APPENDIX A. UPDATING THIS STRATEGY

APPENDIX A. UPDATING THIS STRATEGY

This strategy will be reviewed yearly. Table A-1 lists the governance structure for updating this strategy.

Table A-1 Governance Structure for the NECC 15 Year Energy Strategy

Task	Responsible Organization and Personnel
Establish and Maintain DoD Energy Policy	DoD Installation & Environment
Establish and Maintain DoN Energy Policy	Naval Energy Office (NEO)
Establish CNO Energy Policy	Chief of Naval Operations
Administer/Recommend Changes to CNO Energy Policy	Office of the Chief of Naval Operations N43 TFE and TFE WGs
Administer/Recommend Changes to CNO Energy Policy – For Expeditionary Operations	OPNAV N857 – Expeditionary Combat Branch is the Action Officer for TFE-E
Approval of NECC 15 Year Energy Strategy	Commander, NECC
Recommendations to Commander NECC changes to NECC 15 Year Energy Strategy	NECC/N43 Readiness
Recommendations to NECC N43 changes to NECC 15 Year Energy Strategy	NECE CFT 3 – Equipment & Logistics
Provide Input from USMC	USMC Expeditionary Energy Office
Provide Input from USAF	USAF Director of Energy Policy
Provide Input from United States Army	US Army

Table A-1. Governance Structure for the NECC 15 Year Energy Strategy (Continued)

Task	Responsible Organization and Personnel
Draft and revise energy strategy	NAVFAC Working Group for NECC 15 Year Energy Strategy - ***Team Lead*** – rotates annually among the three primary NECC SYSCOMs: NAVFAC, NAVSEA, and SPAWAR - ***Team Members from these organizations*** ▪ ***Various Codes from NECC*** ▪ ***OPNAV*** *857* ▪ ***NAVFAC Engineering Service Center*** – EX30 Amphibious and Expeditionary Department ▪ ***NAVFAC Expeditionary Logistics Center (NFELC)*** ▪ ***Naval Expeditionary Program Office (NEPO)*** ▪ ***NAVSEA*** ▪ ***SPAWAR***

APPENDIX B: ESTIMATED BASELINE NECC DEPLOYED UNITS ANNUAL FUEL CONSUMPTION FOR FY 2008 AND 2009

APPENDIX B: ESTIMATED BASELINE NECC DEPLOYED UNITS ANNUAL FUEL CONSUMPTION FOR FY 2008 AND 2009

B1.0 INTRODUCTION

This Appendix provides the details of developing the entire baseline of NECC energy consumption. This baseline enables periodic monitoring for measuring progress towards the Navy energy goals.

B2.0 LIST OF END ITEMS USED BY DEPLOYED NECC COMPONENTS

Each deployed NECC Unit has an associated TOA. The Naval Facilities Expeditionary Logistics Center (NFELC) manages these TOAs for many Navy components via the *ABFCTOA VIEW* computer program. TOAs are nested categories of end items arranged to suit the needs of NECC and other users of the *ABFCTOA View* computer program. An end item is smallest unit of issue procured for a particular TOA.

B3.0 TABLE LISTING NUMBER AND TYPE OF END ITEMS CONSUMING FUEL FOR EACH NECC DEPLOYING COMPONENT TOA

NFELC generated a Microsoft (MS) Excel file listing all TOA end items in *ABFCTOA View*. This MS Excel spreadsheet listed different direct fuel consumers (DFCs). This table included the number of DFCs in each NECC deploying component TOA and the multiplier. The multiplier is the number of a particular TOA. For example, the NECC has twelve *P25 Naval Mobile Construction Battalion (NMCB)* TOAs; therefore, the P25 multiplier is 12.

Table B-1. List of NECC Components

TOA Acronym	TOA Name
B17	Riverine
E01	Maritime Civil Affairs Group
E03	Expeditionary Combat Readiness Center
E05	Expeditionary Training Command
G01	Maritime Expeditionary Security Force
G03	Maritime Interdiction Operations-Intel Exploit
J04	Explosive Ordnance Disposal (EOD)
J07	Mobile Diving Salvage Command
N02A	Tent Camp 100 Personnel
N24A	Tent Camp 750 Personnel
P05	Construction Battalion Maintenance Unit (CBMU)
P25	Naval Mobile Construction Battalion (NMCB)

Table B-1. List of NECC Components (Cont.)

TOA Acronym	TOA Name
P05	Construction Battalion Maintenance Unit (CBMU)
P25	Naval Mobile Construction Battalion (NMCB)
P29	Naval Construction Regiment, Modular
P30	Naval Construction Brigade (NCB)
P31	Naval Construction Force Support Unit (NCFSU)
P35	Underwater Construction Team (UCT)
TA57	MPS Squadron (MPSRON) NMCB and NCR
T01T	Navy Expeditionary Logistics Support Force (NELSF) All T-Series Rollup
T03	Naval Cargo Handling Battalion (NCHB) One

B4.0 NOMINAL FUEL CONSUMPTION RATES IN GALLONS PER HOUR (GPH)

Each DFC has estimated fuel consumption in GPH. Fuel consumption rates were determined from many references: Army and USMC standard fuel consumption rates, equipment with similar horsepower, etc.

B5.0 FUEL CONSUMPTION ESTIMATION TOOL (FCET)

The FCET is an MS Excel spreadsheet calculating estimated fuel consumption for each DFC end item.

For this analysis, we assumed that each NECC unit can operate in a maximum of six environments listed in Table B-2.

Table B-2. Six Different Environments Used In this Analysis

Environment Abbreviation	Environment Title
A	Afghanistan/Iraq
B	Deployed to Non-US Soil
C	Active Unit Homeport
D	Reserve Unit Homeport
E	Maritime Pre-Positioning Force (MPF) Ship
F	Integrated Logistics Overhaul (ILO) /repair status for replacement of end items aboard MPF ships

Environments E and F involve the MPF, which are grouped into 3 MPSRON. Periodically, a MPSRON will travel to United States Marine Corps Blount Island Command (BIC) – Jacksonville, FL for regeneration of all cargo. Table B-3 lists the NECC TOAs aboard MPF ships.

Table B-3. List of NECC TOAs aboard MPF Ships

COMPONENT ACRONYM	COMPONENT TITLE	NOTES
P29	Naval Construction Regiment (NCR) Modular	
P32	Naval Construction Force Support Unit (Selected End Items from P32 TOA)	
TA57	NMCB has one TA57 per each MPSRON plus one TA57 in ILO/repair status.	The TA57 is identical to the P25 NMCB TOA.

Each MPSRON periodically visits BIC, Florida to offload one TA57 and unload a regenerated TA57. Therefore, TA57 has a multiplier of 4 with three TA57 TOAs in the three MSPRONs, and one TA57 is always in ILO/Repair Status, which is regenerated, and replaces another TA57 when the next MSPRON squadron arrives at BIC.

P29 and P32 TOAs are repaired and regenerated as per schedule coordinated by BIC, 1NCD, and NFELC

Table B-4 lists the Estimation Fuel Tool inputs used to calculate NECC total deployed fuel consumption.

Table B-4. List of Inputs for calculating NECC Total Deployed Fuel Consumption (DFC)

Hr/Dy	Hours/Day the NECC unit operates for each environment
Dy/Yr	Days/Year the NECC unit operates for each environment
% Used	Usage Rate = percent of NECC unit operating time that each DFC consumes fuel. NAFCET only allows usage rate regardless of environment
X	Multiplier for each TOA. The number of a particular TOA in ABFC.
DFC Gal/Hr	Nominal Fuel Consumption Rates in GPH

B6.0 NAFCET USES THE FOLLOWING ALGORITHM.

Step 1. Calculate Hr/Yr that each TOA is used in each environment: For TOA, calculate Hr/Yr by multiplying ***Hr/Dy by Dy/Yr*** Table B-5 shows Hr/Dy, Dy/Yr and calculated Hr/Yr for a P25 TOA for each environment.

