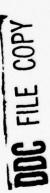


AD A070816



NATIONAL BUREAU OF STANDARDS





DEPLOYMENT REQUIREMENTS FOR U.S. COAST

REPORT NUMBER CG-D-14-79, II

GUARD POLLUTION RESPONSE EQUIPMENT

Volume II: Appendixes

U.S. Department of Transportation Research and Special Programs Administration Transportation Systems Center Cambridge MA 02142



D D C

FEBRUARY 1979

FINAL REPORT

DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION UNITED STATES COAST GUARD Office of Research and Development Washington DC 20590

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

NOTICE

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

(19)		Technical Repor	t Documentation Pag
18 USCG D-14-79 2 2	2. Government Accession No.	3. Recipient's Catalo	og No.
DEPLOYMENT REQUIREMENT POLLUTION RESPONSE EQUIVOLUME II	JIPMENT,	6. Performing Organi DTS-523	tation Code
7. Author's) J. Bellantoni, J. A. O'Brien, Jr. and A	A. Passera	B. Performing Organi DOT TSC-U	JSCG-79-2
U.S. Department of Tra Research and Special I Transportation Systems Cambridge MA 02142	ansportation Programs Administratio	10. Work Unit No. (T CG 915/RS) 11. Contract or Gran 13. Type of Report or	9006 • No.
U.S. Department of Tra United States Coast Gu Office of Research and	ard	Final	Kepert/ 77 — June 107
Washington DC 02590	(10) 80	12	
This is the secon analysis and conclusion	nd of two volumes. Vo	olume I contair	ns the major
1. The Major Oil Spil 2. Outflow rates from 3. Distribution of US 4. Narratives of 17 s 5. A list of debarkat 6. Load/Range Tradeof 7. An analysis of ava 8. Maps of USCG insta 9. The spill potentia 10. A model for distri 11. An analysis of the spills; 12. A list of non-USCG	ins 13 technical appears in seven massive tanker in seven massive tanker in seven massive tanker in selected oil spills, it in ports, with Figure for the USCG towns and DOD air all data base employed abution of equipment; it probabilities of land pollution response of the behavior of surface.	(data base); r oil spills fic in 1958 1967-1978; res, in the U.S G HH3-F and Cla ving vessels; bases; in Volume I; rge and simulta	1985; So aircraft; aneous
			*
0il Pollution, Oil Sp Pollution Response, S	Spill THROU	Statement MENT IS AVAILABLE TO T JIGH THE NATIONAL TECH MATION SERVICE, SPRING	
Cleanup	INFOR	NIA 22161	



494 982



PREFACE

This report is one of a series of studies conducted by the United States Coast Guard in support of the Presidential initiative of March 1977, concerning the ability of the United States to respond to the threat of larger oil spills in U.S. waters. The study was directed by the U.S. Coast Guard Office of Research and Development and Office of Marine Environment and Systems. The authors wish to acknowledge with thanks the expert and indispensible assistance rendered by these Offices throughout the project, and in particular that of Cdr. J.T. Leigh/GDOE, Cdr. J.L. Valenti/GWEP, Lt. R.V. Harding/GDSA and Lt. G.D. Marsh/GDOE. They are also indebted to numerous Coast Guard personnel, both at headquarters and in the field organizations, who were enthusiastic in the provision of data, advice and information.

This, the second of two volumes, contains the technical Appendixes.

TAB	
nnounced	
tification	
atribution/	
vrilability C	-
Availand,	01.
st special	
st Special	

]				111		owces or powds a but tone		2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	colors feet 173			000 000 000 000 000 000 000 000 000 00
Approximate Conversions from Metric Mona	16 86714	1:	221	AREA		MASS (weight)	1 22	VOLUME	2.1	3 * 1	TEMPERATURE (exect)	2. (American	03 00 00 00 00 00 00 00 00 00 00 00 00 0
Apprair	Francis of the free free	mm m. Hamptors	11]		1111							3 ·	
-1-1-1													
1.	1		5 8	. 3	in i	1.	•\$-		13		- î î		1 inches
	1		Cantematers								1. 65 meles		
Approximate Conversions to Metric Mossares	Reference by	LENGTH	\$ 58	32	2822	MASS (weight)	z 5 5	VOLUME	- 2 8	8.0 8.0 8.0	6.0 8.0 8.0	TEMPERATURE (exect)	de la constant de la
Approximete Cor	1	1	1,	11			ili			H			
	1			11	1217				:1:		izł		

TABLE OF CONTENTS (VOLUME II)

Appendix		Page
Α.	MAJOR OIL SPILL INFORMATION SYSTEM (MOSIS)	A-1
В.	OUTFLOW RATES FROM SEVEN MASSIVE TANKER SPILLS	B-1
С.	DISTRIBUTION OF U.S. COASTAL TANKER TRAFFIC IN 1985	C-1
D.	REPORTS ON MARINE OIL SPILLS	D-1
E.	DEBARKATION PORTS	E-1
F.	LOAD/RANGE TRADEOFF CURVES FOR THE HH3-F AND HC-130 AIRCRAFT	F-1
G.	CURRENT U.S. MILITARY HEAVY HELICOPTER CHARACTERISTICS	G-1
н.	AVAILABILITY OF USCG TOWING VESSELS	H-1
I.	COAST GUARD AND DOD AIR BASES	I-1
J.	SPILL POTENTIAL DATA BASE	J-1
к.	POLLUTION RESPONSE ALLOCATION MODEL	K-1
L.	SPILL PROBABILITY MODELS	L-1
М.	NON-COAST GUARD EQUIPMENT CAPABILITIES	M-1
N.	A BRIEF REVIEW OF THE BEHAVIOR OF SURFACE OIL SLICKS	N-1

LIST OF ILLUSTRATIONS

Figure	Į.	Page
B-1.	OUTFLOW RATE ESTIMATES FOR SHOWA MARU STRANDING	B - 4
B-2.	OUTFLOW RATE ESTIMATES FOR METULA STRANDING	B - 7
B-3.	OUTFLOW RATE ESTIMATES FOR ARGO MERCHANT STRANDING.	B - 8
B-4.	OUTFLOW RATE ESTIMATES FOR AMOCO CADIZ STRANDING	B-10
E-1.	PORTS WITH MORE THAN TEN FEET MINIMUM DEPTH AT CARGO PIER AND IN CHANNEL, AND HAVING A LIFT OR CRANE AVAILABLE	E-9
E-2.	PORTS WITH MORE THAN FIFTEEN FEET MINIMUM DEPTH AT CARGO PIER AND IN CHANNEL	E-10
F-1.	PAYLOAD-RANGE RELATIONS FOR HH3F HELICOPTER	F - 3
F-2.	GROSS WEIGHT-FUEL RESTRICTIONS FOR HC130-B AIRCRAFT	F-8
F-3.	GROSS WEIGHT-RANGE RELATIONS FOR HC130-B AIRCRAFT	F-9
F-4.	GROSS WEIGHT-FUEL RESTRICTIONS FOR HC130-H	F-10
F-5.	GROSS WEIGHT-RANGE RELATION FOR HC130-H AIRCRAFT	F-11
H-1.	DISTRIBUTION OF AVAILABILITY TIMES FOR VESSELS UNDERWAY	H - 4
H-2.	ASSUMED DISTRIBUTION OF AVAILABILITY TIMES FOR BOATS AND CUTTERS ON READY STATUS	H-5
H-3.	PROBABILITY OF CUTTER AVAILABILITY IN t HOURS OR LESS	H-6
H-4.	PROBABILITY OF BOAT AVAILABILITY IN t HOURS OR LESS	H-9
I-1.	U.S. COAST GUARD BASES, STATIONS, A/N STATIONS AND LORAN STATIONS IN THE 48 STATES	I - 2
I-2.	USCG AND DOD AIR BASES IN THE 48 STATES	I - 3
J-1.	PORTS WITH OVER 1 MILLION TONS FLOW OF CRUDE AND HEAVY OILS IN 1976 (COASTAL AND FOREIGN)	J-11
J-2.	PORTS WITH OVER 1 MILLION TONS FLOW OF CRUDE AND	I-12

LIST OF ILLUSTRATIONS (CONTINUED)

Figure		Page
J-3.	PORTS WITH OVER 1 MILLION TONS FLOW OF LIGHT OILS IN 1976 (COASTAL AND FOREIGN)	J-13
J-4.	PORTS WITH OVER 1 MILLION TONS FLOW OF LIGHT OILS IN 1976 (INTERNAL AND LOCAL)	J-14
J-5.	PORTS WITH TOTAL OIL FLOW OF LESS THAN 1 MILLION TONS IN 1976 (COASTAL AND FOREIGN)	J-15
J-6.	PORTS WITH TOTAL OIL FLOW OF LESS THAN 1 MILLION TONS IN 1976 (INTERNAL AND LOCAL)	J-16
K-1.	GRAPHICAL SOLUTION OF (14)	K-6
L-1.	PERCENT ERROR IN ESTIMATE OF $P(x)$ AS A FUNCTION OF EXPECTED NUMBER \overline{n} OF SPILLS	L - 3
L-2.	PROBABILITY OF MULTIPLE SPILLS	L-11
	LIST OF TABLES	
Table		Page
C-1.	CRUDE AND PRODUCT IMPORTS IN 1985 (1) (THOUSANDS OF LONG TONS)	C - 2
C-2.	CRUDE AND PRODUCT COASTAL FLOWS IN 1985 (THOUSANDS OF LONG TONS)	C - 3
F-1.	PARAMETERS FOR THREE HH3-F MISSIONS	F - 4
F-2.	PARAMETERS FOR TWO HC130 AIRCRAFT	F-6
н-1.	USCG VESSEL UTILIZATION FOR FY1975 ⁽¹⁾ BY TYPE	H-13
H-2.	VESSEL UTILIZATION FOR FY1975 ⁽¹⁾ BY DISTRICT ⁽²⁾	H-14
H-3	USCG CUTTER AND BOAT SPEEDS USCG DISTRICT	H-15

LIST OF TABLES (CONTINUED)

Table		Page
M-1.	NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT.	. M-2
M-2.	U.S. NAVY EQUIPMENT	. M-14
M-3.	NON-COAST GUARD HARBOR EQUIPMENT CAPABILITY PERFORMANCE CHARACTERISTICS	. M-18
M-4.	NON-COAST GUARD OPEN-WATER EQUIPMENT CAPABILITY PERFORMANCE CHARACTERISTICS	. M-19
M-5.	NON-COAST GUARD HARBOR EQUIPMENT FORMULAS FOR TOTAL CAPABILITY AT EACH SITE	. M-22
M-6.	NON-COAST GUARD OPEN-WATER EQUIPMENT FORMULAS FOR TOTAL CAPABILITY AT EACH SITE	. M-23
M-7.	NON-COAST GUARD HARBOR EQUIPMENT CAPABILITY (KILOGALLONS)	. M-24
M-8.	NON-COAST GUARD OPEN-WATER EQUIPMENT CAPABILITY (KILOGALLONS)	. M-25

APPENDIX A: MAJOR OIL SPILL INFORMATION SYSTEM (MOSIS)

The data base assembled for this study has been designated the Major Oil Spill Information System (MOSIS). It contains information on all identifiable oil spills of 50,000 gallons or more affecting waters in and around the U.S. during the period from January 1974 through July 1977. The primary sources of information for the MOSIS file were Coast Guard maintained records, namely:

- a. The Pollution Incident Reporting System (PIRS)
- b. The National Response Center (NRC) case files
- c. The On Scene Coordinator (OSC) Reports.

Supplementary information from other sources was included wherever possible and so identified.

The MOSIS file is reproduced in this Appendix following a sheet defining the coded entries. Further explanation of the first few entry columns is given here. The TSC file number is constructed as follows: The first digit (5) indicates that the data base is restricted to spills of 50,000 gallons or more; the second digit identifies the year (e.g., 4 = 1974); and the next three represent the sequential number of the spill, with a P as the third digit identifying a potential spill. The NRC file number consists of two parts: the first three digits are the case number and the last two the year. The PIRS file number also consists of two parts: the first two digits indicate the Coast Guard district involved and the remaining five digits represent the sequential oil spill count within that district. The "Other" column is to be used to identify incidents contained in filing systems other than NRC and PIRS. The entry CG in this column refers to the Coast Guard Vessel Casualty File. The entries PDS and SDS refer to primary and secondary data sources. The remaining headings are self-explanatory. Entries are in chronological order.

MOSIS CODING SHEET

DESCRIPTION	NRC REPORT PIRS OSC REPORT	USGS	OTHER	GROUNDING	COLLISION	DAMMING				LEAKAGE OF DISCHARGE (ACCIDENTAL ON DELIBERATE)		EXPLOSION, OF FIRE AND EXPLOSION	OTHER	UNKNOWN	SHELTERED OF SEMI-SHELTERED WATERS	OPEN WATEFS	RIVERS (WITH CURRENTS > 1 KNOT)		ONSHORE TEANSPORTATION PIPELINE	ONSHORE NON-TRANSPORTATION	U.S. FLAG TANKERS AND BULK CAPRIERS (CARRYING	POREIGN FLAG TANKERS AND BULK CARRIEKS (CARRYING	PETROL)	BARGES AND TANK BARGES	VESSELS OTHER THAN 3,4, AND 5	UNDERWATER WELLS	UNDERWATER PIPELINES	KE T	OTHER OR UNKNOWN
CODE	× 0.0	ם ו	1 4	. છ	ပ	æ	ເດ	В	H	-1	[tea	ভা	0	נו	S	0	25	×		2	3	7		5	9	7	30	6	۵
NAME	PDS/SDS			TYP											201				CALEGORY										

Malon our spill labouaging Sysism

73C NaC 24001 24002 24002 24004 24005 24008 24008 24008 24008 24008 24009 24000 24000 24000 24000 2400	\$20014 080425 0804324 0804324 0804324 0806025 0300093	10 0 04 10 10 10	3 C	P LCCATION	SHE LAT	LATH LONG			DATE RODY OF MATER	KGNES KGLES	15 300 E.C.	280.12.210	PF EOS
54001 54003 54003 54004 54004 54006 54006 54006 54000 54001		3											
54002 554003 554003 54005 54005 54007 54008 54010 54010			×	SENTON NJ	10+ 0	0 744	-	0104	DELAWARD B	600 20	CO TIC TITECT	2 PRENETE	CFHIL
24003 24004 24004 24005 24007 24006 24006 24006		~	×	TONGVIEW TA	C 3230	C 3443		0110	5		ONSHOFE PIFFLY	1 221 MEUP	EPP VI
500 4 500 6 500 00 500 00 500 00 500 00 500 10		۵.	115	N OPLEANS LA	0 2529		5 685	0110		123	L'ULA STOFAGE	S HOSSEDP	C N OR
24005 24005 24007 24008 240010 240010			AFC	C N JBERIA LL	0 300	4 9145	S CRUDE	0115			ZV COLUBBIA	3 COLLSW	C N OF
# 006 # 007 # 008 # 010 # 010	0300075 0300099 0600662	d	W W	AL LIVISCINC	0 3955	5 9105	S CRUDE	9119	MISS. ML119.5	1623 80	SH211 011 CC	1 PPLNAUP	C N OE.
24007 24008 24005 24010 24011	0300099	۵.		G YONKEPS NY	2 4647	7 7356	0. 9	6113	HUDGON EIVER	P# 94	Te 1000-9999GT	S SEOJND	C ALBNY
4008 4005 4010 4011	0800000	۵,	×	PATERSON NJ	0 4102		2 16	0123		6.3	NON LELNO FAC	2 COFREN	II des
4005 4010 4011		d	×	POLK TX	0 3015	3 4444	A CEUDE	2125	NCTSSNIVIT .T	28	NITETA THOMSEO	1 PPLHRUP	EPR VI
0103	0200044	٥	×	SHYSNA TENN	0 3602		5 DIESL		P.	7.5	CNSHOP FILENT	2	FPD IV
11011	0800121	0.	×	POLK TX	0 3043		6 CFUDE		-	163	NATULE LIPELN	-	
54012	03 00195 CG	'd .	20 4	C PAULSBORD NJ	0 395		7 .6	0215		285 285	EV ACHOS	~	
		2	×	DECATUR 1X	0 3320		O CAUDE		2	120	ONSHOPE SIPPLY	-	. V.
54013	0800499	۵.	×	PASADENA TA	hh57 0		3 GAS .	0311		6.3	NIAGIG E SCHERC	1 P2137UP	Ere VI
54014	0802210	2	×	JACKSON MISS	0 3239	1	9018 CAUDE	0329	PSS JI NT. 1 13	121	ONS.ICE FLUDUC	2	LPA VI
54015	09 00 162 CG	6	A K G	G ALKNDE BAY N	Y 0 443	2546	6 CRUD	04 15	ST LAWENC IIV	147 147	TSIMPLE SARKIN	3 6200110	CBUPP
54016		0	0 8	B EUG I BLCK L	A C 2300		G CRUDE	0417	GLF OF MEKICO	840 840	OFFSEORT PEOD	8 PPLNSUP	
54017	0801087	۵	×	ADDUVILLE TX	0 3047		O CRUDE	0425		176	ONSHALL PIPELS	1 CRASH	EFA VI
54018	1100442	ď	×	WELTER AFIL	0 331	-	O DIESE		GILA BIVER	0.9	EULA BALL VEH	NACNANU ?	
54015	1100448	2	¥	BAKEFSFLD CA	0 352	-	O CRUDE		KERN	714	ONSHORE PIPER	1 91755102	
54020	0802214	2	×	TYLER IN	0 3228	!	6 CPUDE			50	ONSHORE LIPELN	1 92133.02	
54021		0	×	C CINCINNATI OF	H 0 373		S KRSMF	0522	OHIO RIVES	73 73	BARGE EIDC .1	S COLLSII	CUIDO
	0801837	2	×	MARSHALL TX	0 3237	7 9467				63	ONSHORE PIPELN	-	FPA VI
54023 00575	- 1	*	a	S N ORLEANS LA	0 2950		S CRUDE	0025	dISS. XL136	34 34	TB ABC 2311	5	
		C.	×	TYLER IX	0 323		3 CRUDE				CNSAORE FIRSTS	-	
54025 00675	- 1	Z	P . S	S GALVESTON IX	C 2937	-	9	0708	BAYPOLT CHAMI	378 378	TB TM 10	S SINKING	P HSTN
54026	0900343	C.	×	PARMA OHIG	0 412		1 685	0715			CNSHOFE STOIGE	2 FLNGFIR	PPA V
54027	0300521	4	A S G	G. P.ED HOOK MY	0 4202	2 7356	6 645	0719	HUDSON SIVES	130 130	: 15 dY 51 . DE2	5 67 3785	C & YFK
54028		ď	S	C PCRT ARTHE T	3567 0 X	-	7 86	1270			301-1 8.	S CULLSN	M P AR
540 29 00375	0300986	Z	S	GLENMOUNT SY	0 4235	5 7340	2 . 2	2731	HUDSON SIVER	340 130	CULK TEAMSFEL	2 TROVEFL	CALBNY
54030 00275		*	2 1	BANNER IL	0 4015	5 9010	0 62	1080	ILL P 34139	55 65	TB 101 #162	S COLLSN	CT IS W
54331 01175	01175 0801956		S	BEAUMONT IX	0 3002	2 9355	5 643	0005	NECHES SIVES	45	COLONIAL PIPLN	1 PPLASUP	C SABIN
		z	¥ .	G GRAYS PT NO	0		O TLUEN		MISS. FIVER	60 05	18 385 241	5 620045	EPA VII
54033 04075	0802192	z	×	ABILENE TX	0 322	966 8	10	0817	STOCK PUND	54 54	6" LINE	1 LINERUP	EPA
54034	0802216	a	×	WCHTA FLLS T	x 0 3353		O CRUDS	0822	WICHITA FIVE	63	BULK STOFAGE	2 IMPHMDL	
54035 06975		Z	U O B	B CHNDLUR IS LA	A 0 3003		Z CRUDE		GEL OF MEXICO	35 35	PEPELINE	8 PP. NBSK	
54036 11475	0301289	7 7	P S G	G NEW AAVEN CT	0 4118	8 7255	5 00	1036	N HAVEN HOFF	105 105	NO MESNE BAGN	3 SEOUND	N HAN
54037 11875		N	2	CORP CHEST T	X 0 2749		9726 .6 CE	1009	CORP CHIST HE		TS 20-35K	3 UNDETER	CCRCH
54038 13475		*	×	G DALDSNYLL LA	0 2955	1	S CRUDE	1	MISS. ML176	92 92	NV TROOLE (12)	4 GROUND	C N OPI
54039 13675 0900513	0900513	P	N P	TONOWANDA NY	0 430		4 535	1627	NIEGERA RIVER	7.3	BULK ILANSPIR	2 PURPELE	C BUFFL
4040 18975	0900571	×	Pin	3 ALKNDE BAY NI	r 0 4420		DIEST	-	ST LHENC BIVE	53	NY HOY A JODEY	3 SINKING	C BUPPL
54041 20375 0804145	0804145	N	S	CORP CHRST I	0 274	9 9725	S CEUDE	1202	COPP CHEST HP	51 51	UNGHOLE PIPELN	1 FUPTURE	CCRC
		0	X 3	S MARIETTA OH	0 392		110 0	1212	OHIO RIVER		UNDRGIND LEACH	2 SEEPAGE	M HUNT.
54043 23675		2	C 7	MISS. RIVER	00500		4 CRUDE		MISS. ML89	63 63	SARGE TRANS	S TROVEFI	C N OR
54201	0300024	d	S	MILMNGTON DL	0 394	!		0104		0 50P	15 10-20k	3 COLLSN	C PHIL
54202	0300160	4	S	PIRE I NY	3737 0	C 7308	B MXPTF	0207	ATIVNTIC	0 3334	IS 500-508 GI	3 PRSNERR	C N YR
54203	1100174	a.	0	PNT LUSA CA	0 3239	-		0215	PACIFIC	0 5880	P TS 10-20K	3 GROUND	M SAN
Supou	1100175	4	0	S CLEMENTE CI	A 0 3348	8 11818	B DIESL	0216	PACIFIC	3 50P	OFFULL TE PPLN	8 PIPEFUP	V7 0

		d	1	-										14.1	AMOUNT				
		0	0				DIST								1.5	100		2011	00000
13C N	NAC PIRS OTHER	EF S	SC	C.	LOCATION	NO.	SHS		HONOT HEAT	1106		3001	JATE 300Y OF ALTER	YCALS	X 25 LS	3		160 0 - 14 C	T T T T T T T T T T T T T T T T T T T
100	300000	3			14 5000310	14 500		2747	T H23	STCXF !	32.26		TEADS BAY		50.00	SAY CARGO SHIP	SHIP	GROUND	A ST P
502	9110010		2	3	10000	0.00	,						302020 >:	C	1110	1000-69	S 1956	GEODE	CNYEK
54206	0300306		0	5	MEN TORK GE	1 19 1	3 .	4033	000					0	13100	7 50-130K	2	CENORS	N YEK
1004		a.	0		HEFRD INLT NO	NI IN	200	385		Chune		2 1 1 1 2	CILABLIA STUC	2	231.5	WV CLIESTGR	18	PX PT OS N	U
54P 08 00475	1	-	2	2	PHIL. PA	-	,	1066	1		9	י בידיני	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		2943	PAN THE UPS	VPC 3	GKIICES	MIAMI
54 PO9	0700363	a	S	5	IAMI F	-	0		_			4.4	2.1.1.1.1		27.7	at attended		VEDER	N KEY E
4P10	0700369	а	0	×	KEY MEST PLA	FIA	0	2433					ATLINITE	0	1/62	CASHOFE PLAN.	7	NADES OF	1100
54211	0300662	c.	:1	9	HIRNGTON DI	10 N	0	3942						0	4 100 L	TS 20-356	2 .	GE 00 40	
1012	0300743	0.	.4	C	PEEKSKILL N	TE NY	0	4114	4 7355	S M XPTT			HUDSON FIVER	0	15702	15 10-20K	~	CCLLSN	LALBNI
54013	030000	a	a.	S H	HIDSON NY	XX	7	4210	0 7351		0715		HUDSON FIVER	C	6775P	13 10-20K	~1	GROUND	ALBNI
200	20000		. 0	. n	A VODE	AN.	C	404		1 .6	3624		NIIC	0	185002	AV AFOLUS (LI)	LI) 4	- 1	CNYCK
10.00	0.700.00	-	0		TAMPA HAV PT	I A A		7738	1	7 .6	#C6C		TARPA BAY	0	300%	DAY CARGO SHIP		6 GROUND	Æ
2000	200000	. 0	0		TO WOOM SJEE	10 40		364		S NPTHA	•		DELAWREE S	C	5816F	35 13-20K	~	INPRAIN	C PHII
014	1			9 0	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			4138	A 7055		-		BUZZARDS BAY	0	31002	BOUCAPED#65	0 865 5	GF OUND.	M BOSTN
11 /14	5/611	2	0 >	9 0	20 47 47 5			6650	-	SOTES	-		CNUOS ANTIS	0	705	AV CLABIA	(05) 3	GROUND	CGD 17
54618 13	13675	2 0	< U		AN AUTON MAN	× ×		4039	1				NY HAEBOF	0	1001	TS 20-35h	3	GNUOND	ONYBK
0000	0201242	. 0	0		ADP MA		9	283	•	A CRUDE	-		ATLANTIC	0	48538	IS 10-20h	3	GROUND	TIRG O
100111	17775	. 2	oic		CAHORO.10 P.	D D F	0	1750	1	1	1	1	CARIBBEAN SEA	0	130005		(17)	GEOUND	CSANJ
10001	17975	. 2	0		N HAMBIIDG NV	AN DE	0	4210			1114	1.	UDSON FIVER	20	3000F	TB B 75	5	GROUND	C ALBNY
54023	0301521		0		PALKNER I NY	INY	0	11.7	1	50 1	1210			0	588CP	TS 20-35K	(*)	GROUND	U
100	0301564	. 0	0	- 5	AN UNDOWNATE	AN LA	9	423		9. 9	121		HUDSON RIVER	0	90P	BULK FL VHCL	5 70	CAPSIZE	U
56000	6701182		20	0	G FGMONT KEY PI	KEY P		2737	1		1218		ATLANTIC	a	1001	Par CAEGO SHIP	SHIP 6	GROUND	M KEY W
70000	400000) (, :				37.			-		Van comer	0	100.	TEROTITIONS	OAT	GROUND	d LS H

