 2	1	P	8V-71 7082-3000	1	1	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LPD 4	2	P	8V-71 7082-3000	1	2	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LSD 41	2	P	8V-71 7082-3000	1	2	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LSD 44	2	P	8V-71 7082-3000	1	2	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LSD 45	2	P	8V-71 7082-3000	1	2	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	9,048	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LSD 47	1	P	8V-71 7082-3000	1	1	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LSD 48	1	P	8V-71 7082-3000	1	1	1987	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	1997
32	Detroit Diesel	36' LCP(L)	GRP	LSD 49	1	P	8V-71 7082-3000	1	1	1990	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	2000
32	Detroit Diesel	36' LCP(L)	GRP		18	P	8V-71 7082-3000	1	18	1990	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	81,432	2	2000
32	Detroit Diesel	36' LCP(L)	GRP	LHD 3	1	P	8V-71 7082-3000	1	1	1991	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	2001
32	Detroit Diesel	36' LCP(L)	GRP	LHD 4	1	P	8V-71 7082-3000	1	1	1991	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	2001
32	Detroit Diesel	36' LCP(L)	GRP	LSD 49	1	P	8V-71 7082-3000	1	1	1991	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	C	10	4,524	4,524	2	2001
32	Detroit Diesel	65' PB	Metal		64	P	8V-71TI	1	64	1979	600 BHP	2300	2	Turbo	Unit Injection	Transfer Pump	MPDE	20	C	10	3,082	197,248	2	1994
28	Detroit Diesel	65' TWR	Metal		2	P	12V-71	2	4	1968	450 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	89,741	358,963	6	1983
28	Detroit Diesel	72' TWR	Wood		2	P	12V-71	2	4	1966	450 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	89,741	358,963	6	1981
28	Detroit Diesel	85' TWR	Metal		2	P	12V-71	2	4	1977	450 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	89,741	358,963	6	1992
27	Cummins	20' RX	GRP	PC 11	1	P	6BT5.9M	1	1	1992	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2002
27	Cummins	20' RX	GRP	PC 3	1	P	6BT5.9M	1	1	1992	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2002
27	Cummins	20' RX	GRP	PC 7	1	P	6BT5.9M	1	1	1992	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2002
27	Cummins	20' RX	GRP	PC 10	1	P	6BT5.9M	1	1	1993	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2003
27	Cummins	20' RX	GRP	PC 5	1	P	6BT5.9M	1	1	1993	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2003
27	Cummins	20' RX	GRP	PC 6	1	P	6BT5.9M	1	1	1993	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2003
27	Cummins	24' RX	GRP	PC 13	1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2006
27	Cummins	24' RX	GRP	PC 2	1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2006
27	Cummins	24' RX	GRP	PC 4	1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2006
27	Cummins	24' RX	GRP	PC 8	1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2006
27	Cummins	24' RX	GRP	PC 9	1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2006
27	Cummins	24' RX	GRP	PC 14	1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2006
27	Cummins	7M RIB	GRP	CG 50	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	CG 59	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	CG 60	2	P	6BT5.9M	1	2	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2004
27	Cummins	7M RIB	GRP	CG 62	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	CG 63	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	CG 65	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	DDG 59	2	P	6BT5.9M	1	2	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2004
27	Cummins	7M RIB	GRP	DDG 61	2	P	6BT5.9M	1	2	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2004
27	Cummins	7M RIB	GRP	DDG 62	2	P	6BT5.9M	1	2	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2004
27	Cummins	7M RIB	GRP	DDG 67	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	LSD 46	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2004
27	Cummins	7M RIB	GRP	CG 49	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	CG 52	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	CG 53	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	CG 54	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	CG 73	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	DD 963	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	DD 967	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DD 965	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavanged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
27	Cummins	7M RIB	GRP	DDG 52	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	DDG 63	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 64	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 65	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 66	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 67	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	DDG 68	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 69	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 70	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	DDG 71	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 72	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 73	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 74	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	DDG 75	2	P	6BT5.9M	1	2	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2005
27	Cummins	7M RIB	GRP	LHD 1	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	LHD 5	1	P	6BT5.9M	1	1	1995	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2005
27	Cummins	7M RIB	GRP	CG 70	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	CV 63	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	CVN 65	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	CVN 68	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	CVN 70	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	CVN 73	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	DDG 51	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	DDG 76	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	LHD 6	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	LPD 10	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	LPD 12	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	LPD 14	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	LPD 4	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	LPD 7	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2006
27	Cummins	7M RIB	GRP	LPD 8	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2006
27	Cummins	7M RIB	GRP	CG 64	1	P	6BT5.9M	1	1	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2007
27	Cummins	7M RIB	GRP	CVN 71	2	P	6BT5.9M	1	2	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2007
27	Cummins	7M RIB	GRP	CVN 75	1	P	6BT5.9M	1	1	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2007
27	Cummins	7M RIB	GRP	DDG 77	2	P	6BT5.9M	1	2	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2007
27	Cummins	7M RIB	GRP	DDG 78	2	P	6BT5.9M	1	2	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2007
27	Cummins	7M RIB	GRP	LPD 13	1	P	6BT5.9M	1	1	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2007
27	Cummins	7M RIB	GRP	LPD 15	1	P	6BT5.9M	1	1	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2007
27	Cummins	7M RIB	GRP	LPD 5	1	P	6BT5.9M	1	1	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2007
27	Cummins	7M RIB	GRP	LPD 9	1	P	6BT5.9M	1	1	1997	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2007
27	Cummins	7M RIB	GRP	CVN 74	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DD 975	1	P	6BT5.9M	1	1	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2008
27	Cummins	7M RIB	GRP	DD 985	1	P	6BT5.9M	1	1	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2008
27	Cummins	7M RIB	GRP	DDG 70	1	P	6BT5.9M	1	1	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2008
27	Cummins	7M RIB	GRP	DDG 79	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DDG 80	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DDG 81	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DDG 82	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DDG 83	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DDG 84	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	DDG 85	4	P	6BT5.9M	1	4	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	5,760	2	2008
27	Cummins	7M RIB	GRP	DDG 86	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2008
27	Cummins	7M RIB	GRP	LHD 7	1	P	6BT5.9M	1	1	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2008
27	Cummins	8M PE	GRP	CG 70	1	P	6BT5.9M	1	1	1994	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2004
27	Cummins	8M PE	GRP	CG 49	1	P	6BT5.9M	1	1	1995	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2005
27	Cummins	10M PE	GRP	CVN 76	1	P	6BTA5.9M2	1	1	1994	214 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,656	1,656	2	2004
27	Cummins	12M PE	GRP	CVN 65	2	P	6BTA5.9M2	1	2	1993	220 BHP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,656	3,312	2	2003
27	Cummins	7M RIB	GRP	FFG 28	1	P	6BTA5.9M2	1	1	1994	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2004
27	Cummins	7M RIB	GRP	FFG 33	1	P	6BTA5.9M2	1	1	1994	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2004
27	Cummins	7M RIB	GRP	FFG 45	1	P	6BTA5.9M2	1	1	1994	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2004
27	Cummins	7M RIB	GRP	FFG 47	1	P	6BTA5.9M2	1	1	1994	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2004
27	Cummins	7M RIB	GRP	FFG 59	1	P	6BTA5.9M2	1	1	1994	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2004
27	Cummins	7M RIB	GRP	FFG 8	1	P	6BTA5.9M2	1	1	1994	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2004
27	Cummins	7M RIB	GRP	FFG 54	1	P	6BTA5.9M2	1	1	1995	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2005
27	Cummins	7M RIB	GRP	FFG 55	1	P	6BTA5.9M2	1	1	1995	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2005
27	Cummins	7M RIB	GRP	FFG 49	1	P	6BTA5.9M2	1	1	1996	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2006
27	Cummins	7M RIB	GRP	FFG 56	1	P	6BTA5.9M2	1	1	1996	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2006
27	Cummins	7M RIB	GRP	FFG 61	1	P	6BTA5.9M2	1	1	1996	220 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	828	828	2	2006
27	Detroit Diesel	33' PE	GRP	CV 63	1	P	6088M	1	1	1967	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	1977
27	Detroit Diesel	33' PE	GRP	LCC 19	1	P	6088M	1	1	1967	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	1977
27	Detroit Diesel	33' PE	GRP	CVN 72	1	P	6088M	1	1	1988	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	1998
27	Detroit Diesel	33' PE	GRP	CVN 74	1	P	6088M	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	2001
27	Detroit Diesel	33' PE	GRP	CVN 75	1	P	6088M	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	2001
27	Detroit Diesel	26' PE	GRP	CG 47	1	P	6-71	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,704	1,704	2	2001
27	Detroit Diesel	26' PE	GRP	CG 68	1	P	6-71	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,704	1,704	2	2001
27	Detroit Diesel	40' PE	GRP	CVN 70	1	P	6-71	1	1	1976	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	1986
27	Detroit Diesel	40' PE	GRP	CVN 69	2	P	6-71	1	2	1986	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	3,648	2	1996
27	Detroit Diesel	40' PE	GRP	CVN 71	2	P	6-71	1	2	1986	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	3,648	2	1996
27	Detroit Diesel	40' PE	GRP	CV 67	1	P	6-71	1	1	1988	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	1998
27	Detroit Diesel	40' PE	GRP	CVN 68	1	P	6-71	1	1	1988	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	1998
27	Detroit Diesel	40' PE	GRP	CVN 75	1	P	6-71	1	1	1992	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	1,824	1,824	2	2002
27	Detroit Diesel	11M PL	GRP	LSD 50	2	P	8V-71 7082-3000	1	2	1993	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	4,524	9,048	2	2003
27	Detroit Diesel	11M PL	GRP	LHD 5	1	P	8V-71 7082-3000	1	1	1994	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	4,524	4,524	2	2004
27	Detroit Diesel	11M PL	GRP	LHD 6	1	P	8V-71 7082-3000	1	1	1994	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	S	5	4,524	4,524	2	2004

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavenged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
27	Detroit Diesel	11M PL	GRP	LHD 7	1	P	8V-71 7082-3000	1	1	1994	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	4,524	4,524	2	2004
27	Detroit Diesel	11M PL	GRP	LPD 13	2	P	8V-71 7082-3000	1	2	1994	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	4,524	9,048	2	2004
27	Detroit Diesel	11M PL	GRP	LSD 52	2	P	8V-71 7082-3000	1	2	1994	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	4,524	9,048	2	2004
27	Gray Marine	24' RIB	GRP	FFG 40	1	P	64HN9	1	1	1992	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2002
27	Gray Marine	24' RIB	GRP	FFG 43	1	P	64HN9	1	1	1992	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2002
27	Gray Marine	24' RIB	GRP	FFG 29	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 32	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 36	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 38	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 39	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 41	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 42	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 46	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 48	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 50	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 51	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 52	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 57	2	P	64HN9	1	2	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	864	2	2003
27	Gray Marine	24' RIB	GRP	FFG 58	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 60	1	P	64HN9	1	1	1993	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2003
27	Gray Marine	24' RIB	GRP	FFG 37	1	P	64HN9	1	1	1994	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2004
27	Gray Marine	24' RIB	GRP	FFG 53	1	P	64HN9	1	1	1994	225 BHP	2100	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	S	5	432	432	2	2004
27	Volvo Penta	24' RIB	GRP	CG 69	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2001
27	Volvo Penta	24' RIB	GRP	CG 72	2	P	AQAD41A	1	2	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2001
27	Volvo Penta	24' RIB	GRP	DD 988	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2001
27	Volvo Penta	24' RIB	GRP	DDG 52	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2001
27	Volvo Penta	24' RIB	GRP	DDG 55	2	P	AQAD41A	1	2	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2001
27	Volvo Penta	24' RIB	GRP	LHD 2	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2001
27	Volvo Penta	24' RIB	GRP	CG 48	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	CG 51	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	CG 58	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	CG 67	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	CG 69	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	DD 992	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	DDG 53	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	24' RIB	GRP	DDG 54	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	24' RIB	GRP	DDG 56	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	24' RIB	GRP	DDG 57	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	24' RIB	GRP	DDG 58	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	24' RIB	GRP	DDG 60	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	24' RIB	GRP	LHD 3	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	LHD 4	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	24' RIB	GRP	CG 48	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	CG 50	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	CG 51	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	CG 55	2	P	AQAD41A	1	2	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2003
27	Volvo Penta	24' RIB	GRP	CG 56	2	P	AQAD41A	1	2	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2003
27	Volvo Penta	24' RIB	GRP	CG 57	3	P	AQAD41A	1	3	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	1,296	2	2003
27	Volvo Penta	24' RIB	GRP	CG 58	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	CG 64	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	CG 66	2	P	AQAD41A	1	2	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2003
27	Volvo Penta	24' RIB	GRP	CG 67	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	DD 963	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	DD 975	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	DD 978	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	DD 987	2	P	AQAD41A	1	2	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2003
27	Volvo Penta	24' RIB	GRP	DD 988	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	DD 992	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2003
27	Volvo Penta	24' RIB	GRP	CG 47	1	P	AQAD41A	1	1	1994	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2004
27	Volvo Penta	5M RIB	GRP	MCM 4	1	P	AQAD41A	1	1	1988	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	1998
27	Volvo Penta	5M RIB	GRP	MCM 6	2	P	AQAD41A	1	2	1988	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	1998
27	Volvo Penta	5M RIB	GRP	MHC 52	1	P	AQAD41A	1	1	1988	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	1998
27	Volvo Penta	5M RIB	GRP	MCM 1	1	P	AQAD41A	1	1	1989	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	1999
27	Volvo Penta	5M RIB	GRP	MCM 5	2	P	AQAD41A	1	2	1989	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	1999
27	Volvo Penta	5M RIB	GRP	MHC 58	1	P	AQAD41A	1	1	1989	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	1999
27	Volvo Penta	5M RIB	GRP	MCM 10	1	P	AQAD41A	1	1	1990	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2000
27	Volvo Penta	5M RIB	GRP	MHC 51	1	P	AQAD41A	1	1	1990	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2000
27	Volvo Penta	5M RIB	GRP	MHC 54	1	P	AQAD41A	1	1	1990	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2000
27	Volvo Penta	5M RIB	GRP	MCM 3	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2001
27	Volvo Penta	5M RIB	GRP	MCM 13	2	P	AQAD41A	1	2	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2002
27	Volvo Penta	5M RIB	GRP	MCM 14	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	5M RIB	GRP	MCM 3	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	5M RIB	GRP	MCM 9	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	5M RIB	GRP	MHC 56	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	5M RIB	GRP	MHC 60	1	P	AQAD41A	1	1	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2002
27	Volvo Penta	5M RIB	GRP	MCM 7	2	P	AQAD41A	1	2	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2003
27	Volvo Penta	5M RIB	GRP	MHC 55	1	P	AQAD41A	1	1	1994	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2004
27	Volvo Penta	5M RIB	GRP	MHC 62	1	P	AQAD41A	1	1	1996	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2006
26	Detroit Diesel	42' PPRB	GRP		2	P	8V-71 7082-3000	2	4	1987	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	18,096	72,384	4	1997
26	Detroit Diesel	36' VP	GRP		2	P	8V-71TI	1	2	1966	462 HP	2300	2	Turbo	Unit Injection	Transfer Pump	MPDE	20	N	2	18,096	36,192	4	1976
26	Volvo Penta	24' HS	Metal		2	P	TAMD-41	1	2	1989	200 BHP	3800	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	14,112	28,224	4	2004
24	Cummins	10' RX	GRP		1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2006
24	Cummins	18' RX	GRP		1	P	6BT5.9M	1	1	1991	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2001
24	Cummins	18' RX	GRP		1	P	6BT5.9M	1	1	1993	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2003

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat Is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavenged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
24	Cummins	18' RX	GRP		2	P	6BT5.9M	1	2	1994	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2004
24	Cummins	18' RX	GRP		2	P	6BT5.9M	1	2	1995	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2005
24	Cummins	18' RX	GRP		2	P	6BT5.9M	1	2	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2006
24	Cummins	18' RX	GRP		2	P	6BT5.9M	1	2	1997	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2007
24	Cummins	18' RX	GRP		3	P	6BT5.9M	1	3	1998	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	29,030	2	2008
24	Cummins	20' RX	GRP		1	P	6BT5.9M	1	1	1989	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	1999
24	Cummins	22' RX	GRP		1	P	6BT5.9M	1	1	1988	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	1998
24	Cummins	22' RX	GRP		1	P	6BT5.9M	1	1	1994	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2004
24	Cummins	22' RX	GRP		1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2006
24	Cummins	22' RX	GRP		1	P	6BT5.9M	1	1	1998	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2008
24	Cummins	24' RX	GRP		6	P	6BT5.9M	1	6	1992	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	58,061	2	2002
24	Cummins	24' RX	GRP		3	P	6BT5.9M	1	3	1993	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	29,030	2	2003
24	Cummins	24' RX	GRP		1	P	6BT5.9M	1	1	1994	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2004
24	Cummins	24' RX	GRP		10	P	6BT5.9M	1	10	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	96,768	2	2006
24	Cummins	24' RX	GRP		3	P	6BT5.9M	1	3	1997	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	29,030	2	2007
24	Cummins	24' RX	GRP		1	P	6BT5.9M	1	1	1998	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2008
24	Cummins	25' RX	GRP		1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2006
24	Cummins	25' RX	GRP		1	P	6BT5.9M	1	1	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2006
24	Cummins	4M RX	GRP		1	P	6BT5.9M	1	1	1993	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2003
24	Cummins	7M RIB	GRP	AOE 3	2	P	6BT5.9M	1	2	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	2,880	2	2004
24	Cummins	7M RIB	GRP	ARS 51	1	P	6BT5.9M	1	1	1994	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	1,440	2	2004
24	Cummins	7M RIB	GRP	AGF 3	1	P	6BT5.9M	1	1	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	1,440	2	2006
24	Cummins	7M RIB	GRP	AOE 10	2	P	6BT5.9M	1	2	1996	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	2,880	2	2006
24	Cummins	7M RIB	GRP	AOE 1	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	2,880	2	2008
24	Cummins	7M RIB	GRP	AOE 2	2	P	6BT5.9M	1	2	1998	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	2,880	2	2008
24	Cummins	7M RX	GRP		4	P	6BT5.9M	1	4	1994	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	38,707	2	2004
24	Cummins	7M RX	GRP		10	P	6BT5.9M	1	10	1996	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	96,768	2	2006
24	Cummins	7M RX	GRP		5	P	6BT5.9M	1	5	1997	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	48,384	2	2007
24	Cummins	8M PE	GRP		1	P	6BT5.9M	1	1	1995	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2005
24	Cummins	10M PE	GRP	AOE 10	1	P	6BTA5.9M2	1	1	1994	214 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,656	1,656	2	2004
24	Cummins	10M PE	GRP	AS 39	1	P	6BTA5.9M2	1	1	1994	214 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,656	1,656	2	2004
24	Cummins	10M PE	GRP	AS 39	1	P	6BTA5.9M2	1	1	1994	214 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,656	1,656	2	2004
24	Cummins	10M PE	GRP		3	P	6BTA5.9M2	1	3	1994	214 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	6,624	19,872	2	2004
24	Cummins	12M PE	GRP		1	P	6BTA5.9M2	1	1	1993	220 BHP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	6,624	6,624	2	2003
24	Cummins	22' UB	GRP		1	P	6BTA5.9M2	2	2	1990	220 HP	2500	2	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	7,618	15,235	2	2000
24	Cummins	AAV-7A1	Metal		400	P	VT400	1	400	1983	400 BHP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	4,608	1,843,200	2	2008
24	Detroit Diesel	33' PE	GRP		1	P	6068M	1	1	1971	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1981
24	Detroit Diesel	33' PE	GRP		1	P	6068M	1	1	1986	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1996
24	Detroit Diesel	33' PE	GRP	AGF 3	1	P	6068M	1	1	1988	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	1,824	1,824	2	1998
24	Detroit Diesel	33' PE	GRP	AS 40	2	P	6068M	1	2	1988	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	1,824	3,648	2	1998
24	Detroit Diesel	33' PE	GRP	AOE 3	1	P	6068M	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	1,824	1,824	2	2001
24	Detroit Diesel	33' PE	GRP	AOE 4	1	P	6068M	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	1,824	1,824	2	2001
24	Detroit Diesel	33' PE	GRP		2	P	6068M	1	2	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	14,592	2	2001
24	Detroit Diesel	21' NS	Metal		1	P	6-71	1	1	1974	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1989
24	Detroit Diesel	21' NS	Metal		1	P	6-71	1	1	1991	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2006
24	Detroit Diesel	22' NS	Metal		1	P	6-71	1	1	1983	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1998
24	Detroit Diesel	22' NS	Metal		1	P	6-71	1	1	1985	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2000
24	Detroit Diesel	22' NS	Metal		1	P	6-71	1	1	1990	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2005
24	Detroit Diesel	22' NS	Metal		2	P	6-71	1	2	1991	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	14,592	2	2006
24	Detroit Diesel	22' UB	GRP		4	P	6-71	1	4	1990	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	29,184	2	2000
24	Detroit Diesel	23' NS	Metal		1	P	6-71	1	1	1987	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2002
24	Detroit Diesel	23' NS	Metal		1	P	6-71	1	1	1988	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2003
24	Detroit Diesel	25' NS	GRP		1	P	6-71	1	1	1967	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1977
24	Detroit Diesel	25' NS	Metal		1	P	6-71	1	1	1975	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1990
24	Detroit Diesel	25' NS	GRP		1	P	6-71	1	1	1984	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1994
24	Detroit Diesel	25' NS	GRP		1	P	6-71	1	1	1985	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1995
24	Detroit Diesel	25' NS	GRP		1	P	6-71	1	1	1986	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1996
24	Detroit Diesel	25' NS	GRP		1	P	6-71	1	1	1987	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1997
24	Detroit Diesel	25' NS	Metal		1	P	6-71	1	1	1986	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2001
24	Detroit Diesel	25' NS	Metal		1	P	6-71	1	1	1989	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2004
24	Detroit Diesel	25' NS	GRP		1	P	6-71	1	1	1997	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2007
24	Detroit Diesel	26' NS	GRP		1	P	6-71	1	1	1975	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1985
24	Detroit Diesel	26' NS	Metal		1	P	6-71	1	1	1978	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1993
24	Detroit Diesel	26' NS	GRP		1	P	6-71	1	1	1991	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2001
24	Detroit Diesel	26' NS	GRP		1	P	6-71	1	1	1995	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2005
24	Detroit Diesel	26' PE	GRP		1	P	6-71	1	1	1991	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	6,816	6,816	2	2001
24	Detroit Diesel	27' NS	GRP		1	P	6-71	1	1	1981	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1991
24	Detroit Diesel	27' NS	GRP		1	P	6-71	1	1	1987	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1997
24	Detroit Diesel	27' NS	Metal		1	P	6-71	1	1	1983	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1998
24	Detroit Diesel	27' NS	Metal		1	P	6-71	1	1	1989	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2004
24	Detroit Diesel	28' NS	GRP		1	P	6-71	1	1	1995	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2005
24	Detroit Diesel	28' NS	GRP		2	P	6-71	1	2	1997	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	14,592	2	2007
24	Detroit Diesel	31' NS	GRP		1	P	6-71	1	1	1998	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2008
24	Detroit Diesel	32' NS	GRP		1	P	6-71	1	1	1977	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1987
24	Detroit Diesel	32' NS	GRP		2	P	6-71	1	2	1978	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	14,592	2	1988
24	Detroit Diesel	32' NS	Metal		1	P	6-71	1	1	1983	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1998
24	Detroit Diesel	32' NS	GRP		1	P	6-71	1	1	1993	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2003
24	Detroit Diesel	33' NS	GRP		1	P	6-71	1	1	1970	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1980
24	Detroit Diesel	33' NS	GRP		1	P	6-71	1	1	1978	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	1988
24	Detroit Diesel	40' PE	GRP		112	P	6-71	1	112	1990	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	817,152	2	2000
24	Detroit Diesel	24' BH	Metal		1	P	6V-53	1	1	1979	250 HP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	157	157	2	1994
24	Detroit Diesel	24' BH	Metal		4	P	6V-53	1	4	1985	250 HP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	157	629	2	2000
24	Detroit Diesel	24' BH	Metal		4	P	6V-53	1	4	1988	250 HP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	157	629	2	2003
24	Detroit Diesel	24' BH	Metal		4	P	6V-53	1	4	1990	250 HP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	157	629	2	2005

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavenged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
24	Detroit Diesel	34' HSL	GRP		3	P	8V-71TI	1	3	1990	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	3,082	9,246	2	2000
24	Detroit Diesel	34' HSL	GRP		4	P	8V-71TI	1	4	1991	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	3,082	12,328	2	2001
24	Detroit Diesel	34' HSL	GRP		2	P	8V-71TI	1	2	1997	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	3,082	6,164	2	2007
24	Detroit Diesel	36' HSL	GRP		1	P	8V-71TI	1	1	1985	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	3,082	3,082	2	1995
24	Volvo Penta	22' RB	GRP		72	P	AQAD41A	1	72	1989	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	124,416	2	1999
24	Volvo Penta	22' SC	GRP		6	P	AQAD41A	1	6	1994	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	10,368	2	2004
24	Volvo Penta	24' HS	Metal		92	P	AQAD41A	1	92	1989	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	3,528	324,576	2	2004
24	Volvo Penta	24' RIB	GRP	ARS 50	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	432	432	2	2001
24	Volvo Penta	24' RIB	GRP	ARS 52	1	P	AQAD41A	1	1	1991	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	432	432	2	2001
24	Volvo Penta	24' RIB	GRP		3	P	AQAD41A	1	3	1992	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	5,184	2	2002
24	Volvo Penta	24' RIB	GRP	ARS 53	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Unit Injection	Rotor Type Injection Pump	MPDE	20	N	2	432	432	2	2003
24	Volvo Penta	24' RIB	GRP	ARS 53	1	P	AQAD41A	1	1	1993	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	432	432	2	2003
24	Volvo Penta	24' RX	GRP		3	P	AQAD41A	1	3	1996	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	5,184	2	2006
24	Volvo Penta	27' AP	GRP		8	P	AQAD41A	1	8	1991	165 HP	3600	2	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	3,528	28,224	2	2001
24	Volvo Penta	27' SC	GRP		6	P	AQAD41A	1	6	1994	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	10,368	2	2004
24	Volvo Penta	7M RIB	GRP		3	P	AQAD41A	1	3	1996	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	5,184	2	2006
24	Volvo Penta	24' HS	Metal		36	P	AQAD41A	1	36	1988	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	3,528	127,008	2	2003
18	Detroit Diesel	100' NS	Metal		1	D	16V-71	2	2	1978	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1993
18	Detroit Diesel	100' NS	Metal		1	D	16V-71	2	2	1987	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2002
18	Detroit Diesel	110' NS	Metal		1	D	16V-71	2	2	1974	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1989
18	Detroit Diesel	120' NS	Metal		1	D	16V-71	2	2	1988	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2003
18	Detroit Diesel	180' NS	Metal		1	D	16V-71	2	2	1943	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1958
18	Detroit Diesel	180' NS	Metal		1	D	16V-71	2	2	1980	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1995
18	Detroit Diesel	180' NS	Metal		1	D	16V-71	2	2	1982	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1997
18	Detroit Diesel	53' NS	GRP		1	D	16V-71	2	2	1979	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1989
18	Detroit Diesel	54' NS	Wood		1	D	16V-71	2	2	1978	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1993
18	Detroit Diesel	54' NS	Wood		1	D	16V-71	2	2	1979	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1994
18	Detroit Diesel	55' NS	Wood		1	D	16V-71	2	2	1976	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1991
18	Detroit Diesel	60' NS	GRP		1	D	16V-71	2	2	1983	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1993
18	Detroit Diesel	60' NS	GRP		1	D	16V-71	2	2	1990	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2000
18	Detroit Diesel	65' NS	GRP		1	D	16V-71	2	2	1973	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1983
18	Detroit Diesel	65' NS	GRP		1	D	16V-71	2	2	1979	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1989
18	Detroit Diesel	65' NS	GRP		1	D	16V-71	2	2	1990	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2000
18	Detroit Diesel	68' NS	Metal		1	D	16V-71	2	2	1986	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2001
18	Detroit Diesel	77' NS	Metal		1	D	16V-71	2	2	1983	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1998
18	Detroit Diesel	77' NS	Metal		1	D	16V-71	2	2	1985	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2000
18	Detroit Diesel	85' NS	Metal		1	D	16V-71	2	2	1968	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	1983
18	Detroit Diesel	95' NS	Metal		1	D	16V-71	2	2	1987	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2002
18	Detroit Diesel	120' MR	Metal		1	D	16V-92	4	4	1988	550 HP	2400	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	120,749	482,995	6	2003
17	Cummins	10M UB	GRP	LCC 20	3	D	6B5.9M	1	3	1994	115 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,229	3,686	2	2004
17	Cummins	15M UB	GRP	CVN 73	1	D	6BT5.9M	1	1	1991	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2001
17	Cummins	15M UB	GRP	CVN 73	1	D	6BT5.9M	1	1	1991	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2001
17	Cummins	15M UB	GRP	LSD 48	1	D	6BT5.9M	1	1	1991	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2001
17	Cummins	15M UB	GRP	LSD 49	1	D	6BT5.9M	1	1	1991	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2001
17	Cummins	15M UB	GRP	AOE 3	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	AOE 4	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	CVN 65	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	CVN 71	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	CVN 71	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	CVN 73	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	LSD 44	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	LSD 50	1	D	6BT5.9M	1	1	1992	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2002
17	Cummins	15M UB	GRP	CVN 65	1	D	6BT5.9M	1	1	1993	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2003
17	Cummins	15M UB	GRP	CVN 65	1	D	6BT5.9M	1	1	1993	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2003
17	Cummins	15M UB	GRP	LSD 41	1	D	6BT5.9M	1	1	1993	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2003
17	Cummins	15M UB	GRP	CV 67	1	D	6BT5.9M	1	1	1994	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2004
17	Cummins	15M UB	GRP	CVN 75	1	D	6BT5.9M	1	1	1994	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2004
17	Cummins	15M UB	GRP	CVN 75	1	D	6BT5.9M	1	1	1994	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2004
17	Cummins	15M UB	GRP	CVN 75	1	D	6BT5.9M	1	1	1994	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2004
17	Cummins	15M UB	GRP	CV 67	1	D	6BT5.9M	1	1	1995	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2005
17	Cummins	15M UB	GRP	CVN 71	1	D	6BT5.9M	1	1	1995	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2005
17	Cummins	15M UB	GRP	LSD 52	1	D	6BT5.9M	1	1	1995	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	S	5	1,950	1,950	2	2005
17	Detroit Diesel	33' UB	GRP	LCC 19	1	D	6-71	1	1	1971	250 BHP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	2,964	2,964	2	1981
17	Detroit Diesel	50' UB	GRP	CVN 69	3	D	6-71	1	3	1989	250 BHP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	S	5	2,964	8,892	2	1999
17	Onan	65' PB	Metal		64	P	15MDJF4R4686D	1	64	1979	15 kW	1800	4	N/A	Injection Nozzle	HP Injection Pump	SSDG	5	C	10	576	36,864	2	1994
17	Westerbeke	26' MW	GRP	CVN 72	1	D	14086 SPEC 'B'	1	1	1992	25 HP	2400	4	N/A	Injection Nozzle	HP Distributor Pump	MPDE	10	S	5	390	390	2	2002
17	Westerbeke	26' MW	GRP	CVN 75	1	D	14086 SPEC 'B'	1	1	1992	25 HP	2400	4	N/A	Injection Nozzle	HP Distributor Pump	MPDE	10	S	5	390	390	2	2002
17	Westerbeke	26' MW	GRP	CVN 69	2	D	14086 SPEC 'B'	1	2	1993	25 HP	2400	4	N/A	Injection Nozzle	HP Distributor Pump	MPDE	10	S	5	390	780	2	2003
16	Detroit Diesel	120' TWR	Metal		1	D	12V-71 7122-7000	2	2	1984	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	20,741	4	1999
16	Detroit Diesel	120' TWR	Metal		1	D	12V-71 7122-7000	2	2	1985	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	20,741	4	2000
16	Detroit Diesel	120' TWR	Metal		3	D	12V-71 7122-7000	2	6	1986	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	62,222	4	2001
16	Detroit Diesel	16-180' WB 50' Rep	Metal		3	D	12V-71	2	6	1992	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	62,222	4	2007
16	Detroit Diesel	74' CM	Metal		3	D	12V-71 7122-7000	2	6	1967	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	62,222	4	1982
16	Detroit Diesel	74' CM	Metal		5	D	12V-71 7122-7000	2	10	1968	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	103,704	4	1983
16	Detroit Diesel	74' CM	Metal		10	D	12V-71 7122-7000	2	20	1969	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	207,408	4	1984
16	Detroit Diesel	74' CM	Metal		1	D	12V-71 7122-7000	2	2	1979	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	20,741	4	1994
16	Detroit Diesel	74' CM	Metal		3	D	12V-71 7122-7000	2	6	1987	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	62,222	4	2002
16	Detroit Diesel	74' CM	Metal		8	D	12V-71 7122-7000	2	16	1992	400 HP	2150	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	10,370	165,926	4	2007
16	Detroit Diesel	16-180' WB 50' Rep	Metal		2	D	16V-71	2	4	1992	480 HP	1800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	13,855	55,421	4	2007
16	Detroit Diesel	40' UB	GRP		28	D	6-71	1	28	1989	250 BHP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	11,856	331,968	4	1999
16	Detroit Diesel	50' UB	GRP		2	D	6-71	1	2	1989	250 BHP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	11,856	23,712	4	1999
16	Detroit Diesel	46' NS	Metal		2	D	8V-71 7082-3000	2	4	1982	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	18,096	72,384	4	1997
14	Cummins	35' WB	Metal		2	D	4B3.9M	1	2	1975	76 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	2,263	4,526	2	1990
14	Cummins	10M UB	GRP		8	D	6B5.9M	1	8	1994	115 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	4,914	39,312	2	2004