Table B-5. Using P25 as Example of Inputting a TOA's Hrs/Day and Days/Yr for Each Particular Environment – Calculated Cells are Shaded Grey

Environment Type	Parameter	Input and Calculation
Environment A = Afghanistan/ Iraq	Hr /Day	20
	Dy/Yr	360
	Hr/Yr (calculated)	7200
Environment B = Deployed Non-US Soil	Hr /Day	12
	Dy/Yr	180
	Hr/Yr (calculated)	2160
Environment C. = Active Unit Homeport	Hr /Day	8
	Dy/Yr	140
	Hr/Yr (calculated)	1120
Environment D = Reserve Unit Homeport	Hr /Day	12
	Dy/Yr	24
	Hr/Yr (calculated)	288
Environment E = MPF Ship	Hr /Day	0
	Dy/Yr	0
	Hr/Yr (calculated)	0
Environment F= ILO/Repair Status	Hr /Day	0
	Dy/Yr	0
	Hr/Yr (calculated)	0

Step 2. Input X, the multiplier, for Each Environment for Each TOA: X can be split by whole number or decimal into the six environments. For each environment for each TOA, NAFCET multiplies X by Hr/Yr to obtain the Sum Hr/Yr for a particular TOA. Table B-6 shows P25 NMCB TOA with X split into the six environments, and the resulting Sum Hr/Yr TOA has for particular environment.

Table B-6. Example of Splitting the Multiplier (X) Into the Six Environments and the resulting total hours for the TOA being used

Environment	Calculated Operating Hr/Yr for Each Environment for one P25 TOA (see Table B-5)	X	Sum Hr/Yr TOA Being Used for Each Environment
A. In Afghanistan/ Iraq	7200	2	14400
B. Deployed Non-US Soil	2160	1	2160
C Active Unit Homeport	1120	5	5600
D. Active Unit Homeport	288	4	1152
E. MPF Ship	0	0	0
F In ILO /Repair Status	0	0	0

Step 3. % Used (as Described in Table B-4): Usage Rate = percent of NECC unit operating time for each DFC that consumes fuel. For a particular end item, NAFCET has the same usage rate for all environments.

Step 4. Calculate the Total Hr/Yr for each DFC, Assuming 100% Use During Unit Operation Hours: NAFCET uses a weighted average technique to calculate the total hr/yr for each end item in the TOA assuming 100% usage during unit operating hours. For example, lets create a new NECC TOA called U1 with 12 identical trucks, and there are five (5) U1 TOAs (X = 5). Therefore, the 5 U1 TOAs contain a total of 60 identical trucks.

Step 5. Sum Total Hr/Yr for each DFC Assuming 100% Use During Unit Operation Hours: As per Table B-7, the Sum Total is 260,400Hours.

Step 6. Insert the GPH For Each End Item Assuming 100% Operation at Predetermined Speed or Rounds Per Minute (RPM): For each end item, the standard GPH can vary among services and service components. The justification and reference for each GPH value is noted in the NAFCET. Assume the truck in the example U1 TOA has 3.0 GPH.

Step 7. Calculate Gallons/Year (Gal/Yr) For an End Item: Total End Item (Gal/Yr) = DFC GPH * % Used * 260,400Hours.

Table B-8 is a distribution of multipliers used in this analysis for each NECC Deployable unit in each environment. Table B-9 is the Total Annual Fuel Consumption per NECC End Item in Descending Order

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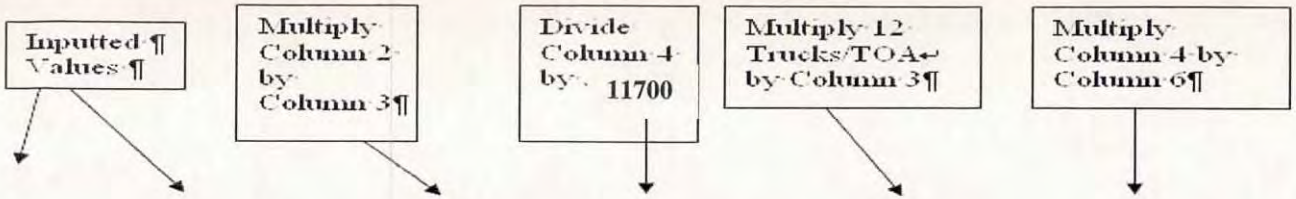
Table B-7. Example of Weighted Average Technique for TOA U1



Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Environment	**Hr/Yr**	**X**	**Sum Hr/Yr TOA Being Used for Each Environment**	**% Of Total Hours Used in Each Environment**	**No. of Trucks in Each Environment**	**Calculate the Total Hr/Yr for Trucks Assuming 100% Use During Unit Operation Hours**
A In Afghanistan/ Iraq	5000	2	10000	85.5%	24	240,000
B. Deployed Non-US Soil	1000	1	1000	8.5%	12	12,000
C Active Unit Homeport	500	1	500	4.3%	12	6,000
D. Active Unit Homeport	200	1	200	1.7%	12	2,400
E. MPF Ship	0	0	0	0.0%	0	0
F In ILO /Repair Status	0	0	0	0.0%	0	0
TOTALS	6700	5	11700	100%	60	260,400

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment

		B17 Riverine	E01 Maritime Civil Affairs Group	E03 Expeditionary Combat Readiness Center
Total Number of TOA's Per Unit		1	1	1
Environment A = In Afghanistan/ Iraq	Environment A No of TOAs	0.25	0	0
	Environment A Hrs /Day	20	0	0
	Environment A Days/Yr	360	0	0
Environment B = Deployed Non-US Soil	Environment B No of TOAs	0.25	0.5	0
	Environment B Hrs /Day	12	12	0
	Environment B Days/ Yr	100	100	0
Environment C. = Active Unit Homeport	Environment C No of TOAs	0.25	0.5	1
	Environment C Hrs /Day	8	8	1
	Environment C Days/Yr	100	100	120
Environment D = Reserve Unit Homeport	Environment D No of TOAs	0.25	0	0
	Environment D Hrs /Day	12	0	0
	Environment D Days/Yr	24	0	0
Environment E = MPF Ship	Environment E No of TOAs	0	0	0
	Environment E Hrs /Day	1	1	1
	Environment E Days/Yr	30	30	30
Environment F= ILO /Repair Status	Environment F No of TOAs	0	0	0
	Environment F Hrs /Day	0	0	0
	Environment F Days/Yr	0	0	0

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment (Cont.)

		E05 Expeditionary Training Command	G01 Maritime Expeditionary Security Force	G03 Maritime Interdiction Operations-Intel Exploit
Total Number of TOAs Per Unit		1	1	1
Environment A= In Afghanistan/ Iraq	Environment A No of TOAs	0	0	0
	Environment A Hrs /Day	0	0	0
	Environment A Days/Yr	0	0	0
Environment B = Deployed Non-US Soil	Environment A No of TOAs	0	0.2	1
	B Hrs /Day	0	12	12
	B Days/ Yr	0	120	100
Environment C. = Active Unit Homeport	Environment C No of TOAs	1	0.4	0
	Environment C Hrs /Day	1	8	0
	Environment C Days/Yr	120	200	0
Environment D = Reserve Unit Homeport	Environment D No of TOAs	0	0.4	0
	Environment D Hrs /Day	0	12	0
	Environment D D Days/Yr	0	30	0
Environment E = MPF Ship	Environment E No of TOAs	0	0	0
	Environment E Hrs /Day	1	1	1
	Environment E Days/Yr	30	30	30
Environment F= ILO /Repair Status	Environment F No of TOAs	0	0	0
	Environment F Hrs /Day	0	0	0
	Environment F Days/Yr	0	0	0

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment (Cont.)

		J04 Explosive Ordnance Disposal (EOD)	J07 Mobile Diving Salvage Command
Total Number of TOA's Per Unit		1	1
Environment A = Afghanistan/ Iraq	Environment A No of TOAs	0	0
	Environment A Hrs /Day	0	0
	Environment A Days/Yr	0	0
Environment B = Deployed Non-US Soil	Environment B No of TOAs	0.2	0.5
	Environment B Hrs /Day	12	12
	Environment B Days/ Yr	130	160
Environment C. = Active Unit Homeport	Environment C No of TOAs	0.4	0.3
	Environment C Hrs /Day	8	8
	Environment C Days/Yr	200	200
Environment D = Reserve Unit Homeport	Environment D No of TOAs	0.4	0.2
	Environment D Hrs /Day	12	12
	Environment D Days/Yr	40	40
Environment E = MPF Ship	Environment E No of TOAs	0	0
	Environment E Hrs /Day	1	1
	Environment E Days/Yr	30	30
F= ILO/Repair Status	Environment F No of TOAs	0	0
	Environment F Hrs /Day	0	0
	Environment F Days/Yr	0	0

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment (Cont.)