	-		1 S 1			-							- X X Z	LADORA				
150	NEC	PIRS OLARE	0000	- a	LOCALION	SHE	LAIN	N LONGS	GW PUL		DATE BODY	OP WATER	STROY		SOURCE	2 143	ZVUSE	PPEOSC
	1							- 1										
	24575		23		EKAS CITY I	×	2923			1, 1		INDSTIL CANAL	204		TAS CITY BENL	¥ 2	PPINBER C	GLVST
20000	22.25	-	0 0	n	MIANI FLA		1					BISCLYNF BLY	0.5	054	DIDGE CASEET	9	SIAKING C	MIABI
55000		0300050	×		PALESTINE TX		3140				O107 LITTL	LITTLE CHEEK	210		o" PIPELINE	1 BRK	(2	TA VI
52005 27775		0100428	2	9	BOY TOTAL	1	11316	1	71.6 20000			5	3/6	376	- 1	3		SANJ
55006		2000			2001200					20 20	0130 476: 4167	52. 17.5	771			2		EPA I
	23075	-	S U	,	REDFER DV CD		, ~			200		0 00 00 00 00 00 00 00 00 00 00 00 00 0	2 0		14: 013 .53b/b	5	mp	N OFL
55008 2	-	0300151	O. N		BUS HOOK PA					FILD F 0131		1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	300	200	TOTT THE			DALI
		1700138	7 d		ALASKA	. 0	1	1	, 3		1		65	3.	CONTROL STORES	,	OLD PETTO	Tips a
_1	- 1		×	I P	PACIFIC	300	3530	13000	CURD DO	0	212 PACIFIC	10	1660	1685	NY GSWGO PITE			
		0900053	0 % 5		MILHAUKEE WIS	S	4559		52 65	. 52	-	AKE MICHIGAN	74	74	HANNAH BEG290	2		CHILLA
	- 1		×	C	VCKSBUFG MISS		0 3215		U	RUDE 03	0305 MISS.	MISS. 31437.3	1600	1603	KY JOHNNY DAN	•		PPA IV
55013 3		0300380	N P X	m	LEBTH CTY NJ	16	5 370		91 6129	10		TIC	6009	0000	NV SPETN LADY	3	0	CGD 3
55014 35375		0100421	o.	- 1	EVERE MA	C	4554		7101 #6	70	3407 CHELS!	CHELSEA EVE	09	35	BULK BAIL VEH	6		P BOSTN
510		0801375	N.	Z U		0			9053 CAUD	w		MISS. ML132	508	>70	BAT GE BITENE	5	1	N ORL
		1100615	S	7	ANGELES CA	0	3343	-			-1	A HARBOR	9	94	MV LORENZO HA	1 3	04	CLA
		6160010	0 4	×		0	5433		8149 BAKE			STRIS OF PLA	69	>60	MV GARBIS	3	1	CKEY
- 1	43775	1200286	N PO	E	MARTINEZ CA	0	3801	-	2204 GAS	0723		SAN PABLO BAY	130		S PACIFIC PPLN	-		M SAN P
		0803308	PAX	7	LONGVIEW TX	0	3230		SO CRUDE			SABINE FIVER	63		ONSHOTE PROD	7		EPA VI
		0500729	2		BALTIMORE MD	0	3913		1633 16	-		PATAPSCO BYR	126	126	TB SHAMBOCK	5 TNK	TANCANT	H BALT
40	0 6/ 111	0907190	4	0	OFF GLUSIN TA	9	~		O	EUDE 0815		GIF OF MEAILO	840	246	MV GLOBITC SUN	~		GULFST
	2000	7911050	4	2	PHILA PA	0	3954		7512 06		- 4	SCHUYLKILL F	69		CNSHOFE FPNFY	2	FLNGFLE C	C PHIL
55053			× .		MIC	O .						DRNGE DITCHES	20	20	PIPELINE	-	FPLNRUP E	EPA V
* * 7000	48575	0301274	o: N	- 1	-	0	4048					RIVER	102	102	BURRD BARGE115	2		C N YEK
		110000	*	9	N.	0	375			_		OHIO R RE339	8	84	TB CHTK 2181/5	'S S GEOUND	UND M	EVANS
	6700	9770071	N P	S	SKAGWAY AK	0	2351					CANAL	300	200	ONSHIE FUELING	2	TNKCLPS C	JNEAU
170	3 6	0803699	N 4		MARSH IS LA	0	5838		9200 CRUDE	-		LION BAY	7250		ONSHOLE PROD	S WILL	WIIBIHI C	N ORL
	ı	0301387	d.		CHESTER PA	0	1951	- 1		•	104 DELAMARE P	a.	73	7.3	TUGBOAT	9	STRUFLR C	PHIL
	57400		2	2 2	LAKE SUPEPIOR		4652		8500 BAKER			LAKE SUPERIOR	10	7.0	7114 GNWGS AW	3	SINKING C	SSMAP
	51115		×	83	BORDENTOWN NJ	0	4007			1122	22 CHOSSWICKS	VICKS CE	250	75	SULINIAL PRINE	1 3		EPA II
55037 5			×	Ű	CONWAY PA	0	101			-	234 OHIO RIVER	RIVER	63	69	PENN CNRTL PA	2 B		EPA III
55032 5	53175 0	0701101	0 0	0	SAN JUAN PE	0	1829		BNKER BO	-	209 ATLANTI	TIC	500	500	.B 2102	2		CSANJ
5 560		08 04 325	N C	۲	TEXAS CITY TX	0	2375		9453 CRUDE	DE 1224	24 TKS CITY	TAHE AL	76	76	MV AMCO YRKTHN	~	0	GLVST
	54575		×	3	WALREN OH	0	4120			1231		SAHONING RIVE	100		STORAGE TANK	7	LKNGTNK F	FPA V
55201	3	0300066	0 4	CO	DELAWARE BAY	0	3908		S15 MXPTP	FP 0117	17 DELAMAPE	APE BAY	0	920JP	TS 20-35K	3 COLLSN		
55 P 0 2	0	0300070	0 2	S	CN NOOH YCNAS	0	4028		7401 WSOIL	IL 0119			0	1001	TR 1000-9990G		2 351	N ADR
55203	-	1200039	P	>	ALLEJO CA	0	3804	12214	4 CAUDE	DE 0122	SAN	PARIO HAY	C	2520	TS 20-35K		0	
55P04	0	0300050	0 4	C	DELAWARE BAY	0	3909		516 01851			VAC GG SUCTED	C	3000	10 20 35	10000	4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	
55P05 2	29675		2	P	PORTSHOUTH NH	0	4305		-			10	15	55000	TO MATANTE	0 0 0	CHOMOROLO	01.00
55P06 3	30775		N.	6 0	OAK HEBR WASH	0	4810	-	98 5			INAN DE FIICA			40.11	Cattorn C	2000	2011
55207	0	0300234	2 5	1	NEW YORK NY	-	40 39			0227	1	a Ca	c	1000		000	1	2717
55P08	0	0300243	co d		NEW YORK NY	-	4038		NIXED	0		808		1000		201100	200	4 4 4 4
55P09 3.	32475		×		PITTSBURG PA	0	4015	ľ				MANGHIA MID. S.	0			217200	0	1111
55p 10 3	32375 0	0700189	0 4 8		SAN JUAN Pu	0	1828					RSVLT RDS PSS	0		HEG CHENICAL	Capouran	,	
55P11		0700203	5		TAMPA BAY FL	0	2738					BAY	3	50405	-S 10-20K	S GEOGIAD		TANDA
55212 34	34375		N	A	ALRANY NY	0	40.00				**	DIVER			00.00	2000		
					1	,	7			1							c	