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavanged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
14	Cummins	12M UB	GRP	AGF 3	1	D	6BT5.9M	1	1	1993	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	1,950	1,950	2	2003
14	Cummins	12M UB	GRP	AOE 10	1	D	6BT5.9M	1	1	1993	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	1,950	1,950	2	2003
14	Cummins	12M UB	GRP	AS 39	2	D	6BT5.9M	1	2	1993	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	1,950	3,900	2	2003
14	Cummins	12M UB	GRP		1	D	6BT5.9M	1	1	1993	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	7,800	7,800	2	2003
14	Cummins	15M UB	GRP	AS 39	1	D	6BT5.9M	1	1	1991	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	1,950	1,950	2	2001
14	Cummins	15M UB	GRP	AOE 10	1	D	6BT5.9M	1	1	1993	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	1,950	1,950	2	2003
14	Cummins	15M UB	GRP		1	D	6BT5.9M	1	1	1995	175 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	7,800	7,800	2	2005
14	Cummins	15M UB	GRP		4	D	6BT5.9M	1	4	1995	180 BHP	2300	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	7,800	31,200	2	2005
14	Cummins	165' NS	Metal		1	D	6BT5.9M	2	2	1969	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	2,419	4,838	2	1984
14	Cummins	165' NS	Metal		1	D	6BT5.9M	2	2	1970	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	2,419	4,838	2	1985
14	Cummins	165' NS	Metal		1	D	6BT5.9M	2	2	1971	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	9,677	19,354	2	1986
14	Cummins	16-180' WB 50' Rep	Metal		3	D	6BTA5.9M2	2	6	1992	220 HP	2500	2	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	7,618	45,708	2	2007
14	Cummins	40' PR	Metal		2	D	6BTA5.9M2	1	2	1993	220 BHP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	7,949	15,898	2	2008
14	Detroit Diesel	60' CT	Wood		1	D	12006A	2	2	1971	278 HP	2100	2	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	10	N	2	3,870	7,740	2	1986
14	Detroit Diesel	65' CT	Wood		2	D	12006A	2	4	1971	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	24,317	2	1986
14	Detroit Diesel	135' LCU	Metal		3	D	12V-71	2	6	1959	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	36,475	2	1974
14	Detroit Diesel	135' LCU	Metal		1	D	12V-71	2	2	1967	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	12,158	2	1982
14	Detroit Diesel	135' LCU	Metal		6	D	12V-71	2	12	1968	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	72,950	2	1983
14	Detroit Diesel	135' LCU	Metal		6	D	12V-71	2	12	1969	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	72,950	2	1984
14	Detroit Diesel	135' LCU	Metal		8	D	12V-71	2	16	1970	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	97,267	2	1985
14	Detroit Diesel	135' LCU	Metal		10	D	12V-71	2	20	1971	425 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,079	121,584	2	1986
14	Detroit Diesel	35' WB	Metal	ARS 50	1	D	4-53	1	1	1984	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	1,380	1,380	2	1999
14	Detroit Diesel	35' WB	Metal	ARS 51	1	D	4-53	1	1	1984	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	1,380	1,380	2	1999
14	Detroit Diesel	35' WB	Metal	ARS 52	1	D	4-53	1	1	1984	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	1,380	1,380	2	1999
14	Detroit Diesel	35' WB	Metal	ARS 53	2	D	4-53	1	2	1984	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	1,380	2,760	2	1999
14	Detroit Diesel	35' WB	Metal		3	D	4-53	1	3	1984	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	5,520	16,560	2	1999
14	Detroit Diesel	35' WB	Metal		1	D	4-53	1	1	1985	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	5,520	5,520	2	2000
14	Detroit Diesel	35' WB	Metal		1	D	4-53	1	1	1991	100 BHP	2400	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	5,520	5,520	2	2006
14	Detroit Diesel	35' NS	Wood		1	D	6-71	1	1	1942	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1957
14	Detroit Diesel	35' NS	GRP		1	D	6-71	1	1	1984	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1994
14	Detroit Diesel	35' NS	Metal		1	D	6-71	1	1	1988	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2003
14	Detroit Diesel	36' NS	GRP		1	D	6-71	1	1	1995	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2005
14	Detroit Diesel	36' NS	GRP		2	D	6-71	1	2	1998	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	14,592	2	2008
14	Detroit Diesel	38' NS	GRP		1	D	6-71	1	1	1973	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1983
14	Detroit Diesel	38' NS	GRP		1	D	6-71	1	1	1991	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2001
14	Detroit Diesel	39' NS	GRP		1	D	6-71	1	1	1983	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1993
14	Detroit Diesel	39' NS	GRP		1	D	6-71	1	1	1990	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2000
14	Detroit Diesel	40' NS	GRP		1	D	6-71	1	1	1979	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1989
14	Detroit Diesel	40' NS	GRP		2	D	6-71	1	2	1989	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	14,592	2	1999
14	Detroit Diesel	40' NS	GRP		1	D	6-71	1	1	1990	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2000
14	Detroit Diesel	40' UB	GRP	AS 40	2	D	6-71	1	2	1989	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	2,964	5,928	2	1999
14	Detroit Diesel	41' NS	Metal		2	D	6-71	1	2	1989	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	14,592	2	2004
14	Detroit Diesel	42' TC	GRP		1	D	6-71	1	1	1983	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1993
14	Detroit Diesel	43' NS	GRP		1	D	6-71	1	1	1976	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1986
14	Detroit Diesel	46' NS	GRP		1	D	6-71	1	1	1976	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1986
14	Detroit Diesel	49' NS	Metal		1	D	6-71	1	1	1992	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2007
14	Detroit Diesel	50' NS	Wood		3	D	6-71	1	3	1944	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	21,888	2	1959
14	Detroit Diesel	50' NS	Wood		1	D	6-71	1	1	1970	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	1985
14	Detroit Diesel	50' UB	GRP	AS 40	2	D	6-71	1	2	1989	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	2,964	5,928	2	1999
14	Detroit Diesel	50' UB	GRP	AS 39	1	D	6-71	1	1	1986	250 BHP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	2,964	2,964	2	1996
14	Detroit Diesel	52' CC	Wood		1	D	6-71	2	2	1963	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	14,592	2	1978
14	Detroit Diesel	16-180' WB 50' Rep	Metal		203	D	6-71 1062-5000	2	406	1992	225 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,838	3,182,390	2	2007
14	Detroit Diesel	50' AC	Wood		1	D	6-71 1062-5000	2	2	1957	225 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,838	15,677	2	1972
14	Detroit Diesel	50' WB	Metal	AS 39	1	D	6-71 1062-5000	2	2	1979	225 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	1,960	3,919	2	1994
14	Detroit Diesel	50' WB	Metal	AS 39	1	D	6-71 1062-5000	2	2	1989	225 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	1,960	3,919	2	2004
14	Detroit Diesel	50' WB	Metal		1	D	6-71 1062-5000	2	2	1989	225 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,838	15,677	2	2004
14	Detroit Diesel	74' WB	Metal		1	D	6-71 1062-5000	2	2	1992	225 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,838	15,677	2	2007
14	Detroit Diesel	192' UB	GRP		2	D	6-71 1062-7000	1	2	1981	190 HP	1900	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	9,360	18,720	2	1991
14	Detroit Diesel	33-50' UB 50' Rep	GRP		73	D	6-71 1062-7000	1	73	1989	190 HP	1900	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	9,360	683,280	2	1999
14	Detroit Diesel	50' DW	Metal		6	D	6V-53	1	6	1990	189 BHP	2500	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	6,144	36,864	2	2005
14	Detroit Diesel	16-180' WB 50' Rep	Metal		7	D	6V-53 5062-700	2	14	1992	297 HP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	768	10,752	2	2007
14	Detroit Diesel	50' DW	Metal	AS 40	1	D	6V-53 5062-7200	2	2	1990	197 HP	2800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	192	384	2	2005
14	Detroit Diesel	89' WT	Metal		1	D	8V-71	2	2	1989	650 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	3,480	6,960	2	2004
14	Detroit Diesel	65' SC	Metal		1	D	8V-71N 7082-3000	2	2	1989	278 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	3,870	7,740	2	2004
14	Detroit Diesel	65' SC	Metal		2	D	8V-71N 7082-3000	2	4	1991	278 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	3,870	15,480	2	2006
14	Detroit Diesel	65' SC	Metal		1	D	8V-71N 7082-3000	2	2	1992	278 HP	2100	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	3,870	7,740	2	2007
14	Westerbeke	26' MW	GRP	AS 39	2	D	14088 SPEC 'B'	1	2	1993	25 HP	2400	4	N/A	Injection Nozzle	HP Distributor Pump	MPDE	10	N	2	390	780	2	2003
14	Westerbeke	26' MW	GRP	AS 40	2	D	14088 SPEC 'B'	1	2	1993	25 HP	2400	4	N/A	Injection Nozzle	HP Distributor Pump	MPDE	10	N	2	390	780	2	2003
14	Westerbeke	26' MW	GRP		5	D	14088 SPEC 'B'	1	5	1993	25 HP	2400	4	N/A	Injection Nozzle	HP Distributor Pump	MPDE	10	N	2	1,560	7,800	2	2003

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2009 AND 2013

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavenged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
27	Cummins	20' RX	GRP	PC 12	1	P	6BT5.9M	1	1	2003	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	2,419	2,419	2	2013
27	Cummins	7M RIB	GRP	CG 71	2	P	6BT5.9M	1	2	1999	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2009
27	Cummins	7M RIB	GRP	CV 67	2	P	6BT5.9M	1	2	1999	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2009
27	Cummins	7M RIB	GRP	CG 52	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CG 54	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CG 59	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CG 63	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CG 65	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CG 73	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CVN 72	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	CVN 76	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	LHA 1	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	LPD 6	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	LSD 47	1	P	6BT5.9M	1	1	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2011
27	Cummins	7M RIB	GRP	DDG 87	2	P	6BT5.9M	1	2	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2011
27	Cummins	7M RIB	GRP	DDG 88	2	P	6BT5.9M	1	2	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2011
27	Cummins	7M RIB	GRP	DDG 89	2	P	6BT5.9M	1	2	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2011
27	Cummins	7M RIB	GRP	CG 57	2	P	6BT5.9M	1	2	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2012
27	Cummins	7M RIB	GRP	CG 61	2	P	6BT5.9M	1	2	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	2,880	2	2012
27	Cummins	7M RIB	GRP	CG 62	1	P	6BT5.9M	1	1	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2012
27	Cummins	7M RIB	GRP	CG 68	1	P	6BT5.9M	1	1	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2012
27	Cummins	7M RIB	GRP	CVN 76	1	P	6BT5.9M	1	1	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2012
27	Cummins	7M RIB	GRP	DD 978	1	P	6BT5.9M	1	1	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2012
27	Cummins	7M RIB	GRP	LCC 20	1	P	6BT5.9M	1	1	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	S	5	1,440	1,440	2	2012
27	Cummins	13M PE	GRP	CVN 73	1	P	6BTA5.9M2	2	2	2000	220 BHP	2800	2	Turbo	Unit Injection	HP Distributor Fuel Pump	MPDE	20	S	5	1,824	3,648	2	2010
27	Iveco	11M RIB	GRP	LSD 46	1	P	8061SRM33.12	1	1	2003	300 HP	2700	4	Turbo	Unit Injection	Transfer Pump	MPDE	20	S	5	2,376	2,376	2	2013
27	Volvo Penta	5M RIB	GRP	MCM 11	2	P	AQAD41A	1	2	2000	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2010
27	Volvo Penta	5M RIB	GRP	MHC 57	1	P	AQAD41A	1	1	2000	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2010
27	Volvo Penta	5M RIB	GRP	MCM 14	1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2011
27	Volvo Penta	5M RIB	GRP	MCM 4	1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2011
27	Volvo Penta	5M RIB	GRP	MHC 53	1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2011
27	Volvo Penta	5M RIB	GRP	MHC 59	1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2011
27	Volvo Penta	5M RIB	GRP	MHC 61	1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2011
27	Volvo Penta	5M RIB	GRP	MCM 1	1	P	AQAD41A	1	1	2002	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2012
27	Volvo Penta	5M RIB	GRP	MCM 10	1	P	AQAD41A	1	1	2002	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2012
27	Volvo Penta	5M RIB	GRP	MCM 9	1	P	AQAD41A	1	1	2002	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	432	2	2012
27	Volvo Penta	5M RIB	GRP	MCM 8	2	P	AQAD41A	1	2	2002	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	S	5	432	864	2	2012
24	Cummins	18' RX	GRP		1	P	6BT5.9M	1	1	1999	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2009
24	Cummins	18' RX	GRP		1	P	6BT5.9M	1	1	2001	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2011
24	Cummins	20' RX	GRP		1	P	6BT5.9M	1	1	2000	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2010
24	Cummins	20' RX	GRP		1	P	6BT5.9M	1	1	2001	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2011
24	Cummins	21' RX	GRP		1	P	6BT5.9M	1	1	2001	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2011
24	Cummins	23' RX	GRP		12	P	6BT5.9M	1	12	2001	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	116,122	2	2011
24	Cummins	24' RX	GRP		2	P	6BT5.9M	1	2	1999	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2009
24	Cummins	24' RX	GRP		1	P	6BT5.9M	1	1	2000	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2010
24	Cummins	25' RX	GRP		4	P	6BT5.9M	1	4	2000	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	38,707	2	2010
24	Cummins	4M RX	GRP		1	P	6BT5.9M	1	1	2003	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2013
24	Cummins	7M RIB	GRP	AOE 4	2	P	6BT5.9M	1	2	1999	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	2,880	2	2009
24	Cummins	7M RIB	GRP		1	P	6BT5.9M	1	1	2001	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	9,677	2	2011
24	Cummins	7M RIB	GRP		275	P	6BT5.9M	1	275	2001	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	5,760	1,584,000	2	2011
24	Cummins	7M RIB	GRP	AGF 11	1	P	6BT5.9M	1	1	2002	180 BHP	2500	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	1,440	1,440	2	2012
24	Cummins	7M RX	GRP		12	P	6BT5.9M	1	12	2000	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	116,122	2	2010
24	Cummins	7M RX	GRP		12	P	6BT5.9M	1	12	2001	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	116,122	2	2011
24	Cummins	7M RX	GRP		23	P	6BT5.9M	1	23	2002	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	222,568	2	2012
24	Cummins	13M PE	GRP		3	P	6BTA5.9M2	2	6	2000	220 BHP	2800	2	Turbo	Unit Injection	HP Distributor Fuel Pump	MPDE	20	N	2	1,824	10,944	2	2010
24	Detroit Diesel	21' NS	Metal		1	P	6-71	1	1	1995	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2010
24	Detroit Diesel	21' NS	Metal		1	P	6-71	1	1	1996	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2011
24	Detroit Diesel	22' NS	Metal		2	P	6-71	1	2	1994	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	14,592	2	2009
24	Detroit Diesel	26' NS	GRP		2	P	6-71	1	2	2001	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	14,592	2	2011
24	Detroit Diesel	28' NS	Metal		5	P	6-71	1	5	1995	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	36,480	2	2010
24	Detroit Diesel	28' NS	Metal		1	P	6-71	1	1	1996	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2011
24	Detroit Diesel	28' NS	Metal		1	P	6-71	1	1	1998	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2013
24	Detroit Diesel	29' NS	GRP		1	P	6-71	1	1	2001	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2011
24	Detroit Diesel	30' NS	Metal		1	P	6-71	1	1	1996	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2011
24	Detroit Diesel	24' BH	Metal		2	P	6V-53	1	2	1994	250 HP	2800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	157	314	2	2009
24	Detroit Diesel	24' BH	Metal		2	P	6V-53	1	4	1995	250 HP	2800	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	157	629	2	2010
24	Detroit Diesel	34' HSL	GRP		2	P	8V-71TI	1	2	1999	462 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	20	N	2	3,082	6,164	2	2009
24	Volvo Penta	21' HS	GRP		1	P	AQAD41A	1	1	2000	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	3,528	3,528	2	2010
24	Volvo Penta	5M RIB	GRP	ARS 50	1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	432	432	2	2011
24	Volvo Penta	5M RIB	GRP		1	P	AQAD41A	1	1	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	1,728	1,728	2	2011
14	Detroit Diesel	48' NS	Metal		1	D	6-71	1	1	1996	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2011
14	Detroit Diesel	50' NS	Wood		2	D	6-71	1	2	1997	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	14,592	2	2012
14	Detroit Diesel	50' NS	Wood		1	D	6-71	1	1	1998	260 HP	2300	2	Blower Scavenged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2013

U.S. NAVY SINGLE FUEL SMALL BOAT DIESEL ENGINE MATRIX, BOATS SCHEDULED TO BE DECOMMISSIONED AFTER 2013

Overall Rating	Manufacturer	Boat Class	Hull Material	Ship Boat is On	# of Boats	Hull Type	Model	# Eng / Boat	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA / Turb / Blower Scavanged	Injection System Type	Pump System	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
28	Detroit Diesel	85' TWR	Metal		2	P	12V-71	2	4	2003	450 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	89,741	358,963	6	2018
28	MTU	AAAV	Metal		1000	P	MT883	1	1000	2005	2740 HP	3300	4	Turbo	L'Orange HP Pump	Injection Nozzle	MPDE	20	N	2	31,200	31,200,000	6	2030
24	Cummins	10M HS	Metal		7	P	6BT5.9M	1	7	2002	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	67,738	2	2017
24	Cummins	10M HS	Metal		19	P	6BT5.9M	1	19	2003	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	183,859	2	2018
24	Cummins	9M RX	Metal		2	P	6BT5.9M	1	2	2002	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2017
24	Cummins	9M RX	Metal		4	P	6BT5.9M	1	4	2005	220 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	38,707	2	2020
24	Cummins	25' HS	Metal		6	P	6BTA5.9M	1	6	2002	315 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	58,061	2	2017
24	Cummins	25' HS	Metal		2	P	6BTA5.9M	1	2	2003	315 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	19,354	2	2018
24	Cummins	32' HS	Metal		4	P	6BTA5.9M	1	4	2001	315 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	9,677	38,707	2	2016
24	Cummins	AAV-7 MK1	Metal		680	P	VT525	1	680	1990	525 BHP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	20	N	2	6,288	4,275,840	2	2015
24	Detroit Diesel	21' NS	Metal		1	P	6-71	1	1	2002	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2017
24	Detroit Diesel	22' NS	Metal		1	P	6-71	1	1	2003	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	20	N	2	7,296	7,296	2	2018
24	Volvo Penta	21' HS	Metal		1	P	AQAD41A	1	1	2003	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	20	N	2	3,528	3,528	2	2018
18	Detroit Diesel	71' NS	Metal		1	D	16V-71	2	2	2003	480 HP	1800	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	91,565	183,130	6	2018
16	Detroit Diesel	40' PS	Metal		1	D	8V-71 7082-3000	2	2	2000	462 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	18,096	36,192	4	2015
14	Cummins	32' IB	Metal		6	D	6BTA5.9M	1	6	2001	315 HP	2800	4	Turbo	Injection Nozzle	HP Distributor Fuel Pump	MPDE	10	N	2	9,677	58,061	2	2016
14	Detroit Diesel	40' NS	Metal		1	D	6-71	1	1	2001	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2016
14	Detroit Diesel	50' NS	Metal		1	D	6-71	1	1	1999	260 HP	2300	2	Blower Scavanged	Unit Injection	Transfer Pump	MPDE	10	N	2	7,296	7,296	2	2014
14	Volvo Penta	8M HS	Metal		5	D	AQAD41A	1	5	2001	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	10	N	2	3,528	17,640	2	2016
14	Volvo Penta	8M HS	Metal		4	D	AQAD41A	1	4	2002	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	10	N	2	3,528	14,112	2	2017
14	Volvo Penta	8M HS	Metal		11	D	AQAD41A	1	11	2003	165 HP	3600	4	Turbo	Injection Nozzle	Rotor Type Injection Pump	MPDE	10	N	2	3,528	38,808	2	2018
					4,134				4,484															
									2,404	Total Boats Excluding AAVs														

Total Annual Fuel Consumption (Gallons): 56,369,835
Total Annual Fuel Consumption (boats scheduled to be decommissioned between 2003 and 2008): 17,214,249
Total Annual Fuel Consumption (boats scheduled to be decommissioned between 2009 and 2013): 2,514,349
Total Annual Fuel Consumption (boats scheduled to be decommissioned after 2013): 36,641,237

Total Annual Fuel Consumption excluding AAVs (Gallons) 19,050,795

NOTE;
1. Boats on ships are assumed to operate 25% of the time of a typical land based boat.
2. The 36' PL engine data was used for the 11M PL boats (LHD5 - LSD52).
3. The 32' RB engine data was used for the 11M RB boat (LSD 46).
4. The 40' UB engine data was used for the 33' UB boat (LCC 19)
5. The (1)33' (1)50' (1)74' WB engine data was used for the 50' WB (AS 39).
6. Planned service lives based on hull construction material: COTS GRP hull; 7-10 yrs and COTS Metal hull; 12-15 yrs. To determine the proposed decommissioning year, the planned service life of the hull was added to the model year of the boat.
7. A service life of 25 years was assumed for USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV). To determine the proposed decommissioning year, the planned service life of the hull was added to the model year of the boat.
8. A service life of 15 years was assumed for wood hulls. To determine the proposed decommissioning year, the planned service life of the hull was added to the model year of the boat.
9. Planned replacement of 110' LCPLs with 11M RIB is progress. Replacement with be on a one-to-one basis.

The following variables make up the overall rating.
Engine Application
If the engine application is MPDE for a planing vessel it scores 20 and for a displacement vessel it scored 10.
If the engine application is either SSDG or EDG it scored 5,
Combat Criticality
If the vessel is a combatant it scored 10,
If the vessel is combatant support it scored 5,
If the vessel is a noncombatant it scored 2.
Annual Fuel Consumption
If the vessel's annual fuel consumption is greater than 30,000 it scored 6,
If the vessel's annual fuel consumption is between 10,000 and 30,000 it scored 4,
If the vessel's annual fuel consumption is less than 10,000 gallons it scored 2.

ENCLOSURE (4)

U.S. NAVY SINGLE FUEL SPECWAR BOATS DIESEL ENGINE MATRIX

Overall Rating	Manufacturer	Craft	# of Craft	Hull Type	Hull Material	Model	# Eng / Craft	Total # of Engines	Model Year	Horse power	RPM	Stroke	NA/Turb	Injection System Type	Pump Type	Application	Application Rating	Combat Use	Combat Criticality Rating	Annual Fuel Cons gal/engine	Annual Fuel Cons gal	Fuel Consumption Rating	Proposed Decommissioning Year
U.S. NAVY SINGLE FUEL SPECWAR BOATS DIESEL ENGINE MATRIX, SPECWAR BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2003 AND 2008																							
32	Caterpillar	11 M RIB	78	P	GRP	3126TA	2	156	1997	470	2950	4	T/C Aftercooled	Hydraulically Actuated Electronic Unit Injector (HEUI-B)	Transfer pump, priming pump	MPDE	20	C	10	6,683	1,042,603	2	2007
U.S. NAVY SINGLE FUEL SPECWAR BOATS DIESEL ENGINE MATRIX, SPECWAR BOATS SCHEDULED TO BE DECOMMISSIONED BETWEEN 2009 AND 2013																							
36	MTU	Mk V SOC	20	P	Metal	12V-396 TE94	2	40	1995	2285	2000	4	T/C	L'Orange HP Pump	Injection Nozzle	MPDE	20	C	10	41,152	1,646,064	6	2010
17	Northern Lights	Mk V SOC	20	P	Metal	ML844	1	20	1995	16kw	1800	2	NA	HP Injection Pump	Pintle Nozzle	SSDG	5	C	10	2,242	44,846	2	2010
U.S. NAVY SINGLE FUEL SPECWAR BOATS DIESEL ENGINE MATRIX, SPECWAR BOATS SCHEDULED TO BE DECOMMISSIONED AFTER 2013																							
32	Yanmar	SOC-R	20	P	Metal	6LY2-STE	2	40	2002	420	3300	4	T/C	Unit Injector	Transfer Pump	MPDE	20	C	10	3,753	150,120	2	2017
			138					256															

Total Annual Fuel Consumption (Gallons):	2,883,633
Total Annual Fuel Consumption (SPECWAR boats scheduled to be decommissioned between 2003 and 2008):	1,042,603
Total Annual Fuel Consumption (SPECWAR boats scheduled to be decommissioned between 2009 and 2013):	1,690,910
Total Annual Fuel Consumption (SPECWAR boats scheduled to be decommissioned after 2013):	150,120

Notes:
1. Delivery of 11M RIB began in November of 1997. The last unit was delivered in January of 2003.
2. Delivery of SOC-Rs began in February of 2002. Source www.specialoperations.com
3. Average yearly operating hours for SOC-Rs were based on engine hours received from SBT 22's inventory. Since these boats are new, the assumption was made that the total engine hours represented the yearly operating hours.
4. Delivery of Mk V SOC began in September of 1995. The last unit was delivered in August of 1999.
5. Average yearly operating hours for 11M RIB and MkV SOC were based on operating hour reports for a 3 month period received from Kip Davis via fax on December 19, 2003.
6. Planned service lifes based on hull construction material: COTS GRP hull; 7-10 yrs and COTS Metal hull; 12-15 yrs. To determine the proposed decommissioning year, the planned service life of the hull was added to the model year of the SPECWAR boat.
7. Assumed an operating profile of 2 MPDEs operating at 80% power.
8. Assumed an operating profile of 1 SSDG operating at 100% power.

The following variables make up the overall rating.
Engine Application
If the engine application is MPDE for a planing vessel it scores 20 and for a displacement vessel it scored 10.
If the engine application is either SSDG or EDG it scored 5,
Combat Criticality
If the vessel is a combatant it scored 10,
If the vessel is combatant support it scored 5,
If the vessel is a noncombatant it scored 2.
Annual Fuel Consumption
If the vessel's annual fuel consumption is greater than 30,000 gallons it scored 6,
If the vessel's annual fuel consumption is between 10,000 and 30,000 gallons it scored 4,
If the vessel's annual fuel consumption is less than 10,000 gallons it scored 2.

ENCLOSURE (5)

U.S. NAVY SINGLE FUEL MISCELLANEOUS DIESEL ENGINE MATRIX

Manufacturer	Class Ship	# of Ships	Model	# / Ship	Total # of Engines	Model Year	Horse	RPM	Stoke	NA / Turbo	Injection System Type	Pump Type	Application	APL NO.
Cummins	AFDM-3	1	KTA-1150G2	2	2	1945			4				Crane	665060078
Cummins			**KTA-1150G2**		**2**									
Deere	AS-39	1	3164DF	2	2		34 BHP	1800	4			HP Distributor Pump	Shop	665720001
Deere			**3164DF**		**2**									
Detroit Diesel	ARDM-4	2	12V-71	2	4			1800	2		Unit Injection		Crane	666010362
Detroit Diesel			**12V-71**		**4**									
Detroit Diesel	AS-39	1	2-53	1	1			2185	2		Unit Injection		Diver	666010247
Detroit Diesel			**2-53**		**1**									
Detroit Diesel	ARS-50	3	3-53	4	12				2		Unit Injection		Pump	666010442
Detroit Diesel	ARS-50	1	3-53	4	4		60 BHP	1800	2		Unit Injection		Pump	666010334
Detroit Diesel			**3-53**		**16**									
Detroit Diesel	ARS-50	6	4-53	2	12				2		Unit Injection		Crane	666010365
Detroit Diesel	CVN-68	1	4-53	1	1			2500	2		Unit Injection		Sewage	666010475
Detroit Diesel			**4-53**		**13**									
Detroit Diesel	AS-39	1	4-71	1	1	1980		1800	2		Unit Injection		Boat Gen	666010448
Detroit Diesel	CVN-68	7	4-71	1	7		160 BHP	2275	2		Unit Injection		Tool	666010339
Detroit Diesel	FFG-7	5	4-71	1	5		152 BHP	2140	2		Unit Injection		Deck	666010355
Detroit Diesel			**4-71**		**13**									
Deutz	ARS-50	1	F3L-912	1	1		42 BHP	1800	4			HP Distributor Pump	Diver	668880038
Deutz	AS-39	1	F3L-912	1	1		42 BHP	1800	4			HP Distributor Pump	Diver	668880045
Deutz			**F3L-912**		**2**									
Deutz	LHD-1	1	MD-151	1	1	2001	15 BHP	3600	4			HP Distributor Pump	Tool	668880099
Deutz			**MD-151**		**1**									
Hawker-Siddeley	LCVP	2	HR-4	8	16		59 BHP	2200	4			HP Distributor Pump	Crane	667150009
Hawker-Siddeley	LCVP	7	HR-4	5	35		62 BHP	2200	4			HP Distributor Pump	Crane	667150015L
Hawker-Siddeley			**HR-4**		**51**									
Lister-Petter	ARS-50	3	LT1-19	2	6		8 BHP	3000	4			HP Distributor Pump	Pump	664170004
Lister-Petter			**LT1-19**		**6**									
Onan	ARS-50	3	DJBM-MS2409	3	9		9 BHP	2000	4			HP Distributor Pump	Pump	664030006
Onan			**DJBM-MS2409**		**9**									
Onan	ARS-50	1	DJBMS/2490V	1	1		14 BHP	1800	4			HP Distributor Pump	Pump	664030068
Onan			**DJBMS/2490V**		**1**									
Onan	AS-39	1	DJCM-MS/3367V	2	2		24 BHP	2400	4			HP Distributor Pump	Diver	664030035
Onan			**DJCM-MS/3367V**		**2**									
Onan	AS-39	1	DJC-MS	1	1		28 BHP		4			HP Distributor Pump	Tool	664030050
Onan			**DJC-MS**		**1**									
Onan	ARS-50	3	DJCMS/2450V	2	6			2400	4			HP Distributor Pump	Salvage	664030059
Onan			**DJCMS/2450V**		**6**									

Manufacturer	Class Ship	# of Ships	Model	# / Ship	Total # of Engines	Model Year	Horse	RPM	Stoke	NA / Turbo	Injection System Type	Pump Type	Application	APL NO.
Onan	ARS-50	1	DJM60-MS1323R	1	1				4			HP Distributor Pump	Pump	664030052
Onan			**DJM60-MS1323R**		**1**									
Perkins	CVN-68	1	4-154	1	1				4			HP Distributor Pump	Deck	664190001
Perkins			**4-154**		**1**									
Yanmar	JAWS-OF-LIFE	770	L100AE-D	1	770		10 BHP	3600	4			HP Distributor Pump	DC Pump	661020001
Yanmar			**L100AE-D**		**770**									
Yanmar	CVN-68	15	L40AE-D	1	15		4 BHP		4			HP Distributor Pump	Tool	668880051
Yanmar			**L40AE-D**		**15**									
Yanmar	FFG-7	2	L40E-D	2	4	1988	6 BHP	3600	4			HP Distributor Pump	Tool	668880046
Yanmar			**L40E-D**		**4**									
Yanmar	FFG-7	6	L60AE-D	3	18	1988	6 BHP		4			HP Distributor Pump	Air	668880096
Yanmar			**L60AE-D**		**18**									
Yanmar	LSD-41	1	L60AE-DE	1	1	1988	6 BHP	3600	4			HP Distributor Pump	Shop	668880078
Yanmar			**L60AE-DE**		**1**									

940 Total Number of Miscellaneous Diesel Engines

Manufacturer	Model	Total # of Eng by Model	Total # of Engines by Manufacturer
Cummins	KTA-1150G2	2	2
Deere	3164DF	2	2
Detroit Diesel	12V-71	4	47
	2-53	1	
	3-53	16	
	4-53	13	
	4-71	13	
Deutz	F3L-912	2	3
	MD-151	1	
Hawker-Siddeley	HR-4	51	51
Lister-Petter	LT1-19	6	6
Onan	DJBM-MS2409	9	20
	DJBMS/2490V	1	
	DJCM-MS/3367V	2	
	DJC-MS	1	
	DJCMS/2450V	6	
	DJM60-MS1323R	1	
Perkins	4-154	1	1
Yanmar	L100AE-D	770	808
	L40AE-D	15	
	L40E-D	4	
	L60AE-D	18	
	L60AE-DE	1	

ENCLOSURE (6)

COMPARISON MATRIX, FUEL CONSUMPTION BY ENGINE MANUFACTURER

OEM	Annual Fuel Consumption by OEM (Gallons)	% of Total Annual Fuel Consumption by OEM
Alco	238,938	0.26%
Caterpillar	9,293,661	9.99%
Colt-Pielstick	29,347,296	31.56%
Cummins	4,719,944	5.08%
Detroit Diesel	32,393,306	34.84%
EMD	907,453	0.98%
Fairbanks Morse	11,030,087	11.86%
Gray Marine	8,640	0.01%
Isotta-Fraschini	1,969,848	2.12%
Iveco	2,376	0.00%
MTU	1,646,064	1.77%
Northern Lights	44,846	0.05%
Onan	36,864	0.04%
Paxman	305,032	0.33%
Volvo Penta	787,824	0.85%
Waukesha	91,726	0.10%
Westerbeke	10,920	0.01%
Yanmar	150,120	0.16%
	92,984,945	Total Gallons by All OEMs

Notes:

(1) Miscellaneous engines were not included as part of these comparisons because fuel consumption and engine vintage were not available.

(2) Although part of the small boat matrix, USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV) were not included in as part of this comparison.

(3) The % of total annual fuel consumption by OEM was determined by summing the total fuel consumption by OEM for ships, boats, and craft and dividing by the total for all vessels.