		P05 CBMU	P25 NMCB
Total Number of TOA's Per Unit		2	12
Environment A = Afghanistan/ Iraq	**Environment A No. of TOAs**	0	2
	Environment A Hrs /Day	0	20
	Environment A Days/Yr	0	360
Environment B = Deployed Non-US Soil	**Environment B No. of TOAs**	0	1
	Environment B Hrs /Day	0	12
	Environment B Days/ Yr	0	180
Environment C. = Active Unit Homeport	**Environment C No. of TOAs**	1	5
	C Hrs /Day	8	8
	C Days/Yr	180	140
Environment D = Reserve Unit Homeport	**Environment D No. of TOAs**	1	4
	D Hrs /Day	12	12
	D Days/Yr	40	24
Environment E = MPF Ship	**Environment E No. of TOAs**	0	0
	E Hrs /Day	1	1
	E Days/Yr	30	30
Environment F= ILO/Repair Status	**Environment F No. of TOAs**	0	0
	F Hrs /Day	0	0
	F Days/Yr	0	0

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment (Cont.)

		P29 Naval Construction Regiment, Modular	P30 NCB	P31 NCFSU
Total Number of TOA's Per Unit		3	1	1
Environment A = Afghanistan/ Iraq	Environment A No. of TOAs	0	0	0
	A Hrs /Day	0	0	0
	A Days/Yr	0	0	0
Environment B = Deployed Non-US Soil	Environment B No. of TOAs	0	0	0.5
	B Hrs /Day	0	0	12
	B Days/ Yr	0	0	100
C. = Active Unit Homeport	Environment C No. of TOAs	2	1	0.5
	C Hrs /Day	12	12	8
	C Days/Yr	14	14	150
D = Reserve Unit Homeport	Environment D No. of TOAs	1	0	0
	D Hrs /Day	12	0	0
	D Days/Yr	14	0	0
E = MPF Ship	Environment E No. of TOAs	0	0	0
	E Hrs /Day	1	1	1
	E Days/Yr	30	30	30
F= ILO /Repair Status	Environment F No. of TOAs	0	0	0
	F Hrs /Day	0	0	0
	F Days/Yr	0	0	0

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment (Cont.)

		P35 UCT	TA57 MPSRON, NMCB AND NCR
Total No of TOA's Per Unit		2	4
A = In Afghanistan/ Iraq	Environment A No. of TOAs	0	0
	A Hrs /Day	0	0
	A Days/Yr	0	0
Environment B = Deployed Non-US Soil	Environment B No. of TOAs	1	0
	B Hrs /Day	12	0
	B Days/ Yr	120	0
Environment C. = Active Unit Homeport	Environment C No. of TOAs	1	0
	C Hrs /Day	8	0
	C Days/Yr	160	0
Environment D = Reserve Unit Homeport	Environment D No. of TOAs	0	0
	D Hrs /Day	0	0
	D Days/Yr	0	0
Environment E = MPF Ship	Environment E No. of TOAs	0	3
	E Hrs /Day	1	1
	E Days/Yr	30	30
Environment F = ILO/Repair Status	Environment F No. of TOAs	0	1
	F Hrs /Day	0	0
	F Days/Yr	0	0

Table B-8. Distribution of Multipliers Used in this Analysis for Each NECC Deployable Unit in Each Environment (Cont.)

		T01T NELSF All T-Series Rollup	T03 NCHB ONE
Total Number of TOA's Per Unit		10	1
Environment A = In Afghanistan/ Iraq	**Environment A No. of TOAs**	0	0
	Environment A Hrs /Day	20	20
	Environment A Days/Yr	360	360
Environment B = Deployed Non-US Soil	**Environment B No. of TOAs**	0	0
	Environment B Hrs /Day	8	12
	Environment B Days/ Yr	180	180
Environment C. = Active Unit Homeport	**Environment C No. of TOAs**	0	0
	Environment C Hrs /Day	8	8
	Environment C Days/Yr	90	90
Environment D = Reserve Unit Homeport	**Environment D No. of TOAs**	0	0
	Environment D Hrs /Day	12	12
	Environment D Days/Yr	24	24
Environment E = MPF Ship	**Environment E No. of TOAs**	0	0
	Environment E Hrs /Day	0	0
	Environment E Days/Yr	0	0
Environment F= ILO/Repair Status	**Environment F No. of TOAs**	0	0
	Environment F Hrs /Day	0	0
	Environment F Days/Yr	0	0