N	N	VINER S S C P LOCATION SIE LAIN LONGW POLL DATE HODY OF WAITER GGALS RGALS SOURCE OFFER S S C P LOCATION SIE LAIN LONGW POLL DATE HODY OF WAITER GGALS RGALS SOURCE NO SAUGHDLAND RESERVED NO SAUGHDLAND NO SA	Value C. P. LOCATION SIE LAIN LUNGW POIL DATE BODY OF WATER GREEK KGELE SOURCE CATOMICS C. P. LOCATION SIE LAIN LUNGW POIL DATE BODY OF WATER CATOMICS C. P. C. CATOMICS C. CATOMI	N	OTHER 5 S C P	OTHER 5 S C P	Value S. C. P. LOCATION SIE LAIN LONGW POIL DATE BODY OF WATER GREEK GENERAL GEN	N	N	VITTER 5 S.C. P. LOCATION SIE LAIN LONGE POIL DATE BODY OF WAISE GRES KGRIS KGRIS SOURCE CATEGORY OF CONTROL OF CONTROL OF CATEGORY OF C	N F C K ORDEANS LA O 2500 7016 #3 0410 MILES 60415 KORIS SOUNCE CAT CANDER OTHER 5 5 C P	Value S. C. P. LOCATION SIE LAIN LONGE POLIT DATE BOOP OF WATSE GGAIS KGRIS SCURCE CAT CAUTSE CAT CA	N	
N A F C M ORLEANS LA 0 1996 0005 CRUDE CS13 ATLANTIC 0 1900 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N S CANDERNS LA 0.2900 9016 #3 0410 MID3. ML93 23300P NV 350LT PARSE 3 COLLSN C C CANDENNAL PRO 0.1930 0005 CHUD CST ATLANTIC C 0.16400P NV 2PC CICTERS 4 SINKER C C CANDENNAL C C CANDENNAL PRO 0.1930 0005 CHUD CST ATLANTIC C 0.16400P NV 2PC CICTERS 4 SINKER C C CANDENNAL C C COCCENTRAL C C COCCENTRAL C C COCCENTRAL C C CANDENNAL C C CANDENNAL C C CANDENNAL C C CANDENNAL C C COCCENTRAL C C COCCENTRAL C C CANDENNAL C C CANDENNAL C C CANDENNAL C C COCCENTRAL C C COCCEN	N S C N ORLEANS LA 0 2500 9016 #3 0410 MISS. MLSD 23 30309 NV 250.CT PNRES C G S S S S S S S S S S S S S S S S S	N A E C M ORLEANS LA D 1996 0005 CRUDE C513 ATLANTIC 0 10400P MY SPC CICTERS 4 CANDRIN NJ C 3 AGUADILLA PRO 0 1996 0005 CRUDE C513 ATLANTIC 0 10400P MY SPC CICTERS 4 CANDRIN NJ C 3 AGUADILLA PRO 0 1995 7512 MILKD 0517 DELAMARE H 0 1070P 0 NOBIOLE FEF S 2 CANDRIN NJ C 3 AGY 734 GAS 0005 NICHOFF H 0 277 P 10400P FEF S 2 CANDRIN PILLS NY 12 AGY 734 GAS 0005 NICHOFF H 0 277 P 10400P FEF S 2 CANDRIN SPLIS NY 12 AGY 734 GAS 0005 NICHOFF H 0 277 P 10400P FEF S 2 CANDRIN NA CANDRA NA CANDRIN NA CANDRIN NA CANDRIN NA CANDRA NA CAN	N S AURDILLA PRENS LA C 2900 9016 #3 0410 MILUS. MISO 23300P MY SCOLT PURSES 2 COLLEGE C C 15400P MY SCOLT PURSES 2 C MADRILLA PRINCE C C 15400P MY SCOLT PURSES 2 C MADRILLA PRINCE C C 15400P MY SCOLT MY SCOLT PURSES C MADRIA MY SCOLT MY	N S CANDERNS LA 0 2900 9016 #3 0410 MILOS. ML93 23300P NV 3500LT PURSES 3 COLLSN C CANDENNAL PRO 0 1930 0005 CEUDE C513 MILANIIC C 16400P NV 2PC CICTERS 4 SINKING C CANDENNAL C CANDENNAL C CANDENNAL C CANDENNAL C COLLSN C CANDENNAL C COCCERCENAL C CANDENNAL C CANDENNAL C CANDENNAL C CANDENNAL C CANDENNAL C COCCERCENAL C CANDENNAL C CANDENNAL C COCCERCENAL C CANDENNAL C COCCERCENAL C CANDENNAL C CANDENNAL C COCCERCENAL CO	N A F C M ORLEANS LA 0 1996 0005 CRUDE CS13 ATLANTIC 0 19406 N. O. S. AGUJOLLAN LA 0 1940 0005 CRUDE CS13 ATLANTIC 0 19406 0005 CRUDE CS13 ATLANTIC 0 19406 N. O. S. AGUJOLLAN LA D. O. 1940 0005 CRUDE CS13 ATLANTIC 0 19406 N. O. C.	N A E C M ORLEANS LA D 2900 9016 #3 0410 MISS. MISO 22 30000 MV SPC CICTENS A CANDRILLA PRO 0 1996 0005 CROUZ CAST ATLANTIC 0 10400P MV SPC CICTENS A CAST AND MAN SPC CICTENS AND MAN SP	N S CANDERNS LA 0.2900 9016 #3 0410 MID3. ML93 23300P NV 350LT PAREE 3 COLLEGE C CANDEN NJ 0.5 AGUAILLA PR 0.1930 0005 CHUD CST NICKED OST NICKED NJ 0.2955 7512 MILKED OST NICKED NJ 0.2377 000405 EFF 5 EUFTREE C C CANDEN NJ 0.2955 7512 MILKED OST NICKED NICKED NJ 0.2377 000405 EFF 5 EUFTREE C C CANDEN NJ 0.2955 7512 MILKED NJ 0.2377 000405 EFF 5 EUFTREE C C CANDEN NJ 0.2955 7512 MILKED NJ 0.2377 000405 EFF 5 EUFTREE C C CANDEN NJ 0.4037 7510 MILKED NJ 0.2377 000405 EFF 5 EUFTREE C C CANDEN NJ 0.4037 7510 MILKED NJ 0.1000 EJF CANDEN NJ 0.4037 7508 MILKED NJ 0.1000 EJF CANDEN NJ 0.4037 7509 MILKED NJ 0.1000 EJF CANDEN NJ 0.4037 7509 MILKED NJ 0.1000 EJF CANDEN NJ 0.4037 7509 MILKED NJ 0.1000 EJF CANDEN NJ 0.4037 MILKED NJ 0	N A F C M ORLEANS LA 0 1996 0005 CRUDE COT3 ATLANTIC 0 19400 F CANDEN NA 0 1996 0005 CRUDE COT3 ATLANTIC 0 19400 F CANDEN NA 0 1996 0005 CRUDE COT3 ATLANTIC 0 19400 F C CANDEN NA 0 1996 1940 1940 F C CANDEN NA 0 1996 1940 1940 F C CANDEN NA 0 1940 1940 1940 F C CANDEN NA 0 1940 1940 1940 1940 1940 F C CANDEN NA 0 1940 1940 1940 1940 1940 1940 1940 19	N A E C M ORLEANS LA D 2900 9016 #3 0410 MISS. MISO 23 3000P MY SPC CICTERS 4 CANDRIN NA	N A E C NOBLEANS LA 0 2900 9016 #3 0410 MILUS. MIGS 23330P NY SCOLT PURSES 2 COLLEGE CONTRING COLLEGE CANDEN NJ 0 3955 7512 MILADIO COLDEN NJ 0 1936 0405 CHURC COLLEGE R 2 10070P NJ 200 CICTERS 4 SINKENG COLLEGE R 2 10070P NJ 200 CICTERS 4 SINKENG COLLEGE R 2 10070P NJ 200 CICTERS 4 SINKENG COLLEGE R 2 10070P NJ 200 CICTERS 4 SINKENG COLLEGE R 2 10070P NJ 200 CICTERS 7 12 0432 7 7449 CIUDE 0737 AILANTIC COLLEGE R 2 10070P NJ 200 CICTERS 8 SECUND NJ 2 CICLERS NY 0 4035 7 7449 CIUDE 0737 AILANTIC COLLEGE R 2 10070P NJ 200 CICLER NY 0 4035 7 7449 CIUDE 0737 AILANTIC COLLEGE R 2 10070P NJ 2	N S G AGNADILLA PRO 0 1930 -0005 CBUDE C513 ATLANTIC C 16470P NV 250 CICCTRRS 4 SINKING C C 16470P NV 250 CICCTRRS 4 SINKING C C 16470P NV 250 CICCTRRS 4 SINKING C C C C C C C C C C C C C C C C C C C	N S CANDALLA PRO 0.2900 9016 #3 0410 MID3. ML93 23300P NV 350LT PAREE 3 COLLSN C CANDALLLA PRO 0.1930 0005 CRUDE C513 MILANIIC C 0.16400P NV 2PC CICTERS 4 SINKENC C CANDALLLA PRO 0.1930 0005 CRUDE C513 MILANIIC C 0.16400P NV 2PC CICTERS 4 SINKENC C CANDALLA PRO 0.1930 0005 CRUDE C513 MILANIIC C CANDAL PRO 0.1930 0005 CANDAL PRO 0.1930	
N A F C M COLEANS LA C 2500 0010 0010 0010 0010 0010 0010 0010	N S C ACTUALLA PRO 0.2903 2010 4.3 N S C ACTUALLA PRO 0.2903 2010 4.3 N S C ACTUALLA PRO 0.2905 2010 4.3 E C CACAGON NJ P	N S C M COLEANS LA C 2950 9014 4 2 2 2 1 2 M 123	N A F C K GELENIS LA C 2500 7014 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	N S C A CHERNS LA O 1930 - 0.055 CHUDE C513 MILLS LA C 10400 FV 20°C CICTENS G SILVERS C C ACCOUNT LA PRO 0 1930 - 0.055 CHUDE C513 MILLS LA C C 10400 FV 20°C CICTENS G SILVERS C C C C C C C C C C C C C C C C C C C	N S C ACREANS LA 0 1930 0005 C510 E 03 1010 E 0	N A F C M COLEANS LA C 2500 0010 A 2500 B 25	N A D C M CALENAS LA D 2500 CHUSE COLS. MILANIEL CALONOS NA CANON NA D C CANON NA CA	N S C ACREANS LA 0 1930 - 0005 CBUDE C613 ATLANTA C 0 16470 FV 200 CICTERS 4 SINKER C C C ACRONN NJ 0 1930 - 0005 CBUDE C613 ATLANTA C 0 16470 FV 200 CICTERS 4 SINKER C C C CANON NJ 0 1930 - 0005 CBUDE NJ 0	N A F C M COLEANS LA C 2500 0010 A 2500 B A 2500	N A F C K GELENIS LA C 2500 7014 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	N S C N CREENS LA C 1930 - 0.05 C 10 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1	N S C AUGUSTEANS LA 0 1930 -0055 CHUNE CS13 MILLA PRO 0 1950 -0055 CHUNE CS13 MILLA PRO 0 1955 7512 MILLED USITURARE B 0 1970 -0055 CHUNE CS13 MILLA PRO 0 1955 7512 MILLED USITURARE B 0 1970 -0055 CHUNE REVEAL BY 0 1955 7512 MILLED USITURARE B 0 1970 -0055 CHUNE REVEAL BY 0 1955 7512 MILLED USITURARE B 0 1970 -0055 CHUNE CS13 MILLED USITURARE B 0 1970 CS13 MILLED USING CS13 MILLED USI	N S C ACREANS LA 0 1930 0005 C510 2 C10 2	J 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
N 0 S AGUNDILA PR 0 1936 0005 CRUDE CST3 ATLANTIC 104020 N M 0 S AGUNDILA PR 0 1956 0405 MILKANTIC 105000 N M M M M M M M M M M M M M M M M M	N O S AGUADILA PRO 0 1930 -0055 CRUDE C513 ATLANTIC	N 0 S AUDULLA PR 0 1936 0605 CRUDE C513 ATLANTIC 10190 DE PER CLICARNO PR C GROEN NJ 0 3955 7512 MILKD DELEARE H 0 1707 0 40540 E EE P 0 G GGANNI MEYER C 0 472 042 643 043 043 043 043 043 043 043 043 043 0	N 0 S AGIADILA PR 0 1930 0055 CEUDE C513 ATLANTIC 0 19470F FV EFC 1.1. TAN 0 C CARDAIN NJ 0 3955 7512 MLEAD 0517 DELAFARE H 0 1777 PUNIONE FEF 5 C CARDAIN NJ 0 3955 7512 MLEAD 0517 DELAFARE H 0 1777 PUNIONE FEF 5 C CARDAIN NJ 0 4035 7449 CEUDE 0709 HIANTIC 0 4277 FE 10 10 20 N	N O S AGUADILLA PRO 01930 C005 C010 C051 ATLANTIC C 10410F FOR 20 CLILIANS B CLARANS NO. 0 1955 7512 MILED 0510 DELANATE B 0 2377 10 10-20 F F F F F F F F F F F F F F F F F F F	N O S AGNAILLA PRO 0 1930 -0005 CRUDE C513 ATLANTIC	N 0 S AGUNDILA PR 0 1936 0055 CRUDE C513 ATLANTIC 104020 N W 0 S AGUNDILA PR 0 1956 045 SIAKE MANUAL N N N N N N N N N N N N N N N N N N N	N 0 S AGIADILA PR 0 1930 6005 CRUDE C513 ATIANNIC 0 19470F FV EFC 1.1. THE	N O S AGUADILA PRO 0 1930 -0055 CRUDE C513 ATLANTIC	N 0 S AGUNDILA PR 0 1936 6055 CRUDE CATS ATLANTIC 1040 CRUDE CATS ATLANTIC 1040 CRUDE CATS ATLANTIC 1050 CRUDE CATS ATLAN	N 0 S AGIADILA PR 0 1930 6055 CHUDE C513 ATLANTIC 0 19470F FV EFC 1.1. PR 2 C	N O S AGUADILLA PRO 0 1930 CEUDE C513 ATLANTIC C 10410F PV 2PC CLULENS C 2178 LT AND SN N S AGUADILLA PRO 0 1950 CEUDE C513 ATLANTIC C 1050 CEUDE E E	N O S AGNAILLA PRO 0 1930 -0005 CRUDE C513 ATLANTIC	N O S AGUADILA PRO 0 1930 0005 CRUDE C513 ATLANTIC	
P G G G G G G G G G G G G G G G G G G G	P G GANGEN NA U 3955 7512 MILKED 0517 DELN-MARR B 0 1000P C NABLOLE FAR F 2 GROUND BY C GANGEN NA U 2 GANGEN NA U	P G GNORN NJ C G GGANAY RIY FL 0 2735 7512 MILED 0517 DELANKE B 0 10707 UNSHOLE FLF F G GLNAY RIY FL 0 2735 5245 635 0622 HUDGON HIVE G 696 TB 10-208 F G GLNAY RILS NY 0 4227 7449 CEDDE 0709 ATLANTIC G 94 CE TB 10-208 P G GREAT NJ 0 4025 7449 CEDDE 0709 ATLANTIC G 94 CE TB 10-108 N G GREAT NJ 0 4025 7449 CEDDE 0709 ATLANTIC G 94 CE TB 10-108 N G GREAT NJ 0 4025 7456 ED 0710 NY HARBOS G 9030- NY OLIVER DALL NY D 4035 7456 ED 0712 ATLANTIC G 9030- NY OLIVER DALL NY D 4035 7529 NY D 4035	P G GENORN NJ C G GENORN NJ E C REAR FORM NJ E C	P G GANDEN NJ P G GANDEN NJ P G GANDEN NJ P G GANDEN KEY FL. 0 1955 7512 MILKED 0517 DELN-AFFE B 0 1000P C 0N5400E FLF 7 5 600 UND P G GANDEN KEY FL. 0 1735 345 635 0005 HIVER C 697 10 10-208 FLF 7 5 600 UND P G GINNS FLIS NY 12 3437 7349 CEUDE 0709 ALLANTEC C 697 110-208 5 600 UND P G GANDEN FLIS NY 12 3437 7349 CEUDE 0709 ALLANTEC C 697 110-208 5 600 UND P G GARA YORK NY 0 4039 7540 CEUDE 0709 ALLANTEC D 609 DAY CARGO SHIP C 600 UND P G GARE AAN NJ 0 3957 7349 CEUDE 0709 ALLANTEC D 609 DAY CARGO SHIP C 600 UND P G GARE AAN NJ 0 3957 7349 CEUDE 0819 CEUDE D 1000P T3 1000 UND C 7 5 10 UND C 7 5 1	P G GANDEN NJ C GANDEN NJ C GANDEN KEY FL 0 3955 7512 MILKED 0517 DELEAFER B 0 1000 C NATIONE FLF 7 STREETER G 0 600 C NATIONE FLE 7	P G GENORN NJ 0 3955 7512 MILED 9517 DELRARE R 0 10772 P 0 G 5548M KEY F L 0 2735 9245 585 9005 P 0 5 5 5 5 8 M	P G GONDEN NJ 0 2955 7512 MILED 9517 DELEMBE R 9 10072 UNSHIES EAT CANDEN NJ 0 2357 11 10-208 EAT CANDEN NJ 0 2377 12 10-208 EAT CANDEN SPLIS NY 0 4259 7349 GAS 9022 HUDSON HIVER C 894 TR 1-704 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P G CANDEN NJ	P G G CANDEN NJ P G G NJ NJ P G G NJ NJ P G G NJ NJ P G NJ P NJ P C NJ NJ P C NJ P NJ	P G GENORN NJ C G GENORN NJ E G RAF FORE NJ E G RAF F	P G GGGONT REY FLO 0 3955 7512 MILKED 0517 DELNARFE B 0 1000P ONSHOLE FLF 2 FURTHER C GGGONT REY FLO 0 4320 7330 GAS 0025 HUSGON HIVEH C G97 18 10-208 FLF 3 GROUND EF C G GLONNS FLLS NY 0 4324 CAS 0025 HUSGON HIVEH C G97 78 10-208 5 GROUND EF C G GLONNS FLLS NY 12 3437 7449 CIUDE 0707 AILANTIC 0 4208 77: 10-208 5 GROUND C GGGONTO R S GGGONTO C GGGONTO C GGGONTO R S GGGONTO C GGGONT	P G GANDEN NJ P G GANDEN NJ P G GANDEN NJ P G GANDEN KEY FL 0 2735 3244 0.85 0905 09010 MT P G GANDEN KEY FL 0 4327 7336 0.85 0905 09010 MT P G GANDEN KEY FL 0 4327 7336 0.85 0905 09010 MT P G GANDEN KEY FL 0 4327 7336 0.85 0905 09010 MT P G GANDEN KEY FL 0 4327 7336 0.85 0905 09010 MT P G GANDEN KEY FL 0 4337 7349 0.80 0.80 0.80 0.80 0.80 0.80 0.80 0.8	P G GANDEN NJ 0 3955 7512 MIKED 0517 DELK-AFR B 0 1000P C NSHOLE FAR F 0 1000PU BF C GANDEN KEY FL 0 2735 3245 GAS 0005 HUNGON BIVE WE FL 0 2735 5245 GAS 0005 HUNGON BIVE W C GAS 1 10 10 20 F 1 10 10 10 10 10 10 10 10 10 10 10 10 1	
P C G EGGONT KEY FL 0 2735 9245 GAS 9055 F A G LENNI PLIS NY 0 4327 7449 CEDDS 9249 HJSCON HIVER 0 6247 P G G LENNI PLIS NY 0 4327 7449 CEDDS 9779 ALLANIIC 0 4227 N G C REW YORK NY 0 4039 7456 Eb 9779 ALLANIIC 0 40204 N G C REW YORK NY 0 4039 7456 Eb 9772 ALLANIIC 0 40304 N G G REW YORK NY 0 9356 7456 Eb 9772 ALLANIIC 0 90304 N F G G REW YORK NY 0 9357 7509 NIKED 0318 CGHYLKILL F 0 90204 N F G REW YORK NY 0 4005 7520 MIKED 0318 CGHYLKILL F 0 90204 N F G G REW YORK NY 0 4005 7520 MIKED 0318 CHHYLKILL F 0 90204 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 90204 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 90204 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0318 REBOLE D 0 400704 N F G G REW YORK NY 0 4005 7520 MIKED 0 4005 MIKED 0 400	P C C C C C C C C C	P. C. C. S.	P. G. EGGONT KEY FL. 0.275 3245 GAS 1985 F. A. GLNAN PELLS NY 0.4327 7449 GAS 19850N HIVER 0.237P 18 10-208 5 F. A. GLNAN PELLS NY 0.4327 7449 GAS 18 10-20 N HIVER 0.697 18 10-208 5 F. S. GLNAN PELLS NY 0.4039 7440 GESUS 0.710 NY HARBOX 0.609 18 10-00 E.5 10-00 N HIVER 0.600 18 10-00 N HIVER 0.600 N HIVER 0.600 18 10-00 N HIVER 0.600 N H	P. C.	P C G EGGONT KEY FL 0 2735 9245 GAS 0005 P A GLNNS FLLS NY 0 4034 GAS 0005 P A GLNNS FLLS NY 0 4034 GAS 0005 P S G MINNS FLLS NY 0 4034 TAREA BY 0 4004 TAREA BY 0 4005 TAREA BY 0 10000 TAREA B	P. G. G. G. S.	P. G. G.GONT KEY PL. D. 275 9245 GAS 0805 NIVER CO. 277 T. 12 1427	P C C C C C C C C C	P. C. G. G. SONT. KEY F.L. 0. 2735 9245 GAS 9055 P. A. G. LANYER PLIS. NY 0. 4327 7449 CEDDS 9719 ALLANYER P. G. G. LANYER PLIS. NY 0. 4327 7449 CEDDS 9719 ALLANYER N. G. G. KARNEN SY 0. 4039 7456 F.B. 0. 779 ALLANYER N. G. G. KARNEN SY 0. 4039 7456 F.B. 0. 779 ALLANYER N. G. G. KARNEN SY 0. 4039 7456 F.B. 0. 779 ALLANYER N. G. G. KARNEN SY 0. 4039 7456 F.B. 0. 779 ALLANYER N. G. G. KARNEN SY 0. 4039 7456 F.B. 0. 779 ALLANYER N. G. G. KARNEN SY 0. 3956 7550 MIXED 0818 GCHUYLKILL F.D. 0. 607 P.B. 0. 4050 F.B. 0.	P. G. EGGOST KEY FL. 0.275 3245 GAS 9045 F. G. GLNAS PLIS NY 0.4327 7349 GAS 6042 HUDSON HIVER 0.237P 18 10-208 F. G. GLNAS PLIS NY 0.4327 7449 GAS 6042 HUDSON HIVER 0.6997 18 50-104 F. G. GLNAS PLIS NY 0.4045 7440 GAS 6042 HUDSON HIVER 0.4020 18 50-104 F. G. GLNAS TORK NY 0.4049 7450 GAS 0.710 NY HARBOX 0.50040 18 50-104 F. G. GLNAS HAY NJ 0.3956 7450 650 0712 HIANIC 0.50040 18 50-104 F. G. GLNAS HAY NJ 0.3956 7450 650 0712 HIANIC 0.5004	P. C.	P. C. G. GASONT KEY FL. C. 2735 3245 GAS 0005	P C C C C C C C C C	
P. C. G. GLANNS FILES N. C. 2330 GAS C. 622 HUDGON BIVER C. 69F. P. C. GLANNS FILES N. C. 23437 7449 CUDLE 0709 FLANTIC P. C. ATLANTIC N. C. GARE MAY N. C. 3856 7449 CUDLE 0701 NY BARBOR OF 10000P N. C. GARE MAY N. C. 3856 7449 CUDLE 0712 ATLANTIC N. C. GARE MAY N. C. 2747 8423 44 D6CH TANPA BAY OF 00P P. G. G. T. PRESBEG F. C. 2747 8423 44 D6CH TANPA BAY OF 00P P. G. GREEF PA C. 4056 7550 MAXED 0818 CCHNYLAGILE D 10000P P. G. GREEF PA C. 4056 7550 MAXED 0818 CCHNYLAGILE D 10000P P. G. GREEF PA C. 4056 7550 MAXED 0818 CCHNYLAGILE D 10000P P. G. GREEF PA C. 4056 7550 MAXED 0819 DELMARE P. C. 14670 P. P. C. CHNYLAGILE D 10000P P. G. GLESTER PA C. 4056 7550 MAXED 0819 DELMARE P. C. 14670 P. P. C. CHNYLAGILE D. C. C. CHNYLAGILE D. C. C. CHNYLAGILE D. C. CHNYLAGILE D. C. C. CHNYLAGILE D. C. C. CHNYLAGILE D. C. C. CHNYLAGILE D. C.	P. C. G. GLANS PLES NY 0 4327 7330 GAS GASZ HUDGON RIVER C 6942 TW 1-704 S GROUND EF C GLANS PLES NY 0 4327 7330 GAS GASZ HUDGON RIVER C 6942 TW 1-704 S GROUND T GASZ HUDGA GASZ HAND C 6942 TW 1-704 GROUND T GASZ HAND C 6942 677 7449 CEUDE 0770 ATTANTEG 0 1000-00-75 100 K GASZ HAND C 6942 740 CEUDE 0770 ATTANTEG 0 1000-00-75 100 K GASZ HAND C 6942 740 K GASZ HAND C 6943 740 K GASZ HAND C	P. C. G.LNAS PLIE F. C.	P. C. GLNNS FILE N. C. 4330 7330 GAS CA22 HUDSON RIVER C 69F TG 1-70A 5 GAS CA22 HUDSON RIVER C 69F TG 1-70A 5 GAS CA22 HUDSON RIVER C 69F TG 1-70A 5 GAS CA22 HUDSON RIVER C 6 420¢ TG 15 G-170K 5 GAS CA22 HUDSON RIVER C 6 420¢ TG 15 G-170K 5 GAS CA22 HUDSON RIVER C 6 420¢ TG 15 GAS CA22 HUDSON RIVER C 6 42	THE CHANNE FILE NO. 0.335 (ASC 6022 HUDSON RIVER C 69F TW 1-70A S GROUND BY C G. GLNNS FILE N. 1.2 3437 7335 (ASC 6022 HUDSON RIVER C 69F TW 1-70A S GROUND BY C G. GLNNS FILE N. 1.2 3437 7449 CIUDE 0703 AILANTIC C 69F TW 1-70A S GROUND C C ALLANTIC C C 420- TW 1-70A S GROUND C C ALLANTIC C C ALLANTIC C C 420- TW 1-70A S GROUND C C C ALLANTIC C C ALLANTIC C C C ALLANTIC C C C ALLANTIC C C C C C C C C C C C C C C C C C C	P. C. G. GLAND P. FLES N. T. 2 34 27 7330 GAS		P. C. GLNNS FILE N. C. 4320 7330 GAS CO22 HUDSON RIVER C 69F TW 1-70A 5 GAS CO22 HUDSON RIVER C 69F TW 1-70A 5 GAS CO32 HUDSON RIVER C 69F TW 1-70A 5 GAS CO32 HUDSON RIVER C 6 GAS CO32 HUSON RIVER C 6 GAS CO32 HUSON RIVER C 750 HUDSON RIVER C 7	P. C. G. GLANS PLES NY 0 4327 7330 AS 6622 HUDGON RIVER C 6942 TE 1-704 5 GROUND EF C GLANS PLES NY 12 3437 7449 CEUDE 0709 ATLANTEG 0 1000-00-75 100 K GROUND C G GROUND C	P. C. G. GLANNS FILES N. C.	P. C. GLNNS FILE N. C. 4320 7330 GAS CA22 HUDSON RIVER C 69F TW 1-10A C G G G G G G G G G G G G G G G G G G	F G GLONGS FREE F. C. 12 3437 7330 GAS GASZ HUDSON RIVER C 694 TW 1-10A S GROUND BY C GLONGS FREE TW 12 3437 7449 CIUDE 0709 ATLANTIC C 694 TW 12 100A GROUND C GROUN	P. C. G. GLANS PLES N. O. 4327 7330 GAS GASZ HUDSON RIVER C 694 TS 1-704 5 GROUND BY C G. GLANS PLES N. O. 4202 TS 2437 7330 GAS GASZ HUDSON RIVER C 694 TS 12 1437 TS 12 1437 7449 CEUDE 0703 ALTANTIC O 1000A TS 100A GAS GAS GAS GAS GAS GAS GAS GAS GAS GA	P. C. G. GLANS PLES N. 12 3427 7330 GAS GASZ HUDGON RIVER C 6942 TE 1-704 5 GROUND EF C GLANS PLES N. 12 3437 7449 CEUDE 0770 ATLANTEG D 1000-07 TE 1004 GAS	
F G SERVICE N. C. 12 3437 7449 CEUDE 0709 ATLANTIC C. 420c. B G SER YORK NY 0 4037 7449 CEUDE 0709 ATLANTIC C. 420c. N O G CARE MAY NJ 0 4037 7449 CEUDE 0710 NY HYBEG D. 100000P. P S G ST PISSBEG FI C. 777 823 PH 0 964 TANNA BAY D. 50 NO. N E G ST PISSBEG FI C. 577 823 PH 0 964 TANNA BAY D. 10000P. P S G ST PISSBE FI D. 0 3957 7509 NIKED 0818 CEUNYLKILL F. 0 10000P. P S G NEW YORK NY 0 4005 7509 NIKED 0818 CEUNYLKILL F. 0 10000P. P S G NEW YORK NY 0 4005 7509 NIKED 0818 CEUNYLKILL F. 0 10000P. P S G NEW YORK NY 0 4005 750 NIKED 0818 CEUNYLKILL F. 0 10000P. P S G NEW YORK NY 0 4005 750 NIKED 0818 CEUNYLKILL F. 0 10000P. P S G NEW YORK NY 0 4005 750 NIKED 0818 CEUNYLKILL F. 0 10000P. P S G NEW YORK NY 0 4005 750 NIKED 0818 CEUNYLKILL F. 0 14000P.	No. A CLANIS FLES NO. 12 3437 7 749 CRUDE 0703 FLEATING 0 420c 25 5c-10ck 5 pasker	F G STENTIC TO 2347 7449 CEDUE 2019 FILENTIC C 420 FIRSON O 420 FIRSON	F G SEANCE TO 12 3437 7449 CEUDE 0710 NI HEBOS 0 10000F TS 100K 0 1000F TS 100K 0 1000F TS 100K 0 1000F TS 100K 0 100F TS	F G ALLANS FLED N 12 3437 7449 CRUDE 0701 MILANIES O 4200 IN 50-1008 S PRENER S PARKERS O ALLANIES O 4009 T 12 3437 7449 CRUDE 0701 MILANIES O 5 0000 T 10 10000 T 10	F G NEWSTELD NI 12 3437 7449 CRUDE 0779 ALLANTEC 0 420c 78 50-1000 5 PERSER NI 12 3437 7449 CRUDE 0770 ALLANTEC 0 10000F 15 1000 CRUDE 0710 NI HPROG 0 10000F 1	F G MENNSTELS NI 12 3437 7449 CEUDE 0799 ATLANTIC 0 420cm N C G MEN NY NY 0 4039 7449 CEUDE 0799 ATLANTIC 0 420cm N O G CAPE MAY NJ 0 3856 7449 CEUDE 0799 ATLANTIC 0 500Jg N O G CAPE MAY NJ 0 3856 7449 CEUDE 0710 NY HP.BGG 0 100J00P N O G CAPE MAY NJ 0 3856 7450 W O NG T ATLANTIC 0 500Jg N O S O S O S O S O S O S O S O S O S O	F G GARREN NA C GA	F G NEWS FLEN NI 12 3437 7449 CRUDE 0701 MILKEN CO 0 100.00F CR 10 CR 10 CRUDE 0701 MILKEN CR CR CR 10		F G MENNO FILD NI 12 3437 7449 CEUDE 0710 NI HEBOS 0 10000F TS 100K 0 10 CENE MAY NJ 0 4039 7440 CEUDE 0710 NI HEBOS 0 10000F TS 100K 0 10 CENE MAY NJ 0 4039 7440 CEUDE 0710 NI HEBOS 0 10000F TS 100K 0 10 CENE MAY NJ 0 4039 7440 CEUDE 0710 NI HEBOS 0 10000F TS 100K 0 10 CENE MAY NJ 0 4039 7440 CEUDE 0710 NI HEBOS 0 10000F TS 100K 0 NI PERSONAL NATURE 0 10 10 COOP DEF CARGO SHIP 0 10 CENE MAY NO 10 CENE MAY NO 10 CENE MAY NJ 0 CENE MAY NJ	F G MINSTELD NI 12 3437 7449 CRUDE 0701 MILANIES D 4200 IN 50-1000 S PERNIER S CALANIES PLEN NI 12 3437 7449 CRUDE 0701 MILANIES D 100000 S 10000 S 100000 S 10000 S 10000 S 10000 S 10000 S 10000 S 100000 S 10000 S 10000 S 10000 S 10000 S 10000 S	F G ALLANIS FLED N 1 12 3437 7449 CHUDE 0791 MILANISCO D 420F IN 56-100K S PARNER S C ALLANIS FLED N 1 12 3437 7449 CHUDE 0791 MILANISCO D 600 L 3.100K N 2 0 4039 7449 CHUDE 0791 MILANISCO D 500W AT 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	F G NEWSTELD NI 12 3437 7449 CRUDE 0701 MTLANTIC 0 420c 78 56-1000 5 PERSTER O ALLANTIC CONTROL OF CRUDE 0701 MTLANTIC CONTROL OF CRUDE 0710 MTLANTIC CONTROL OF CRUDE 0710 MTLANTIC CONTROL OF 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 100K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K CRUDE 0710 MTLANTIC CONTROL OF 0 10000F 75 10K MTLANTIC CONTROL	A SERVICE STANDARD ST
P G RIANTA 12 3637 1492 CTODE 0770 NY HARBAS 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P 0 ATLANTIC 12 3437 149 C 1902 0710 ATLANTIC 0 5004 37 1004 0800 0 1004 58 1004 0 1004 0 1004 58 1004 0 1004	P G ALANTIC 12 3437 7402 CEUDE 0719 ALANTIC 0 0 0000P 25 100A 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P. G. RTLANTIC 1.2 3437 1443 CEDUE 0719 HERBOA O 10000P 15 1004 15 100	P 0 ATLATIC 12 3437 1449 CHOR 0710 NY HARDON 0 1000F 25 100K N 0 G CARE MAN NJ 0 4959 7405 CFUDE 0710 NY HARDON 0 1000F 25 100K N 0 G CARE MAN NJ 0 4956 7456 60 0710 ATLANTIC 0 5000F 75 100K N 0 G CARE MAN NJ 0 8956 7456 60 0710 ATLANTIC 0 5000F 77 101YRFC NAL 3 GROUND C NJ 0 8957 7508 NIKED 0814 CARTALLE 0 1000F 90LK CARLS NA 0 4005 7240 NIKED 0814 DELWARE 0 0 9970F 08160E FF 2 TANKEUP C NJ 0 8957 7508 NIKED 0814 DELWARE 0 0 9970F 08160E FF 2 TANKEUP C NJ 0 9957 7508 NIKED 0814 NEW NJ 0 4036 7407 NIKED 0914 NIKED 0814 NIK	P 0 ATLANTIC 12 3437 149 C CONTRACTOR 0 1000F 73 100K N 0 G CAPE MAY NJ 0 4039 7402 C TUDE 0710 NY HARON 0 1000F 73 100K N 0 G CAPE MAY NJ 0 4039 7402 E TUDE 0710 NY HARON 0 1000F 73 100K N 0 G CAPE MAY NJ 0 3956 7456 80 0712 ATLANTIC 0 500- DY 7 1014 C CONTROL NY 0 1000F 73 100K N 0 G CAPE MAY NJ 0 3957 7509 MIXED 0810 DZELWARE 0 0 9970F 00L 00 DY 7 C DYSTOR 0 C CONTROL NY 0 4038 740 DZELWARE 0 0 9970F 0 00C DY 7 C DYSTOR 0 C CONTROL NY 0 1000F 7520 MIXED 0810 DZELWARE 0 0 9970F 0 00C DY 7 C DYSTOR 0 C CONTROL NY 0 1000F 7520 MIXED 0810 DZELWARE 0 0 9970F MY 7 C C CALTF 3 GEOUND C NY 0 C CONTROL NY 0 1000F 7520 MIXED 10 NY 10 C CALTF 3 GEOUND C NY 0 C CALTF NY 0 C CAL	P G KTANTY 12 3437 1443 CHOR D 773 KTANTAL C 190000 P G G KAPE MAY N3 0 4035 7456 66 0712 ATTANTAL C 1900000 P G G KAPE MAY N3 0 3856 7456 66 0712 ATTANTAL C 1900000 P G G KAPE MAY N3 0 3856 7456 66 0712 ATTANTAL C 19000000 P G G G KAPESBEG FL 0 2747 8423 44 0 9641 G KAPE MAY 0 0 997000 P G G KAPE MAY 0 1900000 P G G G KAPE MAY 0 1900000 P G G G KAPE MAY 0 1900000 P G G G G G G KAPE MAY 0 1900000 P G G G G G G G G G G G G G G G G	P G RELAKTIC 12 3437 1443 CEUDE 0710 NY HARBOA 0 10000 TS 1004 NA CEUDE 0710 NY HARBOA 0 10000 TS 1004 NA CEUDE 0710 NY HARBOA 0 10000 TS 1004 NA CASE NA CEUDE 0710 NY HARBOA 0 10000 TS 1004 NA CASE	P 0 ATLATIC 12 4847 149 C 1005 C 100	P G RIANTA NO 4 0437 7408 C CODE 0710 NY HARGAS O 100000 P S G MRR WORK NY 0 4035 7408 C CODE 0710 NY HARGAS O 100000 P S G G RPE MAY NJ 0 4035 7408 C CODE 0712 ATLANTIC 0 5000 N 5000 N 5 S G G RESERVE F D 0 2457 7508 N/KED 0818 G CHRISTEL F D 100000 P S G G RESERVE F D 0 3457 7508 N/KED 0818 G CHRISTEL F D 100000 P S G G NEW YORK NY 0 4008 7500 N 10 0 10 0 10 0 10 0 10 0 10 0 10 0	P. G. RTLANTIC 12 3437 1443 CEDUE 0719 HERBOA O 10000P 13 1004 15 1004	P O ATLATIC 12 3437 1449 CIDDS 0710 NY HARDON 0 1000P TS 100K N O G CARE MAN NJ O 4039 7449 CIDDS 0710 NY HARDON 0 1000P TS 100K N O G CARE MAN NJ O 4039 7456 60 0712 AILANIC 0 5000F M/T 0LYRC DAL 3 GROUND C S G ST PASSHG FL 274 832 84 0 864 TANNA BAY 0 505 P DAY CARGOSHIP 0 600 NO 2 FIFE N F E GLESTER PA 0 4036 7240 MIXED 0849 SCHUYLALE 0 10000F TS 100K N F G GLENARRE BAY 0 4036 7240 MIXED 0849 SCHUYLALE 0 10000F TS 50-100K N F G GLENARRE BAY 0 4036 7240 MIXED 0849 SCHUYLALE 0 10000F TS 50-100K N F G GLENARRE BAY 0 4036 7240 MIXED 100 DELWARRE NO 0 1000F TS 50-100K N F G GLENARRE BAY 0 4036 7240 MIXED 120 MIXED NO 0 400P MY WANTS HERD C TANNEUP C S GROUND C S GR	P 0 ATLATIC 12 3437 149 CEUDE 0710 NY HARON 0 10000 73 100K N 0 G CAPE MAY NJ 0 4035 7405 CEUDE 0710 NY HARON 0 10000 73 100K N 0 G CAPE MAY NJ 0 3956 7456 60 0712 ATLANTC 0 5004 A77 0LYMPC NAL 3 GROUND C NO G CAPE MAY NJ 0 3956 7456 60 0712 ATLANTC 0 5004 A77 0LYMPC NAL 3 GROUND C NO G CAPE MAY NJ 0 4005 7520 MIXED 0819 CMIXED 0819 CMIXED 0819 CMIXED 0819 CMIXED NA 0 4005 7520 MIXED NA 0 4005 7520 MIXED NA 0 4005 MIXED NA 0 4005 7520 MIXED NA 0 4005 MIXED NA 0 400	P 0 ATLANTIC 12 4847 149 C 1000 C 10 M H H H H H H H H H H H H H H H H H H	
