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FUELS & LUBRICANTS DIVISION
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Research Report

SINGLE NAVAL FUEL AT-SEA FEASIBILITY STUDY – PHASE ONE

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EXECUTIVE SUMMARY

BACKGROUND: The U.S. Navy has completed the first of a two-phase study to determine the feasibility of converting to JP-5, MIL-DTL-5624, NATO F-44, as the single naval fuel at-sea. This naval single battlefield fuel would be used in all aircraft propulsion, ship propulsion, electrical power generation systems, and USMC ground force equipment. JP-5 was chosen as the single fuel because the aircraft requirements are the most stringent of all the naval fuel user requirements. *As an approved alternate to both F-76 and JP-8, JP-5 is the only fuel that can be used by all services for all bulk fuel requirements.* It is anticipated that if JP-5 is not available for shipboard propulsion, then limited quantities of commercial marine middle distillate (diesel) fuel, purchased under local bunker contracts, may still be required.

JUSTIFICATION: This study was initiated by Chief of Naval Operations, Code N420, in response to:

- A request from the Deputy Chief of Naval Operations for Logistics.
- An action item from a meeting of Fleet handlers of shipboard liquids.
- A long-standing U.S. Navy policy to minimize the number of fuels used for aircraft and non-nuclear-powered ships.

OBJECTIVE: The objective of Phase One was to identify significant availability or cost issues that would prevent proceeding with a more extensive cost/benefit study in Phase Two.

APPROACH: The approach to this first phase of the feasibility study was to:

- Assess historical U.S. Naval requirements of ships' fuel, MIL-F-16884, Fuel, Naval Distillate (NATO F-76) and aircraft fuel, MIL-DTL-5624, Turbine Fuel, Aviation JP-5 (NATO F-44).
- Survey current and potential JP-5 suppliers for their views on cost and availability issues.
- Determine the potential worldwide availability of JP-5 to meet the increased demand.
- Determine the historical costs of both JP-5 and F-76 to determine potential cost impacts.

CONCLUSIONS:

Availability: There appears to be a sufficient potential JP-5 fuel supply base available to convert to JP-5 as the single fuel at-sea for U.S. Naval aviation, ship propulsion systems and USMC ground forces equipment. This is based on (1) a theoretical requirement for approximately 35 million barrels [based on FY 2000], (2) the historical responses to solicitations for F-76 and JP-5 between FY 1990 and FY 2000, provided an average coverage of 88 percent without soliciting for the increased JP-5 requirement (3) positive response from a fuel supplier survey, and (4) the conversion would take place over a five to ten year period to give refiners time to make any modifications required to produce the increased amount of JP-5. Multi-year fuel supplier contracts were also recommended as a possible method to ease the fuel changeover period, and beyond, which may stabilize cost.

Cost: Since the contract price of JP-5 is more than that for F-76, ranging from 2 – 11 cents/gallon, there will be an increase in the fuel purchase price for the conversion. Historical

EXECUTIVE SUMMARY (Continued)

data from FY 1996 – FY 2000 showed an average increased cost of approximately $49 million annually, which is about 5 percent of the Navy's average total fuel budget of $940 million. However, there are potential cost savings and benefits to help offset the initial conversion cost increase such as those that may be realized from:

- Reduced shipboard maintenance from handling and consuming an inherently cleaner fuel.
- Infrastructure savings from handling one less fuel in transportation systems, and in down-stream distribution terminals.
- Economies-of-scale from procuring larger quantities of JP-5.
- Fewer fuel rotation requirements due to the more storage-stable characteristics of JP-5.
- Rising diesel fuel costs which will result from the U.S. EPA mandatory ultra-low sulfur diesel requirements.
- Intrinsic benefits such as:
    - Greater flexibility for scheduling underway replenishment events.
    - Reduced fuel supply and transportation risks.
    - Improved readiness.
    - Enhanced naval capability to sustain major contingency operations.

Refiner Survey: A survey of JP-5 suppliers worldwide produced the following responses:

- Availability of JP-5 should not be a problem although local, temporary shortages may occur.
- Most suppliers that were not already providing JP-5 said that they could provide JP-5.
- Most current and potential JP-5 suppliers felt that the price of JP-5 would increase. Several major JP-5 refiners stated, however, that the price would be market-driven.
- Most suppliers stated that nearly doubling the JP-5 requirement would increase the price and decrease availability of JP-8, as well as other kerosene fuels, but neither statement was quantified.

PHASE TWO RECOMMENDATIONS: Based on these findings, the Executive Committee of the Naval Fuels and Lubricants Integrated Product Team decided to move forward with Phase Two of this study. In addition to a more detailed cost / benefit study, Phase Two will also investigate the operational impact of conversion including joint operations with Allies as well as the other U.S. Military Services and agencies.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the Defense Energy Support Center (DESC) and the Naval Petroleum Office (NPO) for their assistance in providing historical fuel data for JP-5, F-76 and bunker fuels. In addition, DESC provided historical fuel cost data and significant contributions during the preparation and delivery of survey letters to refiners and suppliers.

LIST OF ACRONYMS/ABBREVIATIONS

Accel ....Accelerated
AEM....................................Atlantic, Europe, Mediterranean region
AFB....................................Air Force Base
ATA ....Air Transport Association
ASCC-WP15..........................Air Standardization Coordinating Committee – Working Party 15
ASTM ....American Society for Testing and Materials
B..Barge
BF..Bunker Fuel – Commercial fuel products consumed for ship propulsion
BFLRF ....Belvoir Fuels and Lubricants Research Facility
BP..Boiling Point
BTU.....................................British Thermal Units
CID......................................Commercial Item Description
CLF ....Combat Logistics Force
CNA.....................................Center for Naval Analyses
CONSOL..............................Consolidated (Oil Replenishment at Sea)
CONUS ....Continental United States
CRC.....................................Coordinating Research Council
DESC ....Defense Energy Support Center
DFM....................................Diesel Fuel, Marine; MIL-F-16884G. This has been superceded by the current specification, MIL-F-16884J, Fuel, Naval Distillate (NATO F-76)
DFSP ....Defense Fuel Supply Point
DFSC....................................Defense Fuel Supply Center
DOD.....................................Department of Defense
DOE ....Department of Energy
DON.....................................Department of Navy
EG..East/Gulf Coast region
EGR......................................Exhaust gas recirculation

LIST OF ACRONYMS/ABBREVIATIONS (Continued)

EIA	Energy Information Agency
EPA	Environmental Protection Agency
FY	Fiscal Year
F-76	NATO designation for naval distillate fuel, complying with MIL-F-16884 for the U.S. Navy
Gal	Gallon
HDS	Hydro-desulfurization
Hg	Mercury
IPT	Integrated Product Team
ISO	International Standards Organization
IW	Inland/West Coast region
JP-4	Aviation fuel, wide cut, gasoline type, complying with MIL-DTL-5624
JP-5	Aviation turbine fuel (high flashpoint) complying with MIL-DTL-5624
JP-8	Aviation turbine fuel complying with MIL-DTL-83133
JP-8+100	Aviation turbine fuel with special additive package to improve thermal stability
Jet A	Aviation turbine fuel for civil use complying with ASTM D 1655; used primarily CONUS
Jet A-1	Aviation turbine fuel for civil use complying with ASTM D 1655; used primarily OCONUS
kg	Kilogram
L	Liter
lb	Pound
max	Maximum
M Bbls	Units in thousands of barrels
M USG	Units in thousands of gallons
min	Minimum

LIST OF ACRONYMS/ABBREVIATIONS (Continued)

mg .... Milligram
MGO .... Marine Gas Oil
MGO PD .... Marine Gas Oil Purchase Description
MJ .... Millijoule
mL .... Milliliter
mm .... Millimeter
mm^2 .... Millimeter squared
MM Bbls .... Units in millions of barrels
MM USG .... Units in millions of gallons
MSC .... Military Sealift Command
NATO .... North Atlantic Treaty Organization
NAVAIR .... Naval Air Systems Command
NAVSEA .... Naval Sea Systems Command
NSFO .... Navy Special Fuel Oil
NAWC .... Naval Air Warfare Center
NPO .... Naval Petroleum Office
OCONUS .... Outside of the continental United States
PM .... Particulate matter
PMS .... Planned Maintenance Schedule
ppm .... Parts per million
PQIS .... Petroleum Quality Information System
R-ABCANZ 98-04 .... Information Exchange Annex among the navies of America, Britain, Canada, Australia, and New Zealand for Fuel, Lubricants, and Allied Products
RFP .... Request for Proposal
TACOM .... U.S. Army Tank-Automotive and Armaments Command
TT .... Tank trucks
ULSD .... Ultra-low sulfur diesel
WESTPAC .... Western Pacific region

DEFINITIONS

Availability .... Ability to procure a fuel to a specified requirement.

Bulk Fuel Contracts .... A contract issued by the DESC Bulk Fuels Commodity Business Unit to purchase quantities of mil-spec products, such as F-76 and JP-5.

Bulk Fuel Requirements .... Anticipated needs of F-76 and JP-5 each year estimated by NPO and confirmed by DESC.

Bunker Fuel Contracts .... Commercial fuel products consumed for ship propulsion and electrical power generation. They are provided by contracts established worldwide by the DESC Bunker Fuels Branch where U.S. Government-owned stocks and fuel exchange agreements are not available.

Bunker Fuel Requirements .... Anticipated needs of commercial middle distillate fuel, e.g., marine gas oil and DF-2, estimated for each fiscal year by NPO and confirmed by DESC.

Contract Prices .... The cost paid to a supplier on a Free-On-Board (FOB) basis. The initial cost of the fuel as presented by bidders and accepted by DESC in the basic contract award document, i.e., without any equitable price adjustments.

Effective Coverage .... Total quantity of fuel bid in response to acquisition solicitations by all prospective suppliers divided by the amount required multiplied by 100.

Lowest Delivered Costs .... Fuel cost that includes the initial contract price as well as shipping and storage costs used in the DESC evaluation process.

Offered Quantities .... Amount of a fuel type bid in response to an acquisition solicitation by DESC.

Requirements .... Annual anticipated needs of a fuel type established by the Service Control Point, e.g., NPO and confirmed by DESC.

Total Purchases .... Total amount of a specific fuel procured for a specific fiscal year.

MGO PD .... Marine Gas Oil Purchase Description. The commercial substitute that DESC uses when F-76 is not available. It contains most of the important requirements of the F-76 specification. This fuel is purchased only through DESC bunker contracts.

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Single Naval Fuel At-Sea Feasibility Study – Phase One

1.0 BACKGROUND

1.1 GENERAL: The U.S. Navy initiated a feasibility study to assess the potential impacts of converting to a single fuel, aviation turbine fuel JP-5, MIL-DTL-5624 (NATO F-44), for all at-sea naval aircraft, ship propulsion and electrical power generation systems and USMC ground force equipment. JP-5 was chosen as the single fuel because the aircraft requirements are the most stringent of all naval fuel user requirements. Also, JP-5 has a minimum flash point of 140°F (60°C), which is required to minimize shipboard fires. *As an approved alternate to both F-76 and JP-8, JP-5 is the only fuel that can be used by all services for all bulk fuel requirements.* However, it is anticipated that if JP-5 is not available, limited quantities of commercial marine middle distillate (diesel) fuel, purchased under local bunker contracts, will still be required for ship propulsion.

1.2 STUDY JUSTIFICATION: This feasibility study is being conducted at this time in response to the following:

- A request from the Third Fleet Commander citing potential benefits which include providing Battle Group Commanders greater flexibility in scheduling fuel replenishment events, cost savings through infrastructure reductions and economies-of-scale that could offset the higher price of JP-5. Additional savings could also be realized because JP-5 has better storage stability characteristics than F-76 and, therefore, does not have the rotation requirements of F-76. In addition, it is cleaner burning and has fewer impurities and suspended solids, thereby having a positive impact on shipboard fuel system maintenance and engine operating systems.
- A request from a semi-annual meeting of Fleet handlers of shipboard liquids to answer the question of why the Navy had not converted to a single aircraft and ships fuel as the Army had recently completed their conversion from DF-2 (diesel fuel) to JP-8 for ground vehicles and from JP-4 to JP-8 for helicopters.
- The continuation of a long-term U.S. Navy policy to minimize the number of fuels used for aircraft and non-nuclear ships. This, in turn, is consistent with the DOD policy as given in Reference (a), DOD Directive 4140.25, "DOD Management of Bulk Petroleum Products, Natural Gas, and Coal", dated June 1994, for the purpose of "minimizing the number and complexity of fuels required, and maximizing the use of commercial fuels".

Other conditions, which make this review timely, are refining industry consolidations such as the mergers of EXXON/MOBIL and that of BP/AMOCO/ARCO. As a result of these consolidations and other industry business decisions, several refinery ownerships have changed, which could lead to more potential JP-5 offerors or suppliers and consequently enhance the JP-5 availability compared to past experience.

2.0 OBJECTIVE

The objective of Phase One of this study is to identify significant availability or cost issues that would prevent proceeding with a more extensive and detailed cost/benefit study in Phase Two.