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
	MTVR GROUP					22,529,305.00	36%
	GENERATOR GROUP					5,945,031.38	10%
	WATERCRAFT GROUP (EXCLUDING LANDING CRAFT)					10,707,732.80	17%
	ECU GROUP					2,978,653.60	5%
	HMMWV 1152A1 GROUP					2,101,543.40	3%
3930015080886	TRUCK FORKLIFT ROUGH TERRAIN 7 000 - 11 000 LB TELHDL	321910.0	3.5	1	3.5	1,126,685.00	2%
3805010416823	GRADER ROAD MOTORIZED DED 125 NET HP MINIMUM	204796.0	5.5	1	5.5	1,126,378.00	2%
3930LLLC32815	TRUCK FORKLIFT ROUGH TERRAIN 12 000 LB	144302.0	7.8	1	7.8	1,125,555.60	2%
2410011687599	TRACTOR CRAWLER TRACK TYPE DED 105 NET HP	202126.0	5.5	1	5.5	1,111,693.00	2%
2320LLLCA0206	LSSV CARGO CREWCAB 4X4 TROOP SEATS	655540.0	1.5	1	1.5	983,310.00	2%
3805010719753	LOADER SCOOP WHEEL MTD DED 125 HP MIN 6000 LB FORK (KKK-L-1542B)	186946.0	5	1	5	934,730.00	1%
4310010705616	COMPRESSOR AIR ROTARY 250 CFM AT 100 PSIG DED	140856.0	6	1	6	845,136.00	1%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3805010487857	LOADER SCOOP TYPE FULL TRACKED DED 2 1/2 CU YD (KKK-L-1086)	93608.0	9	1	9	842,472.00	1%
3895011184017	ROLLER MOTORIZED VIBRATORY DED COMPACTOR SELF-PROP	202126.0	7	0.5	3.5	707,441.00	1%
2320LLLC32752	TRUCK STAKE 6X6 DED 46000 GVW (or 15,133 Lbs GVW)	189904.0	3.6	1	3.6	683,654.40	1%
3805011856126	SCRAPER TRACTOR EARTHMOVING DED 4X2 SINGLE 11CY (MIL-S-28632)	46624.0	12	1	12	559,488.00	1%
2320011950532	TRUCK STAKE 6X6 DED AUTOMATIC TRANSMISSION ISO (46000)	119080.0	4.6	1	4.6	547,768.00	1%
3805LLLCA0203	LOADER SKID STEER DED 73HP MIN. W/ 78 DIRT (MODEL 873) (MELROE/BOBCAT	203000.0	2.6	1	2.6	527,800.00	1%
2420013189186	TRACTOR WHEELED INDUSTRIAL 4 X 2 60 NET HP MIN FRONT END LOADER	186856.0	2.7	1	2.7	504,511.20	1%
3930LLLC32772	TRUCK FORKLIFT 20000 LB CAP ROUGH DED	35240.0	13	1	13	458,120.00	1%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3930LLLC32772	TRUCK FORKLIFT 20000 LB CAP ROUGH DED	35240.0	13	1	13	458,120.00	1%
3895010698003	MIXER CONCRETE 11 CU FT PORTABLE WHEEL MOUNTED	188686.0	3	0.75	2.25	424,543.50	1%
6230010963508	FLOODLIGHT SET ELECTRIC SELF-CONTAINED TRLR-MTD	185720.00	2	1	2	371,440.00	1%
3805012767222	EXCAVATOR CRAWLER MOUNTED DED HYDRAULICALLY (81349-MIL-E-29239)	55444.0	7	0.85	5.95	329,891.80	0.528%
3431012462247	WELDER ARC ELECTRIC 300 AMPS AC/DC TIG DED	246394.0	2	0.65	1.3	320,312.20	0.513%
2410004052449	TRACTOR CRAWLER TRACK TYPE DED T-11 300HP NET (D8K)	19200.0	15.8	1	15.8	303,360.00	0.485%
3695006796914	SAW CHAIN 18N	301942.0	1	1	1	301,942.00	0.483%
4230014921540	DECONTAMINATING APPARATUS M17MCHF	273832.0	10	0.1	1	273,832.00	0.438%
2410010862395	TRACTOR CRAWLER TRACK TYPE DED T-9 200 NET HP	25502.0	10.5	1	10.5	267,771.00	0.429%
2410010883807	TRACTOR CRAWLER TRACK TYPE DED T-9 200 NET HP	23582.0	10.5	1	10.5	247,611.00	0.396%
3805005858121	TRUCK DUMP 20T 4X2 COMMERCIAL OFF-HIGHWAY (GVW 42,300 Lbs)	24000.0	9.9	1	9.9	237,600.00	0.380%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3810LLLC32763	CRANE HYD TRK MTD 40 TON 2 ENGINE AUXILIARY WINCH	48094.0	6	0.75	4.5	216,423.00	0.346%
2320015402017	HMMWV M1165A1 4-SEAT C&C BELLY ARMOR [D15402] (GVW 7190 Lbs)	100448.0	1.7	1	1.7	170,761.60	0.273%
4320010130798	PUMP WATER/TRASH CENTRIFUGAL DED 33 000GPH/400GPM	198736.0	4	0.2	0.8	158,988.80	0.254%
3895010449369	MIXER CONCRETE 6X4 DED 8 CU YD TRUCK MOUNTED NLT (C-13 Caterpillar Engine AVE 405 MAX HP)	7200.0	28.6	0.75	21.45	154,440.00	0.247%
6230LLLCA0220	FLOODLIGHT SET MLT5060MIT	269768.00	0.5	1	0.5	134,884.00	0.216%
2320LLLCC5534	TRUCK LSSV MAINTENANCE UTILITY CREWCAB 4X4 (GVW 10,500 Lbs)	106608.0	2.5	0.5	1.25	133,260.00	0.213%
0000LLCJ68500	TRUCK FORKLIFT 20000 LB DED PNEUMATIC TIRE	9576.0	13	1	13	124,488.00	0.199%
3930015227364	FORKLIFT 53K CAPABILITIES DIESEL RT CONT HANDLER	12000.0	9.5	1	9.5	114,000.00	0.182%
3930009357975	TRUCK FORKLIFT (6000 LBS DED) 177 LIFT HEIGHT	24872.0	4.5	1	4.5	111,924.00	0.179%
4320001379690	PUMP UNIT CENTRIFUGAL DED 1000 GPM MIN 10FT LIFT (Seawater Pump)	53914.0	10	0.2	2	107,828.00	0.173%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
4520015611996	HEATER DUCT, TYPE PORTABLE 60K	233120.0	0.65	0.7	0.455	106,069.60	0.170%
3805010883653	SCRAPER-TRACTOR EARTHMOVING DED 4X2 18 CU 14CY (MIL-S-28632)	7740.0	12	1	12	92,880.00	0.149%
4520015657620	HEATER SPACE (1.25 GALLONS/HR)	101636.0	1.25	0.7	0.875	88,931.50	0.142%
3825010692492	DISTRIBUTOR WATER MINIMUM 7K GAL OFF-HIGHWAY WHEEL	7380.0	11.5	1	11.5	84,870.00	0.136%
2320013360344	TRUCK VAN FORWARD CONTROL 4X2 GED AUTOMATIC FOR 15 PEOPLE	139316.0	2	0.3	0.6	83,589.60	0.134%
2320LLLCC5532	TRUCK LSSV LITTER CARRIER 2-PERSON 4X4 (GVW 10,500 Lbs)	96340.0	2.5	0.3	0.75	72,255.00	0.116%
3930LLLC32804	TRUCK FORKLIFT PNEUMATIC TIRES 6000LB.	14152.0	4.5	1	4.5	63,684.00	0.102%
4320002738468	PUMP CENTRIFUGAL DED SALT WATER 500 GPM AT 152FT	62734.0	5	0.2	1	62,734.00	0.100%
3805013592889	LOADER WHEEL MTD DED 125 HP MIN 2 1/2 CU YD	15360.0	4	1	4	61,440.00	0.098%
1940LL0730135	CRAFT LANDING UTILITY (135 Feet)	3072.0	38	0.5	19	58,368.00	0.093%
3805013310969	LOADER WHEEL DED 185 NET HP MIN ARTICULATED (Scoop)	14400.0	4	1	4	57,600.00	0.092%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3895013193301	ROLLER MOTORIZED TAMPING FOOT DRUMS LEVELING	9600.0	16.5	0.35	5.775	55,440.00	0.089%
2320013398009	TRUCK TRACTOR 6X4 DED AUTOMATIC TRANSMISSION 15 (52000)	14152.0	3.8	1	3.8	53,777.60	0.086%
1905001536696	LANDING CRAFT MECHANIZED	3072.0	35	0.5	17.5	53,760.00	0.086%
3810LLLCA0217	CRAWLER CRANE 50T LATTICE BOOM	8400.0	7.5	0.75	5.625	47,250.00	0.076%
2320013010655	TRUCK TRACTOR 6X6 DED AUTOMATIC TRANSMISSION (60000)	9152.0	5	1	5	45,760.00	0.073%
3805013279955	LOADER WHEEL DED 125 HP MIN MULTIPURPOSE (Scoop Type)	9600.0	4	1	4	38,400.00	0.061%
3820010758345	CRUSHER ROCK PRIMARY 250 TPH JAW SIZE NLT 20 IN	8400.0	20	0.2	4	33,600.00	0.054%
3820010770756	CRUSHER ROCK SECONDARY 250 TPH CONE TYPE	8400.0	20	0.2	4	33,600.00	0.054%
2310010095273	BUS MOTOR BOC 36 PASSENGER 4X2 DED AUTOMATIC	29024.0	3.8	0.3	1.14	33,087.36	0.053%
2310LLLC32735	TRUCK SUV 8600 CARRYALL 6 PASSENGER 4X4 7000GVW AIRCON	141880.0	0.7	0.3	0.21	29,794.80	0.048%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3895002346787	PAVER ASPHALT 10-16 FT PAVING WIDTH NLT 4-1/2	6000.0	18.7	0.25	4.675	28,050.00	0.045%
2310LLLC32735	TRUCK SUV 8600 CARRYALL 6 PASSENGER 4X4 7000GVW AIRCON	141880.0	0.7	0.3	0.21	29,794.80	0.048%
3895002346787	PAVER ASPHALT 10-16 FT PAVING WIDTH NLT 4-1/2	6000.0	18.7	0.25	4.675	28,050.00	0.045%
4320002674573	PUMP UNIT CENTRIFUGAL DEWATERING DED 135 GPM	102336.0	1.3	0.2	0.26	26,607.36	0.043%
4310001435850	COMPRESSOR AIR ROTARY 750 CFM AT 100 PSIG DED	2490.0	18	0.5	9	22,410.00	0.036%
4320013181853	PUMP WATER DED 125GPM MOUNTED IN SIXCON MODULE	104798.0	1	0.2	0.2	20,959.60	0.034%
2320011790669	TRUCK WRECKER 6X6 DED AUTO TRANS 25 TON FRONT/	3640.0	11.5	0.5	5.75	20,930.00	0.033%
3895004826521	MIXER ROTARY SOIL STABILIZER SELF PROPELLED (CUMMINS 6BT5.9) made 1988 - 160 HP Assume	3600.0	11.6	0.5	5.8	20,880.00	0.033%
2320LLLC32744	TRUCK MAINT/AERIAL PLATFORM (GVW 24,590 Lbs)	4320.0	5.8	0.7	4.06	17,539.20	0.028%
2340LLLCC4599	ATV QUADRUNNER MODEL MV500 6X6	75504.0	0.77	0.3	0.231	17,441.42	0.028%
2320LLLCA0238	TRUCK TRACTOR W SLEEPER 6X4 DED 52000GVW 80000GCWR (GVW 16185)	4576.0	3.8	1	3.8	17,388.80	0.028%
4320010292786	PUMP WATER/TRASH RECIPROCATING DED 100 GPM 4 INCH	58324.0	1	0.2	0.2	11,664.80	0.019%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
1930LLLCD0220	LIGHTER AMPHIBIOUS RESUPPLY CARGO 5-TON A2	5440.0	4	0.5	2	10,880.00	0.017%
3695001418291	SAW CHAIN 36N	7200.0	1.5	1	1.5	10,800.00	0.017%
3895013230382	ROLLER MOTORIZED ASPHALT TANDEM DRUM DED	6000.0	7	0.25	1.75	10500.0	0.017%
4310LLLCC3233	COMPRESSOR UNIT REC (Part O26-D) BAUER 5000 PSIG, 22 SCFM 4 STAGE	31440.0	1.6	0.2	0.32	10060.8	0.016%
3820012404340	AUGER EARTH GED (81349-MIL-A-28624)	36932.0	1	0.25	0.25	9233.0	0.015%
3895013230382	ROLLER MOTORIZED ASPHALT TANDEM DRUM DED	6000.0	7	0.25	1.75	10500.0	0.017%
4310LLLCC3233	COMPRESSOR UNIT REC (Part O26-D) BAUER 5000 PSIG, 22 SCFM 4 STAGE	31440.0	1.6	0.2	0.32	10060.8	0.016%
3820012404340	AUGER EARTH GED (81349-MIL-A-28624)	36932.0	1	0.25	0.25	9233.0	0.015%
3805000892192	DITCHING MACHINE LADDER TYPE CRAWLER MOUNTED (81349-MIL-D-633)	2490.0	7	0.5	3.5	8715.0	0.014%
3470LLLCA0207	ULTIMATE BUILDING MACHINE DED TRAILER MIC-240	9600.0	4.4	0.2	0.88	8448.0	0.014%
3805010848528	DITCHING MACHINE WHEEL TYPE TRENCHER CRAWLER (ELC PD3805-1562-79-3)	2490.0	6	0.5	3	7470.0	0.012%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3820011210960	DRILL ROCK HYDRAULICALLY ACTUATED DRIFTER TRACK	9600.0	3.75	0.2	0.75	7200.0	0.012%
2340LLLCA0205	TRUCK UTILITY GROUNDS MAINTENANCE 6X4 DED 18HP	73216.0	0.3	0.3	0.09	6589.4	0.011%
3895014767954	TAMPER VIBRATING RAMMER TYPE GED 4HP	123160.0	0.2	0.25	0.05	6158.0	0.010%
2320LLLC32736	TRUCK MULTISTOP DELIVERY GED 14000GVW	3432.0	1.6	1	1.6	5491.2	0.009%
5130001341207	SAW,CIRCULAR,GASOLINE,PORTABLE RESCU/EMERG	15630.0	1	0.3	0.3	4689.0	0.008%
3895002311362	TAMPER VIBRATING PORT 4HP GED	17760.0	1	0.25	0.25	4440.0	0.007%
3895002814692	SCREED VIBRATORY CONCRETE PORTABLE POWER UNIT GED	21360.0	1	0.2	0.2	4272.0	0.007%
3805014648333	POWER UNIT HYDRAULIC PORTABLE	8160.0	1	0.5	0.5	4080.0	0.007%
3820011647867	PAVING BREAKER TAMPER DRIVER AND DRILL (Portable)	16110.0	1	0.25	0.25	4027.5	0.006%
4930012404579	PUMP FUEL DED 100GPM MOUNTED IN SIXCON MODULE	7740.0	1	0.5	0.5	3870.0	0.006%
3895011254575	MIXER CONCRETE AND MORTAR 6CF GED 7 HP TILTING	4800.0	1	0.75	0.75	3600.0	0.006%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
3895LLLCA0200	CENTRAL MIX PLANT CONCRETE 220 CUBIC CY PH (100 HP JOHN DEERE DIESEL ENGINE)	2400.0	6.1	0.2	1.22	2928.0	0.005%
3895001502337	HAMMER PILE SELF-POWERED DIESEL 16 000 FT LBS	9600.0	1.5	0.2	0.3	2880.0	0.005%
2320011232665	TRUCK UTILITY COMMERCIAL 4X4 DED AUTOMATIC (6000) [M1009 (CUCV) [D11302]	1344.0	1.2	1	1.2	1612.8	0.003%
2330009981059	TRAILER CABLE REEL COMMERCIAL 14 000 LB PAYLOAD (GVW 8890 Lbs)	2400.0	2.1	0.3	0.63	1512.0	0.002%
2320LLLC32753	TRUCK EMERGENCY RESPONSE EOD	3432.0	1.4	0.3	0.42	1441.4	0.002%
4940010063229	SHOP EQUIPMENT GENERAL PURPOSE REPAIR SEMITRAILER	1290.0	2	0.5	1	1290.0	0.002%
6115LLLCC1795	STARTING UNIT 12/24VDC AT 700AMP OUTPUT GED	3260.0	1	0.3	0.3	978.0	0.002%
3895009177416	FINISHING MACHINE CONCRETE ROTARY GED 6HP	4800.0	1	0.2	0.2	960.0	0.002%
3895003392929	MIXER CONCRETE 6 CUBIC METERS (7.8 CUBIC YARDS) (SEMI-TRAILER)	12000.0	0.1	0.75	0.075	900.0	0.001%
3220004883674	SAW RADIAL OVERARM WOODWORKING SHOP 16 INCH DIESEL	360.0	2	1	2	720.0	0.001%