ENCLOSURE (7)

COMPARISON MATRIX, TOTAL NUMBER OF ENGINES BY ENGINE MODEL

OEM	Model	Total # of Engines by Engine Model	% of Total Engines by Engine Model
Cummins	6BT5.9M	655	17.81%
Detroit Diesel	6-71 1062-5000	416	11.31%
Volvo Penta	AQAD41A	344	9.36%
Detroit Diesel	6-71	288	7.83%
Caterpillar	3126TA	156	4.24%
Detroit Diesel	16V-149TI	132	3.59%
Detroit Diesel	12V-71	106	2.88%
Colt-Pielstick	PC2.5 STC	96	2.61%
Detroit Diesel	8V-71 7082-3000	96	2.61%
Isotta-Fraschini	36SS6V-AM	84	2.28%
Detroit Diesel	8V-71TI	78	2.12%
Detroit Diesel	6-71 1062-7000	75	2.04%
Detroit Diesel	12V-71 7122-7000	74	2.01%
Fairbanks Morse	12-38ND 8 1/8	66	1.79%
Onan	15MDJF4R4686D	64	1.74%
Caterpillar	3608 DITA	60	1.63%
Isotta-Fraschini	36SS8V-AM	60	1.63%
Fairbanks Morse	8-38ND 8 1/8	54	1.47%
Paxman	16RP200CM	52	1.41%
Detroit Diesel	16V-71	48	1.31%
Detroit Diesel	6V-53	48	1.31%
Detroit Diesel	3-71	44	1.20%
MTU	12V-396 TE94	40	1.09%
Yanmar	6LY2-STE	40	1.09%
Cummins	6BTA5.9M2	39	1.06%
EMD	16-LL16-645E5N	32	0.87%
Fairbanks Morse	38D 8-1/8	29	0.79%
Caterpillar	D-399B-TA	28	0.76%
Alco	16-251C	26	0.71%
Caterpillar	3306B DITA	26	0.71%
Detroit Diesel	4-71	26	0.71%
Fairbanks Morse	6-38F 5 1/4	22	0.60%
Detroit Diesel	12V-71 7122-3001	21	0.57%
Detroit Diesel	12V-71 7122-7001	21	0.57%
Gray Marine	64HN9	20	0.54%
Northern Lights	ML844	20	0.54%
Cummins	6BTA5.9M	18	0.49%
Detroit Diesel	6088M	16	0.44%
Detroit Diesel	6V-53 5062-700	14	0.38%
Waukesha	L1616DSIN	14	0.38%
Westerbeke	14088 SPEC 'B'	13	0.35%

OEM	Model	Total # of Engines by Engine Model	% of Total Engines by Engine Model
Cummins	6B5.9M	11	0.30%
Detroit Diesel	4-53	10	0.27%
Detroit Diesel	8V-71N 7082-3000	8	0.22%
EMD	16-LL16-645E4	8	0.22%
Cummins	VTA28	6	0.16%
Detroit Diesel	12006A	6	0.16%
EMD	16-567C	6	0.16%
Fairbanks Morse	10-38ND 8 1/8	6	0.16%
Caterpillar	3608	5	0.14%
Caterpillar	3512B DITA	4	0.11%
Caterpillar	D-399	4	0.11%
Detroit Diesel	12V-71T	4	0.11%
Detroit Diesel	16V-92	4	0.11%
Detroit Diesel	2-71 P2 2055	4	0.11%
Detroit Diesel	3-71RC 1033-7005	4	0.11%
Fairbanks Morse	6-38D 8 1/8	4	0.11%
Fairbanks Morse	38F 5-1/4	4	0.11%
Cummins	4B3.9M	2	0.05%
Cummins	KTA50-M	2	0.05%
Detroit Diesel	12V-71 7122-3000	2	0.05%
Detroit Diesel	6V-53 5062-7200	2	0.05%
Detroit Diesel	8V-71	2	0.05%
Fairbanks Morse	12-38D 8 1/8	2	0.05%
Volvo Penta	TAMD-41	2	0.05%
Cummins	KTA-2300G	1	0.03%
EMD	12-645E2	1	0.03%
Fairbanks Morse	8-38D 8-1/8	1	0.03%
Iveco	8061SRM33.12	1	0.03%

Notes:

(1) Miscellaneous engines were not included as part of these comparisons because fuel consumption and engine vintage were not available.

(2) Although part of the small boat matrix, USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV) were not included in as part of this comparison.

ENCLOSURE (8)

COMPARISON MATRIX, TOTAL NUMBER OF ENGINES BY VINTAGE

OEM	Engine Vintage	# of Engines by Vintage	% of Total Engines by Vintage
Alco	1970's	10	0.27%
Alco	1980's	2	0.05%
Alco	1990's	10	0.27%
Alco	2000's	4	0.11%
Caterpillar	1940's	4	0.11%
Caterpillar	1980's	28	0.76%
Caterpillar	1990's	187	5.09%
Caterpillar	2000's	64	1.74%
Colt-Pielstick	1980's	32	0.87%
Colt-Pielstick	1990's	16	0.44%
Colt-Pielstick	2000's	48	1.31%
Cummins	1960's	2	0.05%
Cummins	1970's	7	0.19%
Cummins	1980's	10	0.27%
Cummins	1990's	284	7.72%
Cummins	2000's	431	11.72%
Detroit Diesel	1940's	6	0.16%
Detroit Diesel	1950's	20	0.54%
Detroit Diesel	1960's	123	3.35%
Detroit Diesel	1970's	255	6.94%
Detroit Diesel	1980's	432	11.75%
Detroit Diesel	1990's	699	19.01%
Detroit Diesel	2000's	14	0.38%
EMD	1960's	7	0.19%
EMD	1970's	8	0.22%
EMD	1980's	12	0.33%
EMD	1990's	12	0.33%
EMD	2000's	8	0.22%
Fairbanks Morse	1960's	50	1.36%
Fairbanks Morse	1970's	23	0.63%
Fairbanks Morse	1980's	72	1.96%
Fairbanks Morse	1990's	42	1.14%
Fairbanks Morse	2000's	1	0.03%
Gray Marine	1990's	20	0.54%
Isotta-Fraschini	1980's	35	0.95%
Isotta-Fraschini	1990's	109	2.96%
Iveco	2000's	1	0.03%
MTU	1990's	40	1.09%
Northern Lights	1990's	20	0.54%
Onan	1970's	64	1.74%

OEM	Engine Vintage	# of Engines by Vintage	% of Total Engines by Vintage
Paxman	1990's	52	1.41%
Volvo Penta	1980's	210	5.71%
Volvo Penta	1990's	99	2.69%
Volvo Penta	2000's	37	1.01%
Waukesha	1980's	14	0.38%
Westerbeke	1990's	13	0.35%
Yanmar	2000's	40	1.09%
		3,677	

Notes:

(1) Miscellaneous engines were not included as part of these comparisons because fuel consumption and engine vintage were not available.

(2) Although part of the small boat matrix, USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV) were not included in as part of this comparison.

ENCLOSURE (9)

COMPARISON MATRIX, ENGINE RATINGS

OEM	Model	Total # of Engines	Model Year	Appli-cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
MTU	12V-396 TE94	40	1995	20	10	30	6	36
Caterpillar	3126TA	156	1997	20	10	30	2	32
Detroit Diesel	6088M	2	1991	20	10	30	2	32
Detroit Diesel	6V-53	23	1970	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	2	1967	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	2	1981	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	5	1984	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	16	1985	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	19	1986	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	11	1987	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	19	1990	20	10	30	2	32
Detroit Diesel	8V-71 7082-3000	3	1991	20	10	30	2	32
Detroit Diesel	8V-71TI	64	1979	20	10	30	2	32
Yanmar	6LY2-STE	40	2002	20	10	30	2	32
Detroit Diesel	12V-71	4	1966	20	2	22	6	28
Detroit Diesel	12V-71	4	1968	20	2	22	6	28
Detroit Diesel	12V-71	4	1977	20	2	22	6	28
Detroit Diesel	12V-71	4	2003	20	2	22	6	28
Cummins	6BT5.9M	3	1992	20	5	25	2	27
Cummins	6BT5.9M	3	1993	20	5	25	2	27
Cummins	6BT5.9M	16	1994	20	5	25	2	27
Cummins	6BT5.9M	38	1995	20	5	25	2	27
Cummins	6BT5.9M	29	1996	20	5	25	2	27
Cummins	6BT5.9M	12	1997	20	5	25	2	27
Cummins	6BT5.9M	24	1998	20	5	25	2	27
Cummins	6BT5.9M	4	1999	20	5	25	2	27
Cummins	6BT5.9M	17	2001	20	5	25	2	27
Cummins	6BT5.9M	9	2002	20	5	25	2	27
Cummins	6BT5.9M	1	2003	20	5	25	2	27
Cummins	6BTA5.9M2	2	1993	20	5	25	2	27
Cummins	6BTA5.9M2	7	1994	20	5	25	2	27
Cummins	6BTA5.9M2	2	1995	20	5	25	2	27
Cummins	6BTA5.9M2	3	1996	20	5	25	2	27
Cummins	6BTA5.9M2	2	2000	20	5	25	2	27
Detroit Diesel	6088M	2	1967	20	5	25	2	27
Detroit Diesel	6088M	1	1988	20	5	25	2	27
Detroit Diesel	6088M	2	1991	20	5	25	2	27
Detroit Diesel	6-71	1	1976	20	5	25	2	27
Detroit Diesel	6-71	4	1986	20	5	25	2	27
Detroit Diesel	6-71	2	1988	20	5	25	2	27
Detroit Diesel	6-71	2	1991	20	5	25	2	27
Detroit Diesel	6-71	1	1992	20	5	25	2	27
Detroit Diesel	8V-71 7082-3000	2	1993	20	5	25	2	27

OEM	Model	Total # of Engines	Model Year	Appli-cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
Detroit Diesel	8V-71 7082-3000	7	1994	20	5	25	2	27
Gray Marine	64HN9	2	1992	20	5	25	2	27
Gray Marine	64HN9	16	1993	20	5	25	2	27
Gray Marine	64HN9	2	1994	20	5	25	2	27
Iveco	8061SRM33.12	1	2003	20	5	25	2	27
Volvo Penta	AQAD41A	4	1988	20	5	25	2	27
Volvo Penta	AQAD41A	4	1989	20	5	25	2	27
Volvo Penta	AQAD41A	3	1990	20	5	25	2	27
Volvo Penta	AQAD41A	9	1991	20	5	25	2	27
Volvo Penta	AQAD41A	27	1992	20	5	25	2	27
Volvo Penta	AQAD41A	24	1993	20	5	25	2	27
Volvo Penta	AQAD41A	2	1994	20	5	25	2	27
Volvo Penta	AQAD41A	1	1996	20	5	25	2	27
Volvo Penta	AQAD41A	3	2000	20	5	25	2	27
Volvo Penta	AQAD41A	5	2001	20	5	25	2	27
Volvo Penta	AQAD41A	5	2002	20	5	25	2	27
Detroit Diesel	8V-71 7082-3000	4	1987	20	2	22	4	26
Detroit Diesel	8V-71TI	2	1966	20	2	22	4	26
Volvo Penta	TAMD-41	2	1989	20	2	22	4	26
Cummins	6BT5.9M	1	1988	20	2	22	2	24
Cummins	6BT5.9M	1	1989	20	2	22	2	24
Cummins	6BT5.9M	1	1991	20	2	22	2	24
Cummins	6BT5.9M	6	1992	20	2	22	2	24
Cummins	6BT5.9M	1	1993	20	2	22	2	24
Cummins	6BT5.9M	4	1993	20	2	22	2	24
Cummins	6BT5.9M	11	1994	20	2	22	2	24
Cummins	6BT5.9M	3	1995	20	2	22	2	24
Cummins	6BT5.9M	28	1996	20	2	22	2	24
Cummins	6BT5.9M	10	1997	20	2	22	2	24
Cummins	6BT5.9M	10	1998	20	2	22	2	24
Cummins	6BT5.9M	5	1999	20	2	22	2	24
Cummins	6BT5.9M	18	2000	20	2	22	2	24
Cummins	6BT5.9M	303	2001	20	2	22	2	24
Cummins	6BT5.9M	33	2002	20	2	22	2	24
Cummins	6BT5.9M	20	2003	20	2	22	2	24
Cummins	6BT5.9M	4	2005	20	2	22	2	24
Cummins	6BTA5.9M	4	2001	20	2	22	2	24
Cummins	6BTA5.9M	6	2002	20	2	22	2	24
Cummins	6BTA5.9M	2	2003	20	2	22	2	24
Cummins	6BTA5.9M2	2	1990	20	2	22	2	24
Cummins	6BTA5.9M2	1	1993	20	2	22	2	24
Cummins	6BTA5.9M2	6	1994	20	2	22	2	24
Cummins	6BTA5.9M2	6	2000	20	2	22	2	24
Detroit Diesel	6088M	1	1971	20	2	22	2	24

OEM	Model	Total # of Engines	Model Year	Appli-cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
Detroit Diesel	6088M	1	1986	20	2	22	2	24
Detroit Diesel	6088M	3	1988	20	2	22	2	24
Detroit Diesel	6088M	4	1991	20	2	22	2	24
Detroit Diesel	6-71	1	1967	20	2	22	2	24
Detroit Diesel	6-71	1	1970	20	2	22	2	24
Detroit Diesel	6-71	1	1974	20	2	22	2	24
Detroit Diesel	6-71	2	1975	20	2	22	2	24
Detroit Diesel	6-71	1	1977	20	2	22	2	24
Detroit Diesel	6-71	4	1978	20	2	22	2	24
Detroit Diesel	6-71	1	1981	20	2	22	2	24
Detroit Diesel	6-71	3	1983	20	2	22	2	24
Detroit Diesel	6-71	1	1984	20	2	22	2	24
Detroit Diesel	6-71	2	1985	20	2	22	2	24
Detroit Diesel	6-71	2	1986	20	2	22	2	24
Detroit Diesel	6-71	3	1987	20	2	22	2	24
Detroit Diesel	6-71	1	1988	20	2	22	2	24
Detroit Diesel	6-71	2	1989	20	2	22	2	24
Detroit Diesel	6-71	117	1990	20	2	22	2	24
Detroit Diesel	6-71	5	1991	20	2	22	2	24
Detroit Diesel	6-71	1	1993	20	2	22	2	24
Detroit Diesel	6-71	2	1994	20	2	22	2	24
Detroit Diesel	6-71	8	1995	20	2	22	2	24
Detroit Diesel	6-71	3	1996	20	2	22	2	24
Detroit Diesel	6-71	3	1997	20	2	22	2	24
Detroit Diesel	6-71	2	1998	20	2	22	2	24
Detroit Diesel	6-71	3	2001	20	2	22	2	24
Detroit Diesel	6-71	1	2002	20	2	22	2	24
Detroit Diesel	6-71	1	2003	20	2	22	2	24
Detroit Diesel	6V-53	1	1979	20	2	22	2	24
Detroit Diesel	6V-53	4	1985	20	2	22	2	24
Detroit Diesel	6V-53	4	1988	20	2	22	2	24
Detroit Diesel	6V-53	4	1990	20	2	22	2	24
Detroit Diesel	6V-53	2	1994	20	2	22	2	24
Detroit Diesel	6V-53	4	1995	20	2	22	2	24
Detroit Diesel	8V-71TI	1	1985	20	2	22	2	24
Detroit Diesel	8V-71TI	3	1990	20	2	22	2	24
Detroit Diesel	8V-71TI	4	1991	20	2	22	2	24
Detroit Diesel	8V-71TI	2	1997	20	2	22	2	24
Detroit Diesel	8V-71TI	2	1999	20	2	22	2	24
Volvo Penta	AQAD41A	36	1988	20	2	22	2	24
Volvo Penta	AQAD41A	164	1989	20	2	22	2	24
Volvo Penta	AQAD41A	10	1991	20	2	22	2	24
Volvo Penta	AQAD41A	3	1992	20	2	22	2	24
Volvo Penta	AQAD41A	2	1993	20	2	22	2	24

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Volvo Penta	AQAD41A	12	1994	20	2	22	2	24
Volvo Penta	AQAD41A	6	1996	20	2	22	2	24
Volvo Penta	AQAD41A	1	2000	20	2	22	2	24
Volvo Penta	AQAD41A	2	2001	20	2	22	2	24
Volvo Penta	AQAD41A	1	2003	20	2	22	2	24
Paxman	16RP200CM	12	1992	10	10	20	2	22
Paxman	16RP200CM	16	1993	10	10	20	2	22
Paxman	16RP200CM	16	1994	10	10	20	2	22
Paxman	16RP200CM	4	1995	10	10	20	2	22
Paxman	16RP200CM	4	1999	10	10	20	2	22
Coltec Industries	16-PC2.5V-RR1	4	1983	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	4	1984	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	4	1986	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	4	1987	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	8	1988	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	8	1989	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	8	1993	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	4	1994	10	5	15	6	21
Coltec Industries	16-PC2.5V-RR1	4	1996	10	5	15	6	21
Coltec Industries	PC2.5 STC	32	AU	10	5	15	6	21
Coltec Industries	PC2.5 STC	16	UC	10	5	15	6	21
Cummins	KTA50-M	2	1989	10	5	15	6	21
Detroit Diesel	12V-71 7122-3001	3	1984	10	5	15	4	19
Detroit Diesel	12V-71 7122-3001	4	1985	10	5	15	4	19
Detroit Diesel	12V-71 7122-3001	6	1986	10	5	15	4	19
Detroit Diesel	12V-71 7122-3001	6	1987	10	5	15	4	19
Detroit Diesel	12V-71 7122-7000	2	1957	10	5	15	4	19
Detroit Diesel	12V-71 7122-7000	2	1959	10	5	15	4	19
Detroit Diesel	12V-71 7122-7001	3	1984	10	5	15	4	19
Detroit Diesel	12V-71 7122-7001	4	1985	10	5	15	4	19
Detroit Diesel	12V-71 7122-7001	6	1986	10	5	15	4	19
Detroit Diesel	12V-71 7122-7001	6	1987	10	5	15	4	19
Detroit Diesel	16V-149TI	132	1976-1988	5	10	15	4	19
Detroit Diesel	12V-71	4	1994	10	2	12	6	18
Detroit Diesel	12V-71 7122-3000	2	1954	10	2	12	6	18
Detroit Diesel	16V-71	2	1943	10	2	12	6	18
Detroit Diesel	16V-71	2	1968	10	2	12	6	18
Detroit Diesel	16V-71	2	1973	10	2	12	6	18
Detroit Diesel	16V-71	2	1974	10	2	12	6	18
Detroit Diesel	16V-71	2	1976	10	2	12	6	18
Detroit Diesel	16V-71	4	1978	10	2	12	6	18
Detroit Diesel	16V-71	6	1979	10	2	12	6	18
Detroit Diesel	16V-71	2	1980	10	2	12	6	18

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Detroit Diesel	16V-71	2	1982	10	2	12	6	18
Detroit Diesel	16V-71	4	1983	10	2	12	6	18
Detroit Diesel	16V-71	2	1985	10	2	12	6	18
Detroit Diesel	16V-71	2	1986	10	2	12	6	18
Detroit Diesel	16V-71	4	1987	10	2	12	6	18
Detroit Diesel	16V-71	2	1988	10	2	12	6	18
Detroit Diesel	16V-71	4	1990	10	2	12	6	18
Detroit Diesel	16V-71	2	2003	10	2	12	6	18
Detroit Diesel	16V-92	4	1988	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	1	1962	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	1	1963	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	2	1964	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	2	1965	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	1	1966	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	3	1968	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	3	1969	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	4	1971	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	1	1972	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	3	1973	10	2	12	6	18
Fairbanks Morse	38D 8 1/8	4	1974	10	2	12	6	18
Caterpillar	3306B DITA	6	1992	5	10	15	2	17
Caterpillar	3306B DITA	8	1993	5	10	15	2	17
Caterpillar	3306B DITA	8	1994	5	10	15	2	17
Caterpillar	3306B DITA	2	1995	5	10	15	2	17
Caterpillar	3306B DITA	2	1999	5	10	15	2	17
Caterpillar	3512B DITA	4	UC	5	10	15	2	17
Cummins	6B5.9M	3	1994	10	5	15	2	17
Cummins	6BT5.9M	4	1991	10	5	15	2	17
Cummins	6BT5.9M	8	1992	10	5	15	2	17
Cummins	6BT5.9M	3	1993	10	5	15	2	17
Cummins	6BT5.9M	4	1994	10	5	15	2	17
Cummins	6BT5.9M	3	1995	10	5	15	2	17
Detroit Diesel	6-71	1	1971	10	5	15	2	17
Detroit Diesel	6-71	3	1989	10	5	15	2	17
EMD	16-567C	4	1960	5	10	15	2	17
EMD	16-LL16-645E4	4	1972	5	10	15	2	17
EMD	16-LL16-645E4	4	1975	5	10	15	2	17
EMD	16-LL16-645E5N	4	1980	5	10	15	2	17
EMD	16-LL16-645E5N	4	1984	5	10	15	2	17
EMD	16-LL16-645E5N	4	1988	5	10	15	2	17
EMD	16-LL16-645E5N	4	1990	5	10	15	2	17
EMD	16-LL16-645E5N	4	1993	5	10	15	2	17
EMD	16-LL16-645E5N	4	1996	5	10	15	2	17
EMD	16-LL16-645E5N	4	2001	5	10	15	2	17

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EMD	16-LL16-645E5N	4	2003	5	10	15	2	17
Fairbanks Morse	10-38ND 8 1/8	6	1960	5	10	15	2	17
Fairbanks Morse	12-38D 8 1/8	2	1967	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1979	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1980	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1981	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1982	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1983	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1984	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	2	1985	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1986	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1988	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1989	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1990	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1991	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1992	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1993	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1994	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1995	5	10	15	2	17
Fairbanks Morse	12-38ND 8 1/8	1	1996	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	2	1974	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	1	1976	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	2	1978	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1979	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1981	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	4	1982	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	4	1983	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	4	1984	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1985	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1986	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	2	1987	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	2	1988	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	1	1989	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1990	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1991	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	5	1992	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	2	1993	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	3	1994	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	2	1995	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	1	1997	5	10	15	2	17
Fairbanks Morse	8-38ND 8 1/8	1	UC	5	10	15	2	17
Isotta-Fraschini	36SS6V-AM	4	1986	10	5	15	2	17
Isotta-Fraschini	36SS6V-AM	4	1987	10	5	15	2	17
Isotta-Fraschini	36SS6V-AM	4	1988	10	5	15	2	17

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Isotta-Fraschini	36SS6V-AM	8	1989	10	5	15	2	17
Isotta-Fraschini	36SS6V-AM	12	1990	10	5	15	2	17
Isotta-Fraschini	36SS6V-AM	8	1991	10	5	15	2	17
Isotta-Fraschini	36SS6V-AM	4	1992	10	5	15	2	17
Isotta-Fraschini	36SS6V-AM	4	1993	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	2	1991	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	2	1992	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	6	1993	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	4	1994	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	4	1995	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	4	1996	10	5	15	2	17
Isotta-Fraschini	36SS8V-AM	2	1997	10	5	15	2	17
Northern Lights	ML844	20	1995	5	10	15	2	17
Onan	15MDJF4R4686D	64	1979	5	10	15	2	17
Waukesha	L1616DSIN	4	1985	10	5	15	2	17
Waukesha	L1616DSIN	4	1987	10	5	15	2	17
Westerbeke	14088 SPEC 'B'	2	1992	10	5	15	2	17
Westerbeke	14088 SPEC 'B'	2	1993	10	5	15	2	17
Caterpillar	3608 DITA	40	AU	5	5	10	6	16
Caterpillar	3608 DITA	20	UC	5	5	10	6	16
Caterpillar	D-399B-TA	4	1983	10	2	12	4	16
Caterpillar	D-399B-TA	12	1984	10	2	12	4	16
Cummins	VTA28	6	1989	5	5	10	6	16
Detroit Diesel	12V-71	6	1992	10	2	12	4	16
Detroit Diesel	12V-71	4	1998	10	2	12	4	16
Detroit Diesel	12V-71 7122-3001	1	1984	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	6	1967	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	10	1968	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	20	1969	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	2	1979	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	2	1984	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	2	1985	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	6	1986	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	6	1987	10	2	12	4	16
Detroit Diesel	12V-71 7122-7000	16	1992	10	2	12	4	16
Detroit Diesel	12V-71 7122-7001	1	1984	10	2	12	4	16
Detroit Diesel	16V-71	4	1992	10	2	12	4	16
Detroit Diesel	6-71	2	1967	10	2	12	4	16
Detroit Diesel	6-71	2	1968	10	2	12	4	16
Detroit Diesel	6-71	30	1989	10	2	12	4	16
Detroit Diesel	8V-71 7082-3000	4	1982	10	2	12	4	16
Detroit Diesel	8V-71 7082-3000	2	2000	10	2	12	4	16
Caterpillar	3608	5	1996	5	5	10	4	14
Cummins	4B3.9M	2	1975	10	2	12	2	14

OEM	Model	Total # of Engines	Model Year	Appli-cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
Cummins	6B5.9M	8	1994	10	2	12	2	14
Cummins	6BT5.9M	2	1969	10	2	12	2	14
Cummins	6BT5.9M	2	1970	10	2	12	2	14
Cummins	6BT5.9M	2	1971	10	2	12	2	14
Cummins	6BT5.9M	1	1991	10	2	12	2	14
Cummins	6BT5.9M	6	1993	10	2	12	2	14
Cummins	6BT5.9M	5	1995	10	2	12	2	14
Cummins	6BTA5.9M	6	2001	10	2	12	2	14
Cummins	6BTA5.9M2	6	1992	10	2	12	2	14
Cummins	6BTA5.9M2	2	1993	10	2	12	2	14
Detroit Diesel	12006A	6	1971	10	2	12	2	14
Detroit Diesel	12V-71	6	1959	10	2	12	2	14
Detroit Diesel	12V-71	2	1967	10	2	12	2	14
Detroit Diesel	12V-71	14	1968	10	2	12	2	14
Detroit Diesel	12V-71	12	1969	10	2	12	2	14
Detroit Diesel	12V-71	16	1970	10	2	12	2	14
Detroit Diesel	12V-71	20	1971	10	2	12	2	14
Detroit Diesel	12V-71 7122-3001	1	1987	5	5	10	4	14
Detroit Diesel	12V-71 7122-7001	1	1987	5	5	10	4	14
Detroit Diesel	3-71	1	1957	5	5	10	4	14
Detroit Diesel	3-71	1	1959	5	5	10	4	14
Detroit Diesel	4-53	8	1984	10	2	12	2	14
Detroit Diesel	4-53	1	1985	10	2	12	2	14
Detroit Diesel	4-53	1	1991	10	2	12	2	14
Detroit Diesel	6-71	1	1942	10	2	12	2	14
Detroit Diesel	6-71	3	1944	10	2	12	2	14
Detroit Diesel	6-71	2	1963	10	2	12	2	14
Detroit Diesel	6-71	1	1970	10	2	12	2	14
Detroit Diesel	6-71	1	1973	10	2	12	2	14
Detroit Diesel	6-71	2	1976	10	2	12	2	14
Detroit Diesel	6-71	1	1979	10	2	12	2	14
Detroit Diesel	6-71	2	1983	10	2	12	2	14
Detroit Diesel	6-71	1	1984	10	2	12	2	14
Detroit Diesel	6-71	1	1986	10	2	12	2	14
Detroit Diesel	6-71	1	1988	10	2	12	2	14
Detroit Diesel	6-71	8	1989	10	2	12	2	14
Detroit Diesel	6-71	2	1990	10	2	12	2	14
Detroit Diesel	6-71	1	1991	10	2	12	2	14
Detroit Diesel	6-71	1	1992	10	2	12	2	14
Detroit Diesel	6-71	1	1995	10	2	12	2	14
Detroit Diesel	6-71	1	1996	10	2	12	2	14
Detroit Diesel	6-71	2	1997	10	2	12	2	14
Detroit Diesel	6-71	3	1998	10	2	12	2	14
Detroit Diesel	6-71	1	1999	10	2	12	2	14

OEM	Model	Total # of Engines	Model Year	Appli-cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
Detroit Diesel	6-71	1	2001	10	2	12	2	14
Detroit Diesel	6-71 1062-5000	2	1957	10	2	12	2	14
Detroit Diesel	6-71 1062-5000	2	1979	10	2	12	2	14
Detroit Diesel	6-71 1062-5000	4	1989	10	2	12	2	14
Detroit Diesel	6-71 1062-5000	408	1992	10	2	12	2	14
Detroit Diesel	6-71 1062-7000	2	1981	10	2	12	2	14
Detroit Diesel	6-71 1062-7000	73	1989	10	2	12	2	14
Detroit Diesel	6V-53	6	1990	10	2	12	2	14
Detroit Diesel	6V-53 5062-700	14	1992	10	2	12	2	14
Detroit Diesel	6V-53 5062-7200	2	1990	10	2	12	2	14
Detroit Diesel	8V-71	2	1989	10	2	12	2	14
Detroit Diesel	8V-71N 7082-3000	2	1989	10	2	12	2	14
Detroit Diesel	8V-71N 7082-3000	4	1991	10	2	12	2	14
Detroit Diesel	8V-71N 7082-3000	2	1992	10	2	12	2	14
Fairbanks Morse	12-38ND 8 1/8	4	1983	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	4	1984	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	4	1986	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	4	1987	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	8	1988	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	8	1989	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	8	1993	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	4	1994	5	5	10	4	14
Fairbanks Morse	12-38ND 8 1/8	4	1996	5	5	10	4	14
Fairbanks Morse	38D 8 1/8	2	1963	10	2	12	2	14
Fairbanks Morse	38D 8 1/8	2	1982	10	2	12	2	14
Volvo Penta	AQAD41A	5	2001	10	2	12	2	14
Volvo Penta	AQAD41A	4	2002	10	2	12	2	14
Volvo Penta	AQAD41A	11	2003	10	2	12	2	14
Westerbeke	14088 SPEC 'B'	9	1993	10	2	12	2	14
Alco	16-251C	2	1973	5	5	10	2	12
Alco	16-251C	2	1974	5	5	10	2	12
Alco	16-251C	2	1977	5	5	10	2	12
Alco	16-251C	4	1978	5	5	10	2	12
Alco	16-251C	2	1987	5	5	10	2	12
Alco	16-251C	2	1991	5	5	10	2	12
Alco	16-251C	2	1992	5	5	10	2	12
Alco	16-251C	2	1993	5	5	10	2	12
Alco	16-251C	2	1996	5	5	10	2	12
Alco	16-251C	2	1997	5	5	10	2	12
Alco	16-251C	2	2001	5	5	10	2	12
Alco	16-251C	2	UC	5	5	10	2	12
Detroit Diesel	12V-71	2	1968	5	5	10	2	12
Detroit Diesel	12V-71	2	1969	5	5	10	2	12
Detroit Diesel	12V-71	2	1971	5	5	10	2	12

OEM	Model	Total # of Engines	Model Year	Appli-cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
Detroit Diesel	12V-71T	2	1968	5	5	10	2	12
Detroit Diesel	12V-71T	2	1970	5	5	10	2	12
Detroit Diesel	3-71	6	1984	5	5	10	2	12
Detroit Diesel	3-71	8	1985	5	5	10	2	12
Detroit Diesel	3-71	12	1986	5	5	10	2	12
Detroit Diesel	3-71	14	1987	5	5	10	2	12
EMD	12-645E2	1	1969	5	5	10	2	12
EMD	16-567C	1	1963	5	5	10	2	12
EMD	16-567C	1	1965	5	5	10	2	12
Fairbanks Morse	6-38D 8 1/8	2	1969	5	5	10	2	12
Fairbanks Morse	6-38D 8 1/8	2	1970	5	5	10	2	12
Fairbanks Morse	6-38F 5 1/4	4	1964	5	5	10	2	12
Fairbanks Morse	6-38F 5 1/4	4	1965	5	5	10	2	12
Fairbanks Morse	6-38F 5 1/4	8	1966	5	5	10	2	12
Fairbanks Morse	6-38F 5 1/4	2	1967	5	5	10	2	12
Fairbanks Morse	8-38D 8 1/8	1	1968	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	3	1986	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	3	1987	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	3	1988	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	6	1989	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	9	1990	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	6	1991	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	3	1992	5	5	10	2	12
Isotta-Fraschini	36SS6V-AM	3	1993	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	3	1991	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	3	1992	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	9	1993	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	6	1994	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	6	1995	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	6	1996	5	5	10	2	12
Isotta-Fraschini	36SS8V-AM	3	1997	5	5	10	2	12
Waukesha	L1616DSIN	3	1985	5	5	10	2	12
Waukesha	L1616DSIN	3	1987	5	5	10	2	12
Caterpillar	D-399B-TA	3	1983	5	2	7	4	11
Caterpillar	D-399B-TA	9	1984	5	2	7	4	11
Detroit Diesel	2-71 P2 2055	4	1954	5	2	7	4	11
Detroit Diesel	4-71	4	1994	5	2	7	4	11
Detroit Diesel	6-71	2	1962	5	2	7	4	11
Detroit Diesel	6-71	2	1963	5	2	7	4	11
Detroit Diesel	6-71	4	1964	5	2	7	4	11
Detroit Diesel	6-71	4	1965	5	2	7	4	11
Detroit Diesel	6-71	6	1968	5	2	7	4	11
Detroit Diesel	6-71	6	1969	5	2	7	4	11
Detroit Diesel	6-71	4	1971	5	2	7	4	11

OEM	Model	Total # of Engines	Model Year	Appli- cation Rating	Combat Criticality Rating	Application + Combat Criticality Rating	Total Annual Fuel Consumption Rating	Application + Combat Criticality + Total Annual Fuel Consumption Rating
Caterpillar	D-399	4	1945	5	2	7	2	9
Cummins	KTA-2300G	1	1977	5	2	7	2	9
Detroit Diesel	3-71	2	1984	5	2	7	2	9
Detroit Diesel	3-71RC 1033-7005	2	1967	5	2	7	2	9
Detroit Diesel	3-71RC 1033-7005	2	1968	5	2	7	2	9
Detroit Diesel	4-71	2	1966	5	2	7	2	9
Detroit Diesel	4-71	4	1971	5	2	7	2	9
Detroit Diesel	4-71	2	1972	5	2	7	2	9
Detroit Diesel	4-71	6	1973	5	2	7	2	9
Detroit Diesel	4-71	8	1974	5	2	7	2	9
Detroit Diesel	6-71	4	1998	5	2	7	2	9
Fairbanks Morse	38F 5 1/4	2	1963	5	2	7	2	9
Fairbanks Morse	38F 5 1/4	2	1982	5	2	7	2	9
Fairbanks Morse	6-38F 5 1/4	2	1963	5	2	7	2	9
Fairbanks Morse	6-38F 5 1/4	2	1966	5	2	7	2	9

The following variables make up the overall rating.

Engine Application

If the engine application is MPDE for a planning vessel it scores 20 and for a displacement vessel it scored 10.
If the engine application is either SSDG or EDG it scored 5,

Combat Criticality

If the vessel is a combatant it scored 10,
If the vessel is combatant support it scored 5,
If the vessel is a noncombatant it scored 2.

Annual Fuel Consumption for Diesel Engines on Ships

If the vessel's annual fuel consumption is greater than 500,000 it scored 6,
If the vessel's annual fuel consumption is between 100,000 and 500,000 it scored 4,
If the vessel's annual fuel consumption is less than 100,000 gallons it scored 2.

Annual Fuel Consumption for Diesel Engines on Boats/Craft/SPECWAR

If the vessel's annual fuel consumption is greater than 30,000 gallons it scored 6,
If the vessel's annual fuel consumption is between 10,000 and 30,000 gallons it scored 4,
If the vessel's annual fuel consumption is less than 10,000 gallons it scored 2.

Notes:

(1) Miscellaneous Engines were not included as part of these comparisons because fuel consumption and engine vintage were not available.

(2) Although part of the small boat matrix, USMC vehicles (AAV-7A1, AAV-7 MK1, and AAAV) were not included in as part of this comparison.