3.0 APPROACH

Phase One efforts were focused into three major areas:

- Conduct a literature survey of previous related studies and reports involving proposals to standardize and minimize the number of naval fuels.
- Identify past and future requirements for JP-5 and F-76. The NPO coordinates fuel contracting requirements with navy commands. DESC coordinates fuel procurements in response to those requirements. NPO provided historical data for bunker fuel procurements, while DESC provided bulk fuel (JP-5 and F-76) requirements and contracting information from their database.
- Review DESC's fuel records for total purchases and fuel pricing information for both JP-5 and F-76. DESC is the acquisition agency for the Navy, for all bulk fuels. In a coordinated effort, NPO and DESC generate fuel requirements for the coming calendar year. DESC issues the solicitation to industry and awards contracts with fuel suppliers worldwide for specification fuels on the basis of lowest delivered costs. Generally, DESC contracts are for a one-year period. Limited data was available on purchases through bunker fuel contracts. Data on the awarded fuel contract prices were obtained and evaluated for JP-5 and F-76 bulk fuel purchases.

4.0 JP-5, F-76 AND COMMERCIAL FUEL SPECIFICATIONS

4.1 AVIATION TURBINE FUEL (JP-5) AND NAVAL DISTILLATE (F-76): JP-5 and F-76 were the fuels evaluated in this study. The two fuels are purchased in accordance with military specifications as defined in Table 1. The latest revisions of these specifications at the time of this report are:

A. JP-5: MIL-DTL-5624T, Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8ST, 18 September 1998

B. F-76: MIL-F-16884J, Fuel, Naval Distillate, 31 May 1995

In comparing JP-5 and F-76 for the purpose of this study, there are important properties where the two products differ, as well as where they are similar.

4.2 SIGNIFICANT/CRITICAL PROPERTIES:

4.2.1 Significant Properties: A comparison of significant properties is shown in Table 2 where the criteria for the conversion from F-76 to JP-5 is Similar, Better or Worse. (See Table 1 for property values).

Table 1: Comparison of Physical/Chemical Requirements for F-76 and JP-5

CHARACTERISTIC	MIL-F-16884J, F-76[1]	MIL-DTL-5624T, JP-5[1]
Appearance	C&B and free of visible particulates. If slight haze, BS&W <0.05 vol%	Clear and Bright
Accel Storage Stability, mg/100 mL, max	1.5	NR[2]
Acid Number, mgKOH/g, max	0.30	0.015
Aniline Point, °C, min	60	NR
Ash, % wt, max	0.005	NR
Aromatics, vol %, max	NR	25
Carbon Residue (10% bottoms), wt%, max	0.20	NR
Cetane Index, min	43	Report
Or Cetane Number, min	42	NR
Cloud Point, °C, max	-1	NR (see Freeze Point)
Color, max	3	Report
Copper Strip Corrosion, @ 100 °C, max	No. 1	No. 1
Demulsification @ 25 °C, minutes, max	10	NR
Density @ 15 °C	876 kg/m³ max	0.788 min - 0.845 kg/L max
Distillation, °C		
Initial BP	NR	Report[3]
10% Point, max	Report	206
20% Point	NR	Report
50% Point	Report	Report
90% Point, max	357	Report
End Point, max	385	300
Residue + Loss, % vol, max	3.0	NR
Residue % vol, max	NR	1.5
Loss % vol, max	NR	1.5
Existent Gum, mg/100 mL, max	NR	7.0
Filtration Time, minutes, max	NR	15
Flash Point, °C, min	60	60
Freezing Point, °C, max	NR (see cloud point)	-46
Fuel System Icing Inhibitor, vol %	NR	0.15 - 0.20
Heat of Combustion, MJ/kg (min)	NR	42.6
Hydrogen Content, % wt, min	12.5	13.4
Microseparometer rating	NR	70 - 90, depending on additives
Particulates, mg/L, max	10	1.0
Pour Point, °C, max	-6	NR
Smoke Point, mm, min	NR	19.0
Sulfur, total, wt %, max	1.0	0.40
Sulfur, Mercaptan, wt %, max or	NR	0.002
Doctor Test	NR	negative
Thermal Stability	NR	
Change in pres drop, mmHg, max		25 max
Tube deposit code, less than		3
Trace Metals, ppm, max		NR
Calcium	1.0	
Lead	0.5	
Sodium + Potassium	1.0	
Vanadium	0.5	
Viscosity, mm²/second	1.7 - 4.3 @ 40° C	8.5 max @ -20° C
Water Reaction Interface Rating, max	NR	1b

1. For specific test methods, see specification (specs can be downloaded at http://www.decs.dla.mil/main/quality/spcstd/stand.html).
2. NR denotes No Requirement.
3. Distillation requirements shown for JP-5 are for ASTM D 86 test method.

Table 2: Rating of Property Values for the Conversion of F-76 to JP-5

Property	JP-5 Compared to F-76 is:
Cold Flow (Freeze Point/Cloud Point)	Better
Heat of Combustion	Similar
Ignition Quality (Cetane Number/Index)	Similar
Sulfur	Better
Lubricity	Similar
Storage Stability	Better
Thermal Stability	Better
Flash Point	Similar
Viscosity	Similar
Trace Metals	Better
Particulates	Better

JP-5 produces lower SOx exhaust emissions (lowers exhaust particulates) and improves maintenance for diesel and gas turbine engines, i.e., reduced ring wear and hot corrosion tendencies, respectively. It should be noted that the actual sulfur content of JP-5 [Reference (b), FY 1999 – FY 2001] has averaged 0.07 wt% (700 ppm), which is about seven times lower than that for F-76 (0.52 wt% or 5200 ppm). Lubricity of JP-5 with the corrosion inhibitor additive is about the same as F-76. JP-5 fuel particulate contamination is ten times lower than the F-76 requirement. Ignition quality, cetane index (calculated method) or cetane number (engine method), relates to diesel engine cold startability, and is similar for both JP-5 and F-76.

4.2.2 Critical Properties:

4.2.2.1 Freeze Point/Cloud Point: The maximum cloud point for F-76 is -1°C, but JP-5 does not require this property. Instead, JP-5 has a maximum freeze point requirement of -46°C. Since this proposal is to use JP-5 as a single fuel, this low temperature property would not pose a problem when the fuel is used for non-aircraft applications, including USMC ground equipment. In fact, to the contrary, JP-5 would significantly enhance cold weather shipboard operations. Currently, JP-5 is specified as the cold weather fuel in place of F-76.

4.2.2.2 Energy Per Unit Volume: As reported in Reference (c), JP-5 has a lower energy density (BTU/gal) than F-76. Table 3 provides a comparison of average energy per unit weight and volume and specific gravity for JP-5 and F-76 samples gathered. Since F-76 does not have a minimum heat of combustion requirement, it is not routinely measured, but was done so by the Belvoir Fuels and Lubricants Research Facility (BFLRF) for comparison purposes with JP-5. The JP-5 data came from a database maintained by BFLRF. On average, there is 2.6

percent less volumetric energy content in JP-5 compared to F-76. The lower energy density of JP-5 translates directly into a 2.6 percent reduction in range. Since combustion efficiency in diesel engines is generally close to 100 percent, except at idle conditions, little opportunity exists for improvements in specific fuel consumption to offset the lower energy per unit volume of JP-5. In most diesel engines, the fuel controls can be adjusted to regain maximum power, but a larger volume of fuel will still be required. Burning fuels with lower cetane number/index will result in small increases in thermal efficiency in some diesel engines but generally not enough to offset the lower heating value.

Table 3: JP-5 and F-76 Energy Comparison

Property	Units	F-76*	JP-5
Specific Gravity	kg/L average	0.844	0.819
Specific Gravity	lb/gal average	7.076	6.758**
Heat of Combustion	net BTU/lb	18,456	18,356
Heat of Combustion	net BTU/gal	129,291	125,956

* Extracted from the David Taylor Research Center 1992 F-76 Database

** Reference (c) value of 6.030 probable typo. Value shown was calculated from Reference (b) for FY 1998 – FY 2000.

Therefore, theoretically, should a conversion be made to JP-5, an additional 2.6 percent fuel quantity would be needed to support current Naval requirements. This additional fuel requirement has been shown on a diesel engine test stand comparing the performance of F-76 to that of JP-5 [Reference (d)]. However, the Army found that a similar difference between the BTU/gal for DF-2 and JP-8 was never realized in actual operation because of a combination of diesel engine conditions, operation scenarios and a slight engine efficiency improvement [Reference (e)]. Based on the Army's experience, it is unlikely that there will be any difference between the fuel requirements for F-76 and JP-5 in actual operation because of many shipboard variables such as variations in hull fouling, engine wear status, differences in typical operations from ship to ship, and sea/wind operating conditions, etc.

4.2.2.3 Ignition Quality: The minimum cetane number value for the F-76 specification is 42. While the cetane number of JP-5 is not a reported property, 63 samples of JP-5 were evaluated for cetane number using the ASTM D 613 engine test method [Reference (d)]. (Note: This data was gathered in the late 1980's and therefore may not be representative of today's JP-5 fuels.) All but two (both from Sicily) of the 63 samples came from U.S. refineries. Of the 63 samples of JP-5 that were analyzed, 57 percent (36 samples) had cetane numbers equal to or greater than 42. A frequency histogram for the JP-5 cetane numbers is given in Figure 1.

Figure 1: Frequency Histogram, JP-5, Cetane Number (ASTM D 613)

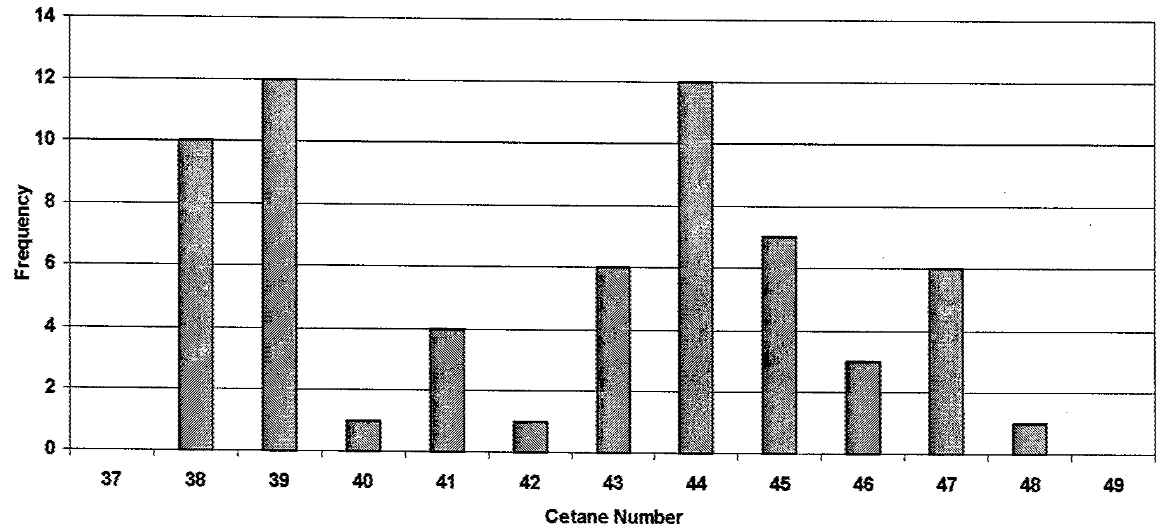
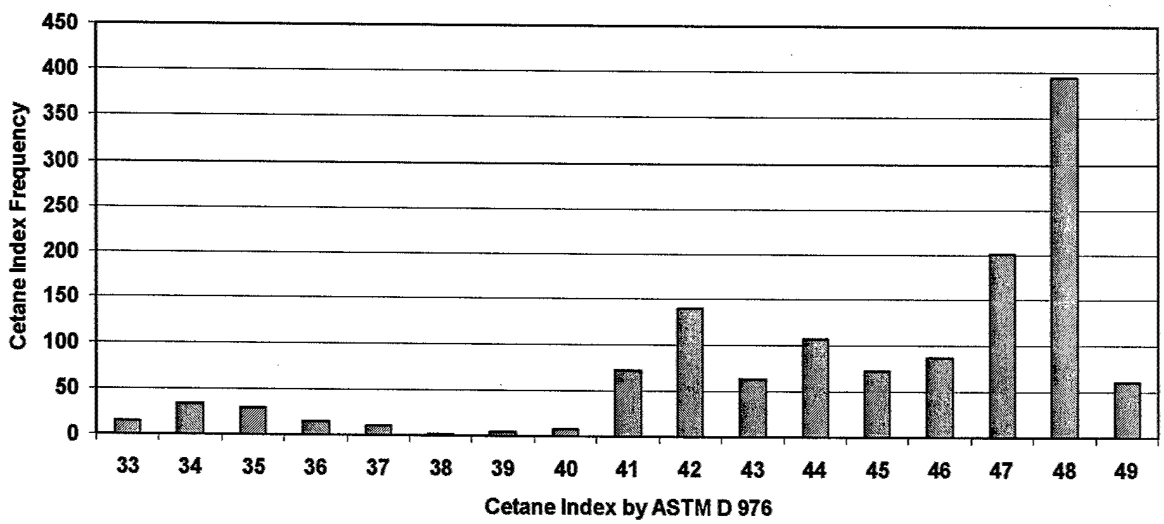


Figure 1A: Frequency Histogram, JP-5, Cetane Index (ASTM D 976) FY 1995-2000



It should be noted, however, that the number of worldwide fuel laboratories capable of running ASTM D 613 is dwindling. Therefore, cetane index by ASTM D 976, or ASTM D 4737, is more commonplace. The JP-5 specification requires that cetane index, by ASTM D 976, only be reported; there is no minimum cetane index requirement. The cetane indices of 1,319 JP-5 purchases, from FY 1995 – FY 2000, were extracted from the DESC PQIS database [Reference (b)]. As shown in the histogram of Figure 1A, 75 percent of the samples tested met the F-76 specification minimum cetane index requirement of 43. Furthermore, approximately 91 percent of the JP-5 purchases had a cetane index equal to or greater than 40, a limit that a significant number of naval high-speed diesel engines were shown to perform successfully in the laboratory, with respect to cold startability and continuous operation [Reference (f)]. The 40 cetane index minimum is common among commercial diesel fuel specifications.