Table B-9. TOTAL ANNUAL FUEL CONSUMPTION PER NECC END ITEM IN DESCENDING ORDER (Cont.)

NSN	NSN DESCRIPTION	Subtotals of Hr/Yr by NSN	Gal/ Hr	Usage Factor (0 to 1)	Adjust Gal/Hr	Gal/Yr	% Of Yr Fuel Used
6530014604782	SAFETY BX & INCINERATION CONTAINER (5 LITER VOL total assume .75 gal fuel)	93608.00	0.03	0.25	0.0075	702.1	0.001%
3895012332391	SCREED VIBRATORY CONCRETE GED TRIANGULAR SHAPE	2400.0	1	0.2	0.2	480.0	0.001%
3895007015860	ROLLER MOTORIZED COMPACTOR SELF PROPELLED	180.0	5	0.5	2.5	450.0	0.001%
7310015079310	BURNER UNIT MODERN JP-8 FUEL HEAT SOURCE FIELD	1620.00	0.5	0.5	0.25	405.0	0.001%
2420010897416	TRACTOR WHEELED 4X2 INDUSTRIAL DED IW-60 REAR MTD	90.0	3	1	3	270.0	0.0004%
4320LLLC32777	PUMP CENTRIFUGAL FUEL DED 150 GPM SELF PRIMING SKID MOUNT	3300.0	0.4	0.2	0.08	264.0	0.0004%
3895010549665	SAW CONCRETE DED SELF-PROPELLED ABRASIVE DISC	1200.0	1	0.2	0.2	240.0	0.0004%
3820012733171	DRILL WELL WATER ROTARY/PERCUSSION 1 500 FT	90.0	3.75	0.5	1.875	168.8	0.0003%
4930002360806	LUBRICATING AND SERVICING UNIT F/DRUMS DED AIR - Power Operate	90.0	1	0.5	0.5	45.0	0.0001%
4310LLLCC2801	COMPRESSOR AIR 6.2 SCFM @ 90 PSI W/4 GAL TANK 3 HP	540.0	0.1	0.25	0.025	13.5	0.00002%

APPENDIX C: WHITE PAPER NAVFAC PETROLEUM USAGE MEASUREMENT & METRICS FOR NAVY EXPEDITIONARY FORCES - 3 MARCH 2010.