APPENDIX B

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4704-0049
March 12, 2007

To: Naval Surface Warfare Center, Carderock Division (Code 9823)
Attn: D. Guimond

Subj: CONTRACT N00024-99-C-4055, DELIVERY ORDER 0078, "DIESEL ENGINE ENGINEERING SUPPORT," JP-5 NAVY SINGLE FUEL AT SEA STUDY OF IMPACTS ON DIESEL ENGINES, TASK 2.2, QUANTIFY THE MAJOR PORTION OF FLEET DIESEL ENGINE MAINTENANCE COSTS AND PROJECT COST SAVINGS IF JP-5 IS USED AS THE SINGLE SHIPBOARD FUEL, FINAL REPORT (A003)

Ref: (a) Contract N00024-99-C-4055, Delivery Order 0078, "Diesel Engine Engineering Support", 18 December 2003
(b) Caterpillar Inc. Commercial Diesel Engine Fluid Recommendations dated April 1999

Encl: (1) Ships Diesel Engines Using JP-5
(2) Fuels Used on FFG-7 Class Ships (SSDGs)
(3) Fuel-related Corrective Maintenance Items for SSDGs and EDGs
(4) Diesel Engines Corrective Maintenance Actions on board Ships that are currently operating on F-76 (F-76), and JP-5 Fuel
(5) U.S. Navy MPDE/SSDG/EDG Maintenance Pool
(6) Fleet Technical Survey of DEI and Diesel Technical Representatives
(7) Diesel engine OEM survey

In accordance with reference (a), this final report is hereby submitted for your review and approval.

1. Summary

John J. McMullen Associates, Inc. (JJMA) was tasked to determine the impact of using JP-5 fuel instead of F-76 fuel on the maintenance and cost of U.S. Navy diesel engines. A report was developed that listed diesel engines on board naval ships currently using JP-5 fuel. These engines are from Fairbanks Morse (FM), Electro Motive Division (EMD) of General Motors, and Alco. From our review of approximately 100,000 corrective maintenance records from the Navy's 3M system Open Architecture Retrieval System (OARS) databases from 1995 to 2003, JP-5 fuel appears to have no detrimental effects on ship diesel engines. A review of the OARS database revealed no correlation between Total

Ownership Costs (TOC) and engines (FM/Alco, EMD, Detroit Diesel Corporation (DDC), and Fairbanks Morse) using F-76 or JP-5 fuel. As a result of this review (and subsequent discussions with engine original equipment manufacturers (OEMs), no cost savings appears to be evident if JP-5 fuel were used instead of F-76. A report provided the survey results from nine diesel engine inspectors (DEIs) and diesel technical representatives (DTRs). In this survey, no overall problems with the use of JP-5 fuel in Navy shipboard diesels were reported. There does appear to be some misinformation regarding perceived problems with using JP-5 fuel. Telephone surveys were conducted with diesel engine OEMs to discuss their experience with using JP-5 fuel in their engines, and to determine any impact on maintenance intervals. FM, Alco, EMD, DDC, Caterpillar, Motoren and Turbinen Union (MTU), Volvo Penta, Cummins, and Isotta Fraschini (I-F) stated that JP-5 fuel is acceptable for use in the engines they have sold to the Navy. Most of the OEMs stated that there could be a 6 to11 percent loss of power when using JP-5 fuel if their engines are not adjusted to compensate for the fuels lower specific gravity. The engine OEMs listed above stated that they have little or no data to substantiate any impact on maintenance intervals. Westerbeke and Onan do not recommend the use of JP-5 fuels in their prime movers.

2. Discussion/Findings

JJMA was tasked to define and integrate information available from engine OEMs, labs, and literature to identify the impact on fleet marine diesel engines if JP-5 fuel were phased in as the single naval at-sea shipboard fuel. JJMA was also tasked to quantify the major portion of the fleet diesel engine maintenance costs and project cost savings if JP-5 were used instead of the current fuel, F-76. This study was limited to Navy ships, boats, and craft. MSC, Coast Guard, and Marine Corps engines were not included. Our findings are contained in enclosures 1 through 7, as discussed.

Enclosure (1) lists diesel engines on board naval ships currently using JP-5 fuel. These engines are from FM, Alco, and EMD. All of the engines listed in Enclosure (1) are emergency diesel generator (EDG) engines on CV, CVN, LHA, and LHD class ships. JP-5 is considered the fuel of choice for these EDGs, as it is the prime fuel on board for the jet and helicopter engines carried on these ships.

Enclosure (2) lists the FFG 7 class Ship Service Diesel Generators (SSDGs), the fuel currently being used (in bold face), a history of fuel usage, their homeport, and their Command. Most of these ships have used JP-5 fuel (underlined) for their SSDGs in the past, but all the ships listed have switched back to F-76 as their current fuel as a result of the removal of the helicopters from the ships. This data was taken from available Fleet Diesel Engine Inspector reports for the periods between 1989 and 2003.

A review of craft and boat engines reveals that these engines are using F-76 fuel.

Enclosure (3), (405 records), lists of all corrective maintenance items for SSDG and EDG engines on board Navy ships, and whether the corrective maintenance actions appear to be fuel-related or JP-5-related.

Enclosure (4), (74 records) is a subset of Enclosure (3) lists corrective maintenance actions that may be fuel-related for Navy ship SSDG and EDG diesel engines. While all of the corrective maintenance actions appear to be fuel-related, engines using JP-5 fuel do not appear to experience any adverse effects.

In our review of approximately 100,000 corrective maintenance records from the Navy's 3M system databases (pertinent CASREP data is a subset of the reviewed 3M data and is a part of the corrective maintenance action reports) from 1995 to 2003, we found that JP-5 fuel does not have any detrimental effects on ship diesel engines.

Main propulsion engines are not listed, as these engines are comparable to the SSDG and EDG engines and do not use JP-5 fuel. Corrective maintenance action narratives in enclosures (3) and (4) were taken verbatim from the 3M data (including associated spelling errors). Engine hours were not obtained because they were not recorded by anyone submitting a TWO KILO report form (form used to submit corrective maintenance actions). Leaky hoses, out-of-calibration gauges, out-of-adjustment governors, fuel racks, etc., were not included in enclosure (3) or (4).

Full power load performance tests are conducted periodically for all diesel generator sets using F-76 as well as JP-5 fuel. No corrective maintenance actions were listed to indicate that the diesel generator sets using JP-5 were unable to achieve and maintain 100-percent power. This was also true for engines using F-76. No increased wear or part change out were evident on fuel-wetted parts (pistons, rings, cylinder liners, intake and exhaust valves, cylinder heads, injectors, fuel pumps) as a result of using JP-5 fuel. Leaky fuel injectors and pumps for engines using either F-76 or JP-5 fuel are due to carbon buildup (as a result of low-load operation) or poorly rebuilt components. Also, it was noted that some of the engines were still using old-style injectors and pumps. Engine manufacturers have improved their component designs to reduce fuel leakage. Engine overhaul life did not appear to be affected by either fuel. Maintenance records revealed that requests for outside activities to overhaul their engines were due to the fact that the engines had surpassed, or were approaching the end of their useful prescribed overhaul life regardless of the fuel used, or as a result of a non-fuel-related casualty. No fuel oil lubricity maintenance action issues were evident using either fuel. None of the engines experienced startability problems regardless of the fuel being used. No maintenance action listed indicates any reliability problems for engines using JP-5 or F-76 fuel.

Enclosure (5) lists fleet MPDE, SSDG, and EDG diesel engines, their quantity, overhaul cost per engine, estimated hours between overhaul, CY-03 fuel-related and total corrective maintenance actions, and CY-03 fuel-related TOC and total TOC (TOC retrieved from OARS database generated reports. Fuel related TOC=TOC x Fuel Relate Corrective Maintenance Actions/Fuel Related Corrective Maintenance Actions). A review of the OARS database provided very little data on small engines or boat engines. No corrective maintenance actions were shown for these engines in the OARS database. Only repair parts costs were listed and are shown for these engines in the CY-03 TOC column.

The fuel-related corrective maintenance actions and corresponding fuel-related TOC are extremely small compared to the non-fuel-related maintenance actions and TOC. Therefore, based on the data in enclosure (5), we find no correlation regarding TOC and engines (FM/Alco, EMD) using F-76 or JP-5 fuel.

Enclosure (6) provides the survey results of nine DEIs and DTRs. The feedback from the recipients of this survey shows that no overall problems were reported with the use of JP-5 fuel in Navy shipboard diesels. However, there does appear to be some misinformation about JP-5 fuel characteristics as evidenced with one interviewee (COMNAVSURFLANT Diesel Manager and DEI). Also, a DEI reported specific problems with his engines that were not caused by the use of JP-5 fuel. For instance, the occasional "burnt" exhaust valve and higher exhaust gas temperatures experienced on LSTs were due to an air intake ventilation problem with the LST class of ships. Ventilation system lineup was critical onboard LSTs and, if not aligned properly, would cause a high engine inlet restriction. This caused higher than normal exhaust gas temperatures and, if left unchecked, cause "burnt" exhaust valves.

Enclosure (7) provides the survey results from the Navy diesel OEMs interviewed. FM/Alco, EMD, DDC, Caterpillar, MTU, Volvo Penta, Cummins, and I-F stated that JP-5 fuel is acceptable for use in the engines they have sold to the Navy. The OEMs that approved the use of JP-5 fuel require a minimum Cetane number of 40 for engine startability and performance. (Minimum Cetane number is not specified in the JP-5 fuel specification.) Caterpillar recommends a minimum viscosity of 1.4 centistokes @ 100°F at the fuel injection pump (ref. (b)). Volvo stated that if their engines are equipped with rotary injection pumps, the JP-5 should be blended with 1- to 2-percent low ash lubricating oil to improve lubricity. MTU uses imbedded engine sensors to adjust its engines fuel combustion characteristics for the different fuels that can be used in them. Most of the OEMs stated, there could be a 6 to 11 percent loss of power when using JP-5 fuel if their engines are not adjusted to compensate for the fuels lower specific gravity.

All of the engines sold to the Navy by the OEMs listed above (except Volvo Penta) have been accepted by the Navy and tested with JP-5 fuel per MIL-E-23457 (medium-speed engines) or MIL-E-24455 (high-speed engines). These OEMs stated that they have little or no data to substantiate any impact on maintenance intervals. Other specific feedback included the following:

- Westerbeke and Onan do not recommend the use of JP-5 fuels in their engines. Westerbeke stated that the CAV fuel pump on all Perkins engines (as the prime mover of the Westerbeke generator set) would not effectively pump the JP-5, and that the pump would fail in a short time due to the poor lubricity characteristics. Westerbeke would be willing to modify the CAV pump to accept JP-5 fuel if the Navy decides to accept JP-5. Onan stated that JP-5 fuel should not be used due its poor lubricity characteristics.
- Waukesha would not discuss JP-5 fuel usage in the Waukesha L1616DSIN engine as it stopped producing the engine and parts in the early 1980's.
- Paxman has been recently sold to MAN/BW. As a result of a major, continuing reorganization, no one contacted had the experience to discuss JP-5 use in the Navy Paxman engine.

3. Conclusions

From our study of the impact of using JP-5 fuel on the Navy's diesel engines, JJMA has concluded the following:

- There is no Navy data (3M (OARS), DEI reports, ships operating logs), or diesel OEM data to indicate any savings in maintenance costs if the Navy were to use JP-5 fuel as a single shipboard fuel.

- All of the carbon buildup problems noted in enclosure (4) were due to low load engine operations (carbon buildup is primarily due to low load operation). While JP-5 fuel does burn cleaner than F-76 (due to its inherent lower sulfur content), it is questionable that this would, in itself reduce the engines' carbon buildup.

- All of the Navy diesel engines above 100 BHP are MILSPEC qualified (including all DDC engines, regardless of horsepower), and as such have been tested with and qualified to use JP-5 fuel.

- In our review of the OARS database, we found that none of the Navy diesel engines that have used or, are currently using JP-5 fuel experienced any performance problems. The fuel did not interfere with the engines ability to achieve full rated power.

- Most of the Navy's medium-speed diesel engines (FM, EMD, and Alco) have used or are currently using JP-5 fuel with no adverse effects. (Although there is no data to indicate that the Colt Pielstick PC 2.5 main propulsion diesel engine onboard LSD 41 class ships has ever used JP-5 fuel, JP-5 fuel was used in the engine as part of the Navy acceptance test in accordance with MIL-E-23457B.)

- The Navy FM, EMD, and Alco diesel engines that are using JP-5 are all shipboard EDGs, and as such should never require overhaul (average use is 300 hours/year). Little or no JP-5 fuel-related corrective maintenance was evident.

- The DDC 149TI prime mover onboard FFG 7 class ships used JP-5 fuel in the past with no adverse effects.

- The only prime mover engines that cannot use JP-5 fuel are the Westerbeke and Onan generator set engines. Both Westerbeke and Onan stated that the engines' attached fuel injection pump would seize due to the inherent lower lubricity of JP-5.

- Most fleet diesel operators have little knowledge of JP-5 fuel oil, and in some cases have provided misinformation about the use of JP-5 in diesel engines.

- None of the fleet diesel users submits engine hours when submitting corrective action/parts requisition reports (although an entry space exists on the TWO-KILO form).

4. Recommendations

To determine long-term savings in maintenance costs when using JP-5 fuel, medium-speed and high-speed diesel engines should be tested in a laboratory under controlled conditions. Parallel engine tests, using the same brand and series of engine should be conducted, with one engine using F-76 and the other engine using JP-5 fuel. Each engine should undergo a 1000-hour endurance test in accordance with MIL-E 23457 (medium-speed diesel engines) or MIL-E-24455 (high-speed diesel engines). These tests will also determine if the engine can achieve the required 110 percent power rating as required for Navy-accepted diesel engines. Before starting the endurance test, each engine should be disassembled and blueprinted. The engines should be disassembled and blueprinted again after successfully completing the cyclic endurance test to determine wear rates. Fuel consumption measurements and lube oil analysis should be taken throughout the test.

JJMA also recommends the following:

- Continue the JP-5 fuel investigation by studying Coast Guard, MSC, and Marine Corps use and experience with this fuel.

- Develop and conduct a 45-minute presentation on JP-5 characteristics and uses at DEI seminars. The DEIs will, in turn, educate the diesel operators about the use of JP-5 fuel in their cognizant diesel engines.

- Modify JP-5 fuel specifications to include a minimum Cetane number of 40.

- Ensure that engine hours are listed on any corrective action report/parts requests (TWO-KILO form) submitted to the supply system by ship's force.

- Conduct laboratory fuel injection pump tests (motoring the fuel pump) for small in-line and rotary pumps with JP-5 fuel as the pumping medium.

- Task and fund Westerbeke and Onan to modify their fuel injection pumps as necessary to accept JP-5 fuel.

- Compare Caterpillar recommended fuel specification to the Navy JP-5 fuel spec to ensure compatibility of the proposed fuel with Caterpillar's fuel recommendations

Please direct any questions about this deliverable to Peter Grotsky (727-204-8798), Bill Remley (412-473-6123), or Kim Fledderman (412-473-6181).

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Enclosure (1)

SHIP DIESEL ENGINES CURRENTLY USING JP-5

SHIP DIESEL ENGINES CURRENTLY USING JP-5

Class Ship	Ship	Mfr	Model	# / Ship	Application	Power	RPM	Stroke	NA/Turb
CV-63	CV 63	FM	10-38ND 8 1/8	3	EDG	1440 HP	720	2	Blower
CV-63	CV 64	FM	10-38ND 8 1/8	3	EDG	1440 HP	720	2	Blower
CV-67	CV 67	FM	12-38D 8 1/8	2	EDG	2250 HP	900	2	Blower
CVN-65	CVN 65	EMD	16-567C	4	EDG	1490 HP	720	2	Turbo
CVN-68	CVN 68	EMD	16-LL16-645E4	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 69	EMD	16-LL16-645E4	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 70	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 71	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 72	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 73	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 74	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 75	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 76	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
CVN-68	CVN 77	EMD	16-LL16-645E5N	4	EDG	2700 HP	900	2	Turbo
LHA-1	LHA 1	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHA-1	LHA 2	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHA-1	LHA 3	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHA-1	LHA 4	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHA-1	LHA 5	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 1	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 2	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 3	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 4	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 5	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 6	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 7	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo
LHD-1	LHD 8	ALCO	16-251C	2	EDG	2800 HP	900	4	Turbo

Enclosure (2)

FUELS USED ON FFG 7 CLASS SHIPS (SSDGs)

FUELS USED ON FFG 7 CLASS SHIPS (SSDGs)

SHIP	FUELS USED (MOST RECENT BOLD FACED)	HOME PORT	COMMAND
FFG-8	NR	MAYPORT, FL	SURFLANT
FFG-28	NR	MAYPORT, FL	SURFLANT
FFG-29	NR	PASCAGOULA, MS	SURFLANT
FFG-32	NR	PASCAGOULA, MS	SURFLANT
FFG-33	**6/03-F-76** (F-76, 5/03-F-76 (F-76), 11/02-F-76, 10/01-F-76, 5/01 F-76, 5/99-F-76, 5/98-F-76, 1/98-F-76, 7/97-F-76, 6/97-F-76, 4/97-F-76, 7/96-F-76, 10/95-F-76, 9/95-JP-5, 12/91-F-76, 9/91-F-76, 8/89-F-76,	SAN DIEGO, CA	SURFPAC
FFG-36	3/03-**F-76**	SAN DIEGO, CA	SURFPAC
FFG-37	**9/01-F-76**, 6/01-F-76, 6/99-F-76, 3/99-F-76, 1/97-F-76, 4/96-F-76, 4/94-JP-5, 4/91-JP-5	PEARL HARBOR, HI	SURFPAC
FFG-38	**4/03-F-76 (F-76)**, 1/03-F-76, 3/01-F-76, 2/01-F-76, 6/00-F-76, 7/99-F-76, 5/99-F-76, 12/97-F-76, 5/96-JP-5	SAN DIEGO, CA	SURFPAC
FFG-39	NR	MAYPORT, FL	SURFLANT
FFG-40	NR	MAYPORT, FL	SURFLANT
FFG-41	**7/03-F-76 (F-76)**, 5/03-F-76, 10/02-F-76, 8/01-F-76, 3/01-F-76, 10/98-F-76, 10/93-F-76, 7/92-JP-5, 5/92-JP-5, 8/90-JP-5, 6/90-JP-5, 4/90-F-76, 8/89-JP-5	SAN DIEGO, CA	SURFPAC
FFG-42	NR	SAN DIEGO, CA	SURFPAC
FFG-43	**7/03-F-76,** 6/03-F-76, 12/02-F-76, 3/01-F-76, 1/01-F-76, 3/00-F-76, 6/99-F-76, 5/95-F-76	SAN DIEGO, CA	SURFPAC
FFG-45	NR	MAYPORT, FL	SURFLANT

SHIP	FUELS USED (MOST RECENT BOLD FACED)	HOME PORT	COMMAND
FFG-46	**3/03-F-76**, 8/00-F-76, 3/97-F-76, 5/96-F-76, 5/99-F-76, 12/97-F-76, 12/94-JP-5, 6/94-F-76, 6/93-JP-5, 5/92-JP-5, 2/91-JP-5, 2/90-JP-5	SAN DIEGO, CA	SURFPAC
FFG-47	NR	NORFOLK, VA	SURFLANT
FFG-48	**5/00-F-76**, 10/99-F-76, 10/98-F-76, 10/97-F-76, 12/93-F-76, 1/97-F-76, 3/91-JP-5	YOKOUSKA, JAPAN	SURFPAC
FFG-49	NR	MAYPORT, FL	SURFLANT
FFG-50	NR	MAYPORT, FL	SURFLANT
FFG-51	**7/02-F-76**, 5/02-F-76, 10/00-F-76, 12/98-F-76, 5/97-F-76, 8/96-F-76, 11/94-JP-5	YOKOUSKA, JAPAN	SURFPAC
FFG-52	NR	NORFOLK, VA	SURFLANT
FFG-53	NR	NORFOLK, VA	SURFLANT
FFG-54	**6/98-F-76**, 8/97-F-76, 9/96-F-76, 8/95-F-76, 7/91-F-76	EVERETT, WA	SURFPAC
FFG-55	NR	NORFOLK, VA	SURFLANT
FFG-56	NR	MAYPORT, FL	SURFLANT
FFG-57	**9/01-F-76,** 5/01-F-76, 4/01-F-76, 9/99-JP-5, 2/99-F-76, 10/96-F-76, 7/96-F-76,	PEARL HARBOR, HI	SURFPAC
FFG-58	NR	MAYPORT, FL	SURFLANT
FFG-59	NR	NORFOLK, VA	SURFLANT
FFG-60	NR	EVERETT, WA	SURFPAC
FFG-61	**3/03-F-76**	EVERETT, WA	SURFPAC

NR=NOT RECORDED
SURFLANT 16 SHIPS
SURFPAC 14 SHIP

Enclosure (3)

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
AFDM 10	CAT	D399	SSDG	F-76	2/4/03	#2 EMERGENCY DIESEL GENERATOR FUEL DILUTION HAS EXCEEDED NORMAL RANGE	Y
AGF 03	FM	38D 8 1/8	EDG	F-76	5/10/02	#1 EDG VERTICAL DRIVE OUTER GRIDMEMBER RETAINER WAS FOUND TO BE CRACKED	N
AGF 03	FM	38D 8 1/8	EDG	F-76	1/18/03	#1 EDG LO STORAGE TANK LOWER LEVEL INDICATING VALVE AND PIPE IS BROKEN OFF WERE THE LINE IS WELDED TO THE TANK	N
AGF 03	FM	38D 8 1/8	EDG	F-76	1/18/03	#2 EDG LO STORAGE TANK NEEDS SIGHT GLASS INDICATOR INSTALLED TO ENABLE TO MONITOR TANK LEVEL.	N
AGF 03	FM	38D 8 1/8	EDG	F-76	4/11/03	#1EDG SW COOLER REQUIRES ZINC ANODE REPLACEMENTS DUE TO DETERIORATED ELEMENT	N
AGF 03	FM	38D 8 1/8	EDG	F-76	5/7/03	FOUND BROKEN WELDED STUD ON THE EMERGENCY DIESEL VERTICAL DRIVE SHAFT	N
AGF 03	FM	38D 8 1/8	EDG	F-76	5/14/03	EDG FLANGE SHIELDINGS ARE WORN OUT AND NEED TO BE REPLACED	N
AGF 03	FM	38D 8 1/8	EDG	F-76	9/20/03	NR 2 EDG ATTACHED SEAWATER PUMP MECHANICAL IS LEAKING THOUGH THE TELLTALE HOLE	N
AGF 03	FM	38D 8 1/8	SSDG	F-76	7/10/03	ATTACHED SALT WATER PUMP MECHANICAL OIL SEAL IS LEAKING	N
AGF 11	FM	38F 5 1/4	EDG	F-76	9/19/02	#1 FUEL OIL PMP WAS FAULTY	N
AGF 11	FM	38F 5 1/4	EDG	F-76	10/16/02	NR2 EDG AUXILIARY DRIVE GEAR BACKLASH IS OVER SPECIFICATION	N
AGF 11	FM	38F 5 1/4	EDG	F-76	1/17/03	OIL TEMP PROBE STUCK AND UNABLE TO REMOVE. XXX REQUEST REPAIR ACTIVITY TO INSPECT AND REMOVE STUCK OIL TEMP PROBE	N
AGF 11	FM	38F 5 1/4	EDG	F-76	2/11/03	NUMBER 1 EDG FUEL INJECTION NOZZLES LEAKS BY DURING OPERATION CAUSING IMPROPER COMBUSTION.	Y
AGF 11	FM	38F 5 1/4	EDG	F-76	2/11/03	NUMBER 2 EDG FUEL INJECTION NOZZLES LEAKS BY DURING NORMAL OPERATION, CAUSING IMPROPER COMBUSTION	Y
AGF 11	FM	38F 5 1/4	EDG	F-76	7/16/03	NO.2 EDG S/W PUMP FOUNDATION	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
						IS SEVERELY CORRODED	
AOE 02	FM	38F 5 1/4	EDG	F-76	2/25/02	7 INJECTOR BUTTON RETAINING SPRINGS BROKEN	N
AOE 03	FM	38F 5 1/4	EDG	F-76	2/21/03	DIESEL ENGINE JACKET WATER COOLER WAS DRAINED FOR REPAIRS AND INSPECTION	N
AOE 03	FM	38F 5 1/4	EDG	F-76	3/20/03	FUEL OIL DISCHARGE GAGE, SCAVENGING AIR GAGE HAVE FAILED CALIBRATION	N
AOE 03	FM	38F 5 1/4	EDG	F-76	3/20/03	DURING SHIPS FORCE DIESEL ENGINE INSPECTION BY FTSCLANT MR VERDESCHI,IT WAS NOTED THAT THE INSPECTION COVER FOR THE VERTICAL DRIVE SHAFT HAS A BROKEN STUD	N
AOE 03	FM	38F 5 1/4	EDG	F-76	7/17/03	#5,6,7,8 CYLINDER RELIEF VALVES ARE BAD	N
AOE 07	FM	38F 5 1/4	EDG	F-76	2/25/02	THE J/W PIPING TO RIGHT BANK PUMP IS LEAKING	N
AOE 07	FM	38F 5 1/4	EDG	F-76	3/12/02	NR.1 SS/EDG RIGHT BANK J/W PUMP IS LEAKING FROM PUMP SEAL	N
AOE 07	FM	38F 5 1/4	EDG	F-76	3/20/02	NR. 3 SS/EDG JACKET WATER PIPING IS LEAKING	N
AOE 07	CAT	3608	EDG	F-76	1/15/03	NR. 1 SS/EDG FLYWHEEL RING GEAR HAS 4 MISSING TEETH IN A ROW WITH ANOTHER 4 RIGHT BESIDE THAT ARE DAMAGED	N
AOE 07	CAT	3608	EDG	F-76	2/15/03	NR. 1 SS/EDG WAS FOUND TO HAVE BENT VALVE AND INJECTOR PUSH RODS	N
AOE 07	CAT	3608	EDG	F-76	3/14/03	NR. 1 SS/EDG REQUIRES ALL 8 HEADS REMOVED AND O RINGS REPLACED	N
AOE 07	CAT	3608	EDG	F-76	3/28/03	NR. 1 SS/EDG J/W EXPANSION JOINT IS WORN AND DAMAGED CAUSING THERMOSTAT ADAPTOR TO BREAK	N
AOE 07	CAT	3608	EDG	F-76	4/27/03	NR. 3 SS/EDG FUEL OIL FILTERS REQUIRE REPLACEMENT	N
AOE 07	CAT	3608	SSDG	F-76	1/5/03	NR 2 SS/EDG J/W PUMP MECH. SEAL LEAKS	N
AOE 07	CAT	3608	SSDG	F-76	2/2/03	NR2 SS/EDG PUSHRODS WHERE FOUND TO BE BENT	N
AOE 07	CAT	3608	SSDG	F-76	3/12/03	NR. 5 SS/EDG NR. 8 HEAD WAS FOUND TO BE LEAKING J/W FROM	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
						O RINGS	
AOE 07	CAT	3608	SSDG	F-76	4/19/03	NR. 2 SS/EDG HAS LEAK ON F/O MANIFOILD	N
AOE 08	CAT	3608	EDG	F-76	1/28/02	NR1 SS/EDG CYLINDER HEAD WAS LEAKING AND REQUIRES O-RING REPLACEMENT	N
AOE 10	CAT	3608	EDG	F-76	2/20/02	NR 3 SSEDG NR 8 CYLINDER EXPERIENCING HIGH EXHAUST TEMPERATURES	N
AOE 10	CAT	3608	EDG	F-76	11/5/02	NUMBER SEVEN CYLINDER EXHAUST ELBOW HAS A CRACK IN THE AFT FLANGE	N
AOE 10	CAT	3608	EDG	F-76	4/24/03	NR. 5 SS/EDG EXPERIENCED HIGH CYLINDER TEMPS ON NR. 4 AND LOW CYLINDER TEMPS ON NR. 7 CYLINDER.	N
AOE 10	CAT	3608	EDG	F-76	5/23/03	NR 5 SS/EDG HAS FAULTY CYLINDER PYROMETERS	N
AOE 10	CAT	3608	EDG	F-76	9/20/03	NR3 SS/EDG NR 8 CYL HAS DAMAGED FUEL INJECTOR PUSHROD	N
AOE 10	CAT	3608	EDG	F-76	10/17/03	NR 3 SS/EDG JACKET WATER PIPING IS LEAKING DUE TO FAILED O RINGS	N
ARS 50	CAT	D399	SSDG	F-76	5/6/03	DURING DIESEL INSPECTION NUMEROUS FUEL OIL INJECTORS, PUMPS AND JUMPER LINES LEAK	Y
ARS 51	CAT	D399	SSDG	F-76	1/29/03	FUEL NOZZELS ARE CLOGGED	Y
ARS 51	CAT	D399	SSDG	F-76	6/1/03	THAT THE FUEL NOZZLES FOR ALL CYLINDERS NEED TO BE REPLACE	N
ARS 52	CAT	D399	EDG	F-76	2/20/02	2SGB, F/O NOZZLES ARE CLOGGED	Y
ARS 52	CAT	D399	EDG	F-76	6/27/02	2SGB SSDG REAR CRANKSHAFT OIL SEAL LEAKS	N
ARS 52	CAT	D399	EDG	F-76	7/8/02	2SGB SSDG HAS LEAKING CRANKSHAFT REAR SEAL	N
ARS 52	CAT	D399	EDG	F-76	10/29/02	2A MPDE GOVERNOR FAILS TO OPERATE IN MECHANICAL	N
ARS 52	CAT	D399	EDG	F-76	1/9/03	L/O SUMP AND J/W EXPANSION TANK CONTAMINATED WITH WATER AND OIL. S/F SUSPUCT RUPTURE L/O COOLER	N
ARS 52	CAT	D399	EDG	F-76	2/5/03	2SGB MANOMETERS ARE EXCESSIVELY DETERIORATED	N
ARS 52	CAT	D399	EDG	F-76	4/11/03	2SGB MECH.SHUT DOWN CABLE ASSEMBLY IS WORN	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
ARS 52	CAT	D399	EDG	F-76	8/26/03	2SGB SSDG SALT WATER ELBOW ON THE INLET SIDE OF THE AFTERCOOLER LEAKS	**N**
ARS 52	CAT	D399	EDG	F-76	102103	2SGB FUEL OIL STRAINERS ARE PARTLLY CLOGGED	**Y**
ARS 53	CAT	D399	SSDG	F-76	11/18/03	12 OF 16 PISTONS ARE CRACKED	**N**
ARS 53	CAT	D399	SSDG	F-76	11/18/03	ALL INJECTION NOZZELS WERE FOULED	**Y**
AS 39	FM	38D 8 1/8	EDG	F-76	3/13/03	SHIPS EMERGENCY DIESEL GENERATOR WILL NOT START.XXX SHIPS FORCE HAS DETERMINED THAT THE HP AIR REDUCER IS NOT FUNCTIONING	**N**
AS 39	FM	38D 8 1/8	EDG	F-76	6/25/03	ENGINE LUBE OIL RELIEF LEAKS ON THE FLANGE CONNECTION	**N**
AS 39	FM	38D 8 1/8	EDG	F-76	6/25/03	EMERGENCY DIESEL SALT WATER BOOSTER PUMP FOR THE EDG FAILED TO OPERATE WHEN DIESEL WAS STARTED IN MANUAL MODE	**N**
AS 40	FM	38D 8 1/8	EDG	F-76	8/26/02	SCAVENGING AIR BLOWER HAS LEAK	**N**
AS 40	FM	38D 8 1/8	EDG	F-76	1/9/03	EDG FUEL OIL RACK TRIP CABLE FOUND TO BE FRAYED DURING DIESEL INSPECTION	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/14/03	DURING OPERARATIONAL TEST FUEL WAS SEEN FROM THE TALETELL PIPE INDICATING A POSSIBLE CLOGGED NOZZLE ON 3 EDG	**Y**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/15/03	RELIEF VAL. UNION IS LEAKING	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/15/03	DURING OPERABILITY TESTS S/F DICOVERED 4 DEFECTIVE NOZZLES ON NR 3 EDG	**Y**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/16/03	DURING NORMAL OPERATION, SHIPS FORCE DISCOVERED THAT 4 INJECTOR NOZZLES ON NR 3 DIESEL GENERATOR WERE DEFECTIVE	**Y**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/20/03	WHILE CONDUCTING OPERATIONAL TEST FOR 3 EDG, SHIPS FORCE DICOVERED 2 EXHAUST INSPECTION COVERS AND GOVERNOR BASE GASKET LEAKING	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	3/14/03	DURING NORMAL OPERATION, CARBON MAY POSSIBLY BUILD UP ON ENGINE EXHAUST PORTS	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	4/4/03	AIR REDUCERS ARE OPERATING ERRATICALLY AND INCONSISTENTLY	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	7/29/03	20 INJECTOR NOZZLES FAILED TESTING DUE TO EXCESSIVE CARBON BUILD UP	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	9/11/03	# 3 EDG TRIPPED OFFLINE ON LOW LUBE OIL PRESSURE ALARM	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	9/15/03	THE FUEL OIL REMOTE VALVE SHUTDOWN LEAKS BY	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	10/2/03	THE HYDRAULIC GOVERNOR WAS SLUGGISH	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	12/16/03	THE FUEL RACKS ON THE DIESELS ARE OUT OF SPEC	**N**
CV 64	FM	38D 8 1/8	EDG	**JP-5**	4/7/03	ROTOR HOUSING DISCHARGE CLEARANCE IS EXCESSIVE	**N**
CV 64	FM	38D 8 1/8	EDG	**JP-5**	5/5/03	NR 3 EDG SALT WATER SUPPLY STRAINER IS STARTING TO LEAK	**N**
CV 66	EMD	567	EDG	**JP-5**	11/20/95	# 3 EMERGENCY DIESEL GENERATOR FRESH WATER TEMPERATURE WAS ABNORMALLY HIGH DURING OPERATION	**N**
CV 67	FM	38D 8 1/8	EDG	**JP-5**	1/11/02	ALL F/O NOZZLES, LINES AND ALL FUEL INJECTION PUMPS LEAK EXCESSIVELY	**Y**
CV 67	FM	38D 8 1/8	EDG	**JP-5**	8/18/03	NR1 EDG HAS 3 LEAKS ON THE L/O HEADER	**N**
CVN 65	EMD	567	EDG	**JP-5**	10/17/02	ATTACHED SALTWATER PUMP SHAFT SEAL LEAKS	**N**
CVN 65	EMD	567	EDG	**JP-5**	2/28/03	DURING INSPECTION OF # 1EDG IT WAS FOUND THAT THERE WAS A SMALL EXAUST LEAK COMMING FROM THE SILENCER	**N**
CVN 65	EMD	567	EDG	**JP-5**	3/20/03	#1 EDG AIR FILTERS NEED REPLACED DUE TO EXTENSIVE	**N**
CVN 65	EMD	567	EDG	**JP-5**	3/21/03	DURING INSPECTION IT WAS FOUND THAT THE LEFT BANK BLOWER DRAIN LINE FLANGE TO ENGINE BLOCK WAS LEAKING OIL	**N**
CVN 68	EMD	645	EDG	**JP-5**	3/15/95	EMERG DSL GEN ENGINE INJECTORS OUT OF SPEC	**N**
CVN 68	EMD	645	EDG	**JP-5**	4/7/96	NR 1 EDG TURBOCHARGER LUBE OIL FILTER LEAKS	**N**
CVN 68	EMD	645	EDG	**JP-5**	5/5/96	NUMEROUS EXHAUST VALVE GUIDES WERE LEAKING INTO THE	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
						CYLINDERS	
CVN 68	EMD	645	EDG	**JP-5**	7/16/96	ATTACHED FRESH WATER PUMP ON #1 EDG SHOWS SIGNS OF WEAR AND TEAR	**N**
CVN 68	EMD	645	EDG	**JP-5**	7/16/96	ATTACHED FUEL OIL PUMP ON #1 EDG SHOWS SIGNS OF WEAR AND TEAR	**Y**
CVN 68	EMD	645	EDG	**JP-5**	10/21/96	#2 EDG AIR STARTING MOTOR HAS A BLOWN BENDIX SEAL	**N**
CVN 68	EMD	645	EDG	**JP-5**	12/3/96	#4 EDG UPPER AND LOWER AIR STARTER MOTORS HAS A WORN BENDIX GEAR	**N**
CVN 68	EMD	645	EDG	**JP-5**	12/12/96	#1 EDG CYLINDER HEADS SHOW SIGNS OF WEAR ON CAMSHAFT LOBES, ROCKER ARMS, EXHAUST VALVES DUE TO LIGHT LOADED OPERATIONS	**N**
CVN 68	EMD	645	EDG	**JP-5**	12/12/96	PISTON RINGS ON #1 EDG SHOWED SIGNS OF WEAR DUE TO LIGHT LOADED OPERATIONS	**Y**
CVN 68	EMD	645	EDG	**JP-5**	6/15/97	#2 EDG CYLINDER LINER AND PISTON ON #15 POWERPAK WHERE DAMAGED	**N**
CVN 68	EMD	645	EDG	**JP-5**	3/13/98	FUEL OIL PUMP SUCTION VALVE (V-202) LEAKS	**Y**
CVN 68	EMD	645	EDG	**JP-5**	8/14/00	PUMP DISHCHARGE PRESSURE LOW	**N**
CVN 68	EMD	645	EDG	**JP-5**	8/28/01	#1 EDG FUEL OIL MANIFOLD GASKETS ARE LEAKING	**N**
CVN 68	EMD	645	EDG	**JP-5**	4/26/03	FRESH WATER DRAIN VALVE ON #2 EDG HAS A SMALL LEAK	**N**
CVN 69	EMD	645	EDG	**JP-5**	9/9/98	FWD CYLINDERS OVERHEATING WHEN AT 100% POWER	**N**
CVN 69	EMD	645	EDG	**JP-5**	9/14/99	#6 CYLINDER HEAD ON #2 EMERGENCY DIESEL ENGINE REQUIRES REPLACEMENT DUE TO A WATER LEAK AT THREADED PLUG ON THE HEAD	**N**
CVN 69	EMD	645	EDG	**JP-5**	12/2/00	THE LUBE OIL WAS FOUND TO BE CONTAMINATED WITH FU EL OIL	**Y**
CVN 69	EMD	645	EDG	**JP-5**	3/11/03	LUBE OIL LEAKS BY INTERNAL CHECK VALVE OF TURBOCHARGER LUBE OIL FILTER ASSEMBLY	**N**
CVN 69	EMD	645	EDG	**JP-5**	3/11/03	DIESEL INADVERTANTLY STARTED WITH JACKING GEAR	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
						ENGAGED	
CVN 70	EMD	645	EDG	**JP-5**	10/8/97	4EDG LUBE OIL SYSTEM IS DILUTED WITH FUEL OIL	**Y**
CVN 70	EMD	645	EDG	**JP-5**	9/8/98	2 EDG LEFT BANK FRESH WATER PUMP LUBE OIL SEAL LEAKING	**N**
CVN 70	EMD	645	EDG	**JP-5**	7/1/99	#1 EDG HAS 16 FUEL OIL INJECTORS THAT ARE NOT FUNCTIONING PROPERLY AND CANNOT BE TIMED PER PMS	**Y**
CVN 70	EMD	645	EDG	**JP-5**	11/3/00	#1 EDG FUEL OIL PUMP IS WORN AND IS CAUSING LOW FUEL OIL PRESSURE READINGS	**Y**
CVN 70	EMD	645	EDG	**JP-5**	10/3/02	#4 EDG SCAVENGING L/O PUMP IS LEAKING FROM CASING SEAL ON FUEL OIL PUMP DRIVE SHAFT	**N**
CVN 70	EMD	645	EDG	**JP-5**	11/1/02	F/W MECHANICAL SEAL LEAKS BY ON #1 EDG FRESHWATER PUMP	**N**
CVN 70	EMD	645	EDG	**JP-5**	1/20/03	DURING DIESEL INSPECTION '02 IT WAS NOTED THAT SOME ACCESSORY DRIVE END FASTENERS WERE NOT OF CORRECT LENGTH.	**N**
CVN 70	EMD	645	EDG	**JP-5**	1/30/03	#1 EDG LOWER STARTER SHOCK MOUNT HOLES ARE NOT ALIGNED PROPERLY WITH STARTER END CAP	**N**
CVN 70	EMD	645	EDG	**JP-5**	8/28/03	#4 EDG SCAVENGING L/O PUMP OUTPUT SHAFT TO F/O PUMP OIL SEAL LEAKING AND NEED REPLACED	**N**
CVN 71	EMD	645	EDG	**JP-5**	9/3/95	PISTON LINER HAD A CATASTROPHIC FAILURE	**N**
CVN 71	EMD	645	EDG	**JP-5**	3/17/99	ATTACHED JACKET WATER PUMP IS LEAKING AT SEAL	**N**
CVN 71	EMD	645	EDG	**JP-5**	7/13/01	SEVERAL VALVE BRIDGE ASSEMBLIES REQUIRE REPLACEMENT	**N**
CVN 71	EMD	645	EDG	**JP-5**	7/13/01	THE FUEL INJECTORS FAILED BENCH TEST	**N**
CVN 71	EMD	645	EDG	**JP-5**	1/26/02	#1 EDG THE L/O SEPERATOR LEAKS AT THE FLANGE	**N**
CVN 71	EMD	645	EDG	**JP-5**	5/6/02	#2 EDG THE SALTWATER STRAINER DRAIN LINE IS CRACKED	**N**
CVN 71	EMD	645	EDG	**JP-5**	6/4/02	THE FUEL PUMP COUPLING ON #2 EDG IS CRACKED	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
CVN 71	EMD	645	EDG	**JP-5**	6/21/02	#2 EDG FUEL OIL PUMP MECHANICAL SEAL LEAKING BY	Y
CVN 71	EMD	645	EDG	**JP-5**	2/8/03	THE TACHOMETER ON #2 EDG IS OUT OF CALIBRATION AND CAN NOT BE CALIBRATED	N
CVN 71	EMD	645	EDG	**JP-5**	2/21/03	THE #3 EDG RIGHT BANK WATER JACKET PUMP IS LEAKING	N
CVN 71	EMD	645	EDG	**JP-5**	3/20/03	THE "D" AIR VALVE IS LEAKING AIR FROM THE FORWARD GASKET	N
CVN 71	EMD	645	EDG	**JP-5**	3/30/03	STUD/BOLT BROKE ON GENERATOR AIR BOX HEAD	N
CVN 72	EMD	645	EDG	**JP-5**	1/19/02	#4 EDG HAS THREE LEAKING FUEL OIL JUMPER LINES	Y
CVN 72	EMD	645	EDG	**JP-5**	2/26/02	FUEL INJECTORS ON #1EDG ARE LEAKING THROUGH THE FUEL INJECTOR BODY	Y
CVN 72	EMD	645	EDG	**JP-5**	3/13/02	FOUR INJECTORS ON #3EDG ARE LEAKING AND NEED TO BE REPLACED	Y
CVN 72	EMD	645	EDG	**JP-5**	4/23/02	REPLACED ALL 16 FUEL OIL INJECTORS ON #4 EMERGENCY DIESEL GENERATOR DUE TO LEAK BY	Y
CVN 72	EMD	645	EDG	**JP-5**	9/5/02	FRESHWATER LEAKING INTO #3 CYLINDER DUE TO LEAKING HEAD GASKET OR WATERSEAL ON #3EDG	N
CVN 72	EMD	645	EDG	**JP-5**	9/6/02	CYLINDER HEAD ON #3CYLINDER IS CRACKED AND IS LEAKING WATER INTO CYLINDER	N
CVN 72	EMD	645	EDG	**JP-5**	11/8/02	FUEL OIL JUMPER LINE ON #7 CYLINDER HEAD ON #4 EDG IS LEAKING FUEL	Y
CVN 72	EMD	645	EDG	**JP-5**	1/3/03	H5 RELAY VALVE ON #1EDG SEAL IS LEAKING OIL	N
CVN 72	EMD	645	EDG	**JP-5**	1/3/03	BLOW DOWN VALVE PACKING ON ALL 16 CYLINDERS NEEDS TO BE REPLACED	N
CVN 72	EMD	645	EDG	**JP-5**	9/23/03	BROKEN BOLT ON #4 EDG'S PISTON COOLING PEE PIPE	N
CVN 73	EMD	645	EDG	**JP-5**	12/11/95	2 EMERGENCY DIESEL GENERATOR INJECTORS REQUIRE REPLACEMENT	Y
CVN 73	EMD	645	EDG	**JP-5**	12/11/95	#3 EDG INJECTORS REQUIRE REPLACEMENT	Y
CVN 73	EMD	645	EDG	**JP-5**	10/10/96	16 FUEL INJECTORS REQUIRE OVERHAUL	Y