In a previous study [Reference (d)], TACOM concluded that it was not likely that any operational problems using JP-5 would occur based on the U.S. Army's diesel engine acceptance evaluation procedure through subsequent use of JP-5 as an alternate fuel for all Army high-speed diesel engines. Military experience using JP-5 as an alternate fuel for ground diesel engines showed no significant detrimental effects [Reference (g)]. However, in laboratory evaluations, some loss in power was generally noted due to the lower heat content per unit volume as well as some increased injector leakage due to the lower density of JP-5. Potential problems resulting from the exclusive use of JP-5 in ship propulsion high- and medium-speed diesel and gas turbine engines should be manageable although more thorough research and testing in specific ship engines and systems may be required to verify this assumption. Also, based on this previous study, a cetane number/index requirement for JP-5 may have to be imposed to ensure a minimum standard is maintained for shipboard diesel engines.

The ignition quality, cetane index by ASTM D 976, of F-76 compared to JP-5 is similar, yet JP-5 is the preferred cold-weather fuel in place of F-76. What allows JP-5 to perform better under cold conditions are its superior cold flow properties and lower viscosity at lower temperatures than F-76, thereby exhibiting better atomization characteristics which enhance diesel engine cold startability compared to F-76.

4.3 COMMERCIAL MARINE FUEL SPECIFICATIONS: The JP-5 conversion is envisioned to take place over a 5 to 10 year time period. As more JP-5 displaces F-76, F-76 will be phased out. However, sufficient quantities of JP-5 will probably not always be available for ship propulsion in all the worldwide locations where the U.S. Navy will operate. Thus, it is likely that some amount of commercial marine middle distillate will always be required for ships propulsion. It is anticipated that a new, proposed off-road ASTM specification will eventually replace the NAVSEA Marine Gas Oil Purchase Description (MGO PD) or Commercial Item Description (CID). Since this proposed specification has a storage stability property requirement, it will not have a "use within six weeks" limitation like the MGO PD. Additionally, as a consequence of the Navy using some amount of commercial marine fuels purchased in CONUS, they will be dyed red in accordance with current U.S. EPA regulations for on- and off-road diesel fuel identification and for Internal Revenue Service (IRS) taxation purposes.

4.3.1 Current Commercial Marine Diesel Fuel Specification: Commercial marine diesel fuel purchased to the NAVSEA MGO PD is an acceptable middle distillate substitute when F-76 or JP-5 is not available and it is readily available in many ports around the world through DESC local bunker contracts. Details of the MGO PD may be found in Appendix A. A number of physical and chemical requirements of the F-76 military specification were adjusted or eliminated in the purchase description with the goal of increasing product availability for the bunkering needs of the Navy, Coast Guard and others. However, storage stability is a major property controlled by the F-76 specification, but it is not a requirement in the MGO PD. Ships taking on bunker fuel must consume it much sooner (within six weeks after purchase) than they would the more stable F-76. However, use of MGO PD in the Fleet is limited to approximately 5 percent of the total F-76 and JP-5 consumed onboard ship because it lacks the storage stability requirement. The current fuel-use priority is F-76 first, JP-5 second, MGO PD third, and commercial ASTM/ISO-type fuels last.

4.3.2 Future Commercial Marine Diesel Fuel Specification: Future commercial fuel specifications will be required because no existing commercial ASTM or ISO specification meets the Navy requirements for continuous operation. On the contrary, the existing commercial specifications are for shipboard emergency-use only. A current Navy effort has produced a new draft specification entitled "ASTM Standard Specification for Distillate Fuel Oils; Long-Term Storage Applications". This new, proposed, stand-alone specification uses ASTM D 975 Grade Number 2-D (off-road applications only) as a starting point. Additional test requirements not found in D 975 include density, particulate contamination, and storage stability. This proposed middle distillate specification is intended only for off-road applications such as military marine use, emergency generators, as well as any other uses that require storage stable middle distillate fuel. In the long-term, it is envisioned that this new commercial specification may be a replacement for MGO PD fuel, potentially useful in a transition period from F-76 to JP-5 and, ultimately, can make up any shortfall in obtaining JP-5 for ships' propulsion worldwide.

5.0 HISTORICAL FUELS REQUIREMENTS

5.1 JP-5 AND F-76 REQUIREMENTS: Annual bulk fuel F-76 and JP-5 anticipated needs, i.e., Requirements, for consumption and inventory are computed through a coordinated effort between the Navy and DESC. DESC develops worldwide purchase programs structured to the fuel needs of the Navy in conjunction with contracting strategies. Purchase programs are designed to consolidate DOD requirements by region to obtain lowest possible product unit cost. F-76 and JP-5 requirements are purchased by the DESC Bulk Commodity Business Unit under geographic programs designated as CONUS [East/Gulf Coasts (EG), Inland/West Coast (IW)], and OCONUS [Atlantic/Europe/ Mediterranean (AEM) and Western Pacific (WESTPAC)].

DESC issues solicitations for F-76 and JP-5 specification fuel to industry worldwide and awards contracts based on lowest costs. Product contracts with suppliers are usually for a one-year period. Bulk fuel (F-76 and JP-5) is distributed from the suppliers to the users directly from the supply source or through intermediate DFSP's using ships, barges, tank trucks, rail cars or pipelines.

At the Navy's request, DESC forwarded their data on quantities of F-76 and JP-5 procured for the Navy for the years FY 1990 - FY 2000. These data were evaluated for trends in quantities of fuel purchased. The requirements data was reviewed for any large variations such as increases or decreases in fleet size and the operations of Desert Storm and Desert Shield. Fuel requirements data, quantities of fuel offered by potential suppliers (percent coverage) and prices were generated and analyzed.

5.1.1 JP-5 Requirements: Figure 2 graphically illustrates requirements for JP-5 by geographic acquisition program and total annual quantities for FY 1990 – FY 2000. These data show ten years of requirements for JP-5 and reflects a decrease of approximately 600 MM USG or 44 percent for the requirements of FY 2000 compared to FY 1990. This nearly 50 percent reduction in requirements for JP-5 is consistent with verbal estimates provided by DESC [Reference (h)]. As shown by Figure 2A, approximately three-quarters of the JP-5 procured is from CONUS suppliers for the last six years of the ten-year period.

5.1.2 F-76 Requirements: Figure 3 shows requirements for F-76 by geographic acquisition program for the same FY 1990 - FY 2000 time period. A 3-year rolling average of the annual F-76 totals shows a reduction of about 260 MM USG (30 percent) over the ten-year period. This reduction in requirements is consistent with reduced operation caused by Navy force downsizing, conservation efforts, and improvements in operational efficiency [Reference (i)]. As shown in Figure 3A, approximately two-thirds of the F-76 procured is from CONUS suppliers, over the 10-year period.

5.2 BUNKER FUEL: Bunker fuels can be defined as those commercial fuel products consumed for ships propulsion and electrical power generation. They are provided by contracts established worldwide where U.S. Government-owned stocks and fuel exchange agreements are not available. These contracts are established through the DESC bunker fuel program to support Navy, Military Sealift Command (MSC), Coast Guard and other federal agencies. The types of fuel received from the contracts of interest are commercial marine middle distillates, generally called marine gas oil (MGO) in OCONUS and diesel fuel No. 2 in CONUS. Bunker fuels are also purchased locally by the ship. At the Navy's request, DESC's Direct Delivery Commodity Business Unit forwarded data on the volume of bunker fuel purchased between FY 1994 - FY 1999. Figure 4 graphically shows the volume of bunker fuel purchased in this time period. The volume of the bunker fuel averages only about 3 percent of the total F-76 required during this same period (see Figure 3) or about 1.3 percent for the combined JP-5/F-76 total (see Figure 11).

5.3 REQUIREMENTS COMPARISON; MILITARY FUELS WITH COMMERCIAL JET FUELS: To put the proposed naval fuel requirements in perspective with worldwide consumption, Table 4 compares the combined naval requirement with the U.S. [Reference (j)] and worldwide [Reference (k)] commercial jet fuel requirements for FY 2000. The JP-8 fuel requirements of the U.S. Army and U.S. Air Force for FY 2000 [Reference (b)] are also given for comparison to the Navy's fuel requirements. Navy proposed combined requirements of JP-5 and F-76 are derived from Figures 2 and 3. The U. S. Navy's JP-5 usage in FY 2000, compared to worldwide jet fuel usage is about 1.2 percent, while the combined requirement for JP-5 and F-76 is about 2.3 percent.

Figure 2: JP-5 Requirements By Geographic Acquisition Region

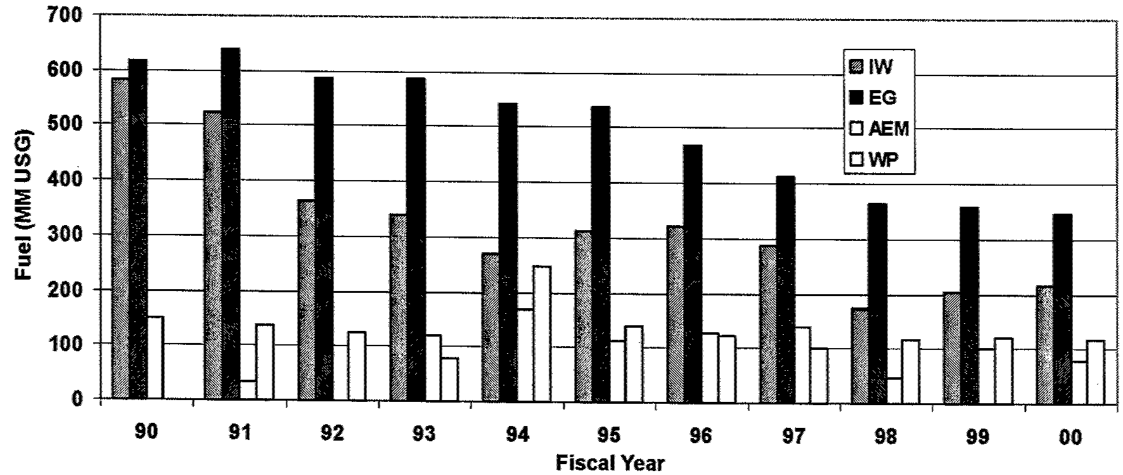


Figure 2A: JP-5 Requirements By CONUS/OCONUS Acquisition Region

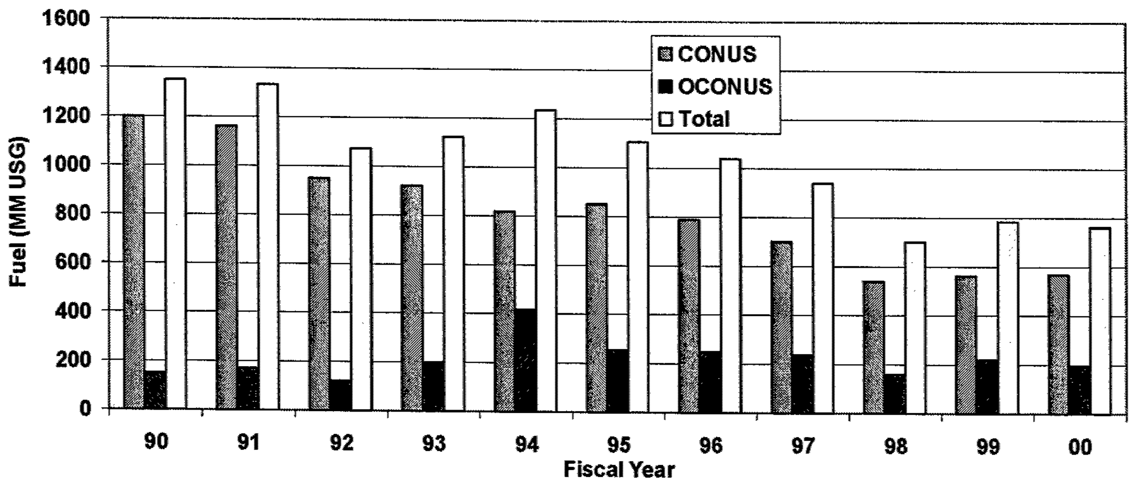


Figure 2 Data Table

	CONUS			OCONUS				
FY	IW (MM USG)	EG (MM USG)	CONUS TOTAL (MM USG)	AEM (MM USG)	WP (MM USG)	OCONUS TOTAL (MM USG)	GRAND TOTAL (MM USG)	GRAND TOTAL (MM BBL)
90	583	616	1199	151	No Data	151	1351	32
91	523	638	1161	35	137	172	1334	32
92	364	586	950	No Data	125	125	1075	26
93	338	586	924	121	79	200	1124	27
94	271	544	815	169	249	418	1234	29
95	312	537	849	114	141	255	1103	26
96	321	469	790	128	122	250	1041	25
97	287	412	699	140	100	240	938	22
98	174	363	537	46	117	163	700	17
99	204	358	562	100	121	221	784	19
00	217	347	564	79	118	197	760	18