Naval Facilities Engineering Command

Petroleum Usage Measurement & Metrics For Navy Expeditionary Forces

3 March 2010

1) Executive Summary

At the strategic, operational, and tactical levels of war there is increasing recognition that fuel conservation and the use of alternative (non-petroleum) fuels provides an advantage for the Nation and its military forces. The Secretary of the Navy has established aggressive goals to drive Navy and Marine Corps forces towards this new reality. Additionally there is a non-quantified goal to reduce fuel consumption at the tactical level in order to:

(1) Save money.

(2) Reduce the logistic burden of transporting fuel and water.

(3) Decrease personnel exposure to attacks during convoy operations.

To reduce fuel use and make investments that result in fuel conservation, current and ongoing fuel use across the Navy must be known. The wide range of fuel consuming equipment, their operating environments, and the commercial or joint nature of their acquisition makes measuring Navy expeditionary fuel use and subsequent investment decisions difficult. Current ability to measure fuel usage by Navy expeditionary units is exceptionally limited. Using data available from the Defense Energy Support Center (DESC), reasonably reliable monthly figures at the force level for domestic use only has been obtained. Data below the Echelon IV level is rare, and certainly not to the vehicle (or class of vehicle) level. Fuel use for non-domestic, i.e. contingency operations is nonexistent; the data most needed to improve conservation is not retrievable.

This paper explores some of the possibilities for correcting this lack of fuel use information and begins to lay out requirements for a Navy expeditionary system. Metrics required are grouped as identifying, contextual, fuel usage, and efficiency. Collecting this data from the majority of expeditionary equipment will provide the required information to make informed decisions. This paper describes several existing and developmental systems that may prove useful or guide the Navy's adoption of a fuel measurement

methodology. None are easy or inexpensive to deploy because of the many and mobile fuel dispensing points, the information technology (and security) involved, and the variety of platforms to be linked. Following this general discussion of the problem, the next step in the process will be to develop an initial capabilities document describing the Navy's requirements for fuel measurement of expeditionary platforms.

2) Background

The Federal government, DoD in particular, is increasingly aware of a need to reduce petroleum fuel usage and increase efficiency. The SECNAV has announced a variety of goals to drive the Navy and Marine Corps towards greater efficiency and increased use of alternative (non-petroleum) fuel.[1] The goals to increase the use of alternative energy sources (Target #1) and to use energy efficiency in acquisition decisions (Target #5) have direct impact on the expeditionary enterprise, and both require knowledge of current and future consumption.

In a related effort, the Chief of Naval Operations (OPNAV) established the Navy Energy Coordination Office (NECO), also known as Task Force Energy, to coordinate the Navy's efforts in energy conservation, the increase in alternative energy sources, and the reduction of greenhouse producing gases. As part of this effort NECO has drafted a set of goals to guide improvements in energy consumption, more focused on reduction than the Secretary's goals. The Task Force Energy-Expeditionary Working Group has proposed the following objectives:

a. Reduce tactical petroleum consumption up to 15% by 2020

- Barrels of oil consumed

b. Increase tactical energy efficiency up to 15% by 2020

- miles / gallon (light vehicles)
- hours / gallon (construction)
- ton-miles / gallon (tactical vehicles)
- kWh / gallon (generators)
- cooling BTU / gallon (ECUs)
- R-Value (tents)

[1] SECNAV 301751Z OCT 09

b. Increase use of non-petroleum fuel to provide 25-40% of tactical fuel consumption by 2020

- Gallons non-petroleum JP-5 & JP-8 procured / total JP-5 & JP-8 procured

2) Discussion

This white paper discusses how to field a highly automated method of tracking fuel usage (both in garrison during normal domestic operations and during OCONUS contingency operations) that can report efficiency of operations for Navy Expeditionary Forces. It identifies methods and schemes to measure fuel use (volume) and operational use (miles driven, hours operated, etc.) with a quantification of costs and benefits of particular methods.

This white paper attempts to answer the following questions within NAVFAC NEPO's sphere of influence:

1. How can the Navy leverage Other Services' Programs?

2. When should the Navy adopt other services' system(s) and how should the Navy contribute to the effort to insure Navy requirements are also met?

Tracking fuel usage to reduce consumption and increase efficiency requires metrics and methods that are clearly defined and that can comprehensively measure progress toward goals. Existing fuel use data from the DESC can supply overall usage numbers at the Echelon IV level as DESC collects financial transaction data for nearly all DoD petroleum fuel transactions. However, this data is not sufficiently comprehensive to guide decisions that reduce consumption and increase efficiency.

a. Metrics

When the Task Force Energy-Expeditionary Working Group objectives (discussed above) are combined with the requirement to determine efficiency of operations for Navy Expeditionary Forces, they imply we collect all of the following information at the platform and equipment level:

- identifying information
- contextual information
- fuel usage information
- efficiency information

i. Identifying information

The following identification metrics are a sample set of constants that provide identifying information about the individual platform or piece of equipment:

- Equipment Unique ID (e.g. (United States Navy (USN))
- Equipment Type or Brand name (e.g. EC or NSN, MTVR MK 24 or D7G Dozer)
- Eq Fuel type(s) used (e.g. JP 8, Diesel Fuel Grade 1, 2, Class 3, or Diesel Fuel, Biodiesel)
- Fuel capacity including auxiliary tanks (e.g. 50 gal main tank with 1 SIXCON)
- Nominal (designed) curb weight (e.g. 6523 lbs)
- Nominal (designed) efficiency (e.g. 4 mpg highway or 4 gph at 1800 rpm)

This identifying information does not provide any usage data, but it does define what is using the fuel, what kind of fuel it can use, how much fuel it should hold, and what range can be expected (calculated from nominal efficiency and fuel capacity).

ii. Contextual logs

The following contextual metrics (and examples) are a sample of variables that provide the background of individual platforms or pieces of equipment over time:

- Organizational relationship log (e.g. Port Hueneme 12-18 Oct 2009 - Deployed Fort Hunter Leggett 19 Oct – 12 Dec 2009, ADCON 31st NCR UIC 40540, OPCON 31st NCR UIC 40540)
- Unit (organizational) id log (e.g. UIC 08913, 12 Oct – 12 Dec 2009)
- Operator id log (e.g. name, rank, serial number)
- Platform/Equipment configuration log (e.g. up armored, June 2008 to present)
- Platform/Equipment health log (e.g. maintenance deadline, 2 to 14 May 2009)

Again, this identifying contextual information does not provide any usage data, but it does define over time what persons or units used the platform or equipment, how the platform/equipment is/was configured, and what the maintenance condition is/was.

iii. Fuel usage logs

The following sample fuel usage metrics (and examples) provide the basis for usage calculations.

- Fuel type used log (e.g. NMU - Gasoline, Automotive Any Type or Grade (non contract source at a gas station

- Fuel level log (e.g. 18 Oct 2009, 1501 startup, 12.80 gal, 1502 12.79 gal, 1503 12.78 gal...)

- Platform/Equipment configuration log (e.g. up armored, June 2008 to present)

Fuel usage logs combined with identifying and contextual data provide the amount and kind of fuel used over time for each platform or piece of equipment. Complete and meaningful fuel quantity measurement requires that running totals of fuel amount and type used be kept for each and every platform or piece of equipment including those in a deployed expeditionary environment.

Measuring the amount and type of fuel used by individual platform/equipment will measure progress toward the objectives; however, the measurement of efficiency requires more data.

iv. Efficiency logs

The following sample fuel usage efficiency metrics provide the basis for efficiency calculations (they should be applied appropriately to type of platform or equipment)

- Work performed log (e.g. miles driven/sailed, engine hours run, engine rpm hours run, ton-miles run, (Kilowatt per Hour (kWh) produced)

- Payload weight log (e.g. 18 Oct 2009, 1012 to 1430, 1286 lbs)

- Electrical load log (e.g. 19 Oct 2009, 0000 to 0100, 22.3 kW)

- Running average efficiency log (e.g. mpg, hours per gallon, kWh)

Measuring efficiency over time will measure progress toward the objectives to increase tactical energy efficiency; however, there are two kinds of efficiency. One measures input (fuel used) relative to output (miles driven, engine hours, engine rpm hours, etc.). This measurement of efficiency is standard in engineering analysis, providing work produced per unit fuel in miles per gallon, kWh per gallon, etc.