P G GARE MAY NO 4039 7402 CEUDE 0710 NY HARON UNDOUGH OF CARE MAY NA 0 8856 7402 CEUDE 0710 NY HARON UNDOUGH OF CARE MAY NA 0 8856 7403 84 0644 1AMPA 8AY 0 60P N 6 CHESTER PA 0 4965 7508 NYKED 0818 5CHMYLKILL F 0 10000 P P G GREEF PA 0 4005 7508 NYKED 0818 5CHMYLKILL F 0 10000 P P G GREEF PA 0 4005 750 NYKED 0818 5CHMYRE F 0 9870 P P G GREEF PA 0 4005 750 011 1011 DELWARE NYK 0 14000 P 14000 P P CHESTER PA 0 4006 750 011 1011 DELWARE NYK 0 14000 P 14000 P P 0 2000 P	P G G CAPE MAY NO 0 4034 7402 CEUDE 0710 NY HARON D 5004 A71 01940 CEUDE MAY NO 0 4034 7402 CEUDE MAY NO 0 G CAPE MAY NO 0 9356 7403 44 964 1118 MAY NO 0 5004 A71 0148 CEUDE MAY NO 0 9356 7403 44 964 118 MAY NO 0 5004 A71 0148 CEUDE MAY NO 0 5004 A71 0148 CEUDE MAY NO 0 5004 A71 0148 CEUDE MAY NO 0 4005 7509 NIKED 0819 CEUDEMAREE D 9 9670 MAY CARE SET E CAPENDE MAY NO 0 4005 7504 MIKED 0819 CEUDEMAREE D 9 9670 MAY NIKED 0819 CEUDEMAREE D 9 9670 MAY NIKED MAY NIKED 0819 CEUDEMAREE D 100700 CEUDEMAREE D	P. S. G. NEW YORK NO. 0.4039 7402 CT002 0710 NY HARBOS 0.10000 S.S. 1000 P.S. 1000 P.S	P G G MEA YORK NY 0 4059 7402 CTUDE UTO NT HARDS 0 1000-0 15 1000-	P S G MEA YORK NY 0 4034 TANA CEUDO 0710 NY HARON 0 5004 AT DLYCE CAL S GROUND COCKER MAX NJ 0 4034 TANA CEUDO 0710 NY HARON 0 5004 AT DLYCE CAL S GROUND NY C CARE MAX NJ 0 4034 TANA CEUDO 0 5004 AT CARE CEUDO 0710 NJ CEUDO 07	P G GARZA YORK NY 0 4039 7402 CEUDZ 0710 NY HARGON U 5004 A.C. IUUND C CAPE MAY NA 0 4039 7402 CEUDZ 0 4039 A.C. IUUND C CAPE MAY NA 0 4039 7402 CEUDZ 0 4030 A.C. IUUND C CAPE MAY NA 0 4030 A.C. IUUND C CAPE MAY NA 0 4030 A.C. IUUND C CAPE MAY CAPE MAY NA 0 4030 A.C. IUUND C CAPE MAY CAPE MAY NA 0 4030 A.C. IUUND C CAPE MAY C	P S G CAPE NAY 0 4034 7402 CEDDE 0712 ATTENDED 0 10000 P 5 G CAPE NAY NA 0 4034 7408 CEDDE 0712 ATTENDED 0 10000 P 100	P G GAREANENNY 0 4055 7402 CT0D2 0710 NT HARDUS 0 10004 15 100	P G G CAPE MAY NO 4 4034 7454 6	P S G MEA YORK NY 0 4039 7402 CEUDE 0712 ATTANTIC 0 10000 N	P G G MEA YORK NY 0 4059 7402 CTUDE 0710 NT HABOR 0 100004 15 1000 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P G G GAPE MAY NO 0 4034 7402 CEUDZ 0710 NY HPADON 0 5004 AZI 0148PC 7AL 3 1000 M	P S G MEA YORK NY 0 4034 7402 CEUDZ 0710 NY HYBOG 0 5004 AT 905 NY 0 1035 P S G MEAN NY 0 4034 7402 CEUDZ 0 710 NY HYBOG 0 5004 AT 001 NY 0 1035 P S G ST PRESEC FI 0 2747 832 N4 0 600 T S G ST PRESEC FI 0 2747 832 N4 0 600 T S G ST PRESEC FI 0 2747 832 N4 0 600 T S G ST PRESEC FI 0 2747 832 N4 0 600 T S G ST PRESEC FI 0 2747 832 N4 0 600 T S G ST PRESEC FI 0 2740 NA	P G G CAPE MAY NO 4039 7402 CEUDE 0710 NY HARON D 5004 A71 0019 CE CAPE MAY NO 4039 7402 CEUDE 0710 NY HARON D 500 CEAPE MAY NO 4039 CEAPE MAY NO 605 CEAPE	99999999999999999999999999999999999999
N O G CAPE MAY NJ 0 3856 7458 #6 0712 ATTANTIC 0 50004 N S G ST PTESSEG FI 0 2747 8422 #4 0 0644 TANTELLILE 0 105000 N S PHILL FA 0 3957 7508 MAKED 0818 SCHIFLELL F 0 105000 P S G NEW YORK NY 0 4005 7509 MAY 0 2614 FREE F 0 98702 P S G NEW YORK NY 0 4036 7500 1000000000000000000000000000000000	N O G CAPE MAY NJ 0 3856 7458 86 0712 AILANTIC 0 5004 77 01770 77 017870 341 A	N O G CAPE MAY NJ 0 3856 7456 #6 0712 ATLANTIC 0 5004 377 DELEMPE DATE OF STREET OF STATE OF	N O G CAPE MAY NJ 0 3956 7456 % 0 9712 AILANTIC 0 50004 %7 DLYATC 08L N S G ST PRESMG FL 0 2747 8423 % 4 08C4 TANPA WAY 0 500 D by CARGO SHIP O 8 9 9 9 9 0 9 9 9 0 0 9 9 9 0 0 0 0 0 0	N O G CAPE MAY NJ 0 3856, 7458 86 0712 AILANTIC 0 5004 37 01770 0350 C 6000MD N O G CAPE MAY NJ 0 3857, 7508 MIXED 0370 C 6001MD N O G CAPE MAY NJ 0 3957 7508 MIXED 0319 C 6001MD N O 10000 DLY CABGO SHIPE 6 GROUND N O 10000 DLY CABGO SHIPE 7 2 TANKENP C P S G MEM YORK NY 0 4038 7404 CADDE 9919 NY HARBOR N O 100000 TS 50-1000 D C 7 ANKENP C P S G MEM YORK NY 0 4038 7404 CADDE 9919 NY HARBOR N O 10000 DLY CONTINE 3 GROUND C P S G MEM YORK NY 0 4036 7501 JASJE 1010 DLY WARE RV N TACO CALLE 3 GROUND C P G G MEM YORK NA 0 3 3850 7750 C MIXER DAY 0 4037 7755 DIEST 1214 CHEPK DAY 0 4030 TS 10100 TS 10000 TS 10000 TS 10000 D S G NEW YORK NY 0 4034 7755 DIEST 1230 NY HARBIC D 6930 TS 10100 TS 10000 TS 10000 TS 100000 TS 1000000 TS 1000000 TS 1000000 TS 1000000 TS 1000000 TS 10000000000	N O G CAPE MAY NJ 0 3856 7458 86 0712 AILANTIC 0 5004 77 01770 0700 070 070 070 070 070 070 0	N O G CAPE MAY NJ 0 3856 7458 #6 0712 ATGNTIC 0 50004 N B G T PRESENCE T 0 2747 8832 #4 0 0644 MAYPA BEX 0 50004 N B PHILLS PA 0 3957 7508 MAKED 0818 CCHITLAGLE F 0 100002 P B G MEM YORK NY 0 4038 7500 MAKED 0818 CCHITLAGLE F 0 100002 N P E G DELLAREE BAY 0 4036 7500 MAKED 0919 NY BARBER F 0 100004 N P E G DELLAREE BAY 0 4006 7500 ML 1011 DELLAREE F 0 20007 N S C HYPTR BDS WA 0 3712 7515 BAREE 1214 MAKE F 0 40007 O G CAPE MAY NJ 3 380 7450 CHUBE 1228 ATLANTIC 0 100002	N O G CAPE MAY NJ 0 3956 7458 #6 0712 ATLANTIC 0 5004 M.Y. DLEAFC 981 N E G ST PRESEG F. 0 2747 MELS N D 964 MAYA MAY 0 500 D by CARGO SHIP O E G ST PRESEG F. 0 2747 7508 MIKED 0918 CHNYLKILL F 0 10702 GULF 0IL CO 2 N E CHESTER PA 0 4905 7528 MIKED 0918 CHNYLKILL F 0 10702 GULF 0IL CO 2 N E G MEN YORK NY 0 4908 7404 GROUP CHNYLKILL F 0 10702 GULF 0IL CO 2 N E G MEN YORK NY 0 4908 7404 GROUP CHNYLKILL F 0 10702 GULF FEF 2 N E G MEN YORK NY 0 4008 7404 GROUP CHNYLKILL F 0 10702 GULF FEF 2 N E G MEN YORK NY 0 10702 GULF SHOW N E G G CAPE MAY B 0 3065 7501 3AS#2 1010 DELN-AFE R N	N O G CAPE MAY NJ 0 3856 7458 86 0712 AILANTIC 0 5004 77 01770 77 017870 351 7 0178	N O G CAPE MAY NJ 0 3856 7458 #6 0712 ATTANTC 0 500 P. N E G ST PTESBEG F I 0 2747 8428 #4 0604 IANNA BLA BLA BLA BLA BLA BLA BLA BLA BLA BL	N O G CAPE MAY NJ 0 3956 7456 % 0 9712 ATTANTEC	N O G CAPE MAY NJ 0 3856 1458 80 0712 AILANIAC 0 5004 7 0177 01787 034 034 05 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N O G CAPE MAY NJ 0 3856 7458 86 0712 AILANTIC 0 5004 77 101787 0345 0340 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N O G CAPE MAY NJ 0 3856 7458 86 0712 AILANTIC 0 5004 77 0177 0177 0177 0178 0180 018 018 018 018 018 018 018 018 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
P. S. G. ST. PTESBEG FI. C. 274.7 823.2 #4 08C4 TANPA BAX. N. P. PHILA. PA. 0.3957 7508 MAKED 0818 SCHIYLKILL F. 0.100000 P. B. CHESTER PA. 0.4005 7504 MAKED 0818 SCHIYLKILL F. 0.100000 N. P. B. G. DELMANFE BAX. 0.4004 750 011 011 DELMANFE P. 0.1000000 P. C. ROSTER PA. 0.4004 750 011 011 DELMANFE P. 0.2000000000000000000000000000000000	P. S. G. T. PRESBEG F. I. C. 2747 8332 #4 9804 TANPA BLY D. 60P DAY CARGO SHIP & GROUND M. P. PHILA PA. D. 9957 7008 MIXED DBHS COMPYLATIL E. D. 9979 ULF OIL CO. Z. F.F.R. P. S. G. NEW YORK NY D. 4038 7404 CRUDE D919 NY HARBON E. D. 10070P 15 97-103K 3 GROUND C. P. S. G. NEW YORK NY D. 4038 7404 CRUDE D919 NY HARBON E. D. 10070P 15 97-103K 3 GROUND C. P. S. G. NEW YORK NY D. 4038 7404 CRUDE D919 NY HARBON E. D. 10070P 15 97-103K 3 GROUND C. P. S. G. NEW YORK NY D. 4038 7404 CRUDE D919 NY HARBON E. D. 2004 DAY NY CALLEY S. AS GROUND C. P. S. G. NEW YORK NY D. 4036 7520 ULL 1011 DELPHARE B. D. 2004 DAY HARBON E. Z. ANKEND C. D. 2004 DAY NY CALLEY S. GROUND C. P. S. G. NEW YORK NY D. 4040 7 755 DIESIL 1230 NY HARBON C. 10070P TS 100K S. GROUND C. P. S. GROUND C. D. S. GROUND C. C. NEW YORK NY D. 4047 755 DIESIL 1230 NY HARBON C. 10070P TS 100K S. GROUND C. C. NEW YORK NY D. 4047 755 DIESIL 1230 NY HARBON C. NA PARSON MY S. S. GROUND C. C. NEW YORK NY D. 4047 755 DIESIL 1230 NY HARBON C. NA PARSON MY S. S. GROUND C. C. NEW YORK NY D. 4047 755 DIESIL 1230 NY HARBON C. NA PARSON MY S.	N	P. S. G. F. PERSBEG F. I. C. 2747 B232 #4 OBC4 TAMPA BAX D. 60P DAY CAGG SHIP 6 OBLIGATION OF STATEMENT OF ST	P. S. G. T. PTESBEG F. L. C. 2747 B32 #4 9804 TANPA BAY 0.60P DAY CARGO SHIP & GROUND M. P. PLILA PA. 0.955 7240 MIXED 0818 GCHUYLALL F. 0.1020CP ULL OIL CO. 2. FIFE P. C. CHANAGUP C.	P. S. G. ST. PRESENG F. L. C. 274.7 843.7 84. N. S. G. ST. PRESENG F. L. C. 274.7 843.7 84. N. S. G. ST. PRESENCE F. R. C. 295.7 750.8 MIXED 0816 CGM9YLLILL F. D. 100.000 ULV. O. LL. CO. 2. P.F.E. P. S. G. MEN YOR W. D. 40.05 750.0 MIXED 0816 CGM9YLLILL F. D. 9970F UNSHOLE F. P. Z. Z. N.K. ST. P. S. G. MEN YOR W. D. 40.05 750.0 MIXED 0919 NV. HARBOR D. D. 9970F UNSHOLE F. P. Z. Z. N.K. ST. P. S. C. C. S.	P S G ST PRESEGG FI C 2747 8232 ## 0864 TAWA 824 0 6079	N	P. S. G. T. PRESBEG F. I. C. 2747 8332 #4 9804 TANPA BLY D. 60P DAY CARGO SHIP & GROUND M. P. PHILA PA. D. 9957 7908 MIXED D8H SCHMYLLE B. D. 9979 ULFF OLLE CO. Z. F.	P. S. G. ST. PTESBEG FI. C. 274.7 823.2 #4 08C4 TANPA BAX. N. P. BHILA PA. 0.3957 7508 MAKED 0818 CCHTYLAILE F. 0.100502- P. B. CHESTER PA. 0.4038 7404 CRUDE 0919 NY HARBUS D. 0.40302- N. P. G. DELRARPE BAX. 0.4036 7500 112. 0010 DELWARE RV. 0.105002- P. R. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.105002- P. R. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.105002- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 112. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. C. CHESTER PA. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. C. DESTER PA. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. C. DESTER PA. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. C. DESTER PA. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 113. 0010 DELWARE RV. 0.40302- P. DELWARE RV. 0.4036 7500 11	P. S. G. ST. PRESEGG FI. C. 27-7 B5-28 MIKED 0814 CAMPA B5. Y. D. 6.0.P. DEV CARGO SHIPP D. S. G. ST. PRESEGG FI. C. 27-7 F5-08 MIKED 0814 CAMPIKELL F. D. 10-20.0 G. US. D. C. 0. 19-7-1 F5-08 MIKED 0814 CAMPIKELL F. D. 19-7-2. US. D. C. 0. 10-7-2. S. G. NEW YORK NY. C. 40-38 A-404 CEUDE 0819 D. S. G. DELWARE BA. C. 40-38 A-404 CEUDE 0819 MIKED S. S. D. 10-20-2. S. S. C. 10-10-K. D. P. C. G. DELWARE BA. C. 40-36 T. S. C. 10-10-K. D. S. C.	P. S. G. T. PTESBEG F. I. C. 2747 B33.2 #4 N. P. PLILA PA. O. 9957 7049 MIXED 0818 CCHNYLALL F. O. 60P. DATA OLL CO. I. C. P. F. E. P. P. B. P. C. BESSEP PA. O. 4036 7520 MIXED 0818 CCHNYLALL F. O. 9979 ULX OLL CO. Z. F. F. E. P. S. G. NEW YORK NY O. 4036 7404 CFUDE 0919 NY HARBOR G. O. 102309 ISSUED F. F. Z. F. M. K. S. P. G. DELARARE BAY O. 4036 7404 CFUDE 0919 NY HARBOR G. O. 102309 ISSUED F. F. F. F. F. P. P. G. DELARARE BAY O. 4036 750 13522 1010 DELWARE BAY. O. 140706 NY TICO CALLF 3 GEOUND C. P. P. C. C. DESTER PA. O. 4036 752 U. D. I. 1011 DELWARE P. O. 2030 ONS 405 E. F. Z. F. M. K. S. P. F.	P. S. G. ST. PRESBEG F. L. C. 2747 B32 84 060 TANNA BAY D. C. O. O. O. D. L. C. A. C.	P. S. G. T. PRESBEG F. D. 2747 832 84 0804 TANPA BLY 0 60P DAY CARGO SHIP & GROUND M P. PHILA PA. 0.957 7408 MIXED 0818 GCHYVALLE 0 0 9070 012F CALGO CO. 2 FIRE CH. 0.9572 P. D. CHORNER P. 0.9972 UNSHORE F. F. Z. TANKSUP C. 0.9972 UNSHORE F. F. Z. TANKSUP C. 0.9972 UNSHORE F. F. Z. TANKSUP C. 0.9973 P. CHORNER P. 0.4038 7404 CRUDE 0919 NY HARBON C. 0.1070P 15 50-105K 3 GROUND C. 0.0016 F. F. Z. TANKSUP C. 0.9076 P. D. CHORNER P. 0.4006 7520 ULL. 1011 CHONNER P. 0.200P UNSHORE F. Z. TANKSUP C. 0.0016 F. P. S. G. CAPL MAY N. J. 2850 CRUDE 1229 ALLANIC C. 1020P T. S. GROUND C. CAPL MAY N. J. 3850 T. S. S. CHONNER C. C. 1020P T. S. GROUND C. CAPL MAY N. J. 3850 T. S. S. CALLEN M. J. S. GROUND C. CAPL MAY N. J. 3850 T. S. S. CALLEN M. J. S. GROUND C. J. S. CAPL MAY N. J. S. CALLEN M. J. S. GROUND C. J. CAPL MAY N. J. S. CALLEN M. J. S. GROUND C. J. CAPL MAY N. J. S. CALLEN M. J. S. GROUND C. J. CAPL MAY N. J. S. CALLEN M. J. J. D. C. D. CAPL MAY N. J. S. CALLEN M. J. C. CAPL MAY N. J. S. CALLE J. J. J. J. CALLEN M. J. C. CAPL MAY N. J. J. D. C. D. CAPL MAY N. J. S. CALLE J. J. J. J. CALLEN M. J. C. CAPL MAY N. J. S. CALLE J. J. J. J. J. C. CAPL MAY N. J. S. CALLE J. J. J. J. C. CAPL MAY N. J. S. CALLE J. J. J. J. CALLE J. J. J. J. C. CAPL MAY N. J. S. CALLE J. J. J. J. J. CALLE J. J. J. J. CALLE J. J. J. J. J. J. CALLE J. J. J. J. J. CALLE J. J. J. J. J. CALLE J. J. J. J. CALLE J. J. J. J. J. J. J. CALLE J. J. J. J. J. CALLE J. J. J. CALLE J.	
N E PHILL PA 0 3957 7500 MIKED 0318 CCHUYLKILL F 0 102022 P B CHESTER PA 0 4005 7540 MIKED 0318 SCHIMARE F 0 967024 P B CHEM YORK NY 0 4005 7540 MIKED 0419 NY HARBOR 0 107004 N P F G DELMARE BAY 0 3656 7501 383#2 1010 DELMARE RV. 0 140004 P F CHESTER PA 0 4006 7500 011 1011 DELMARE RV. 0 140004 P F CHESTER PA 0 4006 7500 011 1011 DELMARE R 0 0 2002	N E PHILLERA O 3957 7508 MIKED 0814 GCHUYLKILL E 0 10202F GULF OIL CO 2 FIFE C C C STERP PA 0 40405 7504 MIKED 0814 GEBLEWARE E 0 10200F 10 5010 C C Z ANKEUP C C C STERP PA 0 40405 C GUUS 0917 NY HARBER E 0 10200F 10 5010 C C C C C C C C C C C C C C C C C C	N E PHILL PA 0 3957 7500 MIKED 0818 CCHUYLKILL F 0 10500P P B CHESTEP PA 0 4005 7520 MIXED 0819 DELWERE F 0 9870P P S G DELMEN NY 0 4038 7404 CHUZE 9919 WY MARBER BW, 0 14070P P F G DELMERE BAY 0 3856 7501 JASS 2 1010 DELWARE RW, 0 14070P P R CHUSTEP PA 0 4006 7520 01L 1011 DELWARE P	N E PHILA PA 0 3957 7538 MIKED 0818 SCHUTLKILL E 0 10000 UULF OLL CO 2 2 PHILA PA 0 4005 7520 MIKED 0819 SCHUTLKILL E 0 10000 UULF OLL CO 2 2 PHILA PA 0 4005 7520 MIKED 0819 NU HARBOAR E 0 98730 TS 50-100K NU HARBOAR E 0 10000 TS 50-100K NU HARBOAR E DELWARRE BAY 0 3862 7501 3AS#2 1010 DELWARRE PV 0 10000 TS 50-100K NU TACO CALIF 3 P E CHESTER PA 0 4006 7520 OLL 1011 DELWARRE P 0 2000 ONSIGE EF 2 P E CHESTER PA 0 3700 ONSIGE EF 2 P S P CHAPTER PS AN WANTS HERM S P G CAPE MAY NU 3 3860 7450 CKUDE 1229 ALLANTO DAY 0 10000 TS 100K 3	N E PHILA PA 0 3957 7508 MIKED 0818 CCHUYLKILL F 0 1020CP GULK DIL CO 2 FIFE C P CHESTER PA 0 4005 7520 MIKED 0819 CCHUYLKILL F 0 9870P UNSHOLD FFF 2 TANKEUP C N 0 4038 7520 MIKED 0919 NY HARBOR F 0 1030CP 105.005 FFF 3 GROUND C N 0 1030CP 10 100CP 10 100	N E PHILL PA 0 3957 7508 MIKED 0818 GCHUYLKILL E 0 1020CP GULF OLL CO 2 FIFE C C C RESIDENTAL OUT OF 04005 7504 MIKED 0818 GCHUYLKILL E 0 1020CP GULF OLL CO 2 FIFE C C RESIDENTAL OUT OF 04005 7504 MIKED 0818 GCHUND C 0 1020CP FIFE C C RESIDENTAL E BAY 0 365C 7501 3852 1010 DELWHARE RV. 0 14070CP NV 17CO CALTE 3 GCHUND C D C RESIDENTAL E BAY 0 365C 7501 3852 1010 DELWHARE RV. 0 14070CP NV 17CO CALTE 3 GCHUND C D C CAPER RAY NA 0 4006 7520 OLL NV 184 RV RV 17CO CALTE 7 C CALTEN NV 184 RV RV 17CO CALTEN 3 GCHUND C D C CAPE MAY NA 3 3850 MIKE 1214 CHEV NA 0 609 RV NATS HERY 3 COLLEN NV 184 RV 1	N E PHILA PA 0 3957 7500 MIKED 0818 CCHUYLKILL E 0 102002P P E CHESSER PA 0 4005 7520 MIKED 0818 GCHUYLKILL E 0 90702P P E G NEW YORK NY 0 4005 7520 MIKED 0819 NY HARBOR 0 100702P N P E G DELARARE BAY 0 385C 7501 3832 1010 DELYARE RV. 0 140702P P E CHESTER PA 0 4006 7520 01L 1011 DELYARE R 0 0 27002P N S C HYPTR BOS YA 0 3712 7450 MIKER 1214 HASPE NAY 0 0 004020P	N E PHILA PA 0 3957 7530 MIKED 081M SCHUYLKILL E 0 100002 GULF OLL CO 2 2 PHILA PA 0 4005 7520 MIKED 081M SCHUYLKILL E 0 100002 LNS 2 PHILA PA 0 4005 7520 MIKED 081M SCHUMBUS	N E PHILLERA O 3957 7508 MIKED 0814 GCHUYLKIILE 0 100002 GULF OIL CO 2 FIFE C C C C C C C C C C C C C C C C C C C	N E PHILL PA 0 3957 7500 MIKED 0318 CCHUYLKILL F 0 102022 P E CHESCER PA 0 4005 7504 MIKED 0318 CCHUYLKILL F 0 102022 P S G NEW YORK NY 0 4005 7504 MIKED 0318 NY HARBOR 0 102024 N P F G DELMARE BAY 0 365C 7501 383F 1010 DELMARE PV. 0 14000F P F C DESCRIPE PA 0 4006 7520 DL 10 1011 DELMARE P 0 2002	N E PHILA PA 0 3957 7538 MIKED 0818 SCHUYLKILL E 0 100002 GULF OLL CO 2 2 PHILA PA 0 4005 7520 MIKED 0818 SCHUYLKILL E 0 98732 UNSHORE FAR 2 2 P 6 CHESTER PA 0 4005 7520 MIKED 0819 NY HARBOSA 0 100702 NOSDOR FAR 2 2 P 6 DELMARRE BAY 0 3862 7501 38382 1010 DELMARRE PV 0 140702 MY IKCO CALIF 3 P 6 CHESTER PA 0 4006 7520 OLL 1011 DELMARRE PV 0 0 2002 ONSHORE FER 2 P 6 CHESTER PA 0 4006 7520 OLL 1011 DELMARRE PV 0 0 2002 ONSHORE FER 2 P 6 CHAPTE ROS VA 0 3712 7615 MIKER FILT PARK DAY 0 0000 MY KANTO HZM 3 9 0 G CAPE MAY NA 3 3850 7450 CKUDE 1220 ALLANTO C 100302 TS 100K	N E PHILLERA P. G. PATLA PA P. G. CHESTER PA	N E PHILA PA 0 3957 7508 MIKED 0818 CCHUYLKILL E 0 1020CP GULE DIE CO 2 FIFE C C C RESERP PA 0 4005 7504 MIKED 0818 CCHUYLKILL E 0 1020CP GULE DIE C ZANKSUP C C C S REW POKEN W 0 4005 7404 MIKED DEL MARE R 0 1030CP 13 CCH 103 CCH	N	
P B CHESTER PA 0 4005 7540 MIXED 0419 5ELEMBRE B 0 9870-P P S G NEW YORK NY 0 4038 7404 CEUDE 9919 NY HARBOR 0 102102-P N P B G DELAMARE BAY 0 385C 7501 3AS#2 1010 DELAWARE B 0 14070EP P B C DESTREP PA 0 4006 752 011 1011 DELAWARE B 0 2002	P. B. CHESTER PA. 0 4036 7540 MIXED 0619 DELFWAREE G. 0 9870P UNSHOLE FEE. 2 TANKEUP C. S. G. NEW YORK NY. 0 4038 7404 CHUDE 0919 NY HARONE. 0 10200- IS SCHOON C. 0 6000 N. S. C. NEGERP PA. 0 4036 7540 14352 1010 DELFWARE BY. 0 14070- IT TCC CALLE B. 6E0UND C. D. SCHOOL C. S. C.	P B CHESTER PA 0 4005 7540 MIXED 0619 DELLWAREE 5 0 9870 P S G NEW YORK NY 0 4038 7404 CRUDE 0919 NY HARBOR 0 10230P N P E G DELLWAREE BAY 0 3850 7501 3A32 1010 DELLWAREE NA. 0 4400C P P E CHESTER PA 0 4006 7540 LL 1011 DELLWAREE PA 0 2000 P	P. B. CHESTER PA. 0 4005 7520 MIXED 0010 DELEMBEE 6 0 9873P UNSHOED PER 2 5 G. REM YORK NY. 0 4008 4404 CENDE 0919 N. BARBOLS. 0 10300 15.5 G. F.	P. B. CHESTER PA. 0 4035 7240 MIXED 0649 DELIMAREE G. 0 9870P UNSHOLE FF. 2 TANKHUP C. 9. CHESTER PA. 0 4036 7240 MIXED 0649 DELIMAREE G. 0 9870P UNSHOLE FF. 2 GANKHUP C. 9. G. NEW YORK NY. 0 4036 7501 JASE 1010 DELIMARE B. 0 14070F. NY. TACO CALF. 3 GEOUND C. 9. E. CHESTER PA. 0 4036 7520 JL. 1011 DELIMARE P. 0 2004P ONSHOLE FF. 2 TANKEUP C. 9. C. GLESTER PA. 0 4036 7520 JL. 1011 DELIMARE G. 0 2004P ONSHOLE FF. 2 TANKEUP C. 9. G. G. P. M. PATA B. 9 S. G. M. PATA B. 9 S. G. D. S. G. C. G. P. PATA B. 9 S. G. D. S. G. C. G. PATA B. 9 S. G. D. PATA B. 9 S. G. D	P	P B CHESTER PA 0 4005 7550 MIXED 0619 DELFREE B 0 9872P 7 5 G MEN YOR WAS 7550 MIXED 0619 DELFREE B 0 9872P 7 10230P 7 8 G DELFRARE BAX 0 4038 7404 CEDDE 0919 WR HARBOR D 10230P 7 8 E G DELFRARE BAX 0 4006 7550 UIL 1011 DELFRARE RW 0 1000 P 750 UIL 1011 DELFRARE RW 0 1000 P 750 UIL 1011 DELFRARE P 0 4006 7550 UIL 1011 DELFRARE P 0 4000 P 750 UIL 1011 DELFRARE P 0 4000 UIL 1011 DELFRARE P 0 4000 P 750 UIL 1011 DELFRARE P 0 4000 P 750 UIL 1011 DELFRARE P 0 400	P. B. CHESTEP PA. 0 4005 7520 MIXED 0819 DELEMBER 5 0 8873P UNSHOED PEP 2 S. G. NEW YORK NY 0 4038 7404 CHUSE 0919 N. HARBOA 1010705 7550 0125 50-100K 3 S. C. NEW YORK NY 0 4038 7404 CHUSE 0919 N. HARBOA 1010705 NY TAKOO CALF 3 P. B. CHESTER P. D. 4000 7520 011 1011 DELEMBER P. D. 2000P ON HOSE EP 2 P. CHESTER P. D. 4000 7520 011 1011 DELEMBER P. D. 2000P ON HOSE EP 2 P. CHESTER D. D. 3000P ON HOSE EP 2 P. C. NEW MAY NJ 3 3850 7450 CHUSE 1214 NHICK CALF TOOK TO COME TOOK TOOK TOOK TOOK TOOK TOOK TOOK TOO	P. B. CHESTER PA. 0 4036 7520 MIXED 0619 DELFWAREE G. 0 9873P UNSHOLE FEE 2 TANKEUP C. S. G. NEW YORK NY. 0 4038 7404 CHUDE 0919 NY HARONE. 0 102304 IS SCHOOK S. G. GOUND C. N. P. E. G. BELARAFE BAY 0 385C 7501 3432P 1010 DELFWARE BY. 0 14070F NY TICC CALLY 3 GEOUND C. P. E. C. MESTER P. D. 0 4006 7520 ULL. 1011 DELFWARE P. D. 2000P ONSHORE FEF 2 TANKEUP C. P. C. MESTER P. D. 0 4006 7520 ULL. 1011 DELFWARE D. D. 0 00PP NY NYIGHER 2 TANKEUP C. P. C. MESTER P. D. 100.P. NY NYIGHER 3 GEOUND C. P. G. MEN YORK NY 0 4047 7355 DIESEL 1230 NY HARROLE C. 10020F TS 100K S. S. GROUND C. NY	P B CHESTER PA 0 4005 7520 MIXED 0419 5ELEMBRE B 0 9970PP P 5 G NEW YORK NY 0 4038 7404 CEUDE 0919 NY HARBOE 0 10710PP P 5 G NEW YORK NY 0 4038 7404 CEUDE 0919 NY HARBOE 0 10710PP P 6 GELEMBRE BAY 0 385C 7501 5AS#2 1010 DELEMBRE P 0 14070PP P 6 CHESTER PA 0 4006 7520 ULL 1011 DELEMBRE P 0 200PP P 6 CHESTER PA 0 4006 7520 ULL 1011 DELEMBRE P 0 200PP P 750 ULL 1011 DELEMBRE P 0 200PP P 750 ULL 1011 DELEMBRE P 0 200PP P 9 P 9 CHESTER P 0 4006 7520 ULL 1011 DELEMBRE P 0 5 200PP P 9 P 9 P 9 P 9 P 9 P 9 P 9 P 9 P 9	P. B. CHESTER PA. 0 4005 7520 MIXED 0519 DELEMBEE 6 0 9873P UNSHOED PEP 2 S. G. NEM YORK NY 0 4058 7404 CHESTE 9519 WITH BARBOL. P. S. G. NEM YORK NY 0 4058 7404 CHESTE 9519 WITH BARBOL. P. E. G. DELEMBEE BAY 0 4056 7501 JASE 1010 DELEMBEE BV. 0 4200-P ON 867E 750 JASE 1011 DELEMBEE PV. 0 4200-P ON 867E FEF 2 P. S. G. WEDTER PR. 0 4006 7520 OIL. 1011 DELEMBEE PV. 0 4200-P ON 867E FEF 2 P. S. G. WEDTER PR. 0 4006 7520 OIL. 1011 DELEMBEE PV. 0 4200-P ON 867E FEF 2 P. S. G. WEDTER PR. 0 4006 7520 OIL. 1011 DELEMBEE PV. 0 400-P OF TOTOL RAY NATION REZET 3 D. G. CRPE, MAY NJ. 3 3850 7450 CHUSH 1229 ATTANTO 0 1020-P TS 100R	P. B. CHESTER PA. 0 4035 7520 MIXED 0619 DELFAREE 5 0 9870P UNSHOLE FF 2 TANKHUP C. S. G. NEW YORK NY 0 4038 7404 CBUDE 0919 NY HARBOR 0 10209.15 SCHOOK 3 0 600 ND C. S. G. NEW YORK NY 0 4038 7404 CBUDE DELFAREE RV. 0 10209.15 SCHOOK 3 600 ND C. P. B. C. G. C. R. R. C.	P. B. CHESTER PA. 0 4036 7240 MIXED 0649 DELIMAREE G. 0 9872P UNSHOLD F.F. 2 TANKHUP C. S. G. BELLAREE BA. 0 4036 7240 MIXED 0941 WITH HARDE. P. S. G. BELLAREE BAX 0 4036 7540 JASJE 1010 DELIMAREE R. W. 14076F. WITKOU CALLE SCHOOLD C. S. C. C. CALLER B. D. 4006 7520 UIL. 1011 DELIMAREE R. W. 0 2004 ONSHOELEE F. Z. TANKHUP C. P. C.	P. B. CHESTER PA. 0 4036 7520 MIXED 0619 DELFWERE B. 0 9873P UNSHOLE FF. 2 TANKHUP C. P. S. G. NEW YORK NY. 0 4038 7404 CHUDE 0919 NY HARONE. 0 102304 IS SCHOOK. 3 660UND C. N. P. B. G. DELARAFE BAY 0 385C 7501 3432P 1010 DELFWERE BY. 0 102304 IS SCHOOK. 3 660UND C. P. P. B. G. DELARAFE BAY 0 385C 7501 3432P 1010 DELFWERE BY. 0 2000 ONSHORE FF. 2 TANKEUP C. P. C. DESTER P. D. 0 4006 752U 011. 1011 DELFWERE D. 0 2000 ONSHORE FF. 2 TANKEUP C. P. C. DESTER P. D. 0 4006 752U 011. 1011 DELFWERE D. 0 500 ONSHORE FF. 2 TANKEUP C. D. C. DELFWERE BAY 0 3712 7615 DNKER 1214 CHSPK DAY. 0 500 NY	20 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