Figure 3: F-76 Requirements by Geographic Acquisition Region

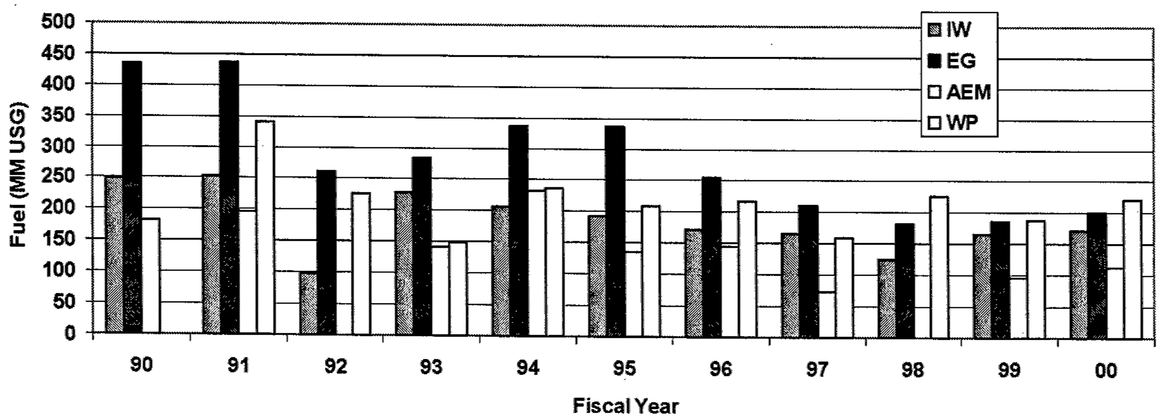


Figure 3A: F-76 Requirements By CONUS/OCONUS Acquisition Region

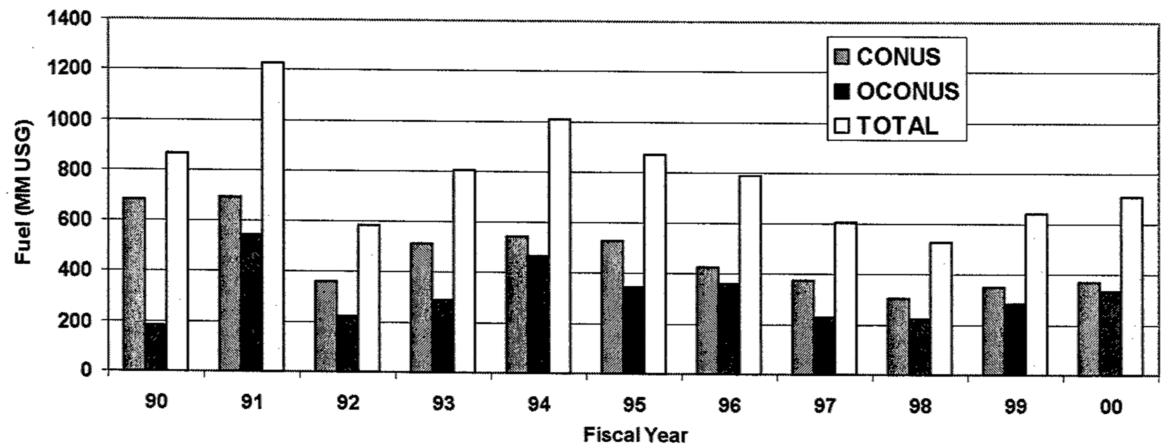


Figure 3 Data Table

	CONUS			OCONUS				
FY	IW (MM USG)	EG (MM USG)	CONUS TOTAL (MM USG)	AEM (MM USG)	WP (MM USG)	OCONUS TOTAL (MM USG)	GRAND TOTAL (MM USG)	GRAND TOTAL (MM BBL)
90	249	435	684	181	No Data	181	866	21
91	254	438	692	196	341	547	1229	29
92	98	261	359	No Data	225	225	584	14
93	229	284	513	143	148	291	804	19
94	207	337	544	232	237	469	1007	24
95	193	337	530	136	209	345	871	21
96	172	256	428	144	218	362	791	19
97	166	211	377	73	158	231	608	14
98	126	181	307	0*	225	225	531	13
99	166	187	353	97	189	286	640	15
00	172	201	373	114	221	335	708	17

*No F-76 purchased under contract due to use of existing assets.

Figure 4: Bunker Fuel Purchases

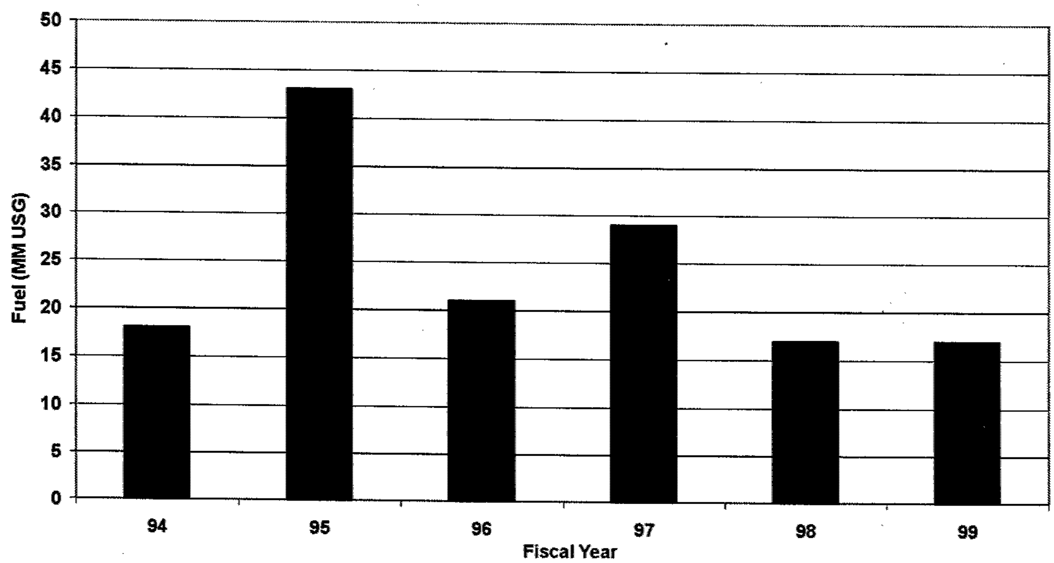


Figure 4 Data Table

Fiscal Year	94	95	96	97	98	99
Distillate Volume (MM BBL)	0.4	1.0	0.5	0.7	0.4	0.4
Distillate Volume (MM USG)	18	43	21	29	17	17

Table 4: Combined JP-5/F-76 Requirement vs U.S. Commercial Jet Fuel, Worldwide Jet Fuel, and JP-8 Consumption, FY 2000

Requirement	Quantity			
	MM Bbl/yr	MM USG/yr	MM Bbl/day	MM USG/day
U.S. Navy Combined JP-5/F-76 Reqt	35	1,506	0.1	4.1
U.S. Commercial Jet Fuel	610	25,603	1.7	70.1
Worldwide Jet Fuel*	1,533	64,386	4.2	176.4
U.S. Military JP-8 Reqt**	63	2,632	0.2	7.2

*** Includes U.S. commercial jet fuel requirements**

**** Extracted from DESC PQIS database for JP-8 purchases for FY 2000[Reference (b)]**

6.0 REVIEW OF HISTORICAL JP-5 AND F-76 COVERAGE

6.1 JP-5 AND F-76 COVERAGE: Figures 5, 5A and 6, derived from DESC-submitted data, show coverage, i.e., quantities of JP-5 and F-76 that were bid in response to acquisition solicitations by all prospective suppliers. Overall, quantities of JP-5 offered exceeded 100 percent in all acquisition areas at all times, except for the AEM region in FY 1994 which reached 94 percent. However, even though JP-5 volume requirements were achieved, multiple requests were occasionally necessary to achieve target costs. DESC stated that competition is limited among refineries offering JP-5 and therefore coverage above 100 percent is often achieved only through re-solicitation of historical suppliers [Reference (h)]. In Figure 5, coverage is shown by percent coverage contributed by the CONUS (EG and IW) and OCONUS (AEM and WP) regions. No accurate estimates of CONUS/OCONUS coverage could be made for FY 1990, 1992, and 1998 because there was no data submitted for the AEM region in FY 1992 and the WP region in FY 1990 and existing assets were used in the AEM region in FY 1998. Upon examining Figure 5, *it is clear that more than 75 percent of JP-5 is procured in CONUS.* In Figure 5A, JP-5 coverage is shown for the four individual geographic regions, which are subsets of CONUS and OCONUS.

Table 5 shows a comparison of the number of refineries that responded to JP-5 solicitations for FY 1990 and FY 2000. The major changes that have occurred have been reductions in the number of refiners that tendered bids to provide JP-5 in the East/Gulf Coast (EG) and Atl/Eur/Med (AEM) regions. In general, the number of companies offering to sell JP-5 to DESC has decreased under each acquisition program, comparing FY 1990 to FY 2000 with the exception of the Western Pacific (WP) region. This reduction in bidders may be due to a combination of factors such as company consolidations, changes in refinery ownerships as well as reduced requirements, which directly relates to smaller volumes of JP-5 being procured.

Table 5: Comparison of Historical Numbers of JP-5 Offerors/Refiners

	CONUS		OCONUS	
Fiscal Year	**East/Gulf Coast (EG)**	**West Coast (IW)**	**Alt/Eur/Med (AEM)**	**WESTPAC (WP)**
1990	10	5	7	3
2000	3	3	3	4

It should be noted that the quantity of JP-5 required for FY 2000 is about one-half of that required for FY 1990 (from the table associated with Figures 2 and 2A) and that the JP-5 plus F-76 requirement for FY 2000 is about equal to that of FY 1990 JP-5 requirement alone (see Figures 11 and 2 respectively). In the questionnaire that was sent to historical suppliers of JP-5 and F-76 and other potential JP-5 suppliers, four CONUS refineries that were not currently supplying JP-5 indicated that they would consider tendering bids for the larger JP-5 plus F-76 requirement. Furthermore, one additional AEM and two additional WP refiners that are not now

Figure 5: JP-5 Coverage By CONUS/OCONUS Acquisition Region

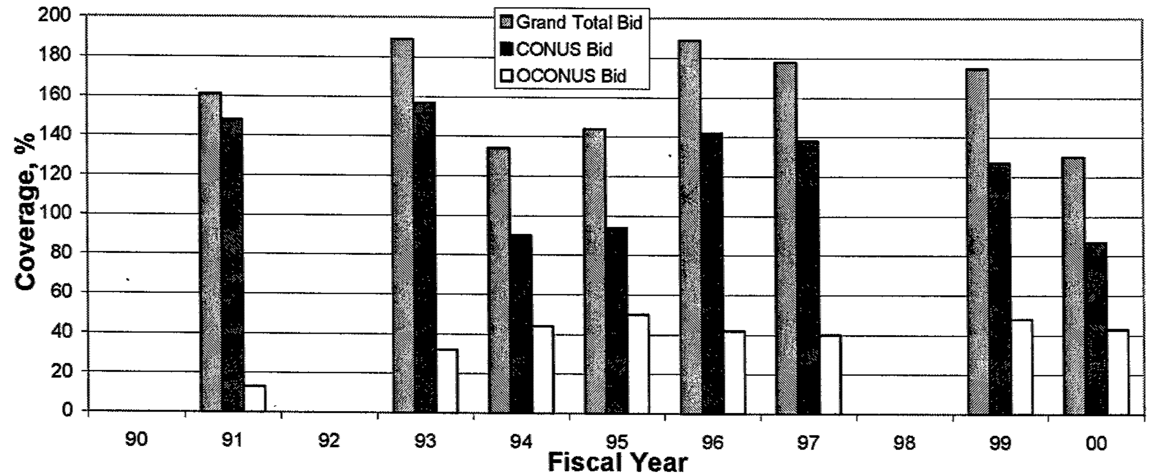


Figure 5A: JP-5 Coverage By Geographic Acquisition Region

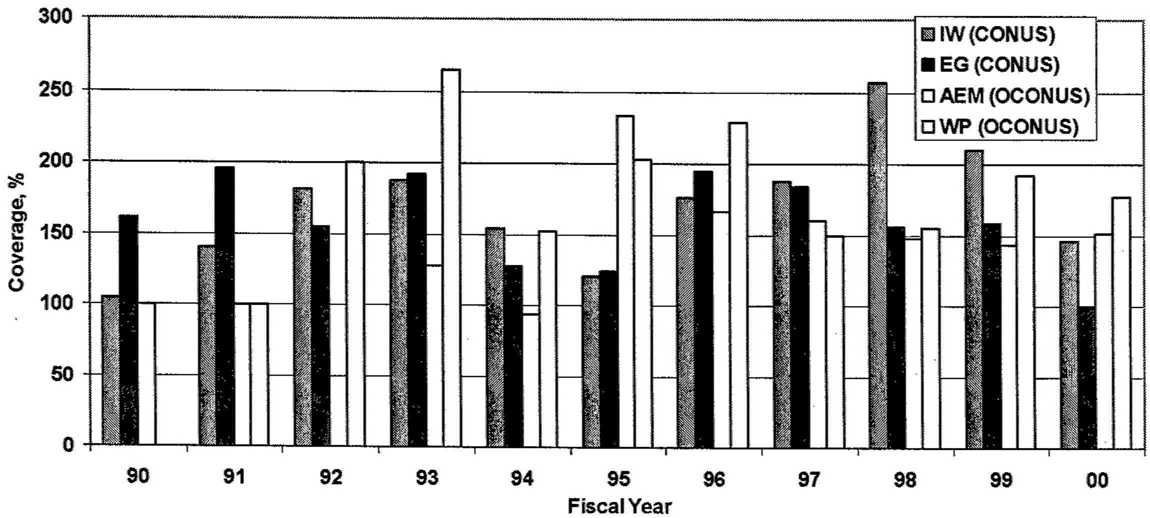


Figure 5 Data Table

FY	IW (CONUS)	EG (CONUS)	AEM (OCONUS)	WP (OCONUS)
90	104%	161%	100%	No Data
91	140%	196%	100%	100%
92	181%	155%	No Data	200%
93	188%	192%	127%	265%
94	154%	127%	94%	152%
95	120%	124%	234%	203%
96	176%	195%	166%	229%
97	188%	184%	160%	150%
98	257%	156%	148%	155%
99	210%	158%	143%	192%
00	146%	100%	151%	177%