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
CVN 73	EMD	645	EDG	**JP-5**	2/14/02	#2 EDG HAS OIL LEAKS AT THE PISTON COOLING PUMP AND MAIN BEARING PRESSURE PUMP	**N**
CVN 73	EMD	645	EDG	**JP-5**	6/24/02	#2 EDG AIR EJECTOR MALFUNCTIONING	**N**
CVN 73	EMD	645	EDG	**JP-5**	1/29/03	NO3 EMERGENCY DIESEL GENERATOR EMERGENCY VENT ACTUATOR STICKS CLOSED	**N**
CVN 73	EMD	645	EDG	**JP-5**	11/10/03	TURBOCHARGER PIPE GASKET LEAKING	**N**
CVN 73	EMD	645	EDG	**JP-5**	11/20/03	#3 EDG FUEL INJECTORS LEAKING INTO DIESEL CRANKCASE	**Y**
CVN 74	EMD	645	EDG	**JP-5**	5/22/97	#4 EMERGENCY DIESEL GENERATOR EXPERIENCED A CRANKCASE EXPLOSION	**N**
CVN 74	EMD	645	EDG	**JP-5**	6/18/00	#4 EDG TURBO CHARGER LEAKING LUBE OIL	**N**
CVN 74	EMD	645	EDG	**JP-5**	5/3/01	COMPRESSION RINGS ARE IN TYPE 2A CONDITION (CHROME GROOVES ARE WORN AWAY).	**Y**
CVN 74	EMD	645	EDG	**JP-5**	3/12/02	PISTON RINGS ARE IN A TYPE 2A WEAR CONDITION	**Y**
CVN 74	EMD	645	EDG	**JP-5**	4/1/02	LEFT AND RIGHT BANK ATTACHED FRESHWATER PUMP DISCHARGE PRESSURE LOW	**N**
CVN 75	EMD	645	EDG	**JP-5**	1/4/03	J/W OUTLET PIPING FROM # 2 EDG HAS BEEN FOUND TO HAVE INADEQUTE WALL THICKNESS AND IS PRONE TO LEAKAGE	**N**
CVN 75	EMD	645	EDG	**JP-5**	1/6/03	REMOTE SHUT DOWN DEVICE REQUIRES MANUFACTURE OF TAPER PIN TO REPLACE BROKEN SHEAR PIN	**N**
CVN 76	EMD	645	EDG	**JP-5**	4/25/03	AIR START VALVE SEALS ARE CRACKED AND REQUIRE REPLACEMENT	**N**
CVN 76	EMD	645	EDG	**JP-5**	8/17/03	LEFT BANK F/W PUMP STARTED TO LEAK FORCING EDG SHUTDOWN	**N**
FFG 08	DDC	149TI	SSDG	F-76	11/2/00	NO. 2 SSDG'S STARTER NEEDS REPLACING	**N**
FFG 09	DDC	149TI	SSDG	F-76	8/1/00	THE VALVES PUNCHED A HOLE IN THE TOP OF THE PISTON	**N**
FFG 09	DDC	149TI	SSDG	F-76	12/20/01	STARTER WOULD NOT ENGAGE	**N**
FFG 12	DDC	149TI	SSDG	F-76	4/20/00	NR 3 SSDG J/W PUMP HAD MASSIVE FAILUR	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
FFG 12	DDC	149TI	SSDG	F-76	5/25/00	#2 SSDG NEEDS A TOP END OVERHAUL	N
FFG 12	DDC	149TI	SSDG	F-76	6/12/00	THAT 4 SSDG HAD DETERIORATED CYLINDERS	N
FFG 12	DDC	149TI	SSDG	F-76	6/12/00	3 SSDG NEEDS NEW CYLINDER HEAD	N
FFG 12	DDC	149TI	SSDG	F-76	6/16/00	FWD BLOWER AND L5, L6 ROCKER ARMS REPLACED	N
FFG 12	DDC	149TI	SSDG	F-76	3/5/02	BOTH BLOWERS HAVE EXCESSIVE THRUST CLEARANCE	N
FFG 12	DDC	149TI	SSDG	F-76	5/25/02	1L CAM FOLLOWER IS STARTING TO FLAKE	N
FFG 15	DDC	149TI	SSDG	F-76	5/12/00	#2SSDG BLOWER DRIVESHAFT AND DRIVE HUBS ARE WORN	N
FFG 15	DDC	149TI	SSDG	F-76	1/22/01	UNSAT F/O DULUTION GREATER THAT 5%.	Y
FFG 19	DDC	149TI	SSDG	F-76	8/2/00	REPLACE TURBOCHARGER	N
FFG 19	DDC	149TI	SSDG	F-76	8/4/00	REPLACE FORWARD AND AFT SCAVENGING BLOWERS	N
FFG 19	DDC	149TI	SSDG	F-76	8/23/00	NO. 3 CYLINDER HEAD HAS A BURNT VALVE	N
FFG 19	DDC	149TI	SSDG	F-76	7/7/02	THE INSPECTORS FOUND A BAD LUBE OIL PUMP	N
FFG 32	DDC	149TI	SSDG	F-76	5/9/03	THAT # 3 SSDG FUEL INJECTORS ARE WORN	Y
FFG 32	DDC	149TI	SSDG	F-76	9/11/03	ROKER ASSEMBLY AND BRIDGES WERE BROKEN	N
FFG 33	DDC	149TI	SSDG	F-76	5/13/00	THE FUEL PUMP WAS BAD	N
FFG 33	DDC	149TI	SSDG	F-76	8/4/00	FORWARD BLOWER HAD FAILED	N
FFG 33	DDC	149TI	SSDG	F-76	11/1/00	NR3 SSDG STARTER IS FROZEN AND REQUIRES REPLACEMENT	N
FFG 33	DDC	149TI	SSDG	F-76	12/5/00	FORWARD OUTBOARD TURBO WAS FOUND TO BE WORN	N
FFG 33	DDC	149TI	SSDG	F-76	7/18/01	FORWARD AND AFT BLOWERS WERE BADLY DAMAGED	N
FFG 33	DDC	149TI	SSDG	F-76	3/22/02	FUEL OIL PUMP FAILURE	N
FFG 33	DDC	149TI	SSDG	F-76	1/23/03	INJECTORS WERE LEAKING BY	N
FFG 33	DDC	149TI	SSDG	F-76	3/14/03	#2 SSDG REAR ENGINE SEAL LEAKS EXCESSIVELY	N
FFG 33	DDC	149TI	SSDG	F-76	6/24/03	#4 RIGHT CYLINDER WAS FOUND TO HAVE BROKEN PISTON RINGS	N
FFG 36	DDC	149TI	SSDG	F-76	2/21/00	F/O PUMP FOR NR 3 SSDG IS BAD	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
FFG 36	DDC	149TI	SSDG	F-76	8/1/00	FOUR CYLINDERS WERE FOUND TO HAVE DAMAGED COMPRESSION RINGS	N
FFG 36	DDC	149TI	SSDG	F-76	2/24/03	#4 SSDG HAS A FAULTY BLOWER	N
FFG 37	DDC	149TI	SSDG	F-76	1/28/00	THE TURBOCHARGER NEEDS TO BE REPLACED	N
FFG 37	DDC	149TI	SSDG	F-76	3/26/01	J/W PUMP IS WORN	N
FFG 37	DDC	149TI	SSDG	F-76	2/24/03	SSDG FOUND TO HAVE CRANK SHAFT DAMAGE IN WAY OF #9 MAIN BEARING	N
FFG 37	DDC	149TI	SSDG	F-76	6/9/03	ON NR2 SSDG, DEI DISCOVERED FIVE WORN POWER PACKS	N
FFG 38	DDC	149TI	SSDG	F-76	2/14/03	DEI FOUND 2 BROKEN FIRING RINGS ON 1L AND 2L. 2L APPEARS TO HAVE A CRACKED PISTON.	N
FFG 38	DDC	149TI	SSDG	F-76	2/24/03	NR 2 SSDG ENGINE BLOCK REPLACEMENT IS NEEDEDX	N
FFG 38	DDC	149TI	SSDG	F-76	8/21/03	THE SSDG HAD A CRANKCASE EXPLOSION	N
FFG 38	DDC	149TI	SSDG	F-76	10/10/03	NR5 PISTON FAILED CAUSING LINER TO SHATTER	N
FFG 40	DDC	149TI	SSDG	F-76	2/9/03	CYLINDER HEAD DROPPED TWO VALVES	N
FFG 40	DDC	149TI	SSDG	F-76	2/9/03	SSDG DROPPED VALVE DESTROYING PISTON, LINER, TURBO AND VARIUOS PARTS	N
FFG 41	DDC	149TI	SSDG	F-76	2/1/00	NR.2 CYLINDER HEAD NEEDS TO BE REPLACED	N
FFG 41	DDC	149TI	SSDG	F-76	2/2/00	NR 2L AND 3L PISTONS AND RODS NEED REPLACING	N
FFG 41	DDC	149TI	SSDG	F-76	2/27/01	REQUEST OUTSIDE ACTIVITY REPLACE 2 BLOWERS, 16 POWER PACS, AND 4 TURBO CHARGERS	N
FFG 41	DDC	149TI	SSDG	F-76	10/15/02	NR2 SSDG EXPERIENCED A CRANKCASE EXPLOSION CREATING A 8 INCH DIAMETER HOLE ON THE OUTBOARD SIDE AND 6 INCH DIAMETER HOLE ON THE INBOARD SIDE OF THE BLOCK	N
FFG 41	DDC	149TI	SSDG	F-76	5/18/03	REPLACE CAMSHAFT	N
FFG 41	DDC	149TI	SSDG	F-76	6/12/03	REMOVE AND REPLACE POWER PACKS	N
FFG 41	DDC	149TI	SSDG	F-76	8/18/03	COMPLETE ENGINE CHANGE OUT AND REMOVAL ARE REQUIRED	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
FFG 41	DDC	149TI	SSDG	F-76	9/15/03	IDENTIFIED WORN BEARINGS ON DIESEL	N
FFG 42	DDC	149TI	SSDG	F-76	10/7/02	NR 3 SSDG IT WAS FOUND THAT THE BLOWER CLEARENCE WAS OUT OF SPECS	N
FFG 42	DDC	149TI	SSDG	F-76	10/31/02	THE REAR MAIN SEAL ON NR 2 SSDG IS LEAKING AND NEEDS REPLACED	N
FFG 43	DDC	149TI	SSDG	F-76	1/10/00	NR3 SSDG HAS A OIL LEAK FROM THE FRONT CRANKSHAFT SEAL	N
FFG 43	DDC	149TI	SSDG	F-76	3/5/00	#6 CYLINDER HEAD EXHAUST VALVE, INJECTOR AND ROCKER ARM DAMAGED	N
FFG 43	DDC	149TI	SSDG	F-76	7/12/01	NR3 SSDG CYLINDER HEAD FUEL INJECTION NOZZEL OPENING TO CYLINDER CRACKED	N
FFG 43	DDC	149TI	SSDG	F-76	6/3/02	NR 8 CYLINDER HEAD ON NR 2 SSDG IS OOC	N
FFG 43	DDC	149TI	SSDG	F-76	6/10/02	REQUEST IMA FACILITY REMOVE AND REPLACE BLOWERS, TURBOS, INJECTORS, HEADS AND POWER PACKS	N
FFG 45	DDC	149TI	SSDG	F-76	3/29/01	SEIZED STARTER	N
FFG 45	DDC	149TI	SSDG	F-76	12/26/01	NR3 SSDG L/O PMP MAIN DRAIVE GEAR SHEARED AND DAMAGE TO GEAR TEETH	N
FFG 45	DDC	149TI	SSDG	F-76	3/21/02	FAULTY INJECTOR/BURNED EXHAUST VALVE	N
FFG 45	DDC	149TI	SSDG	F-76	9/24/03	NR2 SSDG FAILED TO START DUE TO BAD AIR STARTER	N
FFG 46	DDC	149TI	SSDG	F-76	6/14/02	THE AIR START MOTOR WAS NOT ENGAGING	N
FFG 48	DDC	149TI	SSDG	F-76	5/21/00	3 SSDG'S J/W PUMP FAILED	N
FFG 48	DDC	149TI	SSDG	F-76	6/25/00	ONE OF THE CYL HEAD VALVE WAS BURNED	N
FFG 48	DDC	149TI	SSDG	F-76	8/8/01	INJECTORS NEED TO BE REPLACED	Y
FFG 48	DDC	149TI	SSDG	F-76	1/2/03	3 CYLINDER FIRING RING WAS BROKEN	N
FFG 49	DDC	149TI	SSDG	F-76	4/24/00	BAD EXHAUST VALVE IN #1L CYL HEAD	N
FFG 49	DDC	149TI	SSDG	F-76	6/27/00	ALL CYL HEADS REQUIRED OVERHAUL OR REPLACEMENT	N
FFG 49	DDC	149TI	SSDG	F-76	7/10/00	LINER WEAR AND DAMAGED/BROKEN FIRE RINGS	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
FFG 50	DDC	149TI	SSDG	F-76	10/5/01	EXCESSIVE WEAR IN CYLINDER LINERS,	N
FFG 50	DDC	149TI	SSDG	F-76	10/10/01	VALVES WERE BURNT AND A PIECE OF ONE WAS MISSING	N
FFG 51	DDC	149TI	SSDG	F-76	5/20/02	NR 2 SSDG NR 13 CYLINDER IT WAS DISCOVERED THAT CYLINDER HEAD ASSEMBLY WORN OUT	N
FFG 53	DDC	149TI	SSDG	F-76	4/28/00	NR 5R CYLINDER PISTON AND CON ROD FAILED	N
FFG 53	DDC	149TI	SSDG	F-76	5/9/00	BAD CYLINDERS, ONE BURNT VALVE EACH	N
FFG 55	DDC	149TI	SSDG	F-76	1/8/00	NUMBER 2 SSDG REQUIRES THAT ONE OF THE CYLINDER HEADS BE REPLACED	N
FFG 55	DDC	149TI	SSDG	F-76	5/2/02	# 4 SSDG F/O INJECTORS REQUIRE OVERHAUL	N
FFG 57	DDC	149TI	SSDG	F-76	9/1/00	# 2 SSDG HAS BURNT A EXHAUST VALVE	N
FFG 57	DDC	149TI	SSDG	F-76	11/6/01	# 4 SSDG TURBO SEALS HAVE FAILED	N
FFG 57	DDC	149TI	SSDG	F-76	12/4/02	#4 SSDG HAS BROKEN CYLINDER HEAD,	N
FFG 59	DDC	149TI	SSDG	F-76	10/4/00	BLOWERS ARE REQUIRED TO BE REPLACED DUE TO OUT OF CLEARENCE READINGS	N
FFG 59	DDC	149TI	SSDG	F-76	7/25/02	TO REPLACE CYLINDER HEAD DUE TO BAD INTERNAL PARTS	N
FFG 59	DDC	149TI	SSDG	F-76	11/12/02	#2 CYLINDER HEAD HAS BLOWN VALVES REQIURE NEW HEAD	N
FFG 61	DDC	149TI	SSDG	F-76	12/5/01	NR3 SSDG #3L CYLINDER HEAD REQUIRES REPLACEMENT	N
LCC 19	FM	38D 8 1/8	EDG	F-76	7/31/02	REAR MAIN SEAL ON NR2 EDG LEAKS OIL	N
LCC 19	FM	38D 8 1/8	EDG	F-76	9/11/02	#1 EDG LEAKING FUEL JUMPER LINES	Y
LCC 19	FM	38D 8 1/8	EDG	F-76	9/24/02	BROKEN UPPER PISTON COMPRESSION RING IN NR 5 CYLINDER, VERTICAL DRIVE SPRING PACK HAS A BROKEN RING	N
LCC 19	FM	38D 8 1/8	EDG	F-76	3/8/03	NO. 1 EDG AUTO START SOLENOID VALVE HAS EXCESSIVE LEAKS ALLOWING A LARGE AMOUNT OF HP AIR TO ESCAPE THE SYSTEM	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LCC 19	FM	38D 8 1/8	EDG	F-76	6/11/03	THE VERTICAL DRIVE COVER BOLTS STRIPPED OUT.	N
LCC 19	FM	38D 8 1/8	EDG	F-76	7/16/03	NR 1 EDG NR 1 CYLINDER LEAKING EXCESSIVE FUEL	N
LCC 20	FM	38D 8 1/8	SSDG	F-76	7/10/03	UPPER THRUST BEARING NEEDS REPLACMENT DUE TO INSUFFICIENT THRUST CLEARANCE	N
LCC 20	FM	38D 8 1/8	SSDG	F-76	7/28/03	3 FUEL PUMPS ARE STICKING AND NEED REPLACING	Y
LHA 1	ALCO	251C	EDG	**JP-5**	7/10/95	NR 1 SS/EDG HAS FUEL LEAKS AT CYLINDER NUMBERS 4L AND 4R AT FUEL OIL INLET HEADER	Y
LHA 1	ALCO	251C	EDG	**JP-5**	4/3/97	NR2 SHIPS SERVICE/EMERGENCY DIESEL GENERATOR HAS WORN CYLINDER LINERS AND HEADS THROUGHOUT THE ENGINE	N
LHA 1	ALCO	251C	EDG	**JP-5**	8/18/97	ATTATCHED CYLINDER F/O PUMPS LEAKING	Y
LHA 1	ALCO	251C	EDG	**JP-5**	6/3/98	NR 2 SS/EDG'S CROSSHEAD ASSEMBLIES AND FUEL PUMPS ARE LEAKING AT THE BASE OF THE FUEL PUMP	Y
LHA 1	ALCO	251C	EDG	**JP-5**	10/7/98	NR 1 DIESEL GENERATOR TURBOCHARGER WAS FOUND SIEZED	N
LHA 1	ALCO	251C	EDG	**JP-5**	11/10/98	FUEL INJECTION PUMPS AND NOZZLES LEAKS	N
LHA 1	ALCO	251C	EDG	**JP-5**	1/19/99	NR.2 SS/EDG'S CROSSHEAD ASSEMBLIES AND FUEL PUMPS ARE LEAKING AT THE BASEOF THE FUEL PUMPS	Y
LHA 1	ALCO	251C	EDG	**JP-5**	4/23/99	FUEL INJECTION NOZZLES (16 EA) LEAKS	Y
LHA 1	ALCO	251C	EDG	**JP-5**	10/11/00	2R FUEL INJECTION TUBE HAS A PIN HOLE LEAK IN THE FITTING	Y
LHA 1	ALCO	251C	EDG	**JP-5**	2/15/02	TURBOCHARGER JET ASSIST SEQUENCING VALVE IS LEAKING AIR AT BODY	N
LHA 1	ALCO	251C	EDG	**JP-5**	4/23/02	EDG GOVERNOR IS NON OPERATIONAL	N
LHA 1	ALCO	251C	EDG	**JP-5**	5/13/02	NR 2 EDG NR 7L CYLINDER FUEL OIL INJECTION PUMP WAS LEAKING FUEL	N
LHA 1	ALCO	251C	EDG	**JP-5**	5/13/02	NR 2 EDG SEVERAL INTAKE VALVE-LASH'S WERE OUT OF ADJUSTMENT	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LHA 1	ALCO	251C	EDG	**JP-5**	3/28/03	DIESEL OIL NEEDS REPLENISHMENT	**N**
LHA 1	ALCO	251C	EDG	**JP-5**	4/8/03	LEAKING FUEL INJECTION TUBES	**Y**
LHA 1	ALCO	251C	EDG	**JP-5**	5/12/03	VARIOUS LUBE OIL LEAKS ON # 1 EDG	**N**
LHA 1	ALCO	251C	EDG	**JP-5**	7/27/03	VARIOUS LEAKS ON # 1 EDG	**N**
LHA 1	ALCO	251C	EDG	**JP-5**	9/14/03	FUEL PUMPS ARE LEAKING FROM COPPER WASHER	**N**
LHA 1	ALCO	251C	EDG	**JP-5**	9/25/03	TURBO TO BELLOWS ADAPTER IS CRACKED AND DETERIORATED	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	11/6/96	#1 EDG TURBOCHARGER LEAKING	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	3/3/97	F/O NOZZLES DIRTY AND CARBONED	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	9/3/97	#5L HEAD ASSEMBLY AND CYLINDER HAVE EXTENSIVE DAMAGE	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	2/15/98	NO. 1 EDG AIR START MOTOR VANES DETERIORATED	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	3/16/99	#2 EDG CYLINDER HEADS (16) ARE LEAKING OIL THROUGH THE VALVE GUIDES	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	2/3/00	THAT #1 SSDG REAR MAIN OIL SEAL WAS LEAKING OIL	**N**
LHA 2	ALCO	251C	EDG	**JP-5**	4/30/02	#1 EDG FUEL OIL PRESSURE AIR CUTOUT VALVE LEAKS FUEL OIL	**Y**
LHA 2	ALCO	251C	EDG	**JP-5**	2/3/03	#1 DIESEL ENGINE NEEDS NEW FLANGE SHIELDS	**N**
LHA 3	ALCO	251C	EDG	**JP-5**	2/14/96	NUMBER 1, 2, 3, 4, 5 AND 6 LEFT AND NUMBER 4, 5, AND 6 RIGHT CAM LOBES ARE WORN AND SPALLING	**N**
LHA 3	ALCO	251C	EDG	**JP-5**	10/13/98	4 INJECTION PUMPS ARE LEAKING BY.	**Y**
LHA 3	ALCO	251C	EDG	**JP-5**	10/3/99	TURBOCHARGER FAILED	**N**
LHA 3	ALCO	251C	EDG	**JP-5**	10/31/00	SEVERAL INJECTION PUMPS LEAK F/O FROM F/O INLET HEADER CONNECTION	**Y**
LHA 3	ALCO	251C	EDG	**JP-5**	9/4/01	FUEL PUMPS START LEAKING	**Y**
LHA 3	ALCO	251C	EDG	**JP-5**	10/15/01	10 FUEL PUMPS NEED OVERHAUL	**Y**
LHA 3	ALCO	251C	EDG	**JP-5**	6/9/02	GENERATOR INJECTION PUMPS ALL THE FUEL PUMP RETAINING SCREW AND HEADER GASKET NEED REPLACEMENT	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LHA 3	ALCO	251C	EDG	**JP-5**	2/10/03	DURING NORMAL OPERATIONS S/F NOTICED THAT 1EDG JACKET WATER PUMP DISHARGE PRESSURE IS LOW AND THE MECHANICAL SEAL IS LEAKING	**N**
LHA 3	ALCO	251C	EDG	**JP-5**	3/7/03	DURING NORMAL OPERATIONS S/F DISCOVERED THAT THE LUBE OIL STRAINER IS LEAKING	**N**
LHA 4	ALCO	251C	EDG	**JP-5**	7/1/96	CYLINDERS 2R AND 7R ARE NOT FIRING. SUSPECT FAULTY FUEL INJECTOR PUMPS	**Y**
LHA 4	ALCO	251C	EDG	**JP-5**	7/29/96	IS FAULTY INJECTION PUMPS OR INJECTION NOZZLES	**Y**
LHA 4	ALCO	251C	EDG	**JP-5**	7/31/96	NR1 EDG FUEL INJECTION NOZZLES 14 OF 16 NOZZLES FAILED	**Y**
LHA 4	ALCO	251C	EDG	**JP-5**	7/14/99	NR1 EDG FUEL OIL PUMP IS WORN AND LOSING PREASURE	**N**
LHA 4	ALCO	251C	EDG	**JP-5**	1/31/02	#2 DIESEL GASKETS LEAK AND NOZZLE BODY O-RINGS LEAK BY ALLOWING SMALL AMOUNTS OF OIL TO LEAK OUT OF ENGINE	**Y**
LHA 4	ALCO	251C	EDG	**JP-5**	6/18/02	CYLINDER HEADS REQUIRE OVERHAUL, DUE TO EXCESSIVE LEAKAGE AND BLOW-BY	**N**
LHA 4	ALCO	251C	EDG	**JP-5**	2/5/03	#2 EDG LUBE OIL HEATER HEATING ELEMENTS INSIDE THE CRANKCASE HAS A CRACK AND THE LUBE OIL IS SHORTING OUT THE HEATING ELEMENT	**N**
LHA 4	ALCO	251C	EDG	**JP-5**	2/18/03	#1 EDG FUEL/AIR SOLENOID VALVE WAS FOUND TO BE LEAKING SMALL AMOUNTS OF FUEL	**N**
LHA 4	ALCO	251C	EDG	**JP-5**	3/29/03	#2 EDG FUEL BOOSTER PUMP LEAKS SMALL AMOUNT OF FUEL AND HAS RUBBER IN THE FUEL INDICATING THE IMPELLER MAY BE BAD	**Y**
LHA 5	ALCO	251C	EDG	JP-5	12/12/97	1EMERGENCY DIESEL INJECTION NOZZLES REQUIRE OVERHAUL	**Y**
LHA 5	ALCO	251C	EDG	JP-5	1/25/01	3 INJECTION PMPS LEAKING AND NOT WORKING PROPERLY	**Y**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
LHA 5	ALCO	251C	EDG	JP-5	1/2/03	# 1 EDG PYRO TEMP ON 5R CYCLINDER IS OUT OF PARAMETERS AND HIGH. ENGINE SMOKES WHITE WHEN STARTING SHIPS EN1 REMOVE VALVE COVER ON 5R CYCLINDER AND FOUND ROCKER ARM PUSHROD END LOCKNUT BACKED OFF	N
LHA 5	ALCO	251C	EDG	JP-5	2/12/03	PINS FOR HOLDING L/O PUMP IN PLACE ARE WORN	N
LHA 5	ALCO	251C	EDG	JP-5	2/21/03	CUP O RINGS ON FUEL INJECTION PUMPS SEEP FUEL AND NEED TO BE CHANGED OUT	Y
LHA 5	ALCO	251C	EDG	JP-5	3/6/03	DIESEL ENGINE BLOWDOWN PETCOCKS LEAK BY	N
LHA 5	ALCO	251C	EDG	JP-5	3/6/03	# 2 EDG TURBOCHARGER AND INLET PIPING WAS FOUND TO HAVE HEAVY CORROSION	N
LHA 5	ALCO	251C	EDG	JP-5	3/6/03	CYLINDER LINERS NUMBER 3 RIGHT, 4 RIGHT, 5 LEFT, 5 RIGHT, 6 RIGHT, 7 RIGHT, AND 8 RIGHT WERE DISCOVERED WITH LIGHT WEAR ON THE LINERS	Y
LHA 5	ALCO	251C	EDG	JP-5	4/3/03	# 2 EDG AIR START SOLENOID LEAKS AIR BY EXHAUST PORT	N
LHA 5	ALCO	251C	EDG	JP-5	4/8/03	INLET JACKET WATER HOSE TO TURBOCHARGER RUPTURED	N
LHD 1	ALCO	251C	EDG	JP-5	12/31/96	#1SS/EDG FUEL PUMPS ARE WORN	Y
LHD 1	ALCO	251C	EDG	JP-5	7/6/97	FUEL NOZZLE ASSEMBLY NEEDS REPLACEMENT	Y
LHD 1	ALCO	251C	EDG	JP-5	9/22/98	#1 SS/EDG TURBOCHARGER IS LEAKING	N
LHD 1	ALCO	251C	EDG	JP-5	4/6/02	REPAIR AS NEEDED SIXTEEN FUEL NOZZLES	Y
LHD 1	ALCO	251C	EDG	JP-5	11/13/02	THE HIGH PRESSURE FUEL LINE LEAKED	Y
LHD 1	ALCO	251C	EDG	JP-5	2/4/03	THE F/O RETURN LINE WAS HARD AND CHAFFED	N
LHD 1	ALCO	251C	EDG	JP-5	2/6/03	JACKET WATER EXPANSION TANK RELIEF VALVE FAILED TESTING	N
LHD 2	ALCO	251C	EDG	JP-5	8/18/95	FIVE FUEL PUMPS REQUIRE REPLACING	Y
LHD 2	ALCO	251C	EDG	JP-5	9/1/95	7R FUEL INJECTOR WAS DISCOVERED TO BE FAULTY	Y
LHD 2	ALCO	251C	EDG	JP-5	3/9/99	16 NOZZLES TO NEED REBUILT	Y