P G CHESTER FA 0 4038 7404 CHONE 0919 NY HARBOR 0 100000P 1 P G GELRARFE BAY 0 4036 7501 3AS#2 1010 DELYBRE FV. 0 14070F P F C DELLARFE BAY 0 3850 7501 3AS#2 1010 DELYBRE FV. 0 14070F P F C DESTER FA 0 4006 7520 OIL 1011 DELLARFE P 0 2000 P	P G GENERARE BAY 0 4038 7404 CRUZE 0919 NY HARBOR 0 10200P IS 50-100K 3 GEOUND C NEW YORK NY TACO CALLE S GEOUND C NEW YORK NY TACO CALLES NY TACO CALLES NY TACO CALLES NY TACO CALLES NY S C HYPTH BDS WAS 0 3712 7615 MAKER 1214 CHGRAR NY 0 60P MY WANG HPZM 3 COLLESN MY S C HYPTH BDS WAS NY 0 3712 7615 MAKER 1214 CHGRAR NY 0 60P MY WANG HPZM 3 COLLESN MY NO CALLESN MY NY 0 4047 7555 DIESLIZE NY MY MARROW C NO CALLESN NY NY MARROW C NO CALLESN NY NY MARROW NY 0 4047 7555 DIESLIZE NY MARROW NY 0 4032 TESTICAL NY NATURE NO CALLESN NY NY MARROW NY NY MARROW NY	P. B. CHESTER RA. 0 4038 7404 CRUDE 0919 NY HARBOR. 0 102302- NY P. F. G. DELLARRE BAY 0 385C 7501 583#2 1010 DELIMBAR RVs. 0 14000R. P. R. CHESTER PA. 0 4006 7520 DIL. 1011 DELIMBAR RVs. 0 2000P.	P. G. CHESTER F.A. 0 4038 74-04 CRUJE 9919 NY HARBOLE 0 102302 IS 50-100K 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	P G GENERALE BAY 0 4038 7004 CENUZE 0919 NY HARBOAN 0 10200P IS 50-105K 3 GEOUND C NY P G DELARARE BAY 0 4038 7004 CENUZE 2 100 DELWARE RV. 0 10400CE NY TACO CALLE 2 600 UND C NOSHORE C NATE 2 0 2030P 0085H0RE E Z TANKSUP C D 009 NY NYSTS HFZH Z NOSHORE E Z TANKSUP C D 000P NY NYSTS HFZH Z NOSHORE E Z TANKSUP C D 000P NY NYSTS HFZH Z GEOUND C D 00 NY NY NYSTS HFZH Z GEOUND C D 00 NY	P. G. NEW YORK NY 0 4038 7404 CEUJE 0919 NY HARBOR. 0 10200P IS 50-100K 3 GEUJNO C C C C C C C C C C C C C C C C C C C	P. G. CHESLER FA. 0. 4038 7404 CHUNE D919 NY HARBOS. 9 G. NEW YORK NY 0. 4038 7404 CHUNE D919 NY HARBOS. 9 G. DELRARRE BAY 0. 385C 7501 3AS#2 1010 DELPHARE PV. 0. 14070SP. 9 E. CIBSTER PA. 0. 4006 7520 OLL. 1011 DELPHARE P. 0. 2002 PV. N. S. C. MYTH RDS VA. 0. 3712 7515 UNKER 1214 CHSPK DAY 0. 0. 000 PV. NAY NJ. 3. 3850 7400 CHUDE 1229 FILKHIC 0. 10070EP.	P. G. CHESTER FRA. 0 4038 7404 CRUDE 0919 NY HARBOLE. 0 103702 IS 50-100K. 3 1 P. G. DELLMARE BAY 0 406 7501 JASE2 1010 DELLMARE BV. 0 140702 MY TYCO CALLE 3 P. G. DECLMARE BAY 0 406 7520 OLL. 1011 DELLMARE P. 0 20042 ONSHORE FEF 2 P. G. CHOTTER P. D. G.	P G GNEW FORK NY 0 4038 7404 CRUZE 0919 NY HARBOR 0 10200P IS 50-105K 3 GEOUND C NE S GNEW FORK NY TACO CALLE S GEOUND C NO B GLOSERE P. 0 4036 7501 JAS#2 1010 DELMARE RV. 0 14000P NY TACO CALLE Z TAKENDO C P GNESSER P. 0 4036 7520 ULL 1011 DELMARE RV. 0 2030P ONSHOE IER Z TAKENDO C P GNESSER P. 0 4036 7520 ULL 1011 DELMARE RV. 0 500P ONSHOE IER Z TAKENDO C P GNES MAY S GOUND C P G GNES MAY S GOUND C MAY S GOUN	P. G. CHESLER PA. 0 4038 7404 CARDE 0919 NY HARBOS. 0 102302- N. P. G. DELRARE BAY 0 4036 7501 JAS#2 1010 DELFWARE RV. 0 140705P N. P. G. DESERP PA. 0 4006 752 0 JL. 1011 DELFWARE P. 0 20022 D. C. DESERP PA. 0 4006 752 0 JL. 1011 DELFWARE P. 0 20022	P. G. CHESTER F.A. 0 4038 74-04 CRUJE 9919 NY HARBOLE 0 102302 IS 50-100K 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	P G GENERALE BAY 0 4038 7004 CBUJE 0919 NY HARBOR 0 103009 IS 50-105K 3 GEOUND C NO BELLARARE BAY 0 365C 7501 34522 1010 DELMARE BAY 0 1050CR PA 0 305C 7501 34522 1010 DELMARE PAR 0 104006 CALLE PAR 2 FOR SHOWN C P D 2000P ONS 405E EF 2 TANKEND C P C GARLARE BAY 0 3712 7615 BAKER 1214 CHSPK DAY 0 409P MY NATURE PA 3 GEOUND C P O GARLARE BOS WAS 0 3712 7615 BAKER 1214 CHSPK DAY 0 409P MY NATURE BOS WAS 0 3712 7615 BAKER 1214 CHSPK DAY 0 409P MY NATURE 3 GEOUND C P O GARLAR MAY NA 3 3850 MAS 125 BAKER 1214 CHSPK DAY 0 403P MAY NA 3 3850 MAS 125 BAKER 1214 CHSPK DAY 0 543P 78 16 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GARLAR WAS 12 170K 5 GROUND C P O GA	P. G. NEW YORK NY 0 4038 7404 CEUJE 0919 NY HARBOR 0 10270P IS 50-100K 3 GEOUND C 10 10 10 10 10 10 10 10 10 10 10 10 10	P G GNEW TOOLARARE BAY 0 4038 7004 GNUE 0919 NY HARBOR 0 100002 TS 50-100K 3 GROUND C NEED OLIGINARE BAY 0 4038 7004 GNUE 0919 NY HARBOR NY TACO CALLE 3 GROUND C NEED OLIGINARE BAY 0 4006 7520 UIL 1011 DELMARE 8 0 2000 ONS HORE ER 2 TANKON C NO CAPE PA 0 94006 7520 UIL 1011 DELMARE 8 0 2000 ONS HORE ER 2 TANKON C NO CAPE MAY NO 8 TO CAPE MAY NO 8 712 7615 WKER 1214 CHERK 0 90P MY VANG HEZH 3 GOLLSN N S C HYPTA BOS WA 0 3712 7615 WKER 1214 CHERK 0 90P MY VANG HEZH 3 GOLLSN N C GARL MAY NA 3 3850 7450 CRUDE 1229 ALLANIG C 10000F TS 100K 3 GROUND C N C CAPE MAY NA 0 907 7355 DIESEL 1230 NY HARROE C 10000F TS 100K 3 GROUND C N C CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 15 AK 0 0 0 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7355 DIESEL 1231 GROUND CAPE MAY NA 0 907 7350 DIESEL 1231 GROUND CAPE MAY NA 0 907 7350 DIESEL 1231 GROUND CAPE MAY NA 0 907 7350 DIESEL 1231 GROUND CAPE MAY NA 0 907 7350 DIESEL 1231 GROUND CAPE MAY NA 0 907 7350 DIESEL 1231 GROUND CAPE MAY 0 907 7350 DIESEL 1231 MAY NA 0 907 7350 DIESEL	7 0 × 0 × 0 0 0 0
N P S G NEW YORK NY 0 4036 7404 CADD. 2514 N RANGORD 140702 N P S G DELLANKE BAY 0 3667 7501 3832 1010 DELLANKE RV. 0 140702 N P S G OBSTREP PA 0 4006 750 011 1011 DELLANKE RV. 0 100 200 P	Y F G DELAMBEE BAY O 38-5C 7501 38-3Z 1010 DELW-MARE RV. O 14070F RV TACO CALIF 3 GEOUND C 14070F RV TACO CALIF 14070F RV TAC	P. S. G. NEW YORK NY 0 4038 /404 CRUES 2319 M. RANDON N. 140700 N. P. G. DELRAMER MAY 0 3850 7501 JASE 1011 DELYMPER NV. 0 140700 P. P. R. CHESTER PA. 0 4000 7520 JL 1011 DELYMPER P. 0 20002	P 5 G MEN YORK NY 0 4030 4000 4000 13882 1010 DELYNARE RV, 0 14000 MY TACO CALLE 3 P 6 G DELANARE BAY 0 3860 7501 3A882 1010 DELYNARE R 0 0 2000 0 NEGOTI ERF 2 P 7 CHESTER PA 0 4000 7520 OIL 1011 DELYNARE R 0 0 2000 0 NEGOTI ERF 2 N 5 C HATER R DSS VA 0 3712 7615 MYKER 1214 MSR N DAY 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P. S. G. REW YORK NY U. 4036 VALVE, CHOICE BARER BY. 0. 14070F NY TACO CALLE 3 GEOUND C. P. E. G. DELLAAPE BAY 0. 385C 7501 3852 1010 DELWARE RV. 0. 14070F NY TACO CALLE 3 GEOUND C. P. E. G. DELLAAPE BAY 0. 4006 752U OLL 1011 DELWARE RV. 0. 2000F ONSHORE REF. 2. TANKEUP C. P. S. C. HYPLY RDS VA. 0. 3712 7615 BYKER 1214 CHSSK BAY 0. 602 P. 002 PR. VANG HFZA 3 GOUND C. P. G. G. REW YORK BY 0. 4047 7355 DIESEL 1230 NY HARROLE 0. 6932 78 1-104 5 GROUND C.	P 5 G REAR YORK NY U 4036 7501 3872 1010 DELWARE RV. 0 14070F RV TACO CALEF 3 GEOUND C RECORDED BY TAKED PO 3862 7501 3872 1010 DELWARE RV. 0 14070F RV TACO CALEF 3 GEOUND C RV SAFER PO 3862 750 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	P. S. G. NEW FOREK NY 0. 4038 A.744 CRUD. 2919 M. R. RARDER B. 1. 4076 P. 1.	P. S. G. NEW YORK NY 0 4056 7501 5A312 701 N N N N N N N N N N N N N N N N N N N	Y F G DELAMBEE BAY O 38-5C 7501 38-3F 1011 DELW-MARE RV. O 14070F RV TACO CALIF 3 GEOUND C 14070F RV TACO CALIF 3 GEOUND C 14070F RV TACO CALIF 3 GEOUND C 14070F RV TA 14070F RV	P. S. G. NEW YORK NY 0 40346 / A404 CRUDE 0919 AT FARBOR 0 14000F P. P. G. DELMARRE BAY 0 30507 7501 3832 1010 DELMARRE RV. 0 14000F P. P. G. CHESTREP PA. 0 4006 750 ULL 1011 DELMARRE P. 0 2000 P. P. P. G. CHESTREP PA. 0 4006 750 ULL 1011 DELMARRE P. 0 2000 P. P. P. G. CHESTREP PA. 0 400 P.	P 5 G MEN YORK NY V 4050 400 400 400 400 400 400 400 400 40	P. S. G. BELAANDE BAY 0 4036 7404 CADD. DELMARE RVA. 0 14070F NV TACO CALLE 3 GEOUND C. P. E. G. BELAANDE BAY 0 385C 7501 JASE2 1010 DELMARE RVA. 0 14070F NV TACO CALLE 3 GEOUND C. P. E. C. BESSER PA. 0 4006 752 U.O.L. 1011 DELMARE PVA. 0 2000P ONSHOFE IEF 2 TANKEUP C. P. G. CAPLAND RDS VA. 0 3712 7615 BAKEE 1214 CHEPK DAY 0 80P EV VANG HEZK 3 GEOUND C. P. G. CAPL MAY NAJ 3 3850 TATO CADD. 1229 FILVATIC C. 1000P IS 100CK 3 GEOUND C. P. G. CAPL MAY NAJ 3 3850 TATO CADD. 1229 FILVATIC C. 1000P IS 100CK 5 GROUND C. P. G. CAPL MAY NAJ 3 3850 TATO CADD. 1229 FILVATIC C. 1000P IS 100CK 5 GROUND C. P. G. CAPL MAY NAJ 3 8850 TATO CADD. 123 AV HARRIED D. 693P TB 1-10K 5 GROUND C.	P. S. G. REW YORK NY U. 4736 VAC CALCE 1229 ATTACHER BY. 0. 140702 MY TACO CALLE 3 GEOUND C. N. S. C. HAPTR EDS. VA. O. 3712 PASS 1010 DELYMARE P. 0. 2700-P. ONSHOPE FEF 2. TANKEUP C. N. S. C. HAPTR EDS. VA. O. 3712 PASS 1010 DELYMARE P. 0. 2700-P. ONSHOPE FEF 3 COLLSN N. N. S. C. HAPTR EDS. VA. O. 3712 PASS 1010 PASS NA C. 10270-P. 53 106K 3 GEOUND C. P. S. G. REW YORK NY U. 3. 3850 7450 CEUDE 1229 ATTACHER. C. 10270-P. 53 106K 3 GEOUND C. P. S. G. REW YORK NY U. 4047 7355 DIESEL 1220 NY HARROE. C. 6437 TE 1. 100K 3 GEOUND C.	P. S. G. DELARARE BAY 0 4036 7404 CHUJE. 9919 NI RARBORNE N. 0 14000F NV TACO CALIF 3 GEOUND C P. C. DELARARE BAY 0 9085 7509 JLS 1010 DELWAFE PV. 0 14000F NV TACO CALIF 3 GEOUND C P. C. DESSER PA. 0 4006 7520 JLL 1011 DELWAFE PV. 0 2000P ONSHOFE IEP 2 TANKEUP C P. C. DESSER PA. 0 4006 7520 JLL 1011 DELWAFE PV. 0 90P	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
N P. F. G. DELRARRE BAY 0 3850 750 5852 1010 DELRARE HV. 5 140 CT. 720 CT. 1011 DELRARE RV. 5 2002 P. F. C. DESTER PA. 0 4006 750 UT. 1011 DELRARE RV. 5 400 P. C. DESTER PA. 0 4006 P. DESTER PA. 0 4006 P. C. DESTER PA. 0 4006 P. DESTER PA. 0 4	N P. G. DELARARE BAY 0 4056 7520 11 DELARARE NV. 0 4050 0 2050 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N P R G DELAMBER BAY 0 3850 7501 385#2 1010 DELEMBER NW D 14002 P R CARSTER PA 0 4006 7520 01L 1011 DELAMBER P 0 2000P	N P F G DELMARRE BAY 0 385C 7501 5AS#2 1010 DELMARRE PAN 0 145040 N 1750 SATE PAN 0	N P G GELMARKE BAY 0 385C 707 13522 1010 DELFMARE NO. 0 2000 ONSHORE E.P. 2 TANKERP C. P. C. CLESTER PA. 0 4006 7520 011. 1011 DELFMARE NO. 0 2000 ONSHORE E.P. 2 TANKERP C. P. C. CLESTER PA. 0 3712 7615 BAKER 1214 CHEPK DAY 0 400P ONSHORE E.P. 2 TANKERP C. C. CARE MAY NO. 0 3712 7615 BAKER 1214 CHEPK DAY 0 400P T.355 DIESEL 1230 NY HARICC 0 693P TR. 100K 5 680UND C. P. G. NEW YORK MY 0 400P 7355 DIESEL 1230 NY HARICC 0 693P TR. 105K 5 680UND C.	N P. G. DELAMARE BAY 0 385C 750 3832 1010 DELAMARE NY. 0 400C 7510 0 200 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N P. G. DELMARRE BAY 0 3850 7501 5AS#2 1010 DELMARRE NV. 0 1400000 N. S. C. MIPTR B. P. 0 4006 7520 DL. 1011 DELMARRE P. 0 2000P. N. S. C. MIPTR BDS WA 0 3712 7515 BHKER 1214 CHERN BAY 0 600P. D. C. C. MIPTR BDS WA N. 3 3850 7420 GRUDE 1229 FILMIC 0 100000P.	N P F G DELNMARE BAY 0 385C 7501 3AS#2 1010 DELFMARE PAY 0 1450-00 ON 1450-00 ON 1500	N P E G DELAMARE BAY 0 4056 7520 011 DELAMARE NA 0 4050 0150 0150 0150 0150 0150 0150 01	N P. G. DELMARRE BAY 0 3850 750 5852 1010 DELMARE HV. 5 140 04 04 750 011 1011 DELMARE P. 5 200 P. 5 20 01 10 051 MARKE P. 5 200 P. 5 20 P. 5	N P F G DELMARRE BAY 0 385C 7501 5AS#2 1010 DELFARE FAN 0 14504 NF 1750 SET 2 P E CHESTER PA 0 4006 7520 OIL 1011 DELFARE P 0 2004 ON HOFE FER 3 N S C HATRA BOS WA 0 3712 7615 MAKER 1714 CHSPK DAY 0 60P MW WANG HFMM 3 0 G CAPE, MAY NJ 3 3850 7450 CKUDE 1229 ALLYNTIC C 10000F TS 100K 3	N P. G. DELARARE BAY O 385C 7501 385E 7001 DELMARE NV. 1400CF 701 701 385C 701 0 200 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N P E G DELAMARE BAY 0 3850 7501 3852 1010 DELAMARE NA D 19504 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N P E G DELAMARE BAY 0 4006 750 13582 1010 DELAMARE NA 0 4006 750 0 100 DELAMARE PRO 0 2000 0NS 4000 0 100 0	9 U
P E CHESTER PA 0 4006 7520 0IL 1011 0ELF#AFE 8 0 2000P	P S CHESTER PA 0 4006 7520 OIL 1011 DELMARED P 0 5000P 005405E ELF 2 FARKEUF C N S CHAPTREDS VA 0 3712 7545 DIRKE 1214 CHEPK DAY O G CARE MAY WAS 3 8850 FORDE 1229 FILTRITC O G CARE MAY WAS 3 8850 FORDE 1239 FILTRITC O G CARE MAY WAS 10 4047 7355 DIEGEL 1231 GET OF ALREAD C O G CARE MAY WAS NO 0 4047 7355 DIEGEL 1231 GET OF ALREAD	P R CHESTER PA 0 4006 7520 OIL 1011 DELAWAFE P 0 2000P	P S CHESTER PR 0 4.006 75.20 OIL 1011 DELNAREE S 0.200.F ONSHOEF ERF 2 N S CHAPIN BOS WA 0.3712 7615 UNKER 1214 HORK DAY 0.400 MW WANTS HERM S D G CAPE MAY NJ 3.8850 74-30 CKUDE 1229 ATLANTO 0.10000F TS 100K	P E CINSTER PA 0 4006 7520 OLL 1011 DELMARE R 0 2000 ONSHORE REF 2 TANKRUP C N S CHAPTA RDS WA 0 3712 APS 1000 HOSEN BAY 0 900 MAY WANTG HERA 3 COLLEAN N P O G CAPE MAY NA 3 3850 7450 CRUDE 1229 FILENIE C 100.0F T5 1000 B 3 6800 ND C P S G NEW YORK BY 0 4047 7555 DESEL 1230 AY HARROLE 0 6,32 TB 1-104 5 0800 ND C	P S CHEGTER PA 0 4006 7520 OIL 1011 DELMARED 9 0 2000P ONSHORE ELF 2 TANKRUP C N S CHAMTAR BOS VA 0 3712 7655 BMRER 1214 CHSPK DAY 0 60P MY WATGH FRY 3 COLLSN N P 0 G CAPE MAY NA 3 3850 7420 GMUDE 1229 FILMING C 10000P TS 100K 3 GEOUND C P 5 G NEW YORK NY 0 4047 7355 DIEST 1230 NY HARROG D 6932 TB 1-10 N S 6800ND C	P. F. CHESTER PA. 0 4006 7520 OIL 1011 DELMARE P. 0 2000-P. N. S. CHIMPER BOS WA 0 3712 7615 MARER 1214 UNSER DAY 0 0 00-P. D. G. CHADE MAY M. 3 3850 7450 GRUDE 1229 FILMITC 0 100700-P.	P. C.	P S CHESTER PA 0 4006 7520 01L 1011 DELMARED P 0 5000P 005405E ELF 2 FARKEUF C 0 600 MS 470 ELF 2 FARKEUF C 0 600 MS 470 MS 1712 DELS M 3 COLLISM M S C HAPTR BES VA 0 3712 FAST SHEEF 124 CHERM LAAY 0 600 MS 1712 MS 3 GOLDISM M S C GREE MAY MAY 3 3650 7500 MS 1729 FILTHNIC C 10500F TS 160K 3 GOLDIND C S G GREE MAY MAY 0 4047 7355 DIESEL 1230 MY HARROE D 6530 MS 125 H 1-10K MS 2 G G G G G G G G G G G G G G G G G G	P E CHESTER PA 0 4006 7520 OIL 1011 DELMAREE 9 0 2000P	P. C.	P E CHESTER PA 0 4006 7520 OLL 1011 DELPMARE R 0 2000P ONSHORE REF 2 TANKRUP C N S C HAPTA BDS VA 0 3712 7615 BAKER 1214 CHSSK BAY 0 60P WY VANG HPZM 3 GOLLON M P 0 G CAPE MAY NA 3 8850 7450 CABDE 1229 FILMITC 0 1000CP T3 100K 3 GEOUND C P 0 G CAPE MAY NA 3 8850 7450 CABDE 1229 FILMITC 0 6937 TB 1-0K 5 GROUND C	P. S. CHESTEP P. G. 4006 7520 DIL. 1011 DELM#AFE P. G. 2004 ONSHORE F.E.F. Z. FANKRUF C. N. S. C. Hapta RDS VA. G. 3712 7455 BMRER 1214 CHESK DAY G. 900P MY VATG HFZA 3 COLLSN N. D. G. CAPE MAY NJ. 3.3850 7450 CRUDE 1229 FILENTIC C. 1020P F.S. 100K 3 GEOUND C. P. S. G. NÄR YORK NY. G. 4047 7355 DIESEL 1230 NY HARBUE. G. 693P T.B. 110K S. GROUND C.	P E CHESTER PR 0 4006 7520 OLL 1011 DELPHARE P 0 2000P ONSHORE REF 2 TANKBUR C P C G CAR MAY NA 3 3850 7450 CHOR 1229 ATLANTO C 0 00P TAY VANC HEZA 3 GEOUND C P C G CAR MAY NA 3 3850 7450 CHOR 1229 ATLANTO C 0 100.P T3 10.0K 3 GEOUND C P S G MAY NA 10 4047 755 DIESEL 123 NY HARMER D 6937 TB 1-10K 5 G 500ND C N C C CAR YORK NY 0 0 0 0 0 0 0 DIESEL 1231 GLF OF ALBERA 0 100.P FY SANGGA(UB) 4 GEOUND CC	a v
0 HOP 0 AVI MORN HOLD BOARD 121 CONT. CO. C.	N S C HYPTH RDS VA 0 3712 7615 BHKER 1214 CHSPK DAY 0 80P MY VRNUG HFZM 3 GOLLSN M C GAPE MAY NJ 3 3850 7440 GEUDE 1229 FILENTIC 0 1000G R 5 6800ND C P G GREY VERN M C GAPE MAY NJ 3 3850 7450 GEOUD 1229 FILENTIC 0 1000G R 5 6800ND C M C GAPE VERN M C GAPE VERN M C GAPE MAGNATUR C 0 0 0178 L 3 GEOUND C M C GAPE VERN M C GAPE M GAPE M G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		N S C HIPTN RDS WA 0 3712 7615 HAKER 1214 CHSPK DAY 0 BUP MY VANIG HEZM 3 P 0 G CAPE MAY NJ 3 3850 7450 CRUDE 1229 ALLANIC 0 10030P IS 100K	N S C HAPEN RDS VA 0 3712 7615 BRKER 1214 CHSPK DAY 0 60P THY VANG HFZN 3 SOLLEN N O G RPE MAY NJ 3 8450 T450 CHSDK 1239 FILTNITC 0 1050P T5 106K 3 SEGUND C P G GREE MAY NJ 3 8450 T450 CHSDK 1239 FILTNITC 0 1050P T5 1106K 5 GROUND C P G NEW YORK MY 0 4047 7355 50ESL 1239 NY HARRINGS 0 653P T9 1-10K 5 GROUND C	N S C HAPTN RDS VA 0 3712 7615 BNKER 1214 CHSPK DAY 0 60P MY VRNIG HEZN 3 COLLSN N C G CAPE MAY NJ 3 3850 74-0 CGUDE 1229 ATLANIC C 1020CP TS 106K S GROUND C P G G NEW YORK BY 0 4047 7355 DESSE 1233 NY HARRUE D 6932 TS 191-700K BY 0 4047 7355 DESSE 1233 NY HARRUE D 6932 TS 191-700K BY G G NEW YORK BY 0 4047 7355 DESSE 1233 NY HARRUE D 6932 MG NA MG NG	N S C HAPTN RDS VA 0 3712 7615 BAKEF 1214 CHSPK DAY 0 BUP	N S C HIPTN RDS VA 0 3712 7615 BNKEF 1214 CHSPK DAY 0 80P MY VRNIG HFZN 3 P 0 G CAPE MAY NJ 3 3850 7450 CRUDE 1229 ALLANIC C 10000 TS 100K 3 P 0 G MEN YORK BY 0 4047 7355 DIESE 1230 NY HERBUE 0 693P 19 1-000 MEN YORK BY 0 4047 7355 DIESE 1230 NY HERBUE	N S C HYPTH RDS VA 0 3712 7615 BYKER 1214 CHSPK DAY 0 80P MY VRNUG HFZM 3 GOLLSN M S C GAPE MAY NJ 3 3850 7440 GRUDE 1229 RILRHITC 0 10000P TS 100K 3 GROUND C P G GREW VARNE N 0 4047 7355 DIESEL 1230 NY HARRUE 0 603P TB 170K 5 GROUND C N M K G K K K K K K C O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	S C UMONTH BAC UN O 2712 7615 MIKER 1214 CHSPK BAY O 80P	N S C HAPIN RDS WA 0 3712 7615 BINKER 1214 CHSPK DAY 0 BUP MY VANIG HEZH 3 D G G CAPE MAY NJ 3 3850 7450 CAUDE 1229 FILPNIC C 10030P IS 100K 3	N S C HAPEN RDS VA 0 3712 7615 BEKER 1214 CHSPK DAY 0 BDP MY VRNIG HEZM 3 COLLSN N C CAPE MAY NJ 3 3850 7450 MEDDE 1225 FILENTIC 0 10000F TS 100K F 3 GROUND C 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N S C HYPTN RDS VA 0 3712 7615 BNKER 1214 CH9PK DAY 0 80P KV VRNIG HFZM 3 COLLSN M C G G G REW NJ 3 3850 7450 CRUDE 1229 FILENTIC C 1020CF TS 100K 3 GROUND C P S G NEW YORK BY 0 4047 7355 DIESE 1230 NY HARROR D 653PC TS 1-100K NY 0 4047 7355 DIESE 1230 NY NY 0 4047 7355 DIESE 1230 NY 0 404	N S C HYPEN RDS VA 0 3712 7615 BYKER 1214 CHSPK DAY 0 80P MY VRNUG HFZN 3 COLLSN N C CAPE NAY NA 3 3850 7450 GEDUE 1229 FILENTIC 0 1000E TS 100K 3 GEOUND C P G GAPE VGSK NY 0 4047 755 DIESE 1230 NY HARBUE 0 6-3P TB 170K 5 GROUND C N K G KAVAK 13 RX 0 0 0 DIESE 133 GEP OF ALPSKA 0 100F FV SAMBGA(UE) 4 GROUND CC	U S N
The state of the s	P. G. CAPELMAY NJ. 3 3850 7450 CRUDE 1229 ALLANTIC C 10000F TS 106K 3 GEOUND P. G. GAPELMAY NJ. 0 4047 7355 DISCULLAGE AR AND B. S. GEOUND B. G. GAPELMAY NAT. 0 4047 7355 DISCULLAGE AR AND B. S. GEOUND B. G. CAPELMAY S. S. G.	N C HADTH BAC UN O 2712 7615 HIKEE 1214 CHSPK DAY O BOP	P 0 G CAPE MAY NJ 3 3850 7450 CRUDE 1229 FILENTIC C 10000F TS 100K 3	P 0 G CAPE MAY NJ 3 3850 7450 CRUDE 1229 ATLANTIC 0 10030P TS 100K 3 GRUND P S G MEN YORK MY 0 4047 7355 DIESE 1230 KF HARRUE 0 652P IS 1-10K 5 GRUND	P. G. CARE MAY NA. 3 3850 7450 CRUDE 1229 ALLYNTIC C 10010F TS 100K 3 GEOUND P. G. G. NEW YORK BY 0 4047 735 DESCE 1230 NF MERSER 0 6457 TS 5 GEOUND P. S. G. NEW YORK BY 0 4047 735 DESCE 1230 NF MERSER 0 100F FV SANGRAUES 4 GEOUND	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P G G REW YORK MY 0 4047 7355 DIEST 1230 MY HERUF 0 673P TE 100K 5	P 0 G CAPE MAY NA 3 3850 7450 CRUDE 1229 ALLANTIC C 10000F TS 106K 3 GEOUND P 0 G CAPE MAY NA 0 4047 7355 DESGE 1230 NF HERBOR D 6945 15 1-10K 5 650UND N 0 0 0 1000 0 0 1000 1000 1000 1000 10		9 G CAPP MAY NJ 3 3850 7450 CRUDE 1229 FILPNTIC C 10000F IS 100K	P O G CAPE MAY NJ 3 3450 7450 CRUDE 1229 ATLANTIC C 100302 TS 106K 3 GROUND	P G G REW YORK MY 0 4047 7355 DIEGI 1230 NY HARRUF 0 6932 T 8 1-004 B G GOUND	P 0 G.A.P.E.MAY NJ 3 3850 7450 GRUDE 1229 FILENTIC C 10000F TS 106K 3 5600ND P 0 G.A.P.E.MAY NJ 755 DISCULLAGE NF HEROLE D 0 693P 15 15 1-0K 5 600ND N K K K K K K K K K K K K K K K K K K	
2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P S G NEW FORK BY 0 4047 7355 DIESE 1233 NY HARRUE D 6932 19 1-10K 5 GROUND N C NEW 75 EV SAMEGA(UE) 4 GROUND	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		P 0 0 NEW VORK NY 0 4047 7355 DIESE 1230 NY HARBOLF 0 6932 78 1-10K 5 GROUND	2 G MEN YORK MY 0 4047 7355 DIESE 1230 NY HARBUE D 6932 19 1-10K 5 GROUND		P G G NEW FURK BY 0 4047 7555 DIEGL 1230 BY HARROIT 0 6239 TB 1-000 AND 1000 BY	P S G NEW FORK BY 0 4047 7355 DIESE 1230 NY HARRUE D 693P 1B 1-10K 5 GROUND N G NEW FORK BY 0 0 0 DIESE 1231 GLF OF ALBSKA 0 100P FV SENEGA(UE) 4 GROUND	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		5 GROUND 1-10K 5 GROUND 1-10K 5 GROUND 1-10K 5 GROUND	P 0 6 47E M 0 4047 755 01831 1230 RF HARRUE 0 6 93P 18 1-1018 M 0 4047 755 01831 1230 RF HARRUE 0 6 8 8 8 10 18 M M 0 4047 755 01831 1230 RF HARRUE 0 6 8 8 8 10 18 M M 0 4047 755 01831 1230 RF HARRUE 0 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	P S G NEW R TO WAS TO 4047 7355 DISSELIZED NY HARRUR D 6932 IB 1-10K 5 GROUND N G KAYAK IS AK 0 0 0 DISSELIZED OF ALLASKA U 100P PV SENEGA(UE) 4 GROUND	
5 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	N C CLEAR IS C O O DIEST 1231 GLE OF ALASKA O 100P FV SAMGA(UE) 4 GROUND	5 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5 6 6 M N VORK NV 0 4047 7355 01831 1230 KY HARBUR 0 6932 18 1-10K 5		ONDORD # (RE) MUNICIPAL ACT OF THE PROPERTY OF	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	The state of the s	N C KATH IS BY O O DIEST 1231 GLY OF ALASKA O 100F FV SAMEGA (UF) 4 GROUND	5 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5 6 230 1-10K 0 40A7 7355 51951 1235 KY HARBOUR 0 6932 18 1-10K 5		CALLORY II VALLET IN THE COLUMN TO THE COLUMN THE COLUM	N E C KAYAR IS AK O O DIEST 1231 GLE OF ALESKA O 1004 FV SAMRGA (UE) 4 GROUND	0000
	100 C TO			CNDORS TO RECT VOICE OF TABLE AC STORES AC STORES		NA ACCUSATION OF THE PROPERTY		יייייייייייייייייייייייייייייייייייייי	10 M		CALCAS II VALLET CON CO. C.		STATE IS THE COLOR OF THE COLOR	2
2001 0 17311 20 111 111	The state of the s	Ad addit a contract to the con	THE THE WAY OF THE PARTY OF THE		A G KATAR 13 AK U U U U ULESE (23) UES	The state of the s	K G KAYAK IS AK O O DIESE 1231 GLE OF ALPERA	The state of the s	75 700 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	THE PERSON AND COURT OF THE PERSON AND THE PERSON A		C KAVAK IS AK O O DIEST 1231 GET OF ALPERA		
1900 P 19	C C CENTR TS EX O O DITEST 1231 GLF OF ALESKA O 100F FV SERBOR (UE) 4	1900 M HOLE IN 1900 DEED 1900 M HOLE IN 1900 M HOLE	TOTAL		TO TO THE PARTY OF	G NEW YORK BY O 404/ /355 DIEST (230 M MAND)		K IS KENER IN BK O U O DIESE 1231 GLF OF ALASKA U 100F FV SKANGA (UE) 4	G NEW YORK BY O 404/ /355 DIEST (230 M MAND)		10 Maria 10		K G KAYAK IS AK O O O DIESE 1231 GLF OF ALASKA O 100F FV SEMBLAR(US) 4	0
			The state of the s	SENERAL OF SERVICE OF	1 X X X X X X X X X X X X X X X X X X X	TO TO THE OF ALLSKA O 100P PV	K G KAVAK IS AK O O DIESE 1231 GLF OF ALBERA			10 10 10 10 10 10 10 10 10 10 10 10 10 1		E CHAPTE IS BE O O DIESE 1231 GLE OF ALBERTA O 100F TO SECRETARION O SEC		