Figure 6: F-76 Coverage By Geographic Acquisition Region

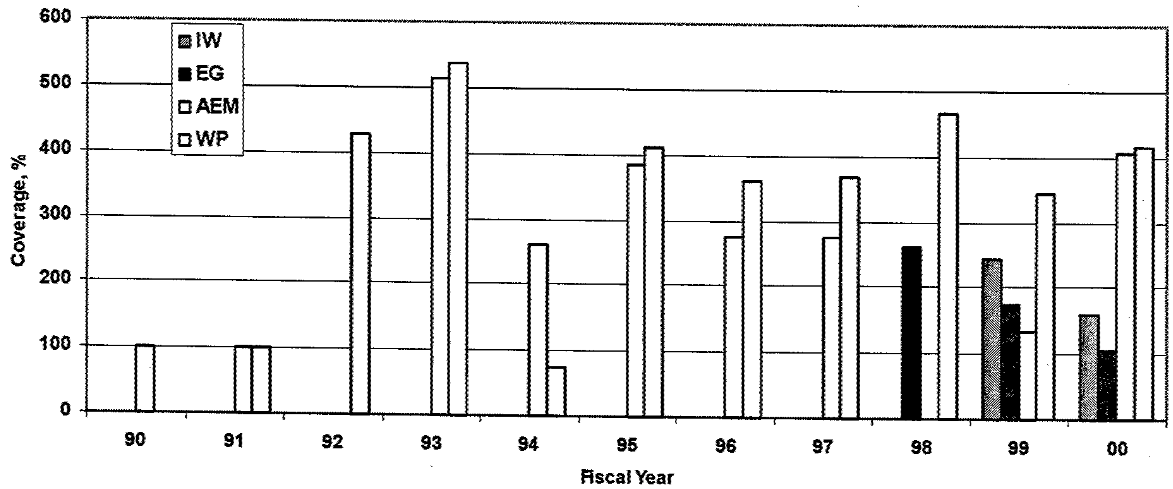


Figure 6 Data Table

Fiscal Year	IW (CONUS)	EG (CONUS)	AEM (OCONUS)	WP (OCONUS)
90	No Data	No Data	100%	No Data
91	No Data	No Data	100%	100%
92	No Data	No Data	No Data	427%
93	No Data	No Data	514%	537%
94	No Data	No Data	260%	75%
95	No Data	No Data	384%	411%
96	No Data	No Data	274%	362%
97	No Data	No Data	275%	368%
98	No Data	261%	No Data	467%
99	244%	174%	134%	344%
00	161%	104%	407%	417%

supplying JP-5 indicated that they would offer bids for a larger JP-5 plus F-76 requirement (see paragraph 7.0 Summary of Refinery Industry Survey).

6.2 COMBINED JP-5 AND F-76 REQUIREMENTS COMPARED TO JP-5 COVERAGE: DESC also provided data that combined JP-5 and F-76 requirements with coverage for JP-5, and is shown graphically in Figures 7-11. *A review of the data shows that between FY 1990 - FY 2000, the weighted-average, effective coverage was approximately 88 percent worldwide, while still about 83 percent between FY 1996 - FY 2000.* [Note that effective coverage is defined as the total quantity of JP-5 bid in response to acquisition solicitations by all prospective suppliers, divided by the amount required for the combined JP-5 and F-76 requirements. Also, the additional quantity of JP-5 equal to current F-76 requirements was for this study's purpose only.] However, the effective coverage for the combined JP-5 and F-76 fuel requirements for FY 2000 would have only been 67 percent. Furthermore, it is likely, based on the survey responses (see paragraph 7.0), the number of offerors may increase when the quantity of JP-5 requested is increased.

Figure 7: Combined JP-5 and F-76 Requirements Versus JP-5 Coverage, EG Region (CONUS)

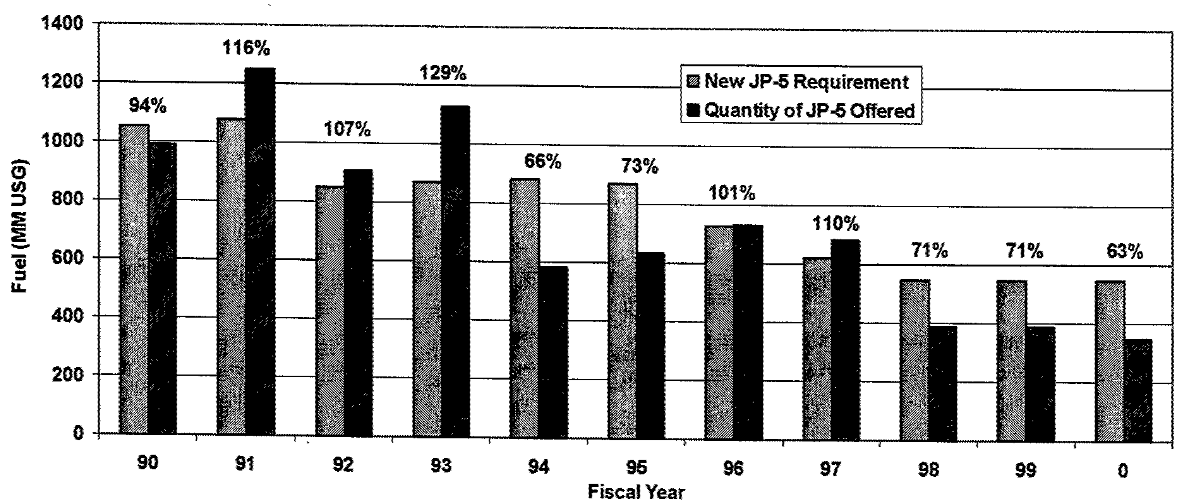


Figure 7 Data Table

JP5 + F76 = New JP5 Req.; Effective Coverage = (Qty JP5 Offered/New JP5 Required) x 100

Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MMUSG)	Effective Coverage (%)	Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Coverage Effective (%)
90	1052	993	94	96	726	732	101
91	1076	1251	116	97	622	683	110
92	847	908	107	98	545	386	71
93	870	1126	129	99	545	387	71
94	881	582	66	00	547	347	63
95	870	633	73				

Figure 8: Combined JP-5 and F-76 Requirements Versus JP-5 Coverage, IW Region (CONUS)

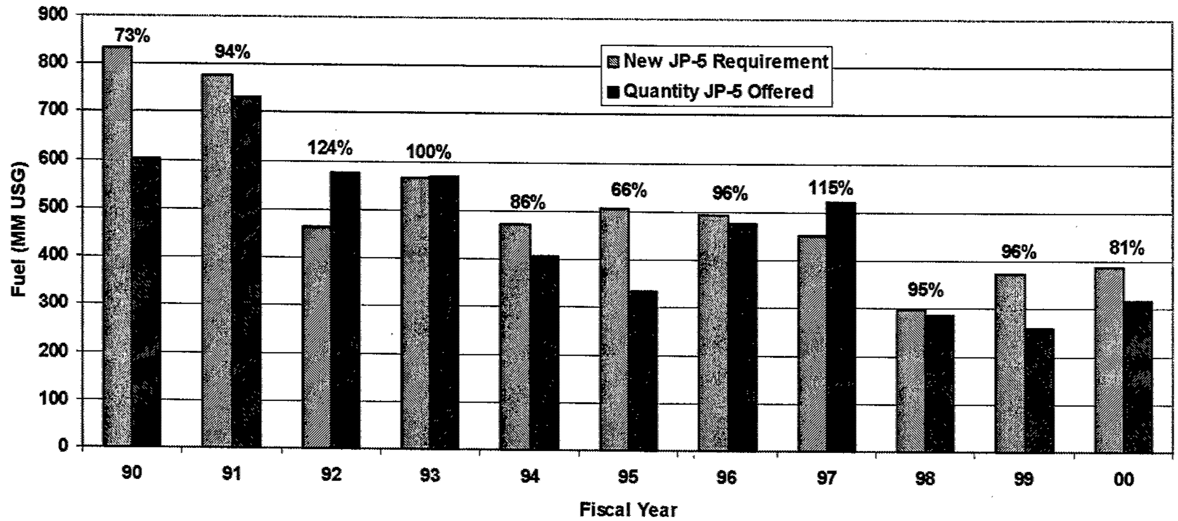


Figure 8 Data Table

JP5 + F76 = New JP5 Req't; Effective Coverage = (Qty JP5 Offered/New JP5 Required) x 100

Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Effective Coverage (%)	Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Effective Coverage (%)
90	833	601	73	96	493	475	96
91	777	732	94	97	453	522	115
92	463	576	124	98	299	285	95
93	567	568	100	99	372	257	69
94	473	407	86	00	389	316	81
95	505	334	66				

Figure 9: Combined JP-5 and F-76 Requirements Versus JP-5 Coverage, WP Region (OCONUS)

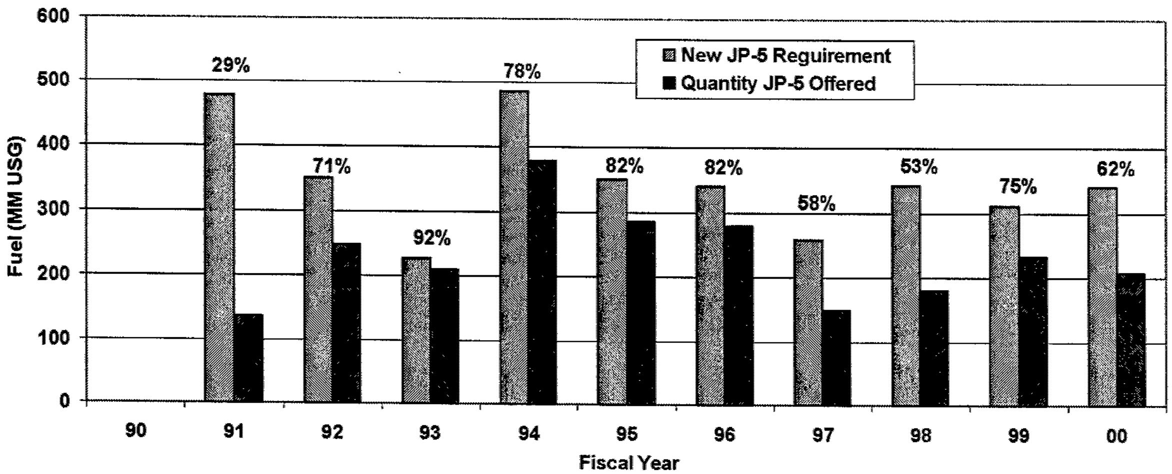


Figure 9 Data Table

JP5 + F76 = New JP5 Req't; Effective Coverage = (Qty JP5 Offered/ New JP5 Required) x100

Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Effective Coverage (%)
90	No data	No data	No data
91	478	137	29
92	350	249	71
93	227	209	92
94	487	314	78
95	349	285	82

Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Effective Coverage (%)
96	340	281	82
97	258	150	58
98	342	182	53
99	311	233	75
00	339	208	62

Figure 10: Combined JP-5 and F-76 Requirements Versus JP-5 Coverage, AEM Reqion (OCONUS)

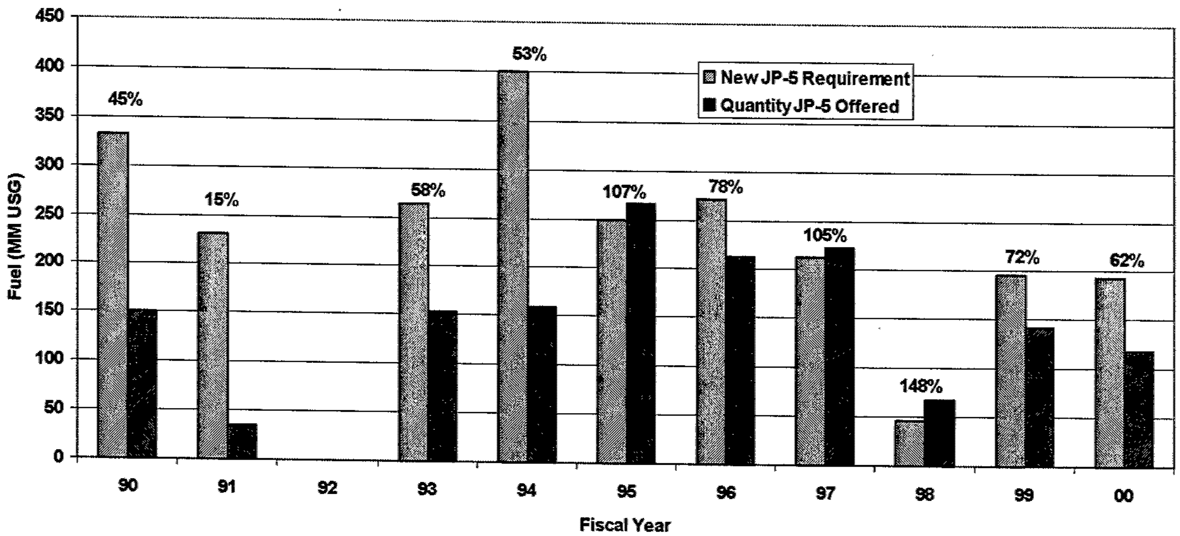


Figure 10 Data Table

JP-5+F-76 =New JP-5 Req. (Qty JP5 offered/New JP5 Req) x 100 = Effective Coverage

Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Effective Coverage (%)	Fiscal Year	New JP-5 Requirement (MM USG)	Quantity JP-5 Offered (MM USG)	Effective Coverage (%)
90	332	151	45	96	272	213	78
91	231	35	15	97	213	223	105
92	no data	no data	no data	98*	46*	67*	148*
93	264	153	58	99	196	142	72
94	400	159	40	00	193	119	62
95	249	266	107				

* No JP-5 or F-76 purchased under contract due to use of existing assets. Quantity shown was a supplemental.