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LHD 2	ALCO	251C	EDG	**JP-5**	5/24/00	# 2 EDG STARTER AND RING GEAR ARE DESTROYED	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	4/9/02	FUEL OIL HEADER TO #8 FUEL INJECTION PUMP WAS FOUND TO BE LEAKING	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	11/20/02	NR 3 RIGHT HEAD WAS DAMAGED BEYOND REPAIR	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	1/4/03	NO.2 EDG, SHIP'S FORCE DISCOVERED DETERIORATED SUMP COVER GASKET	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	1/6/03	# 2 EDG HAS DIRTY LUBE OIL	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	1/14/03	#1 EDG DOES NOT START WITHOUT OVERRIDING THE GOVERNOR INPUT SIGNAL	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	1/15/03	SHIP'S FORCE REPLACED NOS. 1L, 6L, 7L, 8L, 3R AND 6R CYLINDER F/O INJECTOR NOZZLES DUE TO HIGH FIRING PRESSURE	**N**
LHD 2	ALCO	251C	EDG	**JP-5**	3/15/03	DURING TEST ON LUBE OIL, FUEL DILUTION METER DOES NOT GIVE ACCURATE READINGS	**N**
LHD 3	ALCO	251C	EDG	**JP-5**	5/20/03	#2 EDG HAS OIL LEAK BETWEEN FLYWHEEL AND ENGINE AREA.	**N**
LHD 3	ALCO	251C	EDG	**JP-5**	7/17/03	#2 EDG WHEN IN OPERATION UNDER A LOAD OIL LEAKS BETWEEN THE FLYWHEEL AND ENGINE BLOCK AREA	**N**
LHD 3	ALCO	251C	EDG	**JP-5**	8/8/03	#2 SS/EDG F/O BOOSTER PUMP LEAKS FROM THE WEEP HOLE INDICATING SEAL FAILURE	**N**
LHD 3	ALCO	251C	EDG	**JP-5**	9/9/03	CHECK VALVE ASSEMBLY IS LETTING OIL INTO TOP OF EDG CYLDERERS	**N**
LHD 4	ALCO	251C	EDG	**JP-5**	3/24/98	#6 INJECTOR NOZZLE IS FAULTY BY CAUSING BACK PRESSURE WITHIN FUEL INJECTION PUMP	**Y**
LHD 4	ALCO	251C	EDG	**JP-5**	3/9/99	FUEL INJECTION PUMP IS STICKING FOR #8 CYLINDER ON ENGINE DUE TO WORN INTERNAL PARTS	**Y**
LHD 4	ALCO	251C	EDG	**JP-5**	1/27/03	FLANGE SHIELDS WORN AND DETIEORATED.	**N**
LHD 4	ALCO	251C	EDG	**JP-5**	2/3/03	LUBE OIL FILTERS ARE BEYOND ENGINE HOURS OF OPERATION	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LHD 4	ALCO	251C	EDG	**JP-5**	4/16/03	4L FUEL INJECTION PUMP CAN NOT BE ADJUCTED TO THE REQUIRED FUEL DELIVERY SET POINT DUE TO A WORN SPRING	**N**
LHD 5	ALCO	251C	EDG	**JP-5**	4/22/99	SUSPSECT INJECTOR NOZZLES TO BE FOULED	**Y**
LHD 5	ALCO	251C	EDG	**JP-5**	3/12/02	FUEL INJECTION NOZZLE ON THE NUMBER 1L CYLINDER IS SHOWING SIGNS OF LEAKAGE	**Y**
LHD 5	ALCO	251C	EDG	**JP-5**	2/8/03	THE MECH. SEAL FOR THE DIESEL KEEP WARM LEAKS BEYOND REPAIR	**N**
LHD 5	ALCO	251C	EDG	**JP-5**	3/22/03	DURING REPLACEMENT OF NO. 2 SS/EDG F/O BOOSTER PUMP COUPLING SHIP'S FORCE DISCOVERED THE BOOSTER PUMP DRIVE SHAFT KEY WAS ERRODED AWAY	**N**
LHD 5	ALCO	251C	EDG	**JP-5**	10/25/03	1 EDG AIR START MOTOR WOULD NOT TURN ENGINE OVER	**N**
LHD 6	ALCO	251C	EDG	**JP-5**	1/18/02	NR 2 EDG COMPRESSION AND FIRING PRESSURE WERE OUT OF PARAMETERS	**N**
LHD 6	ALCO	251C	EDG	**JP-5**	8/7/02	PUMP IS BAD, IT GIVES LOW COMPRESSION AND FIRING PRESSURE	**Y**
LHD 6	ALCO	251C	EDG	**JP-5**	4/19/03	#2R CYLINDER HEAD EXHAUST TEMP IS EXCEEDING HIGH TEMP LIMIT.	**Y**
LHD 6	ALCO	251C	EDG	**JP-5**	11/6/03	NO.1 DIESEL 4L CYLINDER LINER COMPRESSION SEAL DAMAGED	**N**
LHD 6	ALCO	251C	EDG	**JP-5**	11/17/03	CONNECTING ROD BEARINGS; UPPER AND LOWER ARE WORN	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	1/25/02	#6 CYLINDER LEFT BANK FUEL INJECTION PUMP STICKS	**Y**
LHD 7	ALCO	251C	EDG	**JP-5**	4/5/02	#5R CYL EXHAUST VALVE IS STUCK OPEN AND VALVE IS BENT CAUSING NO COMPRESSION IN 5R CYL	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	1/13/03	#1 EDG TACHOMETER IS BAD	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	1/21/03	RELEIF VALVE IS NOT MAINTAING PROPER PSI	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	1/22/03	PRELUBE PUMP COUPILNG IS BROKE	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	1/27/03	LOW LUBE OIL SWITCH IS BAD	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	3/30/03	EXHAUST GASES LEAK FROM BETWEEN TURBOCHARGER AND	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
						ADAPTER	
LHD 7	ALCO	251C	EDG	**JP-5**	8/15/03	NUMBER 7R FUEL INJECTOR IS CAUSING THE CYLINDER EXHAUST TEMPERATURE TO EXCEED THE MAX TEMPERATURE OF 925 DEGREES	**N**
LHD 7	ALCO	251C	EDG	**JP-5**	10/3/03	FUEL PUMP INLET TO 3R FUEL PUMP FLAT COPPER GASKET LEAKING	**Y**
LPD 04	FM	38F 5 1/4	EDG	F-76	11/25/03	#2 EDG FUEL OIL FILTER LEAKS AT THE CASING	**N**
LPD 04	FM	38F 5 1/4	EDG	F-76	12/9/03	LUBE OIL IS CONTAMINATED IN #1 EDG DUE TO JACKET WATER LEAK	**N**
LPD 05	FM	38F 5 1/4	EDG	F-76	4/1/02	NO 2 EDG BLOWER CLEARANCES ARE BEYOND MANUFACTURE SPECIFICATIONS	**N**
LPD 05	FM	38F 5 1/4	EDG	F-76	7/29/02	THE BLOWER ROTOR TO HOUSING IS OUT OF SPECIFICATION	**N**
LPD 05	FM	38F 5 1/4	EDG	F-76	1/29/03	DURING OPERATION OF NO2 EDG IT WAS NOTED THAT FUEL OIL PUMP LEAK AROUND ADJUSTMENT SCREW BECAUSE OF MISSING GASKET	**N**
LPD 05	FM	38F 5 1/4	EDG	F-76	2/28/03	EXPLOSION COVERS LEAKS OIL AND REQUIRE REPLACEMENT	**N**
LPD 05	FM	38F 5 1/4	EDG	F-76	3/6/03	RECENT OPERATION OF NO. 2 EDG REVEALED A FAULTY JACKET WATER HIGH TEMPERATURE ALARM SWITCH	**N**
LPD 05	FM	38F 5 1/4	EDG	F-76	9/19/03	#2 EDG EMITTED HEAVY BLACK SMOKE WITH OIL COMING FROM EXHAUST	**N**
LPD 06	FM	38F 5 1/4	EDG	F-76	6/22/02	BLOWER ASSEMBLY CLEARANCES ARE OUT OF SPECIFICATION	**N**
LPD 08	FM	38F 5 1/4	EDG	F-76	1/30/03	NO.1 EDG HAS AN UNSAT FRESH WATER CHLORIDE TEST	**N**
LPD 08	FM	38F 5 1/4	EDG	F-76	8/12/03	NO. 2 EDG ENGINE STARTER OOC	**N**
LPD 09	FM	38F 5 1/4	EDG	F-76	1/24/02	BLOWER SEALS ARE LEAKING EXCESSIVELY	**N**
LPD 09	FM	38F 5 1/4	EDG	F-76	3/26/02	THE OUTER GRID COUPLING OF THE VERTICAL DRIVE ON #2 EDG WAS BROKEN	**N**
LPD 09	FM	38F 5 1/4	EDG	F-76	6/4/02	STARTER ENGAGED THE FLYWHEEL WHILE THE ENGINE WAS OPERATING.	**N**

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LPD 09	FM	38F 5 1/4	EDG	F-76	6/22/03	#2 EDG BLOWER HAS EXCESSIVE CLEAREANCES	N
LPD 09	FM	38F 5 1/4	EDG	F-76	7/8/03	COUPLING GRID WAS FOUND TO BE BROKEN	N
LPD 10	FM	38F 5 1/4	EDG	F-76	5/24/02	FLASHED UPPER MAIN BEARINGS AND THE NR.4 CONNECTING ROD BEARINGS ARE SCORED.	N
LPD 12	FM	38F 5 1/4	EDG	F-76	8/15/02	#2 EDG SIEZED UPON SHUTDOWN	N
LPD 12	FM	38F 5 1/4	EDG	F-76	11/8/02	NR 4 PISTON RINGS WORN OUT	N
LPD 12	FM	38F 5 1/4	EDG	F-76	3/7/03	TACHOMETER FLEX SHAFT BROKEN	N
LPD 12	FM	38F 5 1/4	EDG	F-76	3/23/03	NR2 EDG DEVELOP LOW LUBE OIL PRESSURE CAUSING OPERATOR TO STOP NR2 EDG	N
LPD 12	FM	38F 5 1/4	EDG	F-76	3/31/03	UPPER AND LOWER SIGHT GLASS HAS FUEL WEEPAGE FROM THE BOTTOM PACKING NUT	N
LPD 12	FM	38F 5 1/4	EDG	F-76	4/30/03	EXPLOSION COVERS ON NO. ONE EMERGENCY DIESEL GENERATOR LEAKS LUBE OIL DUE TO WEAR	N
LPD 13	FM	38F 5 1/4	EDG	F-76	4/17/02	THE FUEL PUMP ON #1 EDG LEAKS FROM THE FLANGE	Y
LPD 13	FM	38F 5 1/4	EDG	F-76	1/23/03	THE #4 UPPER MAIN BEARING WAS FOUND WIPED	N
LPD 13	FM	38F 5 1/4	EDG	F-76	6/28/03	GOVERNOR WILL NOT DELIVER ADEQUATE FUEL FOR STARTING	N
LPD 14	FM	38F 5 1/4	EDG	F-76	5/3/02	FUEL OIL DULUSION ON 2 EDG IN INCREASING STEADILY	Y
LPD 14	DDC	12V-71T	EDG	F-76	11/2/03	FUEL DILUTION WAS HIGH CAUSING TO CHANGE OIL AND FILTERS	Y
LPD 15	DDC	12V-71T	EDG	F-76	2/12/03	ZINC ANODES FOUND TO BE DETERORATED 50% DURING PMS CHECK	N
LPD 15	DDC	12V-71T	EDG	F-76	2/13/03	DURING 10 MINUTE WARM-UP FOR UNREP, DIESEL STARED TOO SLOW AND SHUTDOWN TOO SLOW. EXHAUST TEMPERATURES WERE OUT OF SET PARAMETERS	N
LPD 15	DDC	12V-71T	EDG	F-76	2/13/03	S/W BOOSTER PUMP FAILED TO COME ONLINE TO KEEP ENGINE COOL	N
LPD 4	FM	38F 5 1/4	EDG	F-76	11/4/03	EXCCESSIVE CLEARANCE ON THE SCAVANGE AIR BLOWERROTER TO HOUSING MEASUREMENT	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
LSD 36	DDC	12V-71	EDG	F-76	1/17/02	#3 AND 4 INJECTOR PUSH RODS ARE BENT AND RIGHT TURBO CHARGER EXHAUST HOS	N
LSD 37	DDC	12V-71	EDG	F-76	7/8/02	S/F DISCOVERED A HOLE IN THE ENGINE BLOCK NEAR THE CAM SHAFT	N
LSD 39	DDC	12V-71	EDG	F-76	5/21/02	REAR CRANCKSHAFT OIL SEAL IS LEAKING OIL	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	2/17/00	#1 SSDG #7, #9 UPPER PISTON COMPRESSION RINGS, #4 LOWER PISTON COMPRESSION RINGS ARE WORN	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	4/26/00	FOUR LOWER PISTONS HAVE BROKEN COMPRESSION RINGS	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	8/1/00	PISTONS HAVE BROKEN COMPRESSION RINGS	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	1/15/02	REAR MAIN CRANKSHAFT SEAL IS LEAKING OIL	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	7/22/02	6 PISTONS REQUIRE REPLACEMENT	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	2/6/03	N0 10N CYLINDER LINNER FOUND TO BE CRACKED	N
LSD 41	FM	38D 8 1/8	SSDG	F-76	0/19/02	#4 SSDG #8 LOWER PISTON RING IS NEED OF REPLACEMENT	N
LSD 42	FM	38D 8 1/8	SSDG	F-76	6/17/01	NR 12, 13, AND 14 MAIN BEARING WERE FLASHED,	N
LSD 42	FM	38D 8 1/8	SSDG	F-76	2/16/02	#1 SSDG F/O PUMP IS STARTING TO LEAKE AT GASKETS	N
LSD 42	FM	38D 8 1/8	SSDG	F-76	8/6/02	F/O INJECTION NOZZLES LEAK BY AT TIP	Y
LSD 42	FM	38D 8 1/8	SSDG	F-76	9/12/03	ON NR 4 SSDG THE NR 3 CYLINDER LOWER CONROD BEARING MELTED AND THE LOWER PISTON SHATTERED	N
LSD 42	FM	38D 8 1/8	SSDG	F-76	11/17/03	DAMAGED LOWER CRANKSHAFT	N
LSD 43	FM	38D 8 1/8	SSDG	F-76	4/17/01	FLASHED BEARING ON NR 13 LOWER THRUST BEARING	N
LSD 43	FM	38D 8 1/8	SSDG	F-76	10/31/01	NOZZLES LEAKING CAUSING FUEL DILUTION ON OIL	Y
LSD 43	FM	38D 8 1/8	SSDG	F-76	4/17/03	CRANKSHAFT SEAL LEAKS	N
LSD 44	FM	38D 8 1/8	SSDG	F-76	10/23/02	NOZZLES LEAKING	Y
LSD 44	FM	38D 8 1/8	SSDG	F-76	11/20/02	NR1 SSDG REAR MAIN SEAL LEAKS	N
LSD 44	FM	38D 8 1/8	SSDG	F-76	5/28/03	#1 SSDG #3 LOWER PISTON RINGS FAILED	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
LSD 45	FM	38D 8 1/8	SSDG	F-76	1/22/01	NR3 SSDG BYPASS BLOWER BUSHING IS WORN OUT	N
LSD 45	FM	38D 8 1/8	SSDG	F-76	2/26/01	PISTON RINGS ARE WORN OUT	N
LSD 45	FM	38D 8 1/8	SSDG	F-76	4/25/02	NR2 SSDG #3 AND #8 LOWER PISTON COMPRESSION RINGS WERE DISCOVERED TO BE BROKEN	N
LSD 45	FM	38D 8 1/8	SSDG	F-76	5/28/02	#2 SSDG BLOWER END GASKET NEEDS REPLACE	N
LSD 47	FM	38D 8 1/8	SSDG	F-76	2/24/00	BROKEN RINGS ON PISTONS	N
LSD 47	FM	38D 8 1/8	SSDG	F-76	3/8/03	THE BLOWER DRIVE COUPLING HUB FAILED	N
LSD 48	FM	38D 8 1/8	SSDG	F-76	4/6/00	NR 11 CYL LINER OUT OF LIMITS	N
LSD 48	FM	38D 8 1/8	SSDG	F-76	8/29/00	#4 SSDG INJECTION NOZZLES REQUIRE REPLACEMENT	N
LSD 48	FM	38D 8 1/8	SSDG	F-76	3/26/01	: BROKEN RINGS ON UPPER PISTONS #2, #.3, #11 & #12 CYLINDER	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	2/28/03	1B SSDG CONTINUES TO OPERATE WITH A UNSATISFACTORY CRANKCASE PRESSURE	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	3/10/03	HIGH FUEL DILUTION IN 2SSDG	Y
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	3/12/03	FUEL NOZZELS ARE CLOGGED	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	4/17/03	1B SSDG 1 LEFT CYLINDER HEAD IS CRACKED	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	5/8/03	2 SSDG 1 RIGHT CYLINDER FUEL INJECTOR FAILED, PUSH ROD, AND SPRING BROKE	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	6/4/03	1A SSDG INTERCOOLERS WERE FOULED	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	12/9/03	DEFECTIVE MAGNETIC PICKUP IN 1B SSDG	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	12/11/03	VALVE BRIDGE ON 6L CLY HEAD SEIZED BENDING PUSH ROD AND VALVES	N
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	1/16/03	1B SSDG DAILY L/O SAMPLE REVEALED 3% FUEL DILUTION	Y
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	2/4/03	1A SSDG'S REAR MAIN SEAL WAS LEAKING.	N
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	8/20/03	2 SSDG JACKET WATER HEATER FAILED AND WAS DAMAGED	N
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	10/16/03	HEAD GASKETS LEAKING ON 1A SSDG	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	11/18/03	1BMPDE DEISEL INJECTORS (12) ARE FAULTY	Y
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/2/03	LEFT AND RIGHT CAMSHAFTS NEED REPLACEMENT	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/6/03	F/O INJECTION PUMP REPLACEMENT	Y
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/19/03	TO REPLACE MAIN AND CONNECTING ROD BEARINGS	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/19/03	FUEL OIL INJECTION PUMP IS DEGRADED	Y
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/24/03	LEFT AND RIGHT BANK INTERCOOLERS ARE LEAKING	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	2/20/03	1RIGHT AND 2RIGHT HEADS WERE BAD	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	2/20/03	1R HEAD WAS INOPERATIVE	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	8/29/03	3 OF 4 TAPPETS WERE BAD	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	9/10/03	REPLACE FOUR CYLINDER HEADS	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	10/31/03	F/O INJECTION PUMP NEEDS REPLACED	Y
MCM 04	IF	36SS6V-AM	SSDG	F-76	1/15/03	THAT LB TURBO OIL SEAL WAS LEAKING	N
MCM 04	IF	36SS6V-AM	SSDG	F-76	8/31/03	THE BLOCK HAD TO BE CHANGED OUT	N
MCM 04	IF	36SS6V-AM	SSDG	F-76	9/24/03	INJECTION NOZZLES WERE DAMAGED	Y
MCM 04	IF	36SS6V-AM	SSDG	F-76	9/29/03	THREE HEADS DAMAGED	N
MCM 05	IF	36SS6V-AM	SSDG	F-76	1/21/03	1ASSDG RIGHT BANK TURBO CHARGER CASING IS CRACKED	N
MCM 05	IF	36SS6V-AM	SSDG	F-76	8/6/03	1B SSDG STARTER WAS BAD	N
MCM 05	IF	36SS6V-AM	SSDG	F-76	8/18/03	NR3 RIGHT CYCLINDER LINER CRACKED	N
MCM 05	IF	36SS6V-AM	SSDG	F-76	8/21/03	NR 1B SSDG HAS A CRACKED CYCLINDER HEAD	N
MCM 06	IF	36SS6V-AM	SSDG	F-76	9/3/03	1R CYLINDER HEAD REQUIRES REPLACEMENT	N
MCM 06	IF	36SS6V-AM	SSDG	F-76	12/4/03	HEAD WAS BAD	N
MCM 07	IF	36SS6V-AM	SSDG	F-76	1/14/03	CYLINDER HEAD WAS LEAKING	N
MCM 07	IF	36SS6V-AM	SSDG	F-76	1/27/03	2SSDGS STARTER WOULDNT ENGAGE THE BENDIX	N
MCM 08	IF	36SS6V-AM	SSDG	F-76	1/16/03	1R,1L CYLINDERS WIPED ON 1A SSDG	N
MCM 08	IF	36SS6V-AM	SSDG	F-76	11/10/03	1A SSDG GOVENOR FAILED	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
MCM 09	IF	36SS6V-AM	SSDG	F-76	1/25/03	1R, 1L CYLINDERS WIPED ON 1A SSDG	N
MCM 09	IF	36SS6V-AM	SSDG	F-76	2/27/03	1R / 1L CON ROD BEARINGS WIPED AND CRANKSHAFT SCARRED	N
MCM 09	IF	36SS6V-AM	SSDG	F-76	7/17/03	LEAKING HEAD, CYLINDER	N
MCM 09	IF	36SS6V-AM	SSDG	F-76	11/8/03	ALL SIX CYLINDER HEADS REQUIRE REPLACEMENT	N
MCM 10	IF	36SS6V-AM	SSDG	F-76	9/2/03	CLYINDER HEAD CRACKED ON # 2 SSDG	N
MCM 10	IF	36SS6V-AM	SSDG	F-76	10/15/03	ENGINE SUFFERED CRANK CASE EXPLOSIONI	N
MCM 10	IF	36SS6V-AM	SSDG	F-76	10/17/03	2SSDG, STARTER FAILED	N
MCM 11	IF	36SS6V-AM	SSDG	F-76	1/11/03	ROCKER ARMS AND CROSSHEADS DAMAGED	N
MCM 11	IF	36SS6V-AM	SSDG	F-76	3/12/03	1A SSDG TWO CYLINDER HEADS WERE LEAKINGWATER	N
MCM 11	IF	36SS6V-AM	SSDG	F-76	6/9/03	2 SSDG HAS 6 LEAKING HEADS	N
MCM 12	IF	36SS6V-AM	SSDG	F-76	1/29/03	THE RIGHT BANK CAM SHAFT GEAR BOLT SHEARED OFF	N
MCM 12	IF	36SS6V-AM	SSDG	F-76	2/2/03	CAM DAMAGED	N
MCM 12	IF	36SS6V-AM	SSDG	F-76	4/27/03	MAIN BEARING DAMAGED CAM SHAFT DAMAGED	N
MCM 12	IF	36SS6V-AM	SSDG	F-76	7/31/03	2 SSDG 2 RIGHT HEAD IS BAD	N
MCM 13	IF	36SS6V-AM	SSDG	F-76	3/18/03	CRANKSHAFT HEAVILY DAMAGED	N
MCM 14	IF	36SS6V-AM	SSDG	F-76	1/22/03	50% OF CYLINDERLINERS NEEDING REPLACEMENT	N
MCM 14	IF	36SS6V-AM	SSDG	F-76	2/2/03	DISCOVERED CYLINDER HEAD LEAKING	N
MCM 14	IF	36SS6V-AM	SSDG	F-76	3/3/03	2R PISTON BAD	N
MCM 14	IF	36SS6V-AM	SSDG	F-76	5/30/03	1A SSDG LUBE OIL COOLER LEAKING	N
MCM 14	IF	36SS6V-AM	SSDG	F-76	8/4/03	CHANGE LH AND RH TURBOCHARGERS	N
MCM 14	IF	36SS6V-AM	SSDG	F-76	8/20/03	REPLACE BOTH CAMS AND TAPPETS	N
MHC 52	IF	36SS8V-AM	SSDG	F-76	6/17/03	NR1 LEFT CYLINDER HEAD AND OR CYLINDER LINER HAS CRACK.	N
MHC 52	IF	36SS8V-AM	SSDG	F-76	6/18/03	J/W LEAKS COMING FROM 4 CYLINDER HEADS	N
MHC 53	IF	36SS8V-AM	SSDG	F-76	7/18/03	CYLINDER HEADS 2R, 3R, 4R, 1L, 2L, 4L HAD J/W LEAK	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	MFR	MODEL	SSDG / EDG / MP	FUEL	DATE OF CM	CM NARRATIVE	FUEL-RELATED
MHC 53	IF	36SS8V-AM	SSDG	F-76	7/25/03	THAT SEVERAL ROCKER ARMS AND CROSSHEADS REQUIRE REPLACEMENT	N
MHC 53	IF	36SS8V-AM	SSDG	F-76	9/12/03	DAMAGED 4L, 4R POWER PACKS AND 4R HEAD DAMAGE	N
MHC 53	IF	36SS8V-AM	SSDG	F-76	9/22/03	PISTON COOLING NOZZLE BROKE OFF CAUSING 4R CYLINDER HEAD TO BE DAMAGED	N
MHC 54	IF	36SS8V-AM	SSDG	F-76	1/9/03	2R CYLINDER FAILURE	N
MHC 54	IF	36SS8V-AM	SSDG	F-76	1/16/03	2R PISTON WAS DISINTEGRATED AND MULTIPLE PISTON COOLING NOZZLES WERE DAMAGED	N
MHC 54	IF	36SS8V-AM	SSDG	F-76	3/26/03	OF 2SSDG ENGINE FAILED TO START DUE TO FAULTY STARTER	N
MHC 55	IF	36SS8V-AM	SSDG	F-76	3/18/03	NR 1A SSDG F/O PRESSURE FLUCTUATES AND LOSES PRESSURE	N
MHC 57	IF	36SS8V-AM	SSDG	F-76	9/14/03	THAT 3R HEAD TO BE FAULTY AND LEAKING BY EXHAUST	N
MHC 60	IF	36SS8V-AM	SSDG	F-76	6/15/03	STARTER IS NOT TURNING OVERXXX	N
MHC 60	IF	36SS8V-AM	SSDG	F-76	7/25/03	NR 1L CYLINDER LINERM SCORED, 3L HEAD J/W LEAK	N
MHC 60	IF	36SS8V-AM	SSDG	F-76	8/18/03	1L, 3L, 4L POWER PAKS SHOWED CAUSES OF REPL ACEMENTS AND 1-4 CYLINDER HEAD	N
MHC 61	IF	36SS8V-AM	SSDG	F-76	6/16/03	BAD VALVES ON 1L, 4R CYLINDER HEAD, AND A BAD CROSSHEAD	N
MHC 61	IF	36SS8V-AM	SSDG	F-76	6/28/03	1A SSDG CONROD AND MAIN BEARINGS ARE WORN	N
MHC 61	IF	36SS8V-AM	SSDG	F-76	7/5/03	4R POWER PACK WAS FOUND TO BE WORN	N
MHC 61	IF	36SS8V-AM	SSDG	F-76	7/11/03	7 OF 8 POWER PACKS AS WORN OUT	N
MHC 62	IF	36SS8V-AM	SSDG	F-76	3/31/03	7 OF 8 POWER PACKS ON NR 1B SSDG REQUIRE REPLACEMENT	N
PC 06	CAT	3306B	SSDG	F-76	5/30/03	ROD END BEARINGS WERE WORN	N
PC 07	CAT	D399	SSDG	F-76	12/16/03	FUEL OIL INJECTORS NEED REPLACE	N
PC 09	CAT	3306B	SSDG	F-76	4/23/03	#1 SSDG IS OOC DUE TO CRANKCASE EXPLOSION	N
PC 10	CAT	3306B	SSDG	F-76	5/17/03	CRANK SHAFT SEAL REQUIRES REPLACMENT	N

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
SSN 21	FM	38D 8 1/8	EDG	F-76	11/16/03	4TH CYLINDER RELIEVE VALVE STARTED LEAKING PAST ITS SEAT	N
SSN 691	FM	38D 8 1/8	EDG	F-76	4/14/03	#2 CYLINDER HAS A CRACKED COMPRESSION RING	N
SSN 700	FM	38D 8 1/8	EDG	F-76	1/2/03	DIESEL TEST COCK #6 BLOW DOWN PIPE CRACKED DUE TO HEAT STRESS	N
SSN 700	FM	38D 8 1/8	EDG	F-76	5/22/03	DIESEL ENGINE BARRING DEVICE INTERLOCK CABLE SNAPPED	N
SSN 705	FM	38D 8 1/8	EDG	F-76	3/20/03	A SMALL FRESH WATER LEAK WAS FOUND ON CYLINDER # 3 AND #4 WERE THE BLOCK MEETS THE CYLINDER LINER.	N
SSN 706	FM	38D 8 1/8	EDG	F-76	6/27/03	FUEL INJECTION PUMPS 2, 7, AND 8 NON CONTROL SIDE FITTINGS HAD MINOR FUEL LEAKAGE	Y
SSN 708	FM	38D 8 1/8	EDG	F-76	9/6/02	BLOWER GATE ROTOR TO MAIN ROTOR CLEARANCES AT SUCTION END ARE OUT OF SPECIFICATION	N
SSN 708	FM	38D 8 1/8	EDG	F-76	3/12/03	THE BLOWER DRIVE SPRING PACK GRIDMEMBER IS BROKEN	N
SSN 710	FM	38D 8 1/8	EDG	F-76	1/8/03	#4 CYLINDER ON THE DIESEL HAS STRIPPED THREADS AND REQUIRES REPLACEMENT	N
SSN 710	FM	38D 8 1/8	EDG	F-76	3/7/03	TREND INDICATES FUEL INJECTOR NEEDS REPLACED	Y
SSN 711	FM	38D 8 1/8	EDG	F-76	2/19/03	DIESEL GENERATOR BEARING LUBE OIL SUPPLY SIGHTGLASS IS CRACKED AND IS LEAKING LUBE OIL	N
SSN 714	FM	38D 8 1/8	EDG	F-76	3/31/02	FUEL INJECTORS ON CYLINDERS 2,3, AND 5 NEED TO BE TESTED DUE TO EXCESSIVE TEMP DIFFERENTIAL	Y
SSN 716	FM	38D 8 1/8	EDG	F-76	11/12/02	ALUMINUM BEARING ON THE UPPER AND LOWER CRANKSHAFT NEEDS TO BE REPLACED DUE TO WEAR AND TEAR	N
SSN 716	FM	38D 8 1/8	EDG	F-76	11/14/02	FUEL INJECTORS ARE LEAKING	Y
SSN 716	FM	38D 8 1/8	EDG	F-76	1/29/03	THE DSW PUMP REQUIRES REPAIR	N
SSN 718	FM	38D 8 1/8	EDG	F-76	3/31/03	DIESEL LUBE OIL FUEL DILUTION IS 3% AND REQUIRES TO BE CHANGED	Y