		7 1 2 Z							ANT A YOUR	UNI			
	THEO SECTION OF SECTION	200	10CA110N	SHR LATE	LONGE	2011 04	OCC SOLY OF STAC	12 42 14		6 A LS	200000	242 24 TSE	PF EOS
	-												
	50301 00176 0301567	NPACT	TARRYTOWN NY	0 411					2		1.4.	5 03118	
	56002 00376	σο 	2	1010	7400			_	2000 230		ICHG OIL	2 FIREK	
	90226	A .	PRESBEG W VA	2	6130		0107 LIHF # 00D C				EUSEKA PIPELA	Ide STH	4.72 N.
•	56004	4	ENINOIE OK	0 3510	2000	Caune of	GION GORTKEON O	1	316	210	Change Little	1 5157	- a
	56.006.01.876		HIBYVILLE IL	0 3924	9920			. 65	213 212	C		1 35	0 P P P
	56007 04576 0500064	N P O S C	HESPKE BAY	0 375	7605	66 02			250 250	0	8174E STC101	S SINKING	
	56008 0886423		TONEHALL TX		10015	C				0	ONSHOLL PIPELN	. PIPERUP	
	56009 03676	U	LACON IL	0 410	8922	0		"AIN				S C0115N	N EPA
'	56010 04276 0802115	N P S P	BUTAS LA	2 2925	7260	CEUDE 02	CALFORN	Y V	56 55	0	2	B 21 P 25 U 2	0
	56011 05676 0900085		SUPERIOR HIS	0	015		0221 ST LOUIS BE	1 16	200	5 .	CASHORE DITE	TANK TO S	10 M C 11
1	56.113 0707, 0903001	D	CTROOM IN	200	9500	2002					1-108	S PEPI OS	N U NS
	56018 07276 0803001	4	HEADEOUD DA	0 415	7840			4				1 LINERUP	IIP EPA
	56015 09376 0200667	7 4	MARTNSVILE IL	0 3920	6750	20		05			ONSHOFE PIPTLN	1 MNFOPLE	61
	56016 1057	A .	PITTSBURG PA		7958		MNNGHLA				HGO HT.	9 VLVIPTO	0
	\$6017 0200555	XX	ANA DAPKO CK	0 3503	9822	١.	1	VEF		5	ONSHOPE PROD	2 EUPPLE	EPA
	12076	N P B C W	ESTVILLE NJ		7509			4.7. Vb	96	P.	NY 15KACO 111	NSTICO	
	56019 0300487		LATTSBEGH NY	•	7328 0	IST		N.	70		ONSHORE STRUE	2 PUMEPLE	u c
A -		-	GALVESTON TE	0 2930	7213	1	DSD4 GALVESTON EAT	EAI	612 612		TO MESS CLOS	O VALUE O	CATE CATE
. 7	56022 12976 0900256	40	CITATIAND ON		8144	RANKER	LAKE		12		,	S COLLSN	
•	56023 13476 0300588	1	JESSET CTY NJ	0 4044	7405	7	1 35	1	5000 >70		JESTS BUCKSHO	2 TANKBUP	PCN
	56024 0886628	X d	ONGVIEW TX		9525	DE		1				1 SPLNRUP	B EP
	56025 14770	3 H	ELLSLEY I NY	0 440	7 7600			EVE	307 337		B NEPCO 140	S GROJND	
1	\$6026 15676 0100025	-	ST JHE WB CAN	0 4518	0 8559 C			10,		-	MY JI GFER (LI)	4 PARTHO	S
	56027 15776		HITEHSE PLA	0	0		OPIEG	25 M	214 071		3 6 6 6	3 65118	2 2 2
	56020 0970730	١	OUTERNO LA	ole	9710	20 03318	0716 GI B OF SEVIO	001	200	٦	TAK NOWN VECTOR	2	1
	56030 17076		EAST BEADY PA		7942			N. A.	184 184		TANK CARS	9 DERLENT	42
	56031 18576	1	HAVERPORD PA		0			NO				2 SEEPAGE	2
	19676	N X	NIKISHKA AK	0	0		-		210 210	1	SNS STAT PAC	9	
	56033 0301256	× :	FOY MY		7345 6	-	HODGON	(ri	150	5	ONSHOEE TRANSF	5 1	
•	56034 99999 0851006	7	NOBILE ALA	000	2003	-1-	OTA TOUTE BAT	-	75 75	2	CAS CITAL CAS	CALCACA	200
	56036 22876 0700966	,	HIS	00		BAKER 11	2	181	70 70	0	ONSHORE PIPELN	1 CPLNPLE	
	56037 0831120	S	TEXAS CITY TX		9454		1129 CEXAS CLIT	CH	168	0	ONSHOEE FIPELN	1 PPLNEUP	U
	56038 24076 0103073	0	MANTCKT SHLS	27 4101	6927		40		7600 7603	2	05.3	4 GROUND	TSO # 0
	56039 24376 1101114	M	L ANGELES CA	0	11816	-	_		1000 >20		AV STASINEN?	3 EXPLOSM	10
	56040 0812139	-	OSTREE OF 150	1	9130 D	-	218 GLF OF MEKICO	i			OFFS HORE PROD	8 PPANEUP	2
	56041 24776	-	RECUS HOOK PA		7507				134 134		MV OLYNPC GAME	4 GROUND	u :
	56042 25576		PUEBTO NO PA	21.716	12226	AUDE 1	1230 ATLANTIC	6	349 349	. 2	DATE NO. DELLE	O TENEDIA	TT WE SAME
		e	SALVONC	,	0777	SA A	N T T N		0 8 6		MV BTLGS (US)	3 GROUND	
	56P03 07776	0	SAN JUAN PR	-	6607	4	ATLANTI		33 80P		UG GELDERLAND	6 GROUND	U
	56204 0900087	P E	BUPPALO NY	0 4252	7850	DIST 0	MIAGEA	RIVER	0 84P		ONSHE BLK TRNS	2	E
	56 POS 12176 0500256	H D C G H	HOLLAND PT MD	0 3850	7630	DI PET	DEOL CHEDKE BAY		3705		(NI) (XHSHX AN	CAUCAC T	TINE C