Figure 11: Combined JP-5 and F-76 Requirements Versus JP-5 Coverage, Worldwide

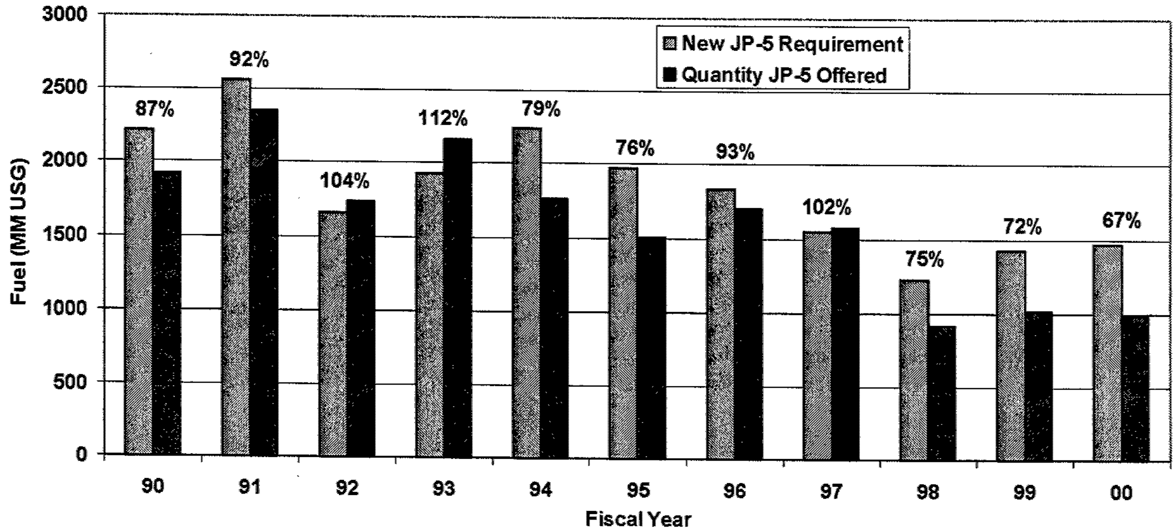


Figure 11 Data Table

JP-5 + F-76 = New Req't; Effective Coverage = (Quantity JP-5 Offered/New JP-5 Requirement)x100

Fiscal Years	New JP-5 Requirement (MM USG)	Qty JP-5 Offered (MM USG)	Effective Coverage (%)	Fiscal Years	New JP-5 Requirement (MM USG)	Qty JP-5 Offered (MMUSG)	Effective Coverage (%)
90	2217	1926	87	96	1832	1701	93
91	2563	2351	92	97	1546	1578	102
92	1659	1733	104	98	1231	920	75
93	1929	2167	112	99	1423	1019	72
94	2241	1767	79	00	1468	990	67
95	1974	1501	76				

7.0 REVIEW OF HISTORICAL JP-5 AND F-76 PROCUREMENT COSTS

The DESC commander and staff gave their assistance in obtaining and assessing cost data for JP-5 and F-76. Historical contract pricing data provided by DESC for both JP-5 and F-76 (Table 6 (OCONUS), Table 7(CONUS)) was used for this cost review. The data covered the time period FY 1996 – FY 2000. Using the current acquisition procedures and practices to procure fuel in the four regional areas, DESC solicits industry for quantities of JP-5 and F-76 to meet customer needs on an annual basis. Potential suppliers offer quantities of JP-5 and F-76 based on their marketing strategies and their ability to provide specification products. In the past, there were usually minimal issues in acquiring coverage greater than 100 percent to satisfy F-76 requirements. However, historically, in order to acquire the minimum 100 percent coverage for JP-5 requirements, DESC had to accept bids from a higher percentage of the offerors, which included the higher-priced bids.

In meetings with DESC Bulk Fuels personnel [(Reference (h)], it was explained that the first barrel of JP-5 purchased cost less than the last barrel purchased. Under the current process, this would generally mean increased JP-5 requirements would result in increased JP-5 prices unless the greater JP-5 demand would lower the contract price. As an example, to estimate the additional cost to purchase all JP-5 (versus both JP-5 and F-76), for the most recent data available, FY 2000, the average price difference between JP-5 and F-76, on a worldwide basis, was 2 – 11.6 cents/gal. The lowest price difference occurred in the West Coast Region and the greatest price difference occurred in the Atlantic/Europe/Mediterranean Region. If the F-76 requirements had been procured as JP-5, the difference in fuel costs worldwide would have been approximately an additional $51 million, for FY 2000. *The worldwide average annual additional cost for the five-year time period FY 1996 – FY 2000, would have been $49 million, or about 5 percent of the average annual cost of $940 million for both JP-5 and F-76, as shown in Table 8.* The actual price differences will be market driven, and may be influenced by the economies-of-scale.

It should be noted that the cost data in Tables 6 and 7 are only annual estimates because all contracts are not awarded at the same time, i.e., DESC contract awards are staggered throughout a given year for the different regions in both CONUS and OCONUS areas to accommodate DESC contract negotiators' work load. Therefore, the data in Tables 6 and 7 show yearly weighted average contract prices and represent a reasonable estimate of the annual cost for JP-5 and F-76, as well as an estimate of the increase in annual costs if JP-5 had been the single naval fuel at-sea during FY 1996 - FY 2000.

Table 6: OCONUS Contract Costs, FY 1996 – FY 2000

	QTY JP-5 (MM USG)	Weighted Avg. JP-5 Price* ($)	Total JP-5 Cost ($M)	QTY F-76 (MM USG)	Weighted Avg F-76 Price* ($)	Total F-76 Cost ($M)	Average Price Difference ($)	Price Difference to Replace F-76 With JP-5 ($M)	JP-5 + F-76 Total Cost ($M)
AEM RFP									
2000	79	0.930	73	114	0.814	93	0.116	13	166
1999	100	0.759	75	97	0.666	65	0.093	9	140
1998**	46	NA	NA	NA	NA	NA	NA	NA	NA
1997	140	0.531	74	73	0.488	36	0.043	3	110
1996	128	0.681	87	144	0.621	90	0.059	9	177
							AEM Regional 4-year Total:	34	593
							AEM Regional Annual 4-year Average:	8	148
WP RFP									
2000	118	0.798	94	221	0.684	151	0.114	25	245
1999	121	0.559	68	189	0.434	82	0.125	24	150
1998	117	0.463	54	225	0.364	82	0.099	22	136
1997	100	0.672	67	158	0.578	91	0.094	15	158
1996	122	0.736	90	218	0.629	137	0.106	23	227
							WP Regional 5-year Total:	109	916
							WP Regional Annual 5-year Average:	22	183
							OCONUS Total:	--	1,509
							OCONUS Average Annual Total Cost:	30	331

* Yearly average of the weighted average award price as escalated twice per month.

** No JP-5 or F-76 purchase under contract due to use of existing assets. Quantity shown was supplemental.

Table 7: CONUS Contract Costs, FY 1996 – FY 2000

	QTY JP-5 (MM USG)	Weighted Avg JP-5 Price* ($)	Total JP-5 Cost ($M)	QTY F-76 (MM USG)	Weighted Avg F-76 Price* ($)	Total F-76 Cost ($M)	Average Price Difference ($)	Price Difference to Replace F-76 With JP-5 ($M)	JP-5 + F-76 Total Cost ($M)
EG RFP									
2000	347	0.727	252	201	0.691	139	0.052	10	391
1999	358	0.624	224	187	0.565	105	0.059	11	329
1998	364	0.401	146	181	0.340	61	0.061	11	207
1997	412	0.541	223	211	0.508	107	0.032	7	330
1996	469	0.648	304	334	0.616	206	0.031	10	510
							EG Regional 5-year Total:	49	1,767
							EG Regional Annual 5-year Average:	10	353
IW RFP									
2000	217	0.783	170	173	0.740	128	0.020	3	298
1999	204	0.827	169	168	0.716	120	0.110	18	289
1998	174	0.523	91	126	0.493	62	0.030	4	153
1997	287	0.508	146	166	0.464	77	0.044	7	223
1996	321	0.673	216	172	0.587	101	0.086	15	317
							IW Regional 5-year Total:	47	1280
							IW Regional Annual 5-year Average:	9	256
							CONUS Total:	--	3047
							CONUS Average Annual Total Cost:	19	609

* Yearly average of the weighted average award price as escalated twice per month.

Table 8: Summary of Worldwide JP-5 and F-76 Average Contract Costs, FY 1996 – FY 2000

	Price Difference to Replace F-76 with JP-5* ($M)	Annual Average Combined JP-5 and F-76 Contract Cost Total* ($M)
OCONUS (Total)		331
AEM	8	148
WP	22	183
CONUS (Total)		609
EG	10	353
IW	9	256
TOTALS	49	940

Potential Annual Average Cost Increase for JP-5	5%

* Extracted from Tables 6 and 7

8.0 REVIEW OF POTENTIAL BENEFITS FROM CONVERSION

8.1 SCOPE OF PHASE ONE BENEFITS REVIEW: While an in-depth analysis will be provided in Phase Two, a preliminary inspection of the potential tangible and intangible savings were explored in this study, Phase One, to determine if sufficient potential savings exist to offset the expected higher procurement costs of approximately $49 million.

8.2. IMPROVED SHIPBOARD MAINTENANCE: There may be shipboard operational maintenance improvements for the operation for gas turbines, high-and medium-speed diesel engines, steam boilers and their respective fuel handling systems because of the advantages noted in the diesel engine tests conducted for the U.S. Army found in Reference (e). The advantages of converting from DF-2 to JP-8 included:

- Less stress placed on the lubricant in terms of acid levels and contaminants.
- Significantly less wear of the critical top ring thereby prolonging the service life of diesel engines.
- Less combustion chamber fuel deposits formation, which can also prolong engine life.
- Reduction in injector scuffing and deposits.
- Generally, an increase in thermal efficiency large enough to offset the lower volumetric energy content of converting from DF-2 to JP-8, but these results have been shown to be engine-specific.

Table 9 is an initial worksheet for the analysis of the total maintenance burden for shipboard combustion, fuel handling, and fuel infrastructure equipment. In Phase Two, the details for this worksheet will be assembled. The Life Cycle Managers of each equipment area will assess the portion of the total maintenance burden that will be reduced by the conversion to JP-5 as the single naval fuel at-sea. Potential savings will be developed.

8.3 ULTRA-LOW SULFUR DIESEL (ULSD) FUEL: By 2009, the U.S. EPA regulation that requires sulfur content to be no greater than 15 ppm (USLD) for on-road, off-road, and probably locomotive, and marine diesel fuel applications as well, will be in effect in the United States. Europe, South America and the Far East also have similar plans with some extension of the implementation dates. This action will result in increased production costs for this fuel. To avoid the expense of manufacturing and storing an additional fuel, refiners may only offer ULSD fuel to the Navy since it will, for all intents and purposes, meet the F-76 specification. Therefore, the impact to the Navy will be an increase in the cost of shipboard fuel even if the single naval JP-5 fuel concept is not adopted. Based on the above, an estimate was made to determine the impact that ULSD fuel could have on minimizing the production cost difference between JP-5 and F-76.

The Energy Information Agency (EIA) reviewed refinery models developed in 2001 by five companies and the EPA to predict the impact that ULSD fuel will have on diesel fuel cost [Reference (l)]. The EIA then developed a model using their proprietary refining industry database. Their fuel cost estimate was in line with the other cost studies that were performed by MathPro, National Petroleum Council, Ensys (for DOE) Argonne National Laboratory (for DOE), Charles River Associations (for the American Petroleum Institute) and U.S. EPA. The EIA result showed an ULSD fuel production cost premium above that to produce current low-sulfur diesel fuel (500 ppm) at about 4.7 cents/gal to 9.2 cents/gal between the years 2007 – 2011.