DIESEL ENGINES CORRECTIVE MAINTENANCE ACTIONS ON BOARD SHIPS THAT ARE CURRENTLY OPERATING ON F-76, AND JP-5 FUEL							
SHIP	**MFR**	**MODEL**	**SSDG / EDG / MP**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL-RELATED**
SSN 719	FM	38D 8 1/8	EDG	F-76	4/26/03	EXPLOSION COVERS ARE WARPED CAUSING OIL TO LEAK OUT OF DIESEL DURING OPERATIONS	N
SSN 719	FM	38D 8 1/8	EDG	F-76	6/13/03	COPPERS SEAL INTO CLYLINDER 5 LINER HAS FAILED	N
SSN 724	FM	38D 8 1/8	EDG	F-76	4/4/02	DURING NORMAL UNDERWAY SNORKELING OPERATION THE DIESEL SUFFERED A CRANK CASE EXPLOSION	N
SSN 724	FM	38D 8 1/8	EDG	F-76	7/14/03	BLOWER WAS FOUND TO BE OUT OF ALIGNMENT IT IS OUT OF TOLERANCE BY .008"	N
SSN 725	FM	38D 8 1/8	EDG	F-76	2/27/03	DIESEL EXHAUST MANIFOLD GASKETS HAVE FAILED	N
SSN 750	FM	38D 8 1/8	EDG	F-76	3/11/03	LOW LUBE OIL PRESSURE AT DISCHARGE OF LUBE OIL PUMP	N
SSN 750	FM	38D 8 1/8	EDG	F-76	6/17/03	DSL CYLINDER # 8 IS LEAKING FRESH WATER.	N
SSN 751	FM	38D 8 1/8	EDG	F-76	5/28/03	#4 CYLINDER LEAKES DFW	N
SSN 752	FM	38D 8 1/8	EDG	F-76	2/6/03	DIESEL ENGINE FUEL OIL PUMP LEAKS	Y
SSN 753	FM	38D 8 1/8	EDG	F-76	2/6/03	THERE WAS 160 PSID BETWEEN CYLINDER FIRING PRESSURES DURING TREND ANALYSIS. (SPEC 100 PSID)	N
SSN 753	FM	38D 8 1/8	EDG	F-76	7/10/03	DSW PUMP MECHANICAL SEAL LEAKS IN EXCESS OF 25 DROPS PER MINUTE	N
SSN 754	FM	38D 8 1/8	EDG	F-76	2/21/03	EXPLOSION COVER GASKETS BEGAN LEAKING DURRING OPERATION OF DSL	N
SSN 755	FM	38D 8 1/8	EDG	F-76	5/23/03	FUEL DILUTION OF DIESEL OIL HAS INCREASED, INDICATING PROBABLE LEAK BY OR CLOGGING OF ONE OR MORE INJECTORS	Y
SSN 757	FM	38D 8 1/8	EDG	F-76	5/30/03	#1 CYLINDER CONTROL SIDE FUEL INJECTOR HAD MULTIPLE LEAKS ONTHE HIGH PRESSURE SIDE	N
SSN 761	FM	38D 8 1/8	EDG	F-76	2/17/03	THE FIRING PRESSURES FOR #8 CYLINDER WERE LOW	N
SSN 762	FM	38D 8 1/8	EDG	F-76	4/11/03	DSL ENG HAS BROKEN GRID MEMBER	N
SSN 766	FM	38D 8 1/8	EDG	F-76	1/11/03	THE DIESEL FUEL OIL PUMP IS LEAKING OIL SLIGHTLY AT THE MOUNTIN FLANGE	N

Enclosure (4)

FUEL-RELATED CORRECTIVE MAINTENANCE ITEMS FOR SSDGs AND EDGs

FUEL RELATED CORRECTIVE MAINTENANCE ITEMS FOR SSDGs AND EDGs								
SHIP	**MFR**	**MODEL**	**SSDG / EDG**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL RELATED**	**JP-5 RELATED**
AFDM 10	CAT	D399	SSDG	F-76	2/4/03	#2 EMERGENCY DIESEL GENERATOR FUEL DILUTION HAS EXCEEDED NORMAL RANGE	**Y**	**N**
AGF 11	FM	38F 5 1/4	EDG	F-76	2/11/03	NUMBER 1 EDG FUEL INJECTION NOZZLES LEAKS BY DURING OPERATION CAUSING IMPROPER COMBUSTION.	**Y**	**N**
AGF 11	FM	38F 5 1/4	EDG	F-76	2/11/03	NUMBER 2 EDG FUEL INJECTION NOZZLES LEAKS BY DURING NORMAL OPERATION, CAUSING IMPROPER COMBUSTION	**Y**	**N**
ARS 50	CAT	D399	SSDG	F-76	5/6/03	DURING DIESEL INSPECTION NUMEROUS FUEL OIL INJECTORS, PUMPS AND JUMPER LINES LEAK	**Y**	**N**
ARS 51	CAT	D399	SSDG	F-76	1/29/03	FUEL NOZZELS ARE CLOGGED	**Y**	**N**
ARS 52	CAT	D399	EDG	F-76	2/20/02	2SGB, F/O NOZZLES ARE CLOGGED	**Y**	**N**
ARS 52	CAT	D399	EDG	F-76	102103	2SGB FUEL OIL STRAINERS ARE PARTLLY CLOGGED	**Y**	**N**
ARS 53	CAT	D399	SSDG	F-76	11/18/03	ALL INJECTION NOZZELS WERE FOULED	**Y**	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/14/03	DURING OPERARATIONAL TEST FUEL WAS SEEN FROM THE TALETELL PIPE INDICATING A POSSIBLE CLOGGED NOZZLE ON 3 EDG	**Y**	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/15/03	DURING OPERABILITY TESTS S/F DICOVERED 4 DEFECTIVE NOZZLES ON NR 3 EDG	**Y**	**N**
CV 63	FM	38D 8 1/8	EDG	**JP-5**	1/16/03	DURING NORMAL OPERATION, SHIPS FORCE DISCOVERED THAT 4 INJECTOR NOZZLES ON NR 3 DIESEL GENERATOR WERE DEFECTIVE	**Y**	**N**
CV 67	FM	38D 8 1/8	EDG	**JP-5**	1/11/02	ALL F/O NOZZLES, LINES AND ALL FUEL INJECTION PUMPS LEAK EXCESSIVELY	**Y**	**N**
CVN 68	EMD	645	EDG	**JP-5**	7/16/96	ATTACHED FUEL OIL PUMP ON #1 EDG SHOWS SIGNS OF WEAR AND TEAR	**Y**	**N**
CVN 68	EMD	645	EDG	**JP-5**	12/12/96	PISTON RINGS ON #1 EDG SHOWED SIGNS OF WEAR DUE TO LIGHT LOADED OPERATIONS	**Y**	**N**
CVN 68	EMD	645	EDG	**JP-5**	3/13/98	FUEL OIL PUMP SUCTION VALVE (V-202) LEAKS	**Y**	**N**
CVN 69	EMD	645	EDG	**JP-5**	12/2/00	THE LUBE OIL WAS FOUND TO BE CONTAMINATED WITH FU EL OIL	**Y**	**N**
CVN 70	EMD	645	EDG	**JP-5**	10/8/97	4EDG LUBE OIL SYSTEM IS DILUTED WITH FUEL OIL	**Y**	**N**

FUEL RELATED CORRECTIVE MAINTENANCE ITEMS FOR SSDGs AND EDGs								
SHIP	**MFR**	**MODEL**	**SSDG / EDG**	**FUEL**	**DATE OF CM**	**CM NARRATIVE**	**FUEL RELATED**	**JP-5 RELATED**
CVN 70	EMD	645	EDG	**JP-5**	7/1/99	#1 EDG HAS 16 FUEL OIL INJECTORS THAT ARE NOT FUNCTIONING PROPERLY AND CANNOT BE TIMED PER PMS	**Y**	**N**
CVN 70	EMD	645	EDG	**JP-5**	11/3/00	#1 EDG FUEL OIL PUMP IS WORN AND IS CAUSING LOW FUEL OIL PRESSURE READINGS	**Y**	**N**
CVN 71	EMD	645	EDG	**JP-5**	6/21/02	#2 EDG FUEL OIL PUMP MECHANICAL SEAL LEAKING BY	**Y**	**N**
CVN 72	EMD	645	EDG	**JP-5**	1/19/02	#4 EDG HAS THREE LEAKING FUEL OIL JUMPER LINES	**Y**	**N**
CVN 72	EMD	645	EDG	**JP-5**	2/26/02	FUEL INJECTORS ON #1EDG ARE LEAKING THROUGH THE FUEL INJECTOR BODY	**Y**	**N**
CVN 72	EMD	645	EDG	**JP-5**	3/13/02	FOUR INJECTORS ON #3EDG ARE LEAKING AND NEED TO BE REPLACED	**Y**	**N**
CVN 72	EMD	645	EDG	**JP-5**	4/23/02	REPLACED ALL 16 FUEL OIL INJECTORS ON #4 EMERGENCY DIESEL GENERATOR DUE TO LEAK BY	**Y**	**N**
CVN 72	EMD	645	EDG	**JP-5**	11/8/02	FUEL OIL JUMPER LINE ON #7 CYLINDER HEAD ON #4 EDG IS LEAKING FUEL	**Y**	**N**
CVN 73	EMD	645	EDG	**JP-5**	12/11/95	2 EMERGENCY DIESEL GENERATOR INJECTORS REQUIRE REPLACEMENT	**Y**	**N**
CVN 73	EMD	645	EDG	**JP-5**	12/11/95	#3 EDG INJECTORS REQUIRE REPLACEMENT	**Y**	**N**
CVN 73	EMD	645	EDG	**JP-5**	10/10/96	16 FUEL INJECTORS REQUIRE OVERHAUL	**Y**	**N**
CVN 73	EMD	645	EDG	**JP-5**	11/20/03	#3 EDG FUEL INJECTORS LEAKING INTO DIESEL CRANKCASE	**Y**	**N**
CVN 74	EMD	645	EDG	**JP-5**	5/3/01	COMPRESSION RINGS ARE IN TYPE 2A CONDITION (CHROME GROOVES ARE WORN AWAY).	**Y**	**N**
CVN 74	EMD	645	EDG	**JP-5**	3/12/02	PISTON RINGS ARE IN A TYPE 2A WEAR CONDITION	**Y**	**N**
FFG 15	DDC	149TI	SSDG	F-76	1/22/01	UNSAT F/O DULUTION GREATER THAT 5%.	**Y**	**N**
FFG 32	DDC	149TI	SSDG	F-76	5/9/03	THAT # 3 SSDG FUEL INJECTORS ARE WORN	**Y**	**N**
FFG 48	DDC	149TI	SSDG	F-76	8/8/01	INJECTORS NEED TO BE REPLACED	**Y**	**N**
LCC 19	FM	38D 8 1/8	EDG	F-76	9/11/02	#1 EDG LEAKING FUEL JUMPER LINES	**Y**	**N**
LCC 20	FM	38D 8 1/8	SSDG	F-76	7/28/03	3 FUEL PUMPS ARE STICKING AND NEED REPLACING	**Y**	**N**

FUEL RELATED CORRECTIVE MAINTENANCE ITEMS FOR SSDGs AND EDGs								
SHIP	MFR	MODEL	SSDG / EDG	FUEL	DATE OF CM	CM NARRATIVE	FUEL RELATED	JP-5 RELATED
LHA 1	ALCO	251C	EDG	**JP-5**	7/10/95	NR 1 SS/EDG HAS FUEL LEAKS AT CYLINDER NUMBERS 4L AND 4R AT FUEL OIL INLET HEADER	Y	N
LHA 1	ALCO	251C	EDG	**JP-5**	8/18/97	ATTATCHED CYLINDER F/O PUMPS LEAKING	Y	N
LHA 1	ALCO	251C	EDG	**JP-5**	6/3/98	NR 2 SS/EDG'S CROSSHEAD ASSEMBLIES AND FUEL PUMPS ARE LEAKING AT THE BASE OF THE FUEL PUMP	Y	N
LHA 1	ALCO	251C	EDG	**JP-5**	1/19/99	NR.2 SS/EDG'S CROSSHEAD ASSEMBLIES AND FUEL PUMPS ARE LEAKING AT THE BASEOF THE FUEL PUMPS	Y	N
LHA 1	ALCO	251C	EDG	**JP-5**	4/23/99	FUEL INJECTION NOZZLES (16 EA) LEAKS	Y	N
LHA 1	ALCO	251C	EDG	**JP-5**	10/11/00	2R FUEL INJECTION TUBE HAS A PIN HOLE LEAK IN THE FITTING	Y	N
LHA 1	ALCO	251C	EDG	**JP-5**	4/8/03	LEAKING FUEL INJECTION TUBES	Y	N
LHA 2	ALCO	251C	EDG	**JP-5**	4/30/02	#1 EDG FUEL OIL PRESSURE AIR CUTOUT VALVE LEAKS FUEL OIL	Y	N
LHA 3	ALCO	251C	EDG	**JP-5**	10/13/98	4 INJECTION PUMPS ARE LEAKING BY.	Y	N
LHA 3	ALCO	251C	EDG	**JP-5**	10/31/00	SEVERAL INJECTION PUMPS LEAK F/O FROM F/O INLET HEADER CONNECTION	Y	N
LHA 3	ALCO	251C	EDG	**JP-5**	9/4/01	FUEL PUMPS START LEAKING	Y	N
LHA 3	ALCO	251C	EDG	**JP-5**	10/15/01	10 FUEL PUMPS NEED OVERHAUL	Y	N
LHA 4	ALCO	251C	EDG	**JP-5**	7/1/96	CYLINDERS 2R AND 7R ARE NOT FIRING. SUSPECT FAULTY FUEL INJECTOR PUMPS	Y	N
LHA 4	ALCO	251C	EDG	**JP-5**	7/29/96	IS FAULTY INJECTION PUMPS OR INJECTION NOZZLES	Y	N
LHA 4	ALCO	251C	EDG	**JP-5**	7/31/96	NR1 EDG FUEL INJECTION NOZZLES 14 OF 16 NOZZLES FAILED	Y	N
LHA 4	ALCO	251C	EDG	**JP-5**	1/31/02	#2 DIESEL GASKETS LEAK AND NOZZLE BODY O-RINGS LEAK BY ALLOWING SMALL AMOUNTS OF OIL TO LEAK OUT OF ENGINE	Y	N
LHA 4	ALCO	251C	EDG	**JP-5**	3/29/03	#2 EDG FUEL BOOSTER PUMP LEAKS SMALL AMOUNT OF FUEL AND HAS RUBBER IN THE FUEL INDICATING THE IMPELLER MAY BE BAD	Y	N
LHA 5	ALCO	251C	EDG	JP-5	12/12/97	1EMERGENCY DIESEL INJECTION NOZZLES REQUIRE OVERHAUL	Y	N
LHA 5	ALCO	251C	EDG	JP-5	1/25/01	3 INJECTION PMPS LEAKING AND NOT WORKING PROPERLY	Y	N

FUEL RELATED CORRECTIVE MAINTENANCE ITEMS FOR SSDGs AND EDGs								
SHIP	MFR	MODEL	SSDG / EDG	FUEL	DATE OF CM	CM NARRATIVE	FUEL RELATED	JP-5 RELATED
LHA 5	ALCO	251C	EDG	**JP-5**	2/21/03	CUP O RINGS ON FUEL INJECTION PUMPS SEEP FUEL AND NEED TO BE CHANGED OUT	Y	N
LHA 5	ALCO	251C	EDG	**JP-5**	3/6/03	CYLINDER LINERS NUMBER 3 RIGHT, 4 RIGHT, 5 LEFT, 5 RIGHT, 6 RIGHT, 7 RIGHT, AND 8 RIGHT WERE DISCOVERED WITH LIGHT WEAR ON THE LINERS	Y	N
LHD 1	ALCO	251C	EDG	**JP-5**	12/31/96	#1SS/EDG FUEL PUMPS ARE WORN	Y	N
LHD 1	ALCO	251C	EDG	**JP-5**	7/6/97	FUEL NOZZLE ASSEMBLY NEEDS REPLACEMENT	Y	N
LHD 1	ALCO	251C	EDG	**JP-5**	4/6/02	REPAIR AS NEEDED SIXTEEN FUEL NOZZLES	Y	N
LHD 1	ALCO	251C	EDG	**JP-5**	11/13/02	THE HIGH PRESSURE FUEL LINE LEAKED	Y	N
LHD 2	ALCO	251C	EDG	**JP-5**	8/18/95	FIVE FUEL PUMPS REQUIRE REPLACING	Y	N
LHD 2	ALCO	251C	EDG	**JP-5**	9/1/95	7R FUEL INJECTOR WAS DISCOVERED TO BE FAULTY	Y	N
LHD 2	ALCO	251C	EDG	**JP-5**	3/9/99	16 NOZZLES TO NEED REBUILT	Y	N
LHD 4	ALCO	251C	EDG	**JP-5**	3/24/98	#6 INJECTOR NOZZLE IS FAULTY BY CAUSING BACK PRESSURE WITHIN FUEL INJECTION PUMP	Y	N
LHD 4	ALCO	251C	EDG	**JP-5**	3/9/99	FUEL INJECTION PUMP IS STICKING FOR #8 CYLINDER ON ENGINE DUE TO WORN INTERNAL PARTS	Y	N
LHD 5	ALCO	251C	EDG	**JP-5**	4/22/99	SUSPSECT INJECTOR NOZZLES TO BE FOULED	Y	N
LHD 5	ALCO	251C	EDG	**JP-5**	3/12/02	FUEL INJECTION NOZZLE ON THE NUMBER 1L CYLINDER IS SHOWING SIGNS OF LEAKAGE	Y	N
LHD 6	ALCO	251C	EDG	**JP-5**	8/7/02	PUMP IS BAD, IT GIVES LOW COMPRESSION AND FIRING PRESSURE	Y	N
LHD 6	ALCO	251C	EDG	**JP-5**	4/19/03	#2R CYLINDER HEAD EXHAUST TEMP IS EXCEEDING HIGH TEMP LIMIT.	Y	N
LHD 7	ALCO	251C	EDG	**JP-5**	1/25/02	#6 CYLINDER LEFT BANK FUEL INJECTION PUMP STICKS	Y	N
LHD 7	ALCO	251C	EDG	**JP-5**	10/3/03	FUEL PUMP INLET TO 3R FUEL PUMP FLAT COPPER GASKET LEAKING	Y	N
LPD 13	FM	38F 5 1/4	EDG	F-76	4/17/02	THE FUEL PUMP ON #1 EDG LEAKS FROM THE FLANGE	Y	N
LPD 14	DDC	12V-71T	EDG	F-76	11/2/03	FUEL DILUTION WAS HIGH CAUSING TO CHANGE OIL AND FILTERS	Y	N
LPD 14	FM	38F 5 1/4	EDG	F-76	5/3/02	FUEL OIL DULUSION ON 2 EDG IN INCREASING STEADILY	Y	N

FUEL RELATED CORRECTIVE MAINTENANCE ITEMS FOR SSDGs AND EDGs								
SHIP	MFR	MODEL	SSDG / EDG	FUEL	DATE OF CM	CM NARRATIVE	FUEL RELATED	JP-5 RELATED
LSD 41	FM	38D 8 1/8	SSDG	F-76	9/3/02	NR 4 SSDG L/O TESTING REVEALS ABOVE FIVE PERCENT F/O DILUTION	Y	N
LSD 42	FM	38D 8 1/8	SSDG	F-76	8/6/02	F/O INJECTION NOZZLES LEAK BY AT TIP	Y	N
LSD 43	FM	38D 8 1/8	SSDG	F-76	10/31/01	NOZZLES LEAKING CAUSING FUEL DILUTION ON OIL	Y	N
LSD 44	FM	38D 8 1/8	SSDG	F-76	10/23/02	NOZZLES LEAKING	Y	N
MCM 01	WAUKESHA	L1616DSIN	SSDG	F-76	3/10/03	HIGH FUEL DILUTION IN 2SSDG	Y	N
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	1/16/03	1B SSDG DAILY L/O SAMPLE REVEALED 3% FUEL DILUTION	Y	N
MCM 02	WAUKESHA	L1616DSIN	SSDG	F-76	11/18/03	1BMPDE DEISEL INJECTORS (12) ARE FAULTY	Y	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/6/03	F/O INJECTION PUMP REPLACEMENT	Y	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	1/19/03	FUEL OIL INJECTION PUMP IS DEGRADED	Y	N
MCM 03	IF	36SS6V-AM	SSDG	F-76	10/31/03	F/O INJECTION PUMP NEEDS REPLACED	Y	N
MCM 04	IF	36SS6V-AM	SSDG	F-76	9/24/03	INJECTION NOZZLES WERE DAMAGED	Y	N
SSN 706	FM	38D 8 1/8	EDG	F-76	6/27/03	FUEL INJECTION PUMPS 2, 7, AND 8 NON CONTROL SIDE FITTINGS HAD MINOR FUEL LEAKAGE	Y	N
SSN 710	FM	38D 8 1/8	EDG	F-76	3/7/03	TREND INDICATES FUEL INJECTOR NEEDS REPLACED	Y	N
SSN 714	FM	38D 8 1/8	EDG	F-76	3/31/02	FUEL INJECTORS ON CYLINDERS 2,3, AND 5 NEED TO BE TESTED DUE TO EXCESSIVE TEMP DIFFERENTIAL	Y	N
SSN 716	FM	38D 8 1/8	EDG	F-76	11/14/02	FUEL INJECTORS ARE LEAKING	Y	N
SSN 718	FM	38D 8 1/8	EDG	F-76	3/31/03	DIESEL LUBE OIL FUEL DILUTION IS 3% AND REQUIRES TO BE CHANGED	Y	N
SSN 752	FM	38D 8 1/8	EDG	F-76	2/6/03	DIESEL ENGINE FUEL OIL PUMP LEAKS	Y	N
SSN 755	FM	38D 8 1/8	EDG	F-76	5/23/03	FUEL DILUTION OF DIESEL OIL HAS INCREASED, INDICATING PROBABLE LEAK BY OR CLOGGING OF ONE OR MORE INJECTORS	Y	N

Enclosure (5)

U.S. NAVY MPDE/SSDG/EDG MAINTENANCE POOL

U.S. NAVY MPDE/SSDG/EDG MAINTENANCE POOL										
Equipment Type/Application	**Unit Rating**	**No./ Vessel**	**No. of Vessels**	**Total Units**	**OH Cost/ Unit, $K**	**Est Hours Btwn OH**	**CY 03 Corrective Maintenance Actions**	**CY 03 Fuel-Related Corrective Maintenance Actions**	**CY 03 Fuel-Related TOC $K**	**CY-03 TOC $K**
Alaska Diesel M844/EDG	24 BHP	1	34	34	$3.00	4,000	ND	ND	ND	ND
ALCO 251/EDG	2000 KW	2	13	26	$1,000.00	16,000	47	6	$38.80	$304.00
CAT 399/SSDG	1100 BHP	1	4	4	$600.00	12,000	12	5	$85.00	$204.00
CAT 3306B/SSDG	150 KW	2	13	26	$20.00	8,000	ND	ND	ND	ND
CAT 3512/SSDG	1000 KW	1	3	3	$750.00	15,000	ND	ND	ND	ND
CAT 3512/MPDE	1175 BHP	2	3	6	$750.00	15,000	ND	ND	ND	ND
CAT 3608/SSDG	3485 BHP	5	4	20	$800.00	20,000	16	0	$0.00	$75.00
Coltec PC2.5V/MPDE	8500 BHP	4	12	48	$3,000.00	18,000	25	4	$79.68	$498.00
Cummins 4B3.9M/MPDE	76 BHP	3	1	3	$20.00	8,000	ND	ND	ND	ND
Cummins 4B3.9M/MPDE	76 BHP	5	1	5	$20.00	8,000	ND	ND	ND	ND
Cummins 6B5.9M/MPDE	115 BHP	1	4	4	$30.00	10,000	ND	ND	ND	ND
Cummins 6BT5.9M/MPDE	180 BHP	1	259	259	$30.00	10,000	ND	ND	ND	ND
Cummins 6BTA5.9M2/MPDE	220 BHP	1	27	27	$30.00	10,000	ND	ND	ND	ND
Onan 15MDJF4R4686D/EDG	15 KW	1	1	1	$5.00	4,000	ND	ND	ND	ND
DD 4-53/MPDE	100 BHP	1	38	38	$15.00	6,000	ND	ND	ND	ND
DD 6V-53/MPDE	160 BHP	1	8	8	$25.00	6,000	ND	ND	ND	ND
DD 3-71/MPDE	67 BHP	51	2	102	$20.00	8,000	ND	0	0	$3.17
DD 4-71/MPDE	80 BHP	2	20	40	$20.00	8,000	ND	0	0	$135.90
DD 6-71/MPDE	250 BHP	1/2	464	706	$25.00	10,000	ND	0	0	$373.55
DD 8V-71/MPDE	462 BHP	1/2	162	197	$40.00	12,000	ND	0	0	$283.00
DD 12V-71/MPDE	400 BHP	2	157	274	$50.00	12,000	ND	0	0	$80.10
DD 6V-92TA/MPDE	455 BHP	10	1	10	$35.00	10,000	ND	0	0	$11.50
DD 8V-92/MPDE	350 BHP	1	89	89	$35.00	10,000	ND	0	0	4.456*
DD 6087/8MALUM/MPDE	250 BHP	1	4	4	$40.00	5,000	ND	0	0	$1.65
Grey Marine 64HN9/MPDE	225 BHP	1	31	31	$25.00	6,000	ND	0	0	$0.092*
DD 16V-149TI/SSDG	1000 KW	4	31	124	$250.00	11,000	20	1	$380.95	$7,619.00

U.S. NAVY MPDE/SSDG/EDG MAINTENANCE POOL										
Equipment Type/Application	**Unit Rating**	**No./ Vessel**	**No. of Vessels**	**Total Units**	**OH Cost/ Unit, $K**	**Est Hours Btwn OH**	**CY 03 Corrective Maintenance Actions**	**CY 03 Fuel-Related Corrective Maintenance Actions**	**CY 03 Fuel-Related TOC $K**	**CY-03 TOC $K**
EMD 567/EDG	1500 KW	4	1	4	$650.00	20,000	3	0	$0.00	$21.00
EMD 645/EDG	2000 KW	4	9	36	$750.00	20,000	20	1	$8.60	$172.00
FM 38ND 8 1/8/SSDG	1200-2000 BHP	1/2/4	108	120	$1,000.00	18,000	65	7	$248.33	$2,306.00
FM 38F 5 1/4/EDG	428 BHP	2	11	22	$800.00	16,000	25	0	$0.00	$15.00
IF ID36SS6V-AM/MPDE/SSDG	600 BHP	7	12	84	$250.00	6,000	44	4	$274.00	$3,014.00
IF ID36SS8V-AM/MPDE/SSDG	800 BHP	5	12	60	$350.00	6,000	19	0	$0.00	$1,933.00
MTU 12V396TE94/MPDE	2285 BHP	2	20	40	$450.00	18,000	ND	ND	ND	ND
Paxman 16RP200CM/MPDG	3350 BHP	4	13	52	$450.00	12,000	10	0	$0.00	$1,435.00
Volvo-Penta VPAQAD41A/MPDG	165 BHP	1	308	308	$20.00	5,000	ND	ND	ND	ND
Volvo-Penta VPAQAD40B/MPDG	165 BHP	1	1	1	$20.00	5,000	ND	ND	ND	ND
Volvo-Penta TAMD-41/MPDG	200 BHP	1	2	2	$20.00	5,000	ND	ND	ND	ND
Waukesha L1616DSIN/MPDG/SSDG	600 BHP	7	2	14	$200.00	6,000	13	3	$507.92	$2,201.00
Westerbeke 14088/MPDE	25 BHP	1	10	10	$15.00	5,000	ND	0	$0.00	$2.10**

ND-No Data

*CY-02

**CY-91

Enclosure (6)

FLEET TECHNICAL SURVEY OF DEI AND DIESEL TECHNICAL REPRESENTATIVES

FLEET TECHNICAL SURVEY OF DEIs AND DIESEL TECHNICAL REPRESENTATIVES

Dan Seagle, DEI SURFLANT

JP-5 was on the LST's (ALCO 251, EMD 645) all the time (all of the LST's have been since decommissioned). F-76 wasn't used for the 1st couple of years after commissioning of the USS Spartanburg. The ship didn't even know what F-76 really was. If at any time the ship got low on F-76 storage they would transfer some from the forward helo storage (JP-5) to the engine storage tanks (F-76).

Ray Dibiasi, DEI/FTSCLANT

The FFG's (Stewart and Stevenson DDC 149 TI) received a lot of JP-5 downloaded from aircraft carriers during refueling on deployments. This never posed a problem, just a little higher exhaust temperatures. JP-5 will clean the gunk out of an engine (residue) left by F-76. The lubricating qualities of JP are not as good as F-76, although no noticeable degradation.
As for the use of JP-5, the only things he ever saw that were different were the higher exhaust temperatures, and he oiled the injection pump racks every day on the LST. On the FFG's, he didn't conduct any additional maintenance, but he did closely monitor the exhaust temps.
No major issues were noticed for the ALCO 251 and EMD 645 engines onboard LSTs. He believes that exhaust temperatures were a little higher (air intake issue on LSTs added to this). These engines ran on the overheating edge due to the small LO and JW coolers. The worst thing that he found was an occasional burnt valve. He didn't see any fuel injector issues.

Wayland Porter, DEI/FTSCLANT

He used JP-5 in FM 38ND 8 1/8 engines onboard submarines, and in engines onboard FFG 7 Class ships. FFGs used nothing but JP-5 when they were first commissioned. In all cases, he saw no adverse effects while using JP-5. He could take an engine, and shift it from F-76 to JP-5 and not notice any difference with the exception of longer lasting fuel filters while using JP-5.

Cary Christenson, DEI SURFLANT

He ran JP-5 on the USS Proteus, AS-19 (EMD 645's) EDGs with no problems.

Dean Meinnert, DEI/FTSCLANT

He used JP-5 in everything. He was on USS Newport (LST 1179, EMD 645 diesel engines) from 73-76 and USS Harlan County (LST 1196, ALCO 251 diesel engines) from 1976-1979 and he ran JP-5. He also used it in the SSDG on the Knox FF-1052 16V 71 SSDGs. The FFGs originally had JP-5, but he never steamed them, just worked on them when they broke. When he was on the Newport and fuel king for a short spell he used JP-5 in the boilers every so often to clean them out. He remembers that it just burned cleaner and was a cleaner fuel. He used it in the small boats during cold weather since the JP-5 wouldn't jell. He stated that you just couldn't leave the fuel sit it needs to be rotated and circulated. On an LST, that was never an issue since the ship rolled and always circulated the fuel.

Don McClarren, COMNAVSURFLANT DEI and Diesel Manager

JP-5 has a lower flash point than F-76. I have also heard that JP-5 burns hotter as witnessed from combined exhaust temperatures. There could be many factors that will raise the exhaust temps, not just the fact that the fuel has a different flash point. At this point in time it will be hard to equate what effect JP-5 has/had on the atmosphere, as we were not that concerned with pollution as we are now. He would not imagine there would be much difference as both have about the same amount of sulfur, carbon etc that have an effect on the ozone through NO_x and other ozone depleting properties in the exhaust.

Phil Jung, NSWCCD Engineer

With engines onboard ships in the fleet being so conservatively rated, the engines should be able to develop rated power. On some fleet engines, the governor and fuel injector racks may have to be adjusted to provide additional power. He was not aware of any engine that could not achieve rated power while using JP-5 fuel. The fuel injectors and fuel pumps should stay cleaner, and have less carbon deposits developed. He is aware of engines onboard CVN, LHA, and LHD class ships that have been using JP-5 fuel for many years, with no adverse effects. The engines are achieving their full overhaul life onboard these ships.

George Campbell, NSWCCD Engineer

SSDGs onboard FFG-7 class ships have used JP-5 fuel over the years with no adverse affects. When the ships helos were removed, the ships switched back to F-76. He reviews all of the Diesel Engine Inspector reports arriving at NSWCCD, and sees no engine abnormalities as a result of using JP-5 fuel.

Rich Caccesse, PACFLT DEI Program Manager, FTSCPAC Division Director, Propulsion Division

At one time in the past, all of the Pacific fleet FFG SSDGs used JP-5 fuel with no reported problems. Since JP-5 has a lower specific gravity than F-76, some engines fuel system may have to be adjusted, or higher output fuel injectors may be needed to achieve full power. JP-5 fuel may be the only fuel available in certain parts of the world, and is loaded onboard as the single source fuel.

Enclosure (7)

DIESEL ENGINE OEM SURVEY

DIESEL ENGINE OEM SURVEY

Fairbanks Morse (FM)

Interviewee: Neil Blythe (608-364-4411)

Navy Engines:

- FM 38F 5 1/4
- FM 38 ND 8 1/8
- Pielstick PC 2.5
- Pielstick PC 4.2 (MSC)
- Pielstick PA6
- FM/Alco 251C

JP-5 Fuel was used for each engine above during Navy acceptance tests in accordance with MIL-E-23457. No engine performance or degradation problems were discovered during or after the test. No lubricity measurements were taken during the tests. FM conducted a 1000-hour test on their PC 2.5 fuel injection pump. They motored the pump while pumping JP-5 fuel. No lubricity or wear problems were evident.

FM did notice slight cavitation/erosion on fuel injector barrels and plungers on their PC 4.2 onboard MSC ships when continually going from F-76 to JP-5 and back again. This cavitation/erosion on the fuel injector parts was not considered to be a serious problem and would not reduce pump performance, or reduce pump life.

Fuel consumption could increase if JP-5 is used.

FM states that no modifications to their engines or components would be necessary if the Navy should switch to JP-5 fuel. FM feels confident that all of their engines are conservatively rated, and that their engines can use any fuel that the Navy wishes to use with no loss of performance, and no degradation to the engine or its parts.

FM has no data that would indicate longer intervals between maintenance or longer engine life due to cleaner burning fuels.

Caterpillar

Interviewee: Lee Anderson (309-578-8445)

Navy Engines:

- 3126
- 3208
- 3306
- 3408
- 3412
- 3512
- 3516
- 3608
- D334
- D349
- D398
- D399

Caterpillar states that JP-5 fuel is an acceptable fuel for their engines if it complies with Caterpillar distillate fuel requirements.