and the same

												AMT	AMOUNT	The second secon	7		
NAC	PIRS OTH	2 C S	100	LOCATION		R LATE	DIST SHE LATH LONGW	1108	DAC	POLL DATE BODY OF WATER	WATCH	NGALS KGALS	KGE TS	SOURCE		CAT CAUSE	PREOSC
						-		-		0	,	0	63005	TS 10-20K		PIPESUP B ST P	H ST P
90	0700452	6	S B S	ST PTRSBRG PL	14	3 2750		9	200	0020 . F.3PA DAI	1 10	00	28632	TB 35-50K		STRUPLR	M PRTL
200	0100237	C	S	POPILAND ME	-	C 434		CEUD	0110	STELL ST.		0 0	40008	75 50-100k		GROUND	CLA
700	1101026	d	000	G SAN PEDRO CA	CA	0 334		6 CRUDA	7711	PACIFIC			185000	IN VITEELA (S	7 (2		C PHIL
7226		×	9	G DIWRE CITY DE	DE	0 393		CRUD	3115	DELP 4R.	7.00	1	10001	HERGE SEC 41		GEOUND	A HA R
2000		2	200	WIFTRAP LIGHT	GHT	0 393		90 2	112	CHSPAL	DEL	0 0	1000	HENS MODERALY			C HONI
11. 2337		Z	9	KANEOHE HAWAL	HAL	0 212		7 1b4/	01130	NANEOUE UN	IIVI .		1560	THE TIME		GROUND	M BALT
12 23074	-		9	MOSS PT MD		0 331		9 0	121	POLOGRA		, ,	16000	13 STC 411		GEOUND	S BALT
13 24676		*	9	CINE BEACH VA	VA	0 375		9 6	777	A CASTARPAN	CASTARPAN S72		16030P	P NV DAPHINE (LI) 4	1) 4		N SAN
56p 14 25076		z	90	G GUAYANILL PE	4 ;	91/10		4357 685 12	1228	H LAKE HILLON	LON	0	558	UNSHOTE TRANS	6	DSGNFIT	-
15	0900887	a.	S	SAGINAM BAY	I	0 433		240	14.4		-						

The second

		O.											A 40037				
NEC	PLAS OCURE	S	00	LOCATION	DIS1	1 11.	1016	TTOU ME	17 DAT	e 64.	BUDY OF ANTER	01504 AGALS	1 13 a 1 T	30.0.02	CAT CAUSE		PAROSC
1000	0.100000	2		6				c		1.00	DEK 43.N CH.3.MI			TB WEA YOUR	5 00115	20	TAMPA
1 600	1300000			S1184 5	c	0 4236	11440	1 1		0122 SN	NAKE E	55		DAUFE TIPEL	N 1 PPLESUE	M	7 × 44
17477	0163020		. 0	CIVIND 1DG	4 5			2				130	100		S GF041ND	U	
03577	0300115	. 0.		AGHIND FLS	N					0204 HU		0.5	964	TH ETHIL H	S GROUND	-	*
34577		×	×	TUSCALOUSA	71		10 67	9			BICK WRFIDE	5 50	05	TB 33 (US)	· 0	25 (PA IV
	0200767	34	×	BRISTON OK		2	96 09	17				D		OUSHE FIFTIN	-	a. 6	
57307 05077		z	X	PACIFIC	30	0	00 178	12	UDE 02	0223 PA	CIFIC	003	0000	NV HAMAIN PURT	7.0		* 100
-	0300500	4	×	HEMPSTEAD NY			30 73	7		7.7				CASHE DIRSIL	v 6	٠.	200
12690		:5	n	7	7	71010	11/ 74	7410 .2		0305 30	SOFILE CANFL	75	35	TABLE TOTAL	CHARGE S C	2	1001 ×
07777	0200259	N.	×	G LOUISVILLE	K Y	200	20 02	42 GAS	- 1	20 0000	CHOO H CTHO	1	240	OF CARACT SERVICE	10	W 450	HR
1610		= 1	2 :	TOP ATOMA			01.	000 0001		0.00	A AMERICA		, ,	DESCRIPTION OF STREET		Ada du c	A IX
-	1100305	2, 3	4	NO.		000	-	TOTAL COC.		1 1000	100000000000000000000000000000000000000			UNSHOFE PIPFL	N 1 PIPEFUP	OP EL	EPA VI
	0804146		٠,	DELCARORE LI		0 5418	•	210 01			PACTPIC	7	72	FISHING VESST	0	DO CK	GD17
77.00 \$107.5	2		٠,			0 00		53 011			DELAGRER H	6	97	SPEIOF ZING 2	2	U	PHIL
1000	0850506	5 0	4 0	CHIE SHOPE		200		8740 ASPHL				S		UNKNOWN	0	0	N OFL
-	G847527	10	-	TRINITY TX		0 31	ï	3C CRU						OMSHE PIPILM	1 PIPERUP	400	
	20000	. 0		POPTIBND AN		0		12 DIE		-	TIANTIC	128	er.	ONSHE BLKSTFG	2 TANKEUP	RUP	
57019	0820631	. 2	cio	CORP CHEST	×	0 2749		9726 3AS				218		73	1 PIPER	200	1
57020 11377		z	10	GEAND ISLE	* 1	2167 0		TGDRD 00		0614 BA	BAY AZLVILLE		0 >100	PIPELING	1 pplkpup		7 00 K
11477	7 0800033			INTRC WIF WA	AY	67 0	0	50 86		+				327GZ MM102	5 CO.LSN	N S	FT AF
11577		d.		YORKTOWN VA		0 371		56 16	- 17	~	OFK SIVER	- 1		83GE ACC586	S COLLSIA		
57023	1			GUTHRIE TX		0 33	-	0015 CRU						ONSHE PIPELS	12416		
57024 13577	9980080 4	O.		WEST HAVEN	CI	0 4114		Se DIESI		0717 NE	NEW HAVEN HBE		5 55	STORAGE TANK	2 PIPERUP	200	N U U
		z	×	JCHNSIONN P	4			710 00			HODYES	2	20.0	Trong and	٠.		
12377		z	×	ANAHEIM CA				52 Caube			CAN. F. P.NA .	200	00	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	- 0		
	0701667	۵.	S		4	0 31	3105 81	8130 # 50		1710		200		Capata Lab Fra	NACANNI L	200	
57028	0200783	2		U MI CANREL	1	-1		DO CHUDE		- 00	30 0000	2 4	-	- 0 1-10×	ď	NU	
	7709090	a :			1 4	200		210 000		10000	DIATES AN EST	2000		HAYONE IND	2 GNKKOW	25	N YFK
7/190 050/5			-1	Serious Seriou		2 0		OC CHANG	1	11 11		100			CUNKNOE	N N N	BALT
77551 15075	0000000			DED NOTED OF	0.0	000			,		4 11	2.0		BUCKEYE PIPEL	N 1 PIPESUP		TOLDO
57031 10077		5 7	1	E FO FRV P		0 29		9100 CRUDE		0913 MI	MISS. P M115		74	TET MARJUESS	4 STKBUOY	DON C	N OF L
57034	0201526	. 0	. >	GENT NGPID NO	c	0 3720		9325 ASPHI					.0	ONSHE NON-IF	2 NATPHEN	HEN	
	0201275			JASPER IN		0 35		30 DIEST		15		06	0	ONSHE OIL PAR	Z INT 5	510	
15377			·	HOUSTON IX		0 29		æ		1026 GA	GALVESTON BAT	Y 300	0	PEDACOD CHEM	2 FIFE		EPA VI
57037 16677	7 0201487	Z	×	PRANKLIN MS							HOMOCHITTO R			8" PIPELINE	1 PIPE		EPR IV
00577		7				0 39		7527 CRU	3		DELASARE R		0 21000P		3 GROUND		CCB 610
57902 01077	3	×		GEND T BAY MI	HI			G			LAKE SICHIGAN		0 230JP		3 60	U	SS
01377	1	2		G TNGR SOUND	Q			99 555		-20-7	TANGLER SOUND	0	3809 O	TH INTRSTATE!	2	ND CM	BALT
01777	1	Z	×	CAPE GRAED M	NO	1					UP MISS. MISO	Q	0 1688	Ta 1250-51 (US)	S BC	HI 0 H	P DOG 4
07377		N		G CUCKHOLD CB				30 • 2KE			PATUXENT F		0 2005	18 48GL 175 (US	2	N.D.	BALT
		ď		*		0 37		7635 DIESI			pr.		0 2052	ONSHE FUELING	7 H	Et up a	HA FD
08277		N	-	G CRLN BCH INL	1.1				0		CALN BCH INLF			4	S GROUND	E GN	THE
	0500585	d	S	CHESAPK BAY		0 37	3728 76	7617 DIESL	0	0519 CH	CHESAPK BAY		205 0	TS 0-1496T	S PROBLEM	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	
CTC21 DOGC3								•									

APPENDIX B:

OUTFLOW RATES FROM SEVEN MASSIVE TANKER SPILLS

In this Appendix seven massive tanker oil spill incidents selected from Table 4-4 of Section 4 are analyzed in order to estimate the rates at which oil entered the water during the incident. Only rough estimates are possible, in most cases, because no direct observations are usually made of oil outflow at the time of the incident. As a result, outflow rates must be deduced indirectly from several sources.

1. POLYCOMMANDER (Source: Reference 4-4)

May 5, 0330: 49,414 tons onboard.

May 5, 0420: Went aground, immediately began to spill oil.

Spark from assisting vessel started fire.

"Now appears there are three big fires."

May 6, 1530*: Fire quenched 36 hours after start.

May 7 : Fire considered terminated as of PM May 6.

May 8, 1200*: "Engineers battled to stem flow of crude oil leaking

from Norwegian Motor tanker."

200 tons out of 35,000 onboard have been pumped off,

slowly.

May 9 : Navy officials estimate "500 tons of oil had leaked

from the tanker." Offloading stopped.

May 12, 1200*: Oil leakage stopped, apparently.

"Officials estimate small vessels transferred

15,000 of the 35,000 tons of crude oil left inside

the vessel."

May 16 : Estimated 20,000 tons pumped out, 15,000 tons

remaining.

From May 5, 0430 to May 8, 1200*, a total of about 80 hrs, the vessel lost about 49,414-35,000 = 14,414 tons of oil to the fire and to Vigo Bay. If the Navy estimate of 500 tons leaked is correct,

^{*}Indicates estimated time.

then about 13,900 tons burned in 36 hours. Assuming the leakage was constant over the 80 hours gives an outflow rate of 6.25 tons per hour (1875 gallons/hr.). If the leakage continued from May 8 to May 12 at the same rate, then about 1050 tons was leaked in 168 hours.

2. WAFRA (Source: Reference 4-4)

Feb. 28, 0530: Grounded at Pt Agulhas, No. 6 port and center tanks also No. 5 port breached. A further four port side tanks filling slowly.

Feb. 28, 1200*: An oil slick about 1/2 mile long reported.

Feb. 28, 1800*: Oil slick 5 miles long.

March 1, : Slick 30 miles long. At least 2 center tanks

and 4 port tanks are leaking.

March 3, : Oil slick more than 30 miles long and five miles

wide.

March 3, : Crude oil from WAFRA "continued to foul ocean."

March 5, : Ship continued to leak.

March 6, : Found that a seventh tank was also leaking (See

March 2).

March 8, 1517: Vessel refloated shortly after 3 PM.

March 8, : Some 20 percent of cargo ... estimated to have

spilled into sea.

March 9, : 32,000 tons remaining.

When refloated it was estimated that 20% or 8,000 tons of oil had spilled, from Feb. 28, 0530 to March 8, 1517, a period of about 226 hours. This gives a leakage rate, averaged over the period, of 35.4 tons/hour (10,620 gallons/hr). No oil was pumped off or burned off in the 226 hours.

3. SHOWA MARU (Reference 4-4)

Jan. 6, 0530 : Ran aground in straits of Singapore. Master claims about 3600 kl (3168 tons) leaked in first 4-5 hours from 3 tanks.

Jan. 6, PM : Still leaking. Master says 1 million gallons leaked so far, three tanks damaged. He also stated that the leakage had almost stopped.

Jan. 7, 1200*: Master says 3,300 tons (1 million gallons) has

leaked so far.

Jan. 7, PM : "The SHOWA MARU has stopped leaking:

Jan. 13, : At least 4,000 tons are believed to have leaked

out.

Jan. 25, : "Previous estimates of cargo spillage may have

to be revised downward."

The estimated leakage in the first 4-5 hours comes to a rate of 633 to 792 tons per hour. If the vessel stopped leaking at say 1200 hrs on Jan. 7, then the leakage rate from 1000 Jan. 6 to 1200 Jan. 7, was about 32 tons per hour assuming that a total of 4000 tons was lost, as stated on Jan. 13. But if the total lost was the 3300 tons stated by the vessel master on Jan. 7, then the rate would be only 5 tons per hour. (See Figure B-1). From Figure B-1, it is seen that in either case there would have had to have been a dramatic drop in outflow rate from Jan. 6, to Jan. 7 if the vessel master's estimates on Jan. 6 are correct. These estimates are consistent with (a) his later statements and (b) the ultimate estimates of total loss made on Jan. 13. If correct, the initial loss rate was very high.

4. URQUIOLA (References 4-4, 4-6, and 4-8)

May 12, 1200 : URQUIOLA grounds, 100,000 tons of crude on board.

Tugs tried for an hour to free her.

1247: Port closed due to explosion and fire. Series of blasts reported. Still burning late in day.

May 13, : Oil turns water of port black. Huge oil slicks moved towards shore. 80,000 tons believed still on board.

May 14 : Undersecretary of State for Spanish Merchant Navy said last night that "as little as 5,000 tons" of oil cargo could have seeped into the sea, with the balance going up in flames.

May 14 : An estimated 5000 tons going toward shore. New explosion and fire; fire brought under control same day.

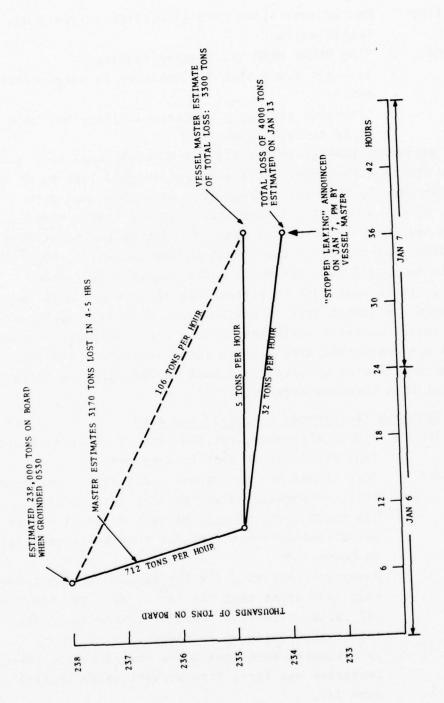


FIGURE B-1. OUTFLOW RATE ESTIMATES FOR SHOWA MARU STRANDING

May 25 : Still 9,000 tons in the vessel, salvage experts estimate. "More than 6,000 tonnes have been discharged."

If the Undersecretary's statement is correct, and if it was made at, say, 2000 May 13, then at least 5,000 tons leaked out in 32 hours, which gives an average outflow rate of 156 tons per hour.