Using the 4.7 cents/gal prediction (favored by the U.S. EPA), plus an additional 1.0 cent/gal premium (to produce the current low sulfur diesel fuel), an estimate was made to show the impact that the ULSD fuel would have in reducing the cost differential between JP-5 and F-76. For simplicity, this estimate assumes JP-5 and F-76 prices and quantities remain constant in the future. All the assumptions to produce this estimate are given in Figure 12. As shown, the cost differential was reduced from the $49 million average shown in Table 8 to $8.5 million over a ten-year period (FY 2006 - FY 2016), when both CONUS and OCONUS suppliers would be providing only ULSD fuel as F-76. Even at this lower premium prediction, the cost to produce ULSD fuel has reduced the cost differential between JP-5 and F-76 significantly.

The lower value of the premium range (4.7 cents/gal) assumed that technology would improve the techniques for sulfur removal resulting in significantly lower production costs. If this technology is not as successful as predicted, the cost to produce ULSD fuel may even exceed the price that the Navy pays for JP-5. As shown in Figure 12, for the most pessimistic case where technology is unable to reduce the cost of refining ULSD fuel (9.2 cents/gal prediction, plus an additional 1.0 cent/gal premium), it will cost more to procure F-76 from about FY 2010 and beyond, assuming the price of JP-5 remains constant.

The difference for the 4.7 cents/gal estimate may be reduced still further when other cost reduction scenarios such as potential maintenance reductions for gas turbine engines, high- and medium-speed diesel engines and shipboard fuel handling equipment are taken into account. Furthermore, as shown in Figure 12, everything else being equal, specifying JP-5 as the single naval fuel at-sea could result in a significant annual cost savings ($21.7 million) for the 9.2 cents/gal premium case.

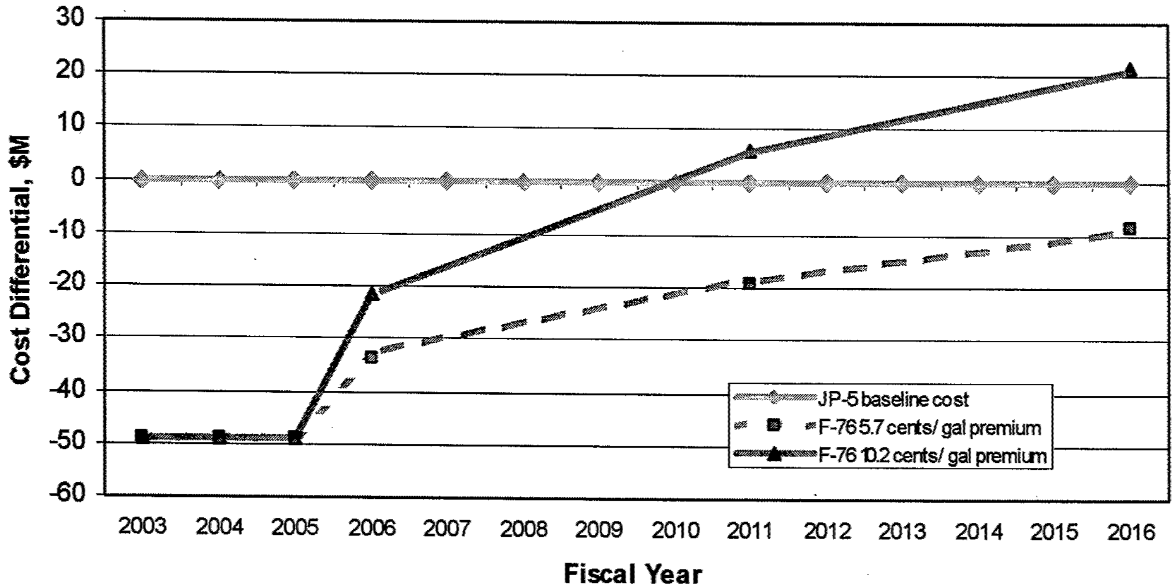
TABLE 9: SHIPBOARD PROPULSION EQUIPMENT MAINTENANCE POOL

	Equipment Type	Unit Rating	No./ Ship	No. of Ships	Total Units	Overhaul Cost/ Unit ($K)	Average Annual Operating Hours	Meantime Between Overhaul (Hours)	Number of Expected Annual Overhauls	Annual Casualty Reports	Other Annual Maintenance Actions ($M)	Total Annual Maintenance Costs ($M)
SHIPS	**GE LM2500 GT**	20,000 HP	4	206	824							
AOE-6, CG-47	PB					757			11			8
DDG-993	SST					775			3			2
FFG-7, DDG-51	PT					775			11			9
	AEC 501 GT	2500 KW	3	171	513							
CG-47, DD-963	K-17					333			27			9
DDG-51, DDG-993	K-34					833			12			10
LCAC	**TF40B**		4	91	364							
	SSDG/MPDE											
FFG-7	DD 149	1600 HP			148	250		11,000				
LSD-41/49	FM38D8-1/4	1600 HP			48	545		13,250				
LSD-41/49	PC2.5V	8500 HP			48	3,000		18,000				
AOE-6	CAT 3608	3300 HP			20	1,125		20,000				
ARS-50	399	1100 HP			28	375		8500				
MCM-3, MHC-51	IF ID36SS6V-AM	600 HP			139	250		6000				
MCM-1	Wauk L1616DSIN	600 HP			14	204		6000				
LST-1181	ALCO 251	2100 HP			18	716		15,500				
BOATS												
Landing Craft EOD Support	DDC-71				1233	5,000						
	CAT D 3512	2100 HP			12	716,000		17,750				
	VPAQAD41	165 HP			124	56,000		6000				
	WB 1488	35			14	12,000		6000				
	DDC-53				36							

TABLE 9: SHIPBOARD PROPULSION EQUIPMENT MAINTENANCE POOL cont'd

	Equipment Type	Unit Rating	No./ Ship	No. of Ships	Total Units	OH Cost/ Unit, $K	Average Annual Operating Hours	Meantime Between Overhaul (Hours)	Number of Expected Annual Overhauls	Annual Casualty Reports	Other Annual Maintenance Actions ($K)	Total Annual Maintenance Costs ($M)
BOATS												
	Cum V8-30M				5							
	Paxman	3600 HP				1,227		9500				
CRAFT												
Training, Harbor Tugs	DDC-71				252			5				
	FM 38D8-1/8	1600 HP			58	545		13,250				
	Cum VTA-28				6							
	KTA-28-50-M				2							
	CAT 3408				2							
	FM 385-1/4				2							
FUEL HANDLING												
	Coalescers		32	125	4000	50		48,000			156	3
	Pre-Filters		16	125	2000	160		24,000			156	4
	Purifiers											
	Heaters											
	Pumps											
	Tanks											
INFRASTRUCTURE												
	Pipeline Assembly											
	Storage Assemblies											
	Controls											

Figure 12: Estimated Impact of ULSD on JP-5/F-76 Cost Differential



Notes: Costs are based on the following assumptions:

- CONUS and OCONUS premiums for ULSD are from models, Reference (l) for FY 2006 – FY 2016: 4.7 cents/gal and 9.2 cents/gal, each with an additional 1.0 cent/gal for low sulfur premium (500 ppm sulfur).
- Requirements for JP-5/F-76 and weighted average prices for JP-5 remain constant from FY 2000 forward, for each of the four regions.
- For FY 2003 – FY 2005, there is no ULSD F-76 supplied in CONUS or OCONUS.

The assumed ULSD F-76 worldwide introduction scenario is as follows:

- 50% of CONUS and 25% of OCONUS suppliers of F-76 will supply ULSD fuel for both on-and off-road in FY 2006.
- By FY 2011, CONUS suppliers of F-76 will supply 100% ULSD fuel and OCONUS will supply 50% ULSD fuel.
- By FY 2016, OCONUS suppliers of F-76 will supply 100% ULSD fuel.

8.4 INTRINSIC BENEFITS: The following discussion was extracted verbatim or paraphrased from Reference (m), a master's thesis prepared for the Navy Post Graduate School, Monterey, CA, in which the benefits of a single naval fuel, JP-5, were examined.

Adopting JP-5, as the single naval fuel at-sea, would substantially reduce both fuel supply risks and fuel transportation risks, improve readiness, and enhance the Navy's capability to sustain major contingency operations. This concept is equivalent to the Army's "Single Battlefield Fuel Forward" that employs JP-8 as the single fuel. The Navy's single "battlefield fuel" then, would be JP-5 *but these requirements are not envisioned for "non-tactical" equipment*.

8.4.1 Increased Peacetime Inventories: The single naval fuel at-sea concept would replace F-76 war reserves and peacetime operating stocks stored in DFSP's around the world with more flexible, critical and difficult-to-obtain JP-5. In February 2000, DESC worldwide

F-76 inventories totaled approximately 311 MM USG and JP-5 inventories totaled approximately 579 MM USG (extracted from DESC website). Replacing F-76 inventories with JP-5 would increase JP-5 inventories by approximately 50 percent. *As an approved alternate to both F-76 and JP-8, JP-5 is the only fuel that can be used by all services for all bulk fuel requirements.* JP-5 stocks provide DOD more flexibility and increased readiness to meet all contingency needs. Even the relatively small JP-5 requirements of the recent short-lived Kosovo operations initially required extraordinary measures for DESC to support. Although DESC would certainly have found a solution, supporting two aircraft carriers would have been very difficult to provide timely re-supply of JP-5. As a result, DESC intends to convert some portion of the JP-8 war reserves in the Mediterranean to JP-5. These reserves could still be supported with JP-8. Ideally, all war reserves, including those currently held as JP-8, would be held as JP-5.

8.4.2 Improved Readiness: Larger JP-5 inventories would extend the time available for DESC to contract for and deliver JP-5 to meet increased contingency requirements. Since other bulk fuels used by DOD, including MGO PD (bunker fuel) and F-76, are more likely than JP-5 to be available through host nation support, increased JP-5 inventories could also reduce the needed quantity and urgency of early tanker lifts. The availability of JP-5 refinery production capacity sufficient to sustain naval forces during a major contingency is uncertain. By adopting JP-5 as the single fuel at-sea, the routine peacetime production of JP-5 will be approximately doubled and most likely more refineries would be contracted by DESC to provide JP-5. Starting from a larger supplier base and a larger base quantity, increased JP-5 requirements during a smaller contingency might be more incremental than substantial.

During a major contingency, doubling the JP-5 production base would also improve the capability to sustain operations. Although adopting JP-5 as the universal fuel at-sea would double peacetime consumption as well as supply, if the supply of JP-5 was inadequate to support both aviation and bunker requirements during a contingency, DESC could contract with local refineries for F-76 or MGO to support bunker requirements. The JP-5 supply, initially twice the current size, could be reserved for aviation needs. The risk of inadequate refinery support for JP-5 requirements would be substantially reduced. By procuring substitute bunker fuels as close as possible to the area of operations, tanker requirements could also be reduced.

8.4.3 Reduced Variation in Demand: Replenishment must be planned to meet the highest reasonably expected demand. It is a statistical certainty that using a single fuel would reduce variation in demand. The total quantity of fuel required would be more predictable and the combined highest reasonably expected demand for both aviation and bunker support would be lower than each requirement determined separately. In other words, a lower quantity of a single fuel that supports all systems provides the same readiness and safety level as higher quantities of two fuels that each support different systems. In addition, increased predictability would enhance the logisticians' capability to direct fuel to the theater rather than waiting for submitted requirements.

8.4.4 Increased Endurance: Using a single fuel increases the days-of-supply endurance of the Fleet. With two fuels, endurance is limited by whichever fuel will be depleted first. A ship loaded with only JP-5 has greater endurance than a ship loaded with both F-76 and JP-5. With a single fuel, UNREPs can be less frequent. Less frequent but higher quantity UNREPs allow greater freedom to schedule around threats, operations and weather and less total time actually alongside. Using a single fuel increases the endurance of the entire battle group and reduces the risk to operations from an unexpected loss of a shuttle ship. Less frequent but higher quantity oiler replenishment-at-sea (CONSOL) would increase shuttle oiler efficiency.

8.4.5 Fewer Shuttle Oilers: In addition, fewer tankers and oilers would be wasted moving fuel that is not needed. Since shuttle oilers would never deplete the onboard inventory of one fuel and still have an excess of another fuel onboard, all fuel onboard could be transferred during every shuttle. Flexibility would be improved, planning would be easier, and less communication would be necessary. Fewer shuttle oilers and fewer escorts would be required.

9.0 SUMMARY OF REFINING INDUSTRY SURVEY

9.1 SURVEY OVERVIEW: As part of the Phase One study, current JP-5 and F-76 refiners, as well as potential JP-5 suppliers, were sent a survey letter (Appendix B) by the DESC Acquisition Programs office. In total, forty-three companies were surveyed. Twenty-four replies were received, although in some cases, a single reply represented several companies which had merged. Some responses were specific, detailed and factual, while others were more generalized. The companies replied to the survey under assurances from DESC and the Navy that their individual responses would be treated confidentially. The survey data is summarized in Table 10 below.