Rated power loss of 11-12% is possible when JP-5 fuel is used (without adjusting the governor or fuel injection system). Fuel consumption could slightly increase.

Caterpillar recommends that JP-5 have a minimum Cetane number of 40, and a minimum viscosity of 1.4 centistokes @ 100 °F at the fuel injection pump.

Caterpillar has not conducted engine component testing. Caterpillar recommends that JP-5 should be tested for lubricity using either ASTM D6078 Scuffing Load Wear Test or ASTM D6079 High Frequency Reciprocating Rig method.

Caterpillar has no data that would indicate longer intervals between maintenance or longer engine life due to cleaner burning fuels.

Westerbeke (Alaska/Northern Lights)

Interviewee: Bob Bisanti (508-823-7677)

Navy Engines:

- 14088
- 4-107
- 4-108
- 4-230
- LB-40

Westerbeke states that JP-5 fuel should not be used in any of their engine applications. The engine that Westerbeke uses for their generator sets is the Perkins diesel engine. This engine utilizes a CAV brand fuel injection pump. Mr. Bisanti stated that the injection pump would fail in a short period of time if JP-5 fuel were used, due to the fuels inherent low lubricity. Westerbeke would be willing to work with the Navy to modify or redesign the injection pump to properly utilize JP-5 fuel.

Westerbeke has no additional information regarding engine performance or possible degradation.

Volvo Penta

Interviewee: Dale Robertson (757-436-2800)

Navy Engines:

- 2003TB
- AQAD-31A
- AQAD-40
- AQAD-41

JP-5 may be used with no modifications for their engines that have in-line injection pumps. For Volvo engines that have rotary injection pumps, JP-5 should be blended with 1 to 2% low ash lubricating oil to improve lubricity.

Using JP-5 fuel could result in a 6 to 8% power loss, and a slight increase in fuel consumption.

If the JP-5 fuel being used has a lower Cetane number, cold starting ability may be reduced.

Volvo Penta has no data that would indicate longer intervals between maintenance or longer engine life due to cleaner burning fuels.

Detroit Diesel Corporation (DDC)

Interviewee: Don Meyer (313-592-5152)

Navy Engines:

- 53 Series
- 71 Series
- 92 Series
- 149 Series (Stewart & Stevenson)
- 64HN9 (Gray Marine)

All Navy DDC engines have used JP-5 while undergoing the 1000-hour MILSPEC test in accordance with MIL-E-24455 with no loss of performance or engine degradation.

JP-5 fuel is considered to be an acceptable fuel for use in Navy DDC engines.

DDC recommends a minimum Cetane number of 40.

The DDC 149 series engine used JP-5 fuel for extensive periods of time (as SSDGs onboard FFG Class ships) with no loss of performance or engine degradation. Fuel consumption measurements were not taken or recorded. An increase in fuel consumption may be realized.

DDC has no data that would indicate longer intervals between maintenance or longer engine life due to cleaner burning fuels.

MTU

Interviewee: Phil Wasinger (202 414-6778)

Navy Engines:

- MT883
- 396

All Navy MTU engines have used JP-5 while undergoing the 1000-hour MILSPEC test in accordance with MIL-E-24455 with no loss of performance or engine degradation.

JP-5 fuel is an acceptable fuel for Navy MTU engines

Engines that MTU are currently selling to the Marine Corps have imbedded sensors that would have the engine automatically adjust itself to compensate for different quality fuels.

MTU sees little or no difference between F-76 and JP-5 and the impact on longer maintenance intervals.

Cummins

Interviewee: Steve Hewitt (812-377-3920)

Navy Engines
4B3.9M
6BT5.9M
KTA-50M
VTA28
VT400
VT525

JP-5 is an acceptable fuel for Navy Cummins engines.

All Navy Cummins engines have used JP-5 while undergoing the 1000-hour MILSPEC test in accordance with MIL-E-24455 with no loss of performance or engine degradation.

Cummins sees little or no difference between F-76 and JP-5 and the impact on longer maintenance intervals.

Onan

Interviewee: Melinda Hughes (612-547-5000)

Navy Engines:

- DJC-MS
- DJB-MS
- DJCM-MS
- MDJF

JP-5 fuel is not recommended in any of the Navy Onan generator set applications due to its poor lubricity characteristics and the fuels effect on their fuel pump.

I-F

Interviewee: Upi Kamal (757-548-6000)

Navy Engines:

- 36SS6V-AM
- 36SS8V-AM

Navy I-F engines have used JP-5 while undergoing the 1000-hour MILSPEC test in accordance with MIL-E-24455 with no loss of performance or engine degradation.

JP-5 fuel is an acceptable fuel for Navy I-F engines.

I-F has no data that would indicate longer intervals between maintenance or longer engine life due to cleaner burning fuels.

EMD

Interviewee: Collin Kochman (800-592-5085)

Navy Engines:

- 567
- 645

JP-5 Fuel was used for each engine above during Navy acceptance tests in accordance with MIL-E-23457. No engine performance or degradation problems were discovered during or after the test.

APPENDIX C

JOHN J. McMULLEN ASSOCIATES, INC.

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4705-006, Rev.1 Final
12 March 2007

To: GEO-CENTERS, Inc.
Attn: Dr. James L. Fye

Subj: GEO-CENTERS PO 43451RB, GEO-CENTERS Statement of Work, JP-5 Usage on USCG Cutters, Final Report

Ref:
(a) United States Coast Guard Engineering Logistics Center Trip Report, 25 August 2004
(b) USCG Maintenance Logistics Center Atlantic Trip Report, 14-15 October 2004
(c) USCG Maintenance Logistics Center Pacific Trip Report, 3-4 November 2004
(d) USCG Sector Key West, and USCG Station St. Petersburg Trip Report, 9 October and 8 December
(e) Naval Engineering Manual, CIM M9000.6E (Chapter 541B, Authorized Fuels for Cutters and Boats), 21 October 2004
(f) Coast Guard Engine List, ELC Baltimore, 16 February 1998
(g) USCGC Healy Main Engine Emission Study, Final Report, MPR-2464, Rev. 0, 16 June 2003
(h) Telecom Integrated Support Center (ISC) Kodiak, 21 December 2004

Encl:
(1) Major Cutter Fuel Consumption, FY 03 and 04
(2) Retired CG Engineering Officer Report on 378 Cutter Fueling Practices

1. Introduction

In accordance with the subject Purchase Order (PO) and Statement of Work (SOW), John J. McMullen Associates, Inc. (JJMA) was tasked to conduct a survey of the United States Coast Guard (USCG) about its use of JP-5 fuel for marine propulsion and auxiliary engines. The Navy is interested in learning about the Coast Guard's experience using JP-5 in its cutter diesel engines. JJMA personnel contacted and met with personnel from the Coast Guard Engineering Logistic Center (ELC), the Atlantic and Pacific Maintenance Logistics Centers (MLCs), the Joint Interagency Task Force South, and marine engineering personnel at Coast Guard bases in St. Petersburg and Key West, Florida. JJMA also contacted cutter, base, and JP-5 supply port personnel who used JP-5 fuel. After a project kickoff meeting at ELC on 25 August 2004, a list of contacts was developed and some initial telephone calls were made to the MLCs. These trips and meetings are documented in references (a) through (d).

2. Discussion

In conducting the survey, JJMA personnel contacted marine engineering personnel for interviews at the aforementioned locations. We chose those people with direct practical experience using JP-5 as well as other propulsion fuels (MGO or F-76). JJMA sought information about the impact of JP-5 on the following:

- Engine fuel filter changeout intervals
- Filter condition
- More/less smoke emission
- More/less power available: Can rated full power be achieved without overheating as indicated by exhaust temperatures?
- More/less endurance
- More/less casualties and/or maintenance. Lubricity issues - injector seizures, evidence of piston ring sticking (indicated by low compression and low firing pressures) or liner scuffing (observed by visual inspection)
- Exhaust pyrometer temperatures
- Smoother/rougher running engines

JJMA also requested copies of cutter engineering reports, full power trial reports for comparing cutter engine performance using JP-5 versus F-76 or MGO, fuel reports showing cutter fuel consumption (type and quantities), and any other documentation that addressed the effects of using JP-5 in cutter diesel engines.

Cutters of interest included 378' WHEC, 270' WMEC, 210' WMEC, 399' WAGB, HEALY, 110' WPB, 87' WPB, and "Over the Horizon" (OTH) RIB.

Specific locations and situations of interest included:

- 110' WPBs operating out of Key West where JP-5 is available. Visiting boats will likely be burning diesel fuel coming into and JP-5 upon refueling at Key West.
- 378s or 399s that were burning JP-5 (before the ban on burning MGO on gas-turbine-powered ships was lifted) when they couldn't get F-76.
- 378, 399s, or CGC HEALY burning JP-5 in port because of smoke emission concerns (as in California, Seattle, or Hawaii).
- Ships taking on JP-5 out of Kodiak AK for propulsion fuel.

Of the documentation obtained, that is, Full Power Trial Reports, Area Fuel Summary Reports, the CGC HEALY Emissions Study, Full Power Trails Procedures for Paxman Diesel Engines, and the USCGC Sherman Fuel Study Report (1998-1999), very little substantiated some of the opinions expressed during the interviews: cutters using JP-5 cannot make full power, suffer maintenance problems, or have less endurance. The CG Naval Engineering Manual (NEM) in reference (e) mentions a possible increase in fuel consumption and difficulty making full power when using JP-5, but does not state this clearly as fact. The information contained in the Naval Engineering Manual is generally treated as the authority by the CG operators, but the specific information regarding JP-5 was grandfathered from previous versions. It is not clear what data the NEM observations were based on, but it is likely that operators perceptions are highly influenced by the NEM's wording.

The Area Fuel summary reports obtained during the MLC visits [refs. (b) and (c)] were very useful in determining the amount of JP-5 cutters used during 2003 and 2004 compared with other fuels (F-76, MGO) and which cutters were using JP-5 and how much. These reports also listed the average price of JP-5 purchased for aircraft and ship propulsion use. The biggest drawback of the summary report was that aircraft and propulsion fuel volumes used by the cutter were combined together. The fuel requisition information provided by the cutter typically showed this separate distinction but the final summary report did not.

Enclosure (1) lists the major cutters, their engines, and the fuels they used in FY03 and FY04. The cutter fuel usage from the area fuel summary reports is shown in the fuel use column of the table there. The cutter and engine information in Enclosure (1) was derived from the CG Engine List in reference (g). FY04 fuel usage data was not complete for MLC Atlantic so JJMA used the FY03 data. Only those cutters that used JP-5 were listed.

The Full Power Trial reports obtained during the MLC Atlantic trip and documented in reference (b), while indicating vessel performance at full power, did not list important information such as the type of fuel being used, the condition of the hull, and when the engines had last been overhauled. MLC personnel were able to surmise the type of fuel by knowing the cutter station and so annotating the report, but not enough reports were available to note any trends. Additional entries in these reports indicating fuel type (JP-5, F-76, MGO or a mix), hull condition (clean, percentage of fouling, etc.), and date of last engine overhaul would have been very useful.

The CGC HEALY Emissions Report [ref. (g)] was devoted to lowering the cutters' engine emissions and therefore explored the use of JP-5 as a means of reducing engine exhaust smoke at low loads. The use of JP-5 reduced the smoke opacity to less than 20 percent at low load (15 percent). The report also noted that there were no negative effects on the engine. The main diesel engines were run for 4 to 6 hours on JP-5 when conducting the opacity tests. Data from the Healy report comparing the engine operating data when operating on F-76 and JP-5 did show an increase in exhaust temperatures when running on JP-5 (see Table 1), thus adding some credence to comments made by many of the Coast Guard people interviewed that cutter engines ran hotter running on JP-5. The higher exhaust temperatures noted with JP-5 are still within normal engine operating limits. In an interview with LCDR Stanclick (Ex. EO of CGC HEALY), he stated that the HEALY did not use that much JP-5 in the propulsion engines. He indicated that when the Coast Guard ran the propulsion engines in port, it used JP-5 (mixed with ship's propulsion fuel, F-76) and also increased the generator loading to reduce smoking. He also said that upon completion of deployment, he mixed the remaining aviation JP-5 with the propulsion F-76 fuel to burn it off, rather than maintain the purity for 6 months while the ship was inactive.

JJMA did not obtain any fueling records for Coast Guard small boats, but during the trip to MLC Pacific [ref. (c)] and to Key West [ref. (d)], two small boat engines using JP-5 were mentioned: the Volvo-Penta (Model 290, 4 cyl, 130 hp) and Yanmar (Model 6LP-STZE, 6 cyl, 600 hp).

Table 1. CGC HEALY Main Diesel Engine (MDE) Exhaust Temperatures (°F)

Parameter	0% Load		15% Load	
	Diesel 2	JP-5	Diesel 2	JP-5
MDE 1 Average Cylinder Exhaust Temp - A bank	318	325	519	520
MDE 1 Average Cylinder Exhaust Temp – B bank	354	355	510	513
MDE 2 Average Cylinder Exhaust Temp - A bank	339	355	517	540
MDE 2 Average Cylinder Exhaust Temp – B bank	343	358	503	522
MDE 3 Average Cylinder Exhaust Temp - A bank	365	359	510	518
MDE 3 Average Cylinder Exhaust Temp – B bank	300	312	493	494
MDE 4 Average Cylinder Exhaust Temp - A bank	371	358	500	509
MDE 4 Average Cylinder Exhaust Temp – B bank	309	325	476	488

The Volvo-Penta engine is used on cutter lifeboats, and the Yanmar in the OTH RIB. The Coast Guard Naval Engineering Manual [ref. (e)] recommends mixing lube oil (5 percent) with the JP-5 in the Volvo-Penta engine as a result of Volvo-Penta engineering recommendations to the USCG due to the inherently lower lubricity of JP-5. In Key West, it was stated that the OTH RIB used JP-5, as it is their single-source fuel, however, this was not the practice of MLC Pacific since F-76 and MGO are readily available.

Many of the findings listed in the following section were based on anecdotal information gathered from the meetings and telecoms with various Coast Guard Engineering personnel [refs. (a) through (d)]. Documentation needed to substantiate most of the statements was not available. For example a number of engineers stated that the engines "ran hotter" using JP-5, but other than the Healy exhaust temperatures recorded during their tests on JP-5, we were unable to obtain engine room log data or pyrometer readings to substantiate these claims.

3. Major Findings

The following findings are a consensus of statements collected during our survey.

Logistics

- The Coast Guard has been using JP-5 as a ship propulsion plant fuel for many years. Interviews with retired Coast Guard cutter engineering personnel confirm that the West Coast 378s were using JP-5 as early as the 1970s and not reporting any operational or maintenance problems related to the fuel. See Enclosure (2).
- Cutters that take on JP-5 for propulsion fuel use it for main propulsion, ship service generators, and for miscellaneous applications such as powering portable fire pumps. [refs. (a) through (c)]
- Coast Guard cutters use JP-5 fuel for logistics reasons rather than performance. The Coast Guard is not a "Single Fuel Service" and there is no prohibition against taking on JP-5 as propulsion fuel. The three primary fuels used by the Coast Guard in its cutters are F-76, JP-5, and MGO. See Enclosure (1) for cutter fuel usage. Guidance on authorized fuels, their specifications, and precautions is contained in the Naval Engineering Manual in reference (e).
- As for fuel preference, reference (e) recommends that the cutters purchase the least expensive of the authorized fuels if there is no limited availability.
- Cutters stationed at or calling at certain ports tend to use JP-5 more. Cutters stationed at Key West use JP-5 since it is the only fuel readily available. F-76 fuel must be trucked in from outside Key West. Mixing JP-5 with other fuels (F-76, MGO) is common practice for cutters calling at Key West and other ports that dispense JP-5. Cutters calling at Kodiak, AK, where JP-5 is readily available, tend to fuel with JP-5 [refs. (d) and (h)].
- On the East Coast JP-5 fuel is more expensive than F-76 and less expensive than MGO. See Table 2 and references (b) and (c). DESC prices are shown for information only.

Table 2. Cutter and Boat Fuel Prices for FY 04 and 05 (Average Cost per Gallon)

Fuel type	FY04 MLC Atlantic	FY04 MLC Pacific	FY05 MLC Pacific	DESC Prices FY04/FY05
F-76	$0.89	$0.84	$1.33	$0.84 / $1.33
JP-5	$0.92	$0.93	$1.36	$0.93 / $1.36
MGO	$1.05	$0.79	$1.02	$0.79 / $1.02

- West Coast cutters use JP-5 - reference (c)
- West Coast 110' and 87' patrol boats use JP-5 - reference (d)
- Alaska cutters and boats use JP-5 - reference (c)
- MLC Pacific prefers JP-5 because it has a more consistent quality with no water and sediment - reference (c)
- Coast Guard Sector Key West, Florida uses JP-5 almost exclusively in cutters and boats - reference (d).

Performance/Reliability

- In general, Coast Guard cutter engineering personnel did not report any problems with performance, reliability, or maintainability when using JP-5 [refs. (a) through (d)].
- There were few reported instances of cutters that could not make full power or suffered endurance problems associated with the lower JP-5 heating value. The exception to this was from LCDR Novotny at MLC Atlantic, who went on record as saying that the 110s could not make full power on JP-5. Key West reported no problems with the 110s making full power [refs. (a) through (d)].
- Some cutters reported increased fuel consumption while using JP-5 fuel, however, this did not appear to be a major concern [refs. (b) and (c)].
- It was noted that the use of JP-5 resulted in "cleaner-burning" engines. JJMA interprets this as meaning there is less exhaust smoke. Using JP-5 to reduce smoke at low loads during the HEALY trials [ref. (g)] did result in lower opacity readings [refs. (b) and c)].
- General experience with JP-5 indicates increased maintenance. Specific maintenance items were not mentioned, but having to change fuel filters more frequently was mentioned often. Also, the engines ran at higher exhaust temperatures of approximately +5° F. No specific engines were mentioned [refs. (b), (c) and (d)].
- Cutter personnel stated that Caterpillar engines run hotter when using JP-5 fuel. It was also reported that the WMEC 270 engines (Caterpillar and Alco) ran hotter when using JP-5, but we could not find data or documentation to determine how much hotter. Cutter personnel stated that the engines ran hotter but not hot enough to cause overheating problems [refs. (b), (c) and (d)].
- Although the P-100 fire pumps with Yanmar engines (Model L90AE, 1 cyl, 9 hp on the WLM) have occasionally used JP-5 fuel, they normally use F-76. No adverse effects were noticed while using JP-5 in the Yanmar engine. This pump is not normally run for long periods of time [ref. (d)].

Maintenance

- If F-76 and JP-5 fuels are mixed, or if JP-5 is added to fuel tanks normally using F-76, cutter crews carry additional fuel filters. They say that any "varnish" in the tanks associated with the F-76 is dissolved by the JP-5 acting as a solvent, and is trapped in the fuel filters. Ship's force accounts for this by storing additional filters if the cutter transits to Key West [ref. (d)].
- Cutters with Alpha Laval fuel oil purifiers have to modify the purifier (change gravity discs) when operating with JP-5. Reference (e) offers guidance for modifying the fuel oil purifiers.
- MLC Pacific reported increased fuel pump and fuel injector wear on Fairbanks-Morse and EMD engines when using JP-5 [ref. (c)].

4. Conclusions

Based on the information gathered from our survey, JJMA has concluded the following:

- The Coast Guard has been using significant quantities of JP-5 fuel on many of its boats and cutters since the mid-1970's with minor problems reported.
- All manufacturers of diesel engines represented on the major cutters and many of the boats in the Coast Guard fleet have used, and continue to use, JP-5 fuel.
- Overall, there are no apparent major performance, maintenance, or reliability issues related to use of JP-5 fuel.
- Engines using JP-5 fuel burn cleaner than engines using MGO or F-76 fuel.
- Mixing JP-5 with F-76 and MGO fuels can result in increased filter use. Information correlated on the frequency of switching fuels with filter use was not available.
- "Outside influences" not directly associated with which fuel is used during the full power trials must be considered. These factors are marine growth on the hull, trim of the cutter, and the condition of the propulsion engines (hours before overhaul, last time tuned, etc.). These factors can affect the ability of a cutter's engines to achieve full power.
- The availability of JP-5 continues to be a major issue for the Coast Guard as well as for other military marine services in many parts of the world.
- The reported effects of JP-5 on cutter maintenance and performance vary depending on the Coast Guard individual interviewed; usually there was little or no documentation available to substantiate any anecdotes.

5. Recommendations

JJMA recommends the following:

- To substantiate that cutters can or can/not make full power on JP-5, conduct a full power trial on a selected cutter or Naval vessel using JP-5 and then F-76 or MGO fuel. As a minimum, the engine parameters of exhaust, lube oil, and fuel temperatures should be recorded at different operating points to develop a curve of speed versus power. A lube oil analysis should be conducted subsequent to the full power trial to determine the condition of the engines. A fuel oil analysis should also be conducted for fuel characteristics and any impact they may have on the full power trial. The "outside influences" such as hull marine growth, engine condition, cutter trim, wind, and wave conditions should also be recorded. The engine manufacturer's full power parameters should be noted to avoid exceeding limits.
- If practical and to cut down on the time spent monitoring the fuel system, before switching to JP-5 for the majority of the time, flush the ship's, boat's, or craft's fuel oil system, i.e., tanks, strainers, and filters. This should be done with the cutter inport at the dock to accommodate the transfer ashore of waste oil generated.
- Carry spare fuel filters on board cutters that normally use F-76 fuel and are refueled or topped off with JP-5.

- Cutters that have centrifugal fuel oil purifiers should carry different purifier rings (gravity discs) for F-76 and JP-5.
- Given the purity of JP-5, review the following Navy based maintenance procedures to see if they are still necessary when using JP-5 most of the time:
    - Running the purifier. Is running it still necessary? Not running it will prevent dumping fuel unnecessarily, will save storing the contaminated bilge water that can't be pumped overboard, and avoid the need to modify the purifier for JP-5.
    - Using the fuel/water coalescer.
    - Basic, bottom sediment, and water (BS&W) and clear and bright tests.
- Upgrade maintenance test kits for fuel dilution and water given the conversion to JP-5.
- Review pertinent manuals, Naval Ships Technical Manuals, etc. for updates to reflect changeover to JP-5.
- Add minimum cetane index requirement rating to JP-5 fuel specification (MIL-DTL-5624U; NATO F-44) for all military marine (USCG, Navy, and MSC) diesel engines.
- Review and revise diesel engine operating parameters that may be affected by the use of JP-5, i.e., engine exhaust, lube oil, and fuel temperatures. These should be checked against original equipment manufacturer specifications.
- Do not make adjustments to diesel engine fuel injection systems to better use JP-5 - it is unnecessary at this time.

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Enclosure (1)

Major Cutter Fuel Consumption for FY03 or FY04 (See "Source" Column for Details)						
Cutter (Type)	**Engines**	**Manufacturer**	**Model**	**HP**	**JP-5, F-76, MGO (Total Gallons)**	**Source**
Beluga (87 WPB)	MDE	MTU	8V396 TE94	2,680	JP-5 (600) MGO (4,583)	FY03 Data Group Hampton Roads
	SSDG	MAN	D-0824 LE3-1	150		
Metompkin (110 WPB)	MDE	PAXMAN	16RP200M	2,880	JP-5 (79,419)	FY03 Data Group Key West
	SSDG	CAT	D3304BT	135		
Monhegan (110 WPB)	MDE	PAXMAN	16RP200M	2,880	JP-5 (122,830) MGO (4,892) F-76 (42,980)	FY03 Data Group Key West
	SSDG	CAT	D3304BT	135		
Nantucket (110 WPB)	MDE	PAXMAN	16RP200M	2,880	JP-5 (151,023) MGO (12,765)	FY03 Data Group Key West
	SSDG	CAT	D3304BT	135		
Padre (110 WPB)	MDE	PAXMAN	16RP200M	2,880	JP-5 (96,869) MGO (6,812)	FY03 Data Group Key West
	SSDG	CAT	D3304BT	135		
Sitkinak (110 WPB)	MDE	PAXMAN	16RP200M	2,880	JP-5 (13,076) MGO (25,604)	FY03 Data Group Key West
	SSDG	CAT	D3304BT	135		
Drummond (110 WPB)	MDE	PAXMAN	16RP200M	2,880	JP-5 (22,004) MGO (16,998)	FY03 Data Group Mayport
	SSDG	CAT	D3304BT	135		
Kodiak Island (110 WPB)	MDE	CAT	3516	2,730	JP-5 (2,000) MGO (50,253)	FY03 Data Group St. Petersburg
	SSDG	CAT	D3304BT	135		
Campbell (270 WMEC)	MDE	ALCO	18-251-F-MS	3,650	JP-5 (18,500) MGO (273,573)	FY03 Data Command AoFC
	SSDG	CAT	D398B (TA)	720		
	ESSDG	CAT	D348TA	755		
Dallas (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (7,408) MGO (1,224,978)	FY03 Data Command AoFC
	SSDG	GM-EMD	8-567-RC	810		
Dauntless (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (1,400) MGO (205,937)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	D333TA	195		

Note: (1) 378 Cutters have CODAG Plants with gas turbines available for main propulsion when power demand is high.
(2) AoFC = Area of Force Command

Major Cutter Fuel Consumption for FY03 or FY04 (See "Source" Column for Details)

Cutter (Type)	Engines	Manufacturer	Model	HP	JP-5, F-76, MGO (Total Gallons)	Source
Decisive (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (22,456) MGO (233,354)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
Dependable (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (16,564) MGO (210,564)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
Diligence (210 WMEC)	MDE	ALCO	16MS-251CE	2,550	JP-5 (27,632) MGO (289,656)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	3306	148		
Gallatin (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (23,500) MGO (517,265)	FY03 Data Command AoFC
	SSDG	GM-EMD	8-567-RC	810		
Legare (270 WMEC)	MDE	ALCO	18-251-F-MS	3,650	JP-5 (21,000) MGO (371,276)	FY03 Data Command AoFC
	SSDG	CAT	D398B (TA)	720		
	ESSDG	CAT	D348TA	755		
Resolute (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (3,435) MGO (206,961)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	D3306TA	195		
Tampa (270 WMEC)	MDE	ALCO	18-251-F-MS	3,650	JP-5 (10,980) MGO (427,602)	FY03 Data Command AoFC
	SSDG	CAT	D398B (TA)	720		
	ESSDG	CAT	D348TA	755		
Valiant (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (28,865) MGO (227,703)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	3306DI	201		
Venturous (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (8,500) MGO (243,184)	FY03 Data Command AoFC
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	D3306TA	195		

Note: (1) 378 Cutters have CODAG Plants with gas turbines available for main propulsion when power demand is high.
(2) AoFC = Area of Force Command

Enclosure (1)

Major Cutter Fuel Consumption for FY03 or FY04 (See "Source" Column for Details)						
Cutter (Type)	**Engines**	**Manufacturer**	**Model**	**HP**	**JP-5, F-76, MGO (Total Gallons)**	**Source**
Active (210 WMEC)	MDE	ALCO	16MS-251CE	2,550	JP-5 (10,145) F-76 (114,348) MGO (151,500)	FY04 PACAREA Energy Purchase Detail
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	D3306TA	195		
Acushnet (213 WMEC)	MDE	F/M	38D8-1/8	1,000	JP-5 (7,551) F-76 (52,254) MGO (140,548)	FY04 PACAREA Energy Purchase Detail
	SSDG	F/M	38D8-1/8	1,000		
Alert (210 WMEC)	MDE	ALCO	16-251-B STBD	2,550	JP-5 (67,629) F-76 (21,690) MGO (10,000)	FY04 PACAREA Energy Purchase Detail
	SSDG	CAT	3406BDT	429		
	ESSDG	CAT	D333TA	195		
Alex Haley (283 WMEC)	MDE	CAT	3516		JP-5 (85,710) F-76 (62,359) MGO (107,666)	FY04 PACAREA Energy Purchase Detail
	SSDG	CAT	D-353			
	FIRE PUMP	CAT	3408B	481		
Boutwell (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (216,586) F-76 (229,343) MGO (201,572)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Chase (378 WHEC)	HALON	VOLVO PENTA	290	130	JP-5 (141,804) F-76 (137,617) MGO (125,000)	FY04 PACAREA Energy Purchase Detail
	MDE	F/M	12-38TD8-1/8	3,627		
	SSDG	GM-EMD	8-567-RC	810		
Hamilton (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (50,831) F-76 (325,296) MGO (115,060)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-645-E6	750		
Healy (420 WAGB)	ESSDG	GM-EMD	L16645F7B	3,100	JP-5 (56,159) F-76 (1,932,318)	FY04 PACAREA Energy Purchase Detail
	MDE	SULZER	12ZAV40S	11,683		
	LANDING CRAFT	DDC	64HN9KCLG	225		

Note: (1) 378 Cutters have CODAG Plants with gas turbines available for main propulsion when power demand is high.
(2) AoFC = Area of Force Command

Major Cutter Fuel Consumption for FY03 or FY04 (See "Source" Column for Details)						
Cutter (Type)	**Engines**	**Manufacturer**	**Model**	**HP**	**JP-5, F-76, MGO (Total Gallons)**	**Source**
Jarvis (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (242,444) F-76 (417,366) MGO (111,235)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Mellon (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (177,514) F-76 (356,869) MGO (195,197)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Midgett (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (372,744) F-76 (284,110)) MGO (118,295	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Morgenthau (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (347,387) F-76 (99,552) MGO (275,000)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Munro (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (141,213) F-76 (135,529) MGO (460,566)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Polar Sea (399 WAGB)	MDE	ALCO	16-251-F	3,500	JP-5 (0) F-76 (887,864) MGO (810,902)	FY04 PACAREA Energy Purchase Detail
	ESSDG	DDC	16V149	590		
	LANDING CRAFT	DDC	64HN9KCLG	225		
	MGT	P/W	FT4A-12	25,000		
	SSDG	ALCO	8-251-E	1,085		
Polar Star (399 WAGB)	MDE	ALCO	16-251-F	3,500	JP-5 (0) F-76 (965,406) MGO (387,295)	FY04 PACAREA Energy Purchase Detail
	ESSDG	DDC	16V149	590		
	LANDING CRAFT	DDC	64HN9KCLG	225		
	MGT	P/W	FT4A-12	25,000		
	SSDG	ALCO	12-251-E	2,100		
	SSDG	ALCO	8-251-E	1,085		

Note: (1) 378 Cutters have CODAG Plants with gas turbines available for main propulsion when power demand is high.
(2) AoFC = Area of Force Command

Enclosure (1)

Major Cutter Fuel Consumption for FY03 or FY04 (See "Source" Column for Details)						
Cutter (Type)	**Engines**	**Manufacturer**	**Model**	**HP**	**JP-5, F-76, MGO (Total Gallons)**	**Source**
Rush (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (404,657) F-76 (406,533) MGO (457,951)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Sherman (378 WHEC)	MDE	F/M	12-38TD8-1/8	3,627	JP-5 (370,874) F-76 (496,003) MGO (362,424)	FY04 PACAREA Energy Purchase Detail
	SSDG	GM-EMD	8-567-RC	810		
Steadfast (210 WMEC)	ESSDG	CAT	D333TA	195	JP-5 (17,477) F-76 (18,307) MGO (142,034)	FY04 PACAREA Energy Purchase Detail
	MDE	ALCO	16-251-B PORT	2,550		
	SSDG	CAT	3406BDT	429		
Storis (230 WMEC)	MDE	GM-EMD	645	1,000	JP-5 (0) F-76 (29,628) MGO (134,612)	FY04 PACAREA Energy Purchase Detail
	SSDG	Cummins	NT855G2 (6 cyl)	150 kW		

Note: (1) 378 Cutters have CODAG Plants with gas turbines available for main propulsion when power demand is high.
(2) AoFC = Area of Force Command

USCG JP 5 Fuel Study
JP5 Fuel Use in 378' WHEC

I served as Engineer Officer in MORGENTHAU from July 1976 to October 1979, High Endurance Cutter Type Desk in San Francisco from October 1979 to May 1981, Naval Engineering Branch Chief in New York from June 1981 to June 1984 and as Executive Officer in CHASE in Boston June 1984-June 1986. In San Francisco I supported four 378' WHECs (SHERMAN, MORGENTHAU, RUSH, MIDGETT) engaged in Alaska Patrol. In New York I supervised intermediate and depot level maintenance for the two 378' WHECs (DALLAS, GALLATIN) in the Third District.

For the most part east coast ships used DFM or F76 and west coast ships used JP5. While in New York, MORGENTHAU normally fueled at Gulfport on Staten Island and loaded DFM. CHASE normally loaded DFM from a barge at Support Center Boston or from the fuel pier at Guantanamo.

In May 1977 MORGENTHAU engaged in a Cadet Cruise/Home Port Change and arrived in San Francisco in July. The worst fuel load of my assignment to MORGENTHAU was at Rodman, CZ during this transit. It was the only planned fuel stop for the transit and the fuel was very dirty-visible large rust particles-so I took the fuel and planned higher filter use. The ship's next deployment was Refresher Training at San Diego. The fuel service arrangement at that point included one main filter with a bypass directly into the system. There were no centrifugal purifiers. The pressure drops across the filters increased so rapidly that we adopted a routine of stopping every night and changing a full set of filters. After REFTRA all the tanks that had seen the Rodman fuel were cleaned. Initial fueling in Richmond, San Francisco Bay was with DFM.

WHECs operating in Alaska primarily used JP5. JP5 was readily available at Air Stations in Kodiak and Adak. JP was generally was better maintained, cleaner and less expensive. DFM could be found in Kodiak and I understand was used by WMECs, but WHECs couldn't run down town for fuel and trucking 100,000 gallons of fuel to the Air Station wasn't cost or time effective. MORGENTHAU had a DFM fuel ring in the Emergency Gas Turbine generator and used DFM for the motor surfboat engines (GM 3-53s). Thus I kept the –328 tanks (under after steering and the EGT) full of DFM and pumped it to the EGT day tank or to jerry cans for fueling boats.

My concerns about lubricity of JP5 in the Fairbanks and EMDs appeared to be unfounded. Although I took no specific data on wear or excessive part failures, nothing seemed out of the ordinary. My concerns about reduced heating value or energy could not be shown from log data, although I never ran comparative full power trials with different fuels. I was concerned about water and 'bugs' in the fuel. I used a biocide, did not ballast and recirculated fuel in the service tank continuously.

I believe that all 378 engineers in ALPAT had pretty similar approaches to using JP5 fuel.

Pete Fontneau

Enclosure (2)