The second kind of efficiency measures how well the platform/equipment is employed relative to how well it should be employed. This kind of efficiency can be called fuel effectiveness. Fuel effectiveness is important because highly efficient platforms or equipment can be employed inefficiently, for example excessive idle time, deploying an efficient fighter aircraft to deliver a gasket or using one large dump to carry small loads

when several smaller dumps would have used less fuel. Fuel effectiveness is also important because it allows the possibility of indicating where behavioral, operational and procedural changes that can affect efficiency are needed.

b. Existing fuel usage measurement data

The Navy has a limited ability to measure platform or equipment specific quantities of fuel used. DESC can provide reasonably reliable fuel quantity figures for non-deployed forces, but doesn't fully collect the data required to perform efficiency calculations, i.e. odometer or engine hours. DESC's transaction data typically only provide the date, fuel volume and type, and financial accounting data used for the transaction. Fuel use data below the Echelon IV level is not to the vehicle (or class of vehicle) level. Fuel use for non-domestic, i.e. contingency operations, is non-existent. NAVFAC has been able to capture the existing DESC data for analysis. NAVFAC is also extracting fuel usage data from non-expeditionary vehicles, e.g. those operated by the regional Naval Facilities Engineering Commands from DESC and other databases. A similar effort is underway for Navy expeditionary combat platforms and equipment. At this time it is unclear how much useful data can be extracted from existing databases. It is clear that fuel used during non-domestic contingency operations is not accounted for. It is also clear that many of the metrics required for comprehensive efficiency calculations do not exist in any database.

c. Petroleum fuel usage measurement options

Four methods[2] have been identified that would be worth further investigation either for adoption by expeditionary forces or to guide development of independent requirements for a measurement system that could guide investments and compliance with Navy goals.

i. Defense Energy Support Center

The DESC mission is to provide the DoD and other government agencies with comprehensive energy solutions in the most effective and economical manner possible[3]. The Fuels Automated System (FAS) Enterprise Server (FES) also known as the "purple hub" is DESC's database for all purchases of fuel for DoD. It uses financial accountability to track and control fuels purchased. The purple hub has data fields for equipment identification, unit identification, fuel type used, and miles driven. At first look it seems that the purple hub can provide data for all fuel use metrics and some efficiency metrics. In practice however, the data is incomplete. Gaps in the data are due to inconsistencies in input methodology across NECC units and incomplete data capture from dispensing sites. The resulting reports from the purple hub only provide unit level

[2] Fuel effectiveness should also include factors of Fully Burdened Cost of Delivered Energy [aka Fully Burdened Cost of Fuel (FBCF)] for the same reasons one should consider fuel effectiveness at the point of use. For example, a deployed expeditionary detachment that routinely sits with idling engines may compound the inefficiency many times because of the added burden to deliver sustainment fuel supplies via escorted convoy.

[3] See http://www.desc.dla.mil

fuel usage data that generally omit non-domestic contingency operations altogether. DESC technologies and procedures are already a part of the NECE and therefore the least expensive option, but also the least comprehensive fuel measurement capability. By expanding fuel card issue to every piece of fuel using equipment (approximately 20,000 individual items) a more complete picture of domestic use can be developed, allowing analysis across categories of equipment. However, fuel cards are not typically used during contingencies, so the vast majority of fuel use data would still not be captured. Dramatically increasing the number of fuel cards also puts an administrative burden on commands to process and account for the transactions.

ii. FuelMaster®

FuelMaster is a private company based in Florida; they have military contracts with the US Air Force and US Army[4]. The Air Force and Army use FuelMaster's Automated Data Capture (ADC), Automated Fuels Service Station (AFSS), Carwash and Aerospace Ground Equipment (A.G.E.) equipment and systems to capture fueling data and financial data on a variety of networks. The FuelMaster system can passively capture vehicle ID, date, time, PTO hours, optional equipment type, fuel type, capacity/quantity, unit identification, fuel type used, fuel level, miles driven, engine hours, running efficiency, and can provide accurate data on odometer, chronometer and average speed. FuelMaster can also control and measure any liquid or gaseous fuel for alternative fuels measurement. The system calculates vehicle efficiency and fuel consumption based on odometer/hour readings. It can also capture refueling accomplished by tanker trucks (by using mobile unit).

Fuel Master was designed for worldwide use by the USAF and boasts a successful program. It is a specified system in the DoD and supports DoD standard data export (presumably DESC's purple hub). The system interfaces with on board diagnostic computer (existing or retrofit) and provides wireless vehicle record updates through secure Radio Frequency(RF) radio communications and RFID tag technologies. The system is activated by many popular credit cards or by ProKee®.

The Army is ruggedizing Fuel Master's hand held data capture devices and cradles for permanent installation into their land vehicles. The FuelMaster literature and discussions with Army developers indicates that it could fulfill most measurement and metric requirements (excluding fuel effectiveness). Integration and adaptation of FuelMaster technologies and procedures into the NECE probably would provide nearly complete fuel measurement capability.

iii. Marine Corps Tactical Autonomic Logistics Capability (TALC)

Tactical Autonomic Logistics Capability (TALC), also known simply as Autonomic Logistics (AL) is a large acquisition program that consists of many efforts ranging from the immediate outfitting of three Marine Corps platforms, to diverse R&D efforts in prognostics and sensors (see next section below). The three platforms are Amphibious

[4] See http://www.syntech-fuelmaster.com for further FuelMaster information

Assault Vehicles (AAVs), Light Armored Vehicles (LAVs), and MTVRs. The Marines employ Lockheed Martin to develop and install the first instance of AL on these platforms[5].

AL uses a combination of onboard sensors (both existing and newly installed), processors, and transmitters to monitor continuously and collect, process, store, transmit, and display time relevant logistics data. AL capitalizes on existing and emerging technology and communications architecture for data collection, transmission, and dissemination. Data transmission is automatically triggered by an event (time interval, vehicle movement or condition) or when remotely queried by the C2 or Enterprise Resource Planning (ERP) systems. Data can also be transmitted when manually initiated by an operator. AL data within the Global Combat Support System (GCSS) and Global Command and Control System (GCCS) environments will be processed for C2, Combat Service Support (CSS), and system life cycle support functions. AL has two programs to outfit vehicles for initial and future AL capability - Embedded Platform Logistics System (EPLS) and Enhanced Maintenance Support System (EMSS).

Once EPLS is installed on a platform it will collect, process, store, transmit, and display that platform's/equipment's health, fuel level, mobile load (if any), and weapons status (if any). EPLS provides accurate operational status and system health data and information to operators, maintainers, and battalion level "fleet" managers through existing Joint Tactical Data Integration (JTDI) servers and EMSS connections. After initial deployment of EPLS, the Marine Corps intends to "turn on" its communications capability and continue to build interfaces under the AL program. AL will also incorporate EPLS technical performance specifications and lessons learned into subsequent AL requirements for new and existing equipment.

EPLS will monitor, record, and report platform data:

- Operational status
- System health
- Fuel consumptions
- Ammunition level / usage
- Mobile load composition
- Distribution events

EPLS will:

- Provide on-platform Interactive Electronic Technical Manuals (IETM) viewing.
- Provide on-platform electronic record books.
- Move captured data to EMSS and provide reports

[5] See http://www.lockheedmartin.com/products/EmbeddedPlatformLogisticsSystem/index.html for more information about Lockheed Martin's support of AL.