9.2 SUMMARY OF SURVEY RESULTS:

Table 10: Summary Of Refinery Survey Data

CONUS (IW and EG)	AEM (OCONUS)	WESTPAC (OCONUS)
21 Sent, 14 Rcvd (60%)	11 Sent, 5 Rcvd (45%)	11 Sent, 3 Rcvd (27%)
QA. *If not a current supplier, can you produce JP-5?*		
14 Yes	2 Yes	2 Yes
	3 No	1 No
Total Worldwide: 18 Yes; 4 No		
QB. *If not a current JP-5 supplier, would the increased requirement of JP-5 influence you to offer it to DESC?*		
7 Current suppliers	1 Yes	1 Yes
1 Maybe	4 No	2 No
6 No		
Total Worldwide: 7 Current suppliers; 2 Yes; 12 No; 1 No clear answer		

Table 10: Summary Of Refinery Survey Data (Cont'd)

CONUS (IW and EG)	AEM (OCONUS)	WESTPAC (OCONUS)
QC. *If currently supplying JP-5, could you/would you increase your offer to DESC to contribute to the increased requirement of JP-5?*		
4 Yes	1 Maybe	3 Not current suppliers
2 Maybe	4 Not current suppliers	
1 No		
7 Not current suppliers		
Total Worldwide: 4 Yes; 14 Not current suppliers; 1 No; 3 No clear answer		
QD. *Are there any properties (excluding flashpoint) which, if revised, would enable you to produce more JP-5?*		
1 Acid number	1 Freeze point	1 Distillation point
5 Freeze point	1 H_2 content	1 No
1 Smoke point	4 No answer	1 No answer
1 H_2 content		
3 No		
5 No answer		
Total Worldwide: 6 Freeze point; 1 Smoke point; 1 Acid number; 2 H_2 content; 4 No; 10 No answer		
QE. *Would there be a price impact (increase or decrease) for JP-5 given the increased volume of JP-5 being propose?*		
9 Increase	2 Increase	2 Increase
1 No increase	1 No increase	1 No answer
3 Unknown	2 No answer	
1 No answer		
Total Worldwide: 13 Price increase; 2 No price increase; 4 No answer; 3 No clear answer		

Table 10: Summary Of Refinery Survey Data (Cont'd)

CONUS (IW and EG)	AEM (OCONUS)	WESTPAC (OCONUS)
QF. *How would increasing the JP-5 requirement to include that for F-76 ship fuel affect your ability to produce more military-specification fuel during a national emergency (when requirements may increase three or four times that of peacetime)?*		
3 Will reduce other fuel production	1 Contingent on commercial jet fuel demand	1 Can produce limited additional JP-5
1 No impact	2 Maybe	1 Contingent on commercial jet fuel demand
5 Can produce limited additional JP-5	2 No answer	1 No answer
2 Contingent on commercial jet fuel demand		
1 Maybe		
2 No answer		
Total Worldwide: 4 Contingent on commercial jet fuel demand; 1 No impact; 3 Reduces other fuel production; 6 Limited additional JP-5; 5 No answer; 3 No clear answer		
QG. *How long would it take to make refinery modifications to produce JP-5 to implement this proposal?*		
1, 12 months or longer	3 Cannot supply JP-5	1, 6 Months
1, 5 to 10 years	1, 15 to 30 months refinery mod., and 3-12 months storage tanks	1 Cannot supply JP-5
2, 3 to 15 months for refinery mods, and 3-12 months for storage modifications	1 No answer	1 No answer
3 At maximum production now		
5 No Answer		
2 Unknown		
Total Worldwide: 3, 15 to 30 months refinery mods; 3, 12 months for storage mods; 1 Greater than 12 Months; 4 Cannot supply JP-5; 3 At maximum production now; 1, 5 to 10 years; 1, 6 Months; 7 No answer; 2 Unknown		

Table 10: Summary Of Refinery Survey Data (Cont'd)

CONUS (IW and EG)	AEM (OCONUS)	WESTPAC (OCONUS)
QH. *What would be the expected impact on availability and price on commercial jet fuel, JP-8, and other kerosene users for the increased JP-5 requirement?*		
4* Increased price and reduced availability	1 Reduced availability	1 Price increase
2 Insignificant globally, but local temporary shortages	1 Reduced availability and $15M increased cost to DESC in the Mediterranean and $20M more in the Arabian Gulf	1 Use commercial diesel instead of JP-5 or F-76
1 Price increase	1 Insignificant globally, but local temporary shortages	1 No answer
4 Reduced availability	2 No answer	
1 Market-driven		
1* Use commercial diesel instead of JP-5 or F-76		
1 No answer		
1 Unknown		
Total Worldwide: 9 Price increase; 10 reduced availability; 3 Insignificant globally; 1 Market-driven; 2 Use only commercial diesel fuel for shipboard applications; 4 No answer; 1Unknown		

* Comments made by same responder

10.0 CONCLUSIONS

- Between FY 1990 - FY 2000, coverage for the combined JP-5 and F-76 requirements averaged 88 percent without soliciting for the increased JP-5 requirement, and 83 percent between FY 1996 – FY 2000. The current theoretical JP-5 requirement in FY 2000 is approximately 35 MM Bbls. In addition, no current or potential JP-5 refiner that was surveyed said that the conversion could not be accomplished because of the lack of JP-5 availability. As a consequence, *it is concluded that converting from F-76 to JP-5 as a single fuel at-sea for U.S. Navy aviation, ship propulsion, electrical power generation systems and USMC ground force equipment is feasible from an availability consideration.*
- Since the contract price of JP-5 is greater than that for F-76, ranging from 2 – 11 cents/gal, there will be an increase in the fuel purchase price for the conversion. Historical data from FY 1996 - FY 2000 showed an average increased cost of approximately $49 million annually which is about 5 percent of the Navy's average total fuel budget of $940 million.
- Regional or localized shortages may occur initially but these can be mitigated by allowing 5 to 10 years for the refining industry to prepare for the change of providing JP-5 in place of F-76. It was noted that DESC was purchasing volumes of JP-5 approximately equal to the combined FY 2000 JP-5 and F-76 requirements as recently as FY 1994.
- Most suppliers surveyed stated they believed the price of JP-5 would increase. Since JP-5 is a specialty product, it carries a premium price. However, one major supplier stated that "prices are determined by the market". In addition, most suppliers felt that doubling the JP-5 volume would have little impact on pricing.

11.0 RECOMMENDATIONS

11.1 PHASE TWO: Conduct evaluations to develop a detailed cost/benefit analysis for the implementation of JP-5 as the single naval at-sea fuel. The study should address:

- An evaluation of the operational impacts of adopting JP-5 as the single fuel for all ships and aircraft of the Battle Force. The analysis will describe operational impacts in terms of Fleet operational flexibility, efficiency, and readiness.
- Potential gas turbine and high-and medium-speed diesel engine maintenance reductions.
- Potential fuel infrastructure reductions that may occur from the use of a single fuel mindful that provision must be made for approximately five percent of the shipboard fuel requirement that will be satisfied with commercial marine diesel fuel.
- Intrinsic benefits of increased ship readiness, safety and operability.
- The impact on the reciprocal agreements that the U.S. Navy has with NATO, ABCANZ, as well as commitments to other services (Coast Guard, Army, and Air Force). The impact on the Military Sealift Command must also be considered.

- The amount of reduction of the cost difference between JP-5 and F-76 due to the EPA-mandated ultra-low diesel sulfur.

11.2 CONTRACTUAL: DESC may want to consider the use of multiyear contracts in the implementation of the proposed conversion.

12.0 REFERENCES

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APPENDIX A
NAVSEA MARINE GAS OIL (MGO) PURCHASE DESCRIPTION (AUG 1996)

	Test	Method	Requirement
1.	Cetane Number or Cetane Index[1/]	ASTM D 613 ASTM D 976	42 min 43 min
2.	Appearance @ 21°C or ambient temp. whichever is higher or Water & Sediment	Visual ASTM D 2709	Clear & Bright 0.05% vol max
3.	Distillation, 90% point	ASTM D 86	357°C max
4.	Flash Point[2/]	ASTM D 93	60°C min
5.	Cloud Point	ASTM D 2500	-1°C max
6.	Viscosity @ 40°C	ASTM D 445	1.7 – 4.5 cSt
7.	Color	ASTM D 1500	3 max
8.	Density @ 15°C	ASTM D 1298	876 kg/m^3 max
9.	Carbon Residue on 10% bottoms	ASTM D 524 ASTM D 189	0.35 wt%
10.	Ash	ASTM D 482	0.01 wt% max
11.	Sulfur	ASTM D 4294 ASTM D 1552 ASTM D 2622	1.0 wt% max
12.	Corrosion	ASTM D 130	3 max
13.	Distillate Fuel (No Residual)		100 %

1/ The cetane index requirement shall apply to the base fuel without cetane improving additives. Where cetane index is reported, the value shall be identified as the cetane index.
2/ The flash point is absolute and no value less than 60°C is permissible.

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APPENDIX B

INDUSTRY SURVEY LETTER

From: DESC-B
To: Oil Companies:

The Department of the Navy has initiated a feasibility study to assess the potential impacts of converting to a single fuel, an aviation jet kerosene with a 60 C minimum flash point, JP-5, for both aircraft and ship propulsion. This study will evaluate benefits and/or disadvantages associated with the prospective use of a single Navy fuel. Conversion to a single fuel could impact the price and availability of JP-5. Use of a single fuel will enhance operational flexibility in scheduling replenishment events and may also offer a potential for terminal and pipeline infrastructure efficiencies. Navy research to-date has found that cost savings will be realized through the use of JP-5 when compared to shipboard marine distillate (F-76) due to its enhanced thermal stability and cleaner burning characteristics. The Navy intends to evaluate all aspects of the single-fuel issue in this study.

The Defense Energy Support Center (DESC) is working with the Navy's consultant, Mr. Calvin Martin, to study the single-fuel conversion impacts for fuel cost and availability. The approximate annual requirement (expressed in gallons) for each major geographical area are depicted below. The total annual requirement when the two products are combined is approximately 1.47 billion gallons.

Geographic area	JP-5	F-76
East/Gulf Coast	346,500,000	200,878,000
West Coast/Alaska/Hawaii	216,745,000	172,545,000
Europe	78,870,000	114,000,000
Pacific/Arabian Gulf	117,750,000	220,838,000
Total	759,865,000	708,261,000

To assist in determining the impact of the increased JP-5 requirement, DESC requests your answers/comments to the following questions. This survey is voluntary and all responses will be treated confidentially.

a. If not a current supplier, can you produce JP-5? (See attached JP-5, F-76 comparison chart.)
b. If not a current JP-5 supplier, would the increased requirement of JP-5 influence you to offer it to DESC?
c. If currently supplying JP-5, could you/would you increase your offer to DESC to contribute to the increased requirement of JP-5?
d. Are there any fuel properties (excluding flash point) which, if revised, would enable you to produce more JP-5?
e. Would there be a price impact (increase or decrease) for JP-5, given the increased volume of JP-5 being proposed?

f. How would increasing the JP-5 requirement to include those for F-76 ship fuel affect your ability to produce more military-specification fuel during a national emergency (when requirements may increase to three or four times peacetime levels)?
g. How long would it take to make refinery modifications to produce JP-5 to implement this proposal?
h. What would be the expected impact on availability and price on commercial jet fuel, JP-8, and other kerosene users for the increased JP-5 requirement?

DESC requests that your survey responses be received by October 31, 2000. Please feel free to address these issues or any other issues related to this survey to:

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Martin & Associates
13325 Fort Washington Road
Fort Washington, MD 20744
Telephone---301-292-3534
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14. ABSTRACT
This report documents the findings of the first phase of a feasibility study investigating the possibility of converting the U.S. Navy to a single fuel for use at-sea. JP-5 was chosen as the possible conversion candidate since it is already an approved alternative to both F-76 and JP-8 and therefore satisfies all of the technical requirements for the Navy's bulk fuel. Responses to past procurement solicitations for both JP-5 and F-76 were studied as indications of potential fuel availability. Refiners were also surveyed to determine their opinions regarding the impact the conversion would have on the cost and availability of Naval and other Military fuels. It was concluded from this study that there would be sufficient JP-5 available to convert, albeit at a marginally higher price. In addition an initial investigation determined that several operational and equipment maintenance benefits from operating on JP-5 could potentially off-set the anticipated higher fuel procurement costs. Finally, the study recommends proceeding on to phase two of the study, a more detailed cost/benefit study.

15. SUBJECT TERMS
Naval Fuel; F-76; JP-5; fuel logistics support

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14. ABSTRACT
This report documents the findings of the first phase of a feasibility study investigating the possibility of converting the U.S. Navy to a single fuel for use at-sea. JP-5 was chosen as the possible conversion candidate since it is already an approved alternative to both F-76 and JP-8 and therefore satisfies all of the technical requirements for the Navy's bulk fuel. Responses to past procurement solicitations for both JP-5 and F-76 were studied as indications of potential fuel availability. Refiners were also surveyed to determine their opinions regarding the impact the conversion would have on the cost and availability of Naval and other Military fuels. It was concluded from this study that there would be sufficient JP-5 available to convert, albeit at a marginally higher price. In addition an initial investigation determined that several operational and equipment maintenance benefits from operating on JP-5 could potentially off-set the anticipated higher fuel procurement costs. Finally, the study recommends proceeding on to phase two of the study, a more detailed cost/benefit study.

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