EMSS hardware will bring commercial and custom government software capabilities right to the platform and provide the maintainer all of the information or tools he may require. EMSS uses a Panasonic Toughbook CF-18 rugged laptop equipped with network interfaces, Built-In-Test/Built-In-Test Equipment (BIT/BITE) interfaces, Software Defined Test Instrument (SDTI) and General Purpose Electronic Test Equipment (GPETE) capabilities. EMSS will initially run Interactive Electronic Technical Manuals (IETMs) and Computer Based Training (CBT) applications. EMSS can facilitate access to Subject Matter Experts (SMEs) over Marine Corps networks and run other maintenance applications as required. EMSS Increment I will be provided to LAV, AAV and MTVR maintenance communities in all MEFs and supporting establishments.

EMSS together with JTDI servers hosting EPLS software will allow fleet data aggregation and analysis. JTDI provides a technical data integrated environment where technical data and maintenance expertise are readily available and accurate to the warfighter. JTDI was originally developed for Navy aviation maintainers, but the infrastructure has been configured to support the Marine Corps' unique mission needs. The JTDI system developed for the Marine Corps consists of tiered servers and EMSS end-user devices. These servers and devices provide data caching and access services at the battalion level and below using regional servers for garrison and deployable servers in the field.

A demonstration of the existing instance of AL (EPLS and EMSS) shows that it will easily be able to measure all fuel measurement requirements except fuel type and fuel effectiveness. Once AL is deployed to fuel transportation assets and interfaced to DESC's purple hub the combination will be able to measure fuel type. Once AL is combined into the GCCS environment, it will also be able to measure fuel effectiveness by comparing planed missions with actual missions. Procurement, adaptation and integration of AL technologies and procedures into the NECE is the most expensive option but also the most comprehensive capability going beyond fuel usage measurement to include efficiency and effectiveness measurement of all functions of logistics.

iv. Pennsylvania State University Applied Research Laboratory

Penn State's Applied Research Laboratory (ARL) is performing experiments for AL with funds from both the Office of Naval Research (ONR) and Marine Corps Systems Command (MCSC) AL programs office. Of particular interest is their remote real time measurement of MTVR fuel tank levels and vehicle health[6]. ARL installed a prototype system on eleven MTVRs. The main components are a (Controller–Area Network) CAN[7] data bus extraction interface, a computer, and an Iridium satellite communication device. The system interprets existing signals resident on the CAN bus to measure current fuel levels and all other aspects of the vehicles health. The database keeps a running log of engine hours, miles driven, and fuel used.

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[6] See http://soademo.arl.psu.edu/CLR3/ for a live status view of MTVRs in Okinawa (please limit distribution of website to DOD Official Use Only)

[7] See http://en.wikipedia.org/wiki/Controller_area_network for more information about CAN

A demonstration of the existing prototype system shows that it is able to measure all fuel measurement requirements except fuel type and fuel effectiveness. The system is a prototype and would need substantial acquisition system treatment before widespread deployment within NECE; however, much of the development could leverage AL lessons learned. Once the ARL system is developed for full military deployment, deployed to fuel transportation assets and interfaced to DESC's purple hub it would be able to measure fuel type. Once the ARL system is combined into the GCCS or other Navy C2 system environment, it will also be able to measure fuel effectiveness by comparing planed fuel missions with actual fuel missions. Development and integration of ARL's system to NECE requirements would cost less than what the USMC is spending on AL; however, it certainly will cost more upfront to NECE since the ARL system needs development where AL only needs to be adapted to NECE systems and processes (AL development is being paid by the USMC). Integration and adaptation of ARL's technologies and procedures into NECE may be as expensive to develop and deploy as it would cost to adapt AL to NECE. This option offers comprehensive fuel measurement capability with less hardware and installation costs and more developmental costs than AL.

d. Discussion Summary

The following table presents a summary of the above four options with respect to metrics and costs. The number of dollar signs represents the relative cost of each option – the more dollar signs the more expensive. Two check marks represent complete fulfillment of metric requirements in the existing system, while one represents a need to perform some sort of acquisition system work (engineering or programmatic) to fully develop the needed capability. Note that none of the options can measure fuel effectiveness without substantial C2 system integration efforts.

Table. Fuel usage measurement options with respect to metrics and costs.

	Fuel usage measurement options			
Metrics	DESC	FuelMaster	AL	Penn State - ARL
Identifying	✓ inconsistent platform / equipment IDs	✓✓	✓✓	✓✓
Contextual	✓ no hierarchical log	✓✓	✓✓	✓✓
Fuel usage	✓✓	✓✓	✓ No Fuel type	✓ No Fuel type
Efficiency	-	✓ No fuel effectiveness	✓ No fuel effectiveness	✓ No fuel effectiveness
Measures other functions of Logistics	-	-	✓	-
Relative Cost	$	$$	$$$$	$$$

DESC is the least expensive and least comprehensive fuel usage measurement option. It is probable that DESC can facilitate complete identifying, contextual and efficiency calculations; however, effort is needed to establish and implement appropriate data collection and transfer. No obvious method presents itself for DESC use during contingencies. AL is the most expensive and most comprehensive fuel and vehicle health measurement option. AL is near an initial operating capability for the first three vehicle types but a majority of its technology is still in development and its costs could be reduced as tradeoffs become clearer. AL also requires some effort to enable fuel type used measurement. FuelMaster, as a deployed system, only requires adaptation into NECE existing processes and systems making it the second least expensive with nearly all measurement options satisfied. Penn State's technology is intended for insertion into AL and is second most expensive because it still requires development to reach initial operating capability. Penn State's system also requires some effort to enable fuel type used measurement.

The various options shown are not mutually exclusive and there may be ways to combine efforts that hedge programmatic risks of developing systems for exclusive NECE use. For example, by using FuelMaster dispensing measurement systems installed on all fuel dispensing equipment and AL or Penn State fleet management software to augment existing DESC data, NECE could quickly and relatively inexpensively achieve near complete fuel usage measurement. The combination would comply with the planned AL architecture and therefore be able to capitalize on existing and future USMC investments.

4) Conclusions

The existing fuel usage data being captured in DESC's purple hub is incomplete but still useful.

- DESC's purple hub can hold most data required for calculating individual platform and equipment fuel usage, and efficiency.

- There is no standardized method (manual or automatic) to record individual platform and equipment fuel use metrics at all refueling events (both in garrison during normal domestic operations and during contingency operations).

- There is no standardized method (manual or automatic) to ensure that individual platform and equipment fuel usage metric information is transferred to DESC's purple hub.

- There are sufficient technology options available to automatically measure individual platform and equipment fuel usage information (both in garrison during normal CONUS operations and during OCONUS contingency operations).

- The implementation cost of AL will likely be reduced as the Marine Corps develops the system further.

- Comprehensive efficiency calculations should include fuel effectiveness.

- Drivers or equipment operators (or units as a whole) need to be informed of their fuel effectiveness achievements in order to know what behaviors to sustain or how to modify them.

- The expeditionary Navy should develop its requirements for a fuel use measurement system, building on the ideas presented by these technologies and the specific equipment, operating environments, and missions of the Navy forces.

5) Specific Tasking

The following questions were answered with respect to objectives and metrics within NEPO's sphere of influence:

a. How can the Navy leverage other Services' Programs?

NEPO should exploit existing deployed systems such as DESC and FuelMaster before

committing to expensive developmental systems such as AL and Penn State's. In order to fully leverage DESC and FuelMaster as well as hedge risks, NEPO should implement these systems in compliance with an overall architecture.

b. When should the Navy adopt other Services' system(s) and how should the Navy contribute to the effort to insure Navy requirements are also met?

Adoption of other Services' systems should be incremental over several years with larger programs requiring more time. The decision to adopt a system should be based on conclusions that are then consistently and regularly tested for compliance with NECE architectures, goals, and objectives. Particular NECE goals and objectives should be gleaned from the leveraged systems through analysis and participation in the development of the candidate system. The opportunities to increase Navy efficiency and effectiveness can only be realized through careful development or adaptation of essential capabilities definition (requirements) and requires NECE participation in their development. For example, a Navy version of the AL architecture is not yet defined; NEPO should adapt the USMC architecture and participate in Service level discussions to further define what a Navy expeditionary AL capability ought to be. A NEPO effort to deploy an interim fuel usage measurement system could inform the AL architecture process with highly reliable information.

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