Subsequent reports, however, report that the vessel contained 107,000 tons of crude and 3,000 tons of Bunker C, and that an estimated 100,000 tons were lost in the fire and leakage to the water (Reference B-2). Reference 4-6 notes that an estimated 25,000 - 30,000 tons of oil were washed ashore, and "most of the oil burned in the fire," which burned for a day (May 12-13) and restarted on the 14th. It is noted that the POLYCOMMANDER (50,000 DWT) supposedly burned off 14,000 tons in 36 hours, or about 10,000 tons per day. If the URQUIOLA burned at a rate of 10-20,000 tons per day for two days, then some 20-40,000 tons went up in smoke. Taking the upper figure leaves 67,000 tons to account for of the original 107,000 tons. Since there were about 9,000 tons still on board on May 25, and allowing 30,000 tons washed ashore, one obtains 28,000 tons of oil lost to the harbor directly, about the same amount as came ashore. This entire chain of conjecture yields about 58,000 tons outflow between May 12 and May 25. The corresponding outflow rate, which is also highly conjectural, is 185 tons per hour on the average.

The surprising aspect of this number, however, is that it is only 18% more than that obtained above from the statements of the Undersecretary of State for the Spanish Merchant Navy, for the first day's outflow rate. The average of the two estimates is 170 tons per hour.

- 5. METULA (Reference B-3)
- Aug. 9, 2220: METULA with 194,000 tons of light Arabian crude grounds at 14.5 knots, opening up 5 of her forward compartments. "About 6,000 tons of oil was initially released."

: "Loss of cargo increased due to the action of Aug. 9-19

tides and current."

Aug. 19 : Spring tides open 4 more compartments, resulting

in an additional loss of 14,000 tons.

Aug. 20 : Estimate total of 40,000 tons have been lost.

Sept. 19 : Estimate total of 50,000 tons lost.

Sept. 25 : Estimated 54,000 tons lost. (Shell Oil Co. esti-

mate). Little leakage after refloated on Sept.

24.

Later estimates based on offloaded amounts revised the 54,000 ton figure to 51,500 tons of crude plus 2,100 of Bunker C. This gives a total of 53,600 tons lost from Aug. 9 through Sept. 24. The above history of outflow is shown in Figure B-2. The "initial release" was assumed to take 6 hrs, and the 14,000 ton loss on August 19 was assumed to take one day, with a loss of 1,000 tons from 2400 Aug. 19 to 1200 Aug. 20, when the 40,000 ton loss estimate was assumed to have been made.

6. ARGO MERCHANT (Reference B-4)

A time-history of outflow rates for the stranding of the ARGO MERCHANT (15 December 1976) was constructed from Reference B-4. This reference agrees approximately with the On-Scene Coordinator's Report for the incident with regard to oil outflows, but some differences exist between the two with regard to wave height readings, which are shown in Figure B-3 as given in Reference B-4.

7. AMOCO CADIZ (Reference 4-4)

March 16, PM : AMOCO CADIZ, 230,000 tons of crude on board, disabled in English Channel, taken in tow by PACIFIC. Towline parted, tanker drifts toward Brest. Towline parted three times.

March 16, 2326: Aground at 48 36 12N, 04 45 54W.

March 17, 1000: Vessel breaks in two, pollution heave. Believe one tank ruptured. "Spillage is 50,000 tons."

March 18, (?): Spillage estimated at 80,000 tons, has 140,000 tons left. (Based on 220,000 total).

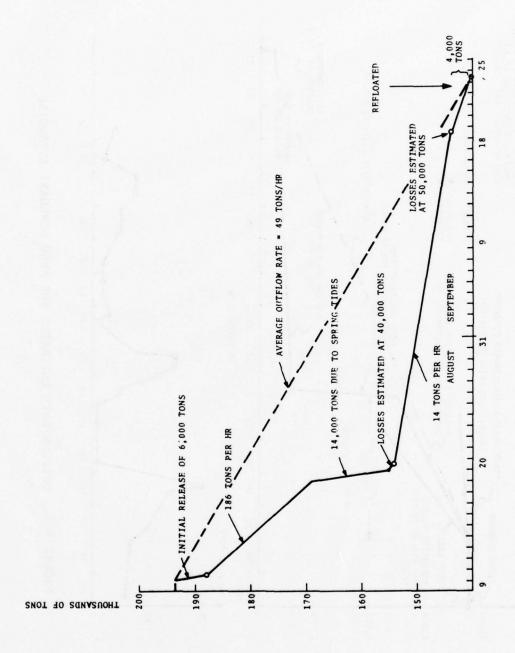
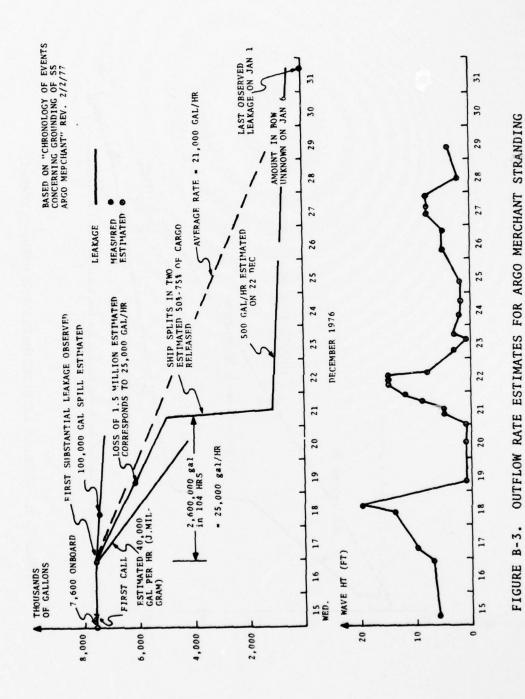


FIGURE B-2. OUTFLOW RATE ESTIMATES FOR METULA STRANDING



B-8

March 20 : "About 60,000 tons of oil leaking into the sea." March 21 : "Heavy seas have apparently opened another leak in a tank." March 21 : "Senior official of owners of AMOCO CADIZ said tonight the vessel had leaked some 170,000 tonnes of crude." Estimates that only 50,000 tons were still onboard. "more than 3 tanks have blown." March 24 : Aft part completely free of fore part, which is issuing more and more oil. March 24 : Estimates are that 30,000-35,000 tons are still inside. March 26, 1300: French Navy opens hatches to release oil. March 27 : About 25,000 tons still on board. March 29 : Breaks into 3 parts; almost all oil released. March 30 : About 10,000 tons left.

March 30

March 31

The time history of outflow for the AMOCO CADIZ is shown in Figure B-4. The initial rate of 4200 tons per hour is relatively uncertain because of the time at which the first estimate was made is uncertain. Because the vessel broke up early (1000 on March 17), it seems that the pattern seen in Figure B-4 is realistic., i.e., rapid discharge at first, followed by slower discharges. The average outflow rate of 600 tons per hour, shown by the dotted line in Figure B-4, is probably accurate to within 5%, the main uncertainty being the initial amount onboard.

: Depth charges release remaining oil.

: Divers report no oil remaining, only Bunker fuel

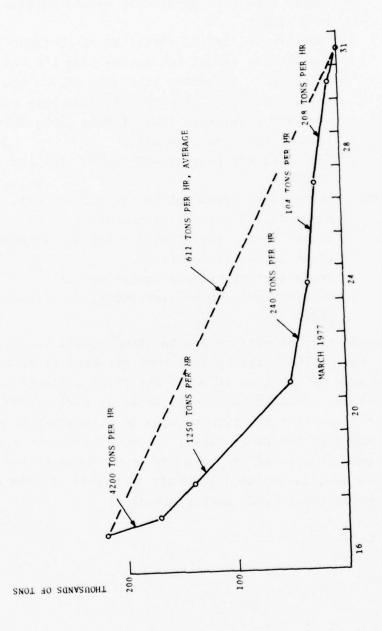


FIGURE B-4. OUTFLOW RATE ESTIMATES FOR AMOCO CADIZ STRANDING

REFERENCES FOR APPENDIX B

- B-1 Canelas, L.D., and J.D. Monteiro, "Some Studies of an Oil Spillage Due to the Jacob Maersk Accident," Proceedings of the 1977 Oil Spill Conference, New Orleans LA, published by the American Petroleum Institute, 2101 L Street N.W., Washington, DC 22037
- B-2 Gundlack, E.R., and M.O. Hayes, "The Urquiola Oil Spill: Case History and Discussion of Clean-Up and Control Methods," Marine Poll. Bull. 8(6): 132-136, 1977.
- B-3 U.S. Coast Guard, "Report of the VLCC Metula Grounding, Pollution and Refloating in the Strait of Magellan in 1974," Submitted by R.I. Price, Rear Admiral, U.S. Coast Guard, Chief, Office of Marine and Environment and Systems, February 1975.
- B-4 "Chronology of Events Concerning Groundings of SS ARGO MERCHANT," (Revised Feb. 2, 1977) U.S. Coast Guard internal notes.

APPENDIX C:

DISTRIBUTION OF U.S. COASTAL TANKER TRAFFIC IN 1985

Reference 4-16, Volume 3, gives U.S. petroleum imports and exports by trade route for the years 1973-2000. The U.S. exports in 1985 are small and will be ignored, and only the major import routes will be employed. The flows of crude/product in thousands of long tons for 1985, as extracted from Reference 4-16, are shown in Table C-1 along with the origins and destinations. The routes of Reference 4-16 are grouped by one of seven foreign origins and one of three domestic destinations. The major U.S. coastal passage area for each route is shown above the crude/product figure.

It should be noted that the petroleum movement projections of Reference 4-16 were made by assuming a 9.8% increase per year from 1975 through 1980, and a 1.1% increase from 1980-2000, in accordance with administrative goals for reduction of energy imports.

Next, one must add to Table C-1 the Canadian, Alaskan and U.S. Gulf-East Coast traffic, as is done in Table C-2.

Canadian Traffic. This has three components. The Caribbean-Canadian component was obtained by taking the 14,000,000 tons of Venezuelan-Canadian oil shown in Reference 4-1 for 1977 and dividing it evenly between crude and products, and then allowing an expansion of 3% per year from 1977 to 1985. The East Coast-Canada and the Gulf Coast-Canada figures for 1985 were taken directly from Reference 4-16, and include exports as well as imports.

Alaskan Traffic: The Trans-Alaska Pipeline is projected to put out 2.0 million BBL per calendar day at its peak in 1983-86. It was assumed that 80% of this amount is transported by vessel from Valdez to the West Coast and 10% to the East and Gulf Coasts each. Transshipment of refined and residual oil from the West Coast is allowed for by assigning 35% of the incoming crude as outbound product movement, 25% to the East Coast and 10% to the Gulf Coast. This is arrived at by allowing for 25% consumption on the West Coast and 40% shipment by pipeline to the Texas/Lousiana

TABLE C-1: CRUDE AND PRODUCT IMPORTS IN 1985 (1) (THOUSANDS OF LONG TONS)

From To	East Coast	Gulf Coast	West Coast
Ecuador	Mona Passage 216/110	Gulf of Mexico 315/14	Pacific Coast 5,398/109
Caribbean		Gulf of Mexico PR-VI, Str. of Florida 33,965/6,687	Pacific Coast 2,766/2,452
N. Europe	N. Atlantic 554/4,859	Str. of Florida 539/185	Pacific Coast 16/15
Mediterranean	Atlantic 25,700/10,832	Str. of Florida 11,239/548	Pacific Coast 273/160
S.W. Pacific			Pacific Ocean 26,148/855
Persian Gulf	Atlantic* 14,660/325	Str. of Florida* 34,207/759	Pacific Ocean 28,426/464
W. Africa	Atlantic 45,759/867	Str. of Florida 23,233/65	

(1) Source: Reference 4-16

The Reference gives only a single figure for East and Gulf Coasts. It has been assigned 70% to the Gulf and 30% to the East Coast.

CRUDE AND PRODUCT COASTAL FLOWS IN 1985 (THOUSANDS OF LONG TONS) TABLE C-2.

					Canada
From	입	East Coast	Gulf Coast	West Coast	(Atlantic)
Ecuador		216/110	315/14	5,398/109	
Caribbean		25,580*/83,760	33,965*/6,687	2,766/2,452	000,6/000,6
N. Europe		554/4,859	539/185	16/15	
Mediterranean		25,700/10,732	11,234/548	273/160	
S.W. Pacific				26,148/855	
Persian Gulf		14,660/325	34,207/760	28,426/464	
W. Africa		45,759/867	23,233/65		
Canada		472/3,250			
Alaska		10,000/00	10,000/00	80,000,00	
Gulf Coast		000,09/000,6			13/166
West Coast		0/20,000	000'8/0		
Total		121,948/163,830	103,489/8,256	163,027/39,055	9,013/9166

*Approximately 10,000 should be shifted to Persian Gulf origination if deepwater ports on U.S. East and Gulf Coasts are employed in 1985 to receive crude from the Persian Gulf that would otherwise be transshipped at P.R. and V.I. See text.

refineries and the rest as product out by vessel.

U.S. Gulf to U.S. East Coast Traffic: Reference 4-2 has estimated that 9 million tons of crude and 43 million tons of product moved eastward through the straits of Florida in 1974, based on ACOE and USGS data. This number would tend to decrease if domestic Gulf Coast production decreases, but increase if crude imports to the Gulf increase. In all likelihood it will increase with total demand and with shift of refining capability to the Gulf Coast. Hence product movement has been expanded by 3 1/2% per year from 1974 through 1985, in unison with anticipated world-wide demand increases (Reference 4-1 p. 243), while crude movement has been left at 9.0 million tons per year on the assumption that any additional refineries built in the East Coast would be balanced by increases in crude imports to the area directly via the Atlantic.

In interpreting Tables C-1 and C-2 it should be realized that the Maritime Administration projections included under a Caribbean origin much of the oil that reached the U.S. through trnashipment at Puerto Rico and the Virgin Islands. It is not known exactly how much oil is involved in these transhipments, but the MARAD report shows 15,64,000 tons of crude imported to Puerto Rico and the Virgin Islands in 1973, 13,683,000 tons in 1975 and projects 20,812,000 tons in 1985. This last figure is about midway between the amounts projected to be received by the Gulf Coast and by the East Coast from the Persian Gulf in 1985, and undoubtedly is more than Puerto Rico and the Virgin Islands can consume in a year. This 20,000,000 tons may go directly to the East and Gulf Coasts in 1985 if deepwater facilities are available to receive it.

APPENDIX D:

Reports on Marine Oil Spills 1967 - 1978

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION Transportation Systems Center Cambridge Massachusetts 02142

Submitted by:

The Center for Short-Lived Phenomena, Inc. 138 Mt. Auburn Street Cambridge Massachusetts 02138

TABLE OF CONTENTS

pa	ige
AMOCO CADIZ OIL SPILL	. 1
TORREY CANYON OIL SPILL	. 4
TRANSHURON OIL SPILL	. 6
ENNERDALE OIL SPILL	. 8
NAPIER OIL SPILL	. 9
ESSO ESSEN OIL SPILL	.10
BRAZILIAN MARINA OIL SPILL	.12
ARROW OIL SPILL	.14
BORAG OIL SPILL	.17
PACIFIC GLORY OIL SPILL	.19
OCEAN EAGLE OIL SPILL	.21
VENOIL/VENPET COLLISION AND OIL SPILL	23
TSESIS OIL SPILL	. 25
JULIANA OIL SPILL	.27
M/V SAINT PETER OIL SPILL	.29
IRENE'S CHALLENGE OIL SPILL	.30
HAWAIIAN PATRIOT OIL SPILL	.31

AMOCO CADIZ OIL SPILL 16 March 1978 off Portsall, France (48°36'02"N, 04°45'09"W)

Event:

At 2226 LT on 16 March 1978, the 224,914-DWT tanker Amoco Cadiz ran aground in heavy seas off Portsall, France, on Men Goulven Rocks at 48°36'02"N, 04°45'09"W, after experiencing a flange failure in her steering hydraulic system. She incurred a 30-meter gash below the water line, just forward of the house. The rupture widened in the severe weather, and the aft storage tank began spilling its cargo of Arabian crude oil into the English Channel.

At 1045 LT on 16 March, while navigating in a storm through the Channel, the ship lost its rudder. At 1110 LT, the captain summoned the assistance of a German tug from Brest. By 1330 LT, the tug had the tanker in tow but made little progress toward port. At 1615 LT, the weather worsened and the towline broke. A second tow, established after nightfall, was only able to slow the tanker's drift, and the Amoco Cadiz grounded while still under tow.

By 2305 LT, French Navy helicopters arrived on-scene to airlift the 41 crew members to safety. The captain and first officer remained on board until dawn. At 0500 LT on 17 March, after hours of pounding by 6-meter seas in winds up to 80 km per hour, the tanker ruptured 3 tanks on its starboard, forward of the aft tank, and began to spill oil. By 18 March, the Amoco Cadiz had spilled 80,000 tons of oil. On 24 March, the stern section split off and swung around 180 degrees.

The Amoco Cadiz was built in 1974 in Cadiz, Spain, and had no history of previous spill incidents. Under Liberian registry, she was on lease to Royal Dutch Shell from a subsidiary of the Standard Oil Company (Indiana). She was carrying 216,000 tons of crude oil from Saudi Arabia and Iran to Le Havre, and then to Lyme, England, for transshipments to Rotterdam.

(AMOCO CADIZ OIL SPILL)

Cleanup:

Initial salvage efforts focused on offloading the cargo, but the heavy seas and spring tides precluded recovery. Seas of 5 meters and winds of up to 45 knots prevented salvage crews from navigating through the rocks surrounding the grounded tanker.

The French government quickly nationalized the cleanup effort and placed it under military jurisdiction. More than 7000 soldiers and 7000 civilians participated in the cleanup. Early efforts concentrated on protecting the most environmentally sensitive areas. On 17 March, workers began deploying booms along the river estuaries to protect the oyster beds. Commercial lobster pens were emptied, and the lobsters taken to other parts of France. Vacuum pumps were deployed to recover oil from inshore waters. The French government allowed the use of dispersants in waters greater than 50 meters deep and with currents moving offshore. A fleet of 30 ships treated the oil with the dispersants BP-1000 X and Corexit. They relied on absorbent polystyrene-based agents and on sinking agents such as chalk for inshore operations.

Prime Minister Raymond Barre immediately announced new regulations to guard against spills, including a ban on all transient tankers within 7 nautical miles of the French coast, increased surveillance of oil-bearing vessels, and a requirement that such ships keep officials informed as to their location at all times when in French waters. The government promised to pay \$12 million in damages to fishermen and others. The tanker's owner, the Amoco International Company, said its insurance policy will cover cleanup costs and damage payments totalling up to \$30 million.

(AMOCO CADIZ OIL SPILL)

Spill:

By 19 March, 10 cm of oil covered the harbor of Portsall, while oil fumes spread over coastal regions. After a week of heavy seas, the tanker had spilled over 200,000 tons. The slick was then 6.5 km wide and 201 km long. It stretched from Portsall to the Ile du Brehat and the port of Paimpol along the Britanny coast. The French military bombed the tanker from 29 to 31 March to release the remaining cargo.

According to local authorities, the spill has caused severe damage to the fishing grounds and commercial seaweed beds. The authorities expect that the seaweed beds, which provide 90% of the French commercial harvest, will take several years to recover and that the fishing industry will take at least a year. A 50% decrease in tourist business is already evident in Britanny.

TORREY CANYON OIL SPILL 18 March 1967 near Scilly Islands, England (50°00'N, 06°05'W)

Event:

At 0850 LT on 18 March 1967, the Liberian-registered tanker Torrey Canyon ran aground on Pollard Rock of the Seven Stones, approximately 20 km west of Land's End, England, and 10 km east-northeast of the Scilly Islands. The previous night, the vessel had gone off its planned course west of the islands. The tanker was travelling at 15.75 knots. The grounding reportedly tore 6 of the tanker's 18 tanks and damaged several others.

The Torrey Canyon was built in Newport News, Virginia, in 1959 and was extended from 66,000 DWT to 120,000 DWT in Japan in 1964. She was owned by a subsidiary of the lessee, Union Oil Company. She was under time-charter to British Petroleum to carry a cargo of 119,193 tons of Kuwaiti crude oil from Mina al Ahmadi in the Persian Gulf to Milford Haven in Wales. Cleanup:

The British government assigned overall control of the cleanup operation to the Under Secretariat of State (Royal Navy). Offloading the oil from the tanker was not attempted since it was impossible to maneuver receiving vessels into the area. Some of the escaping oil burned, after the British military bombed the Torrey Canyon from 28 to 30 March. Booms were deployed but proved ineffective. As a result, the British concentrated their cleanup strategy on dispersants. Two naval vessels began applying dispersants on 18 March, and were later joined by other ships. Within 3 days, 15,000 gallons of detergent were applied. Detergents and steam-cleaning were used to clean the shore.

While the British used dispersants near the Channel Islands, the French applied chalk powder to sink oil in the Bay of Biscay. Sea booms of jute fiber and plastic were deployed to keep the oil out of Roscoff harbor in Britanny. The British government reimbursed local authorities for more than 75% of the cleanup costs and provided troops at no local expense to help during the cleanup.

(TORREY CANYON OIL SPILL)

The Navy's threat to seize and impound the <u>Torrey Canyon</u>'s sister ship, the <u>Lake Palourde</u>, enforced demands that the tanker's owner, in turn, reimburse the British government.

Spill:

By dusk of 18 March, northerly winds had carried a narrow slick over 13 km long to the south. By the next day, an estimated 20,000 tons had leaked from the tanker, with another 10,000 tons leaking out on 20 March. The slick was then more than 30 km long. The winds shifted to the west, driving oil into the English Channel. The westerly winds continued until 24 March, and on 25 March the morning tide brought the first oil onshore in thick layers. On 26 March, when the tanker broke in two, more than 40,000 tons of oil escaped, threatening the British coast and then the Britanny coast, before moving into the Bay of Biscay. After the bombing, oil seeped out in small amounts. In late April, the Torrey Canyon slipped off Pollard Rock and sank. Officials estimated that the sunken tanker contained no significant amounts of oil.

The spilled oil contaminated about 140 km of British coast from Trevose Head to Lizard Point, 150 km of French coast from Roscoff to Paimpol, 40 km of Britanny's west coast, and 25 km along the Channel Island of Guernsey. The oil caused extensive mortalities among seabird populations. The oil and especially the detergents were extremely toxic to marine life, especially planktonic organisms.

TRANSHURON OIL SPILL 26 September 1974 Kiltan Island (11°30'N, 73°01'E)

Event:

At 1630 LT on 26 September 1974, the U.S. tanker <u>Transhuron</u> ran aground on Kiltan Island, an atoll in the Arabian Sea 300 km from the coast of India. The accident occurred when the tanker went out of control due to a fire hazard in the boiler room. The tanker's crew abandoned ship about 400 meters from the island. Upon grounding, several tanks ruptured, and approximately 5000 tons of furnace oil spilled into the sea. Of the remainder of the 18,000-ton cargo, 12,700 tons were removed from the <u>Transhuron</u> on 3 December. The 19,650-DWT vessel, under charter to the U.S. Navy from Hudson Waterways Corp., was en route from Bahrain to the Philippines.

Cleanup:

Several research institutions, with support from the Indian Navy, took measures to prevent further spillage from the grounded tanker. These efforts culminated in the offloading on 3 December. Navy officials made several aerial surveys to track the shoreward movement of the oil. No efforts were undertaken to cleanup the coast of Kiltan Island.

Spill:

The spill impacted all of Kiltan Island, except for the beaches on the eastern shore. Oil that entered the atoll's lagoon was washed ashore, and thick oil patches were reported on the beaches there. The volatile components evaporated, while the remainder seeped into the coarse sand up to a depth of 3 to 10 cm. The oil caused heavy contamination along the rocky intertidal area along the southern shore.

During the first week after the grounding, local flora and fauna suffered widespread mortalities. Dead plankton and seaweed were reported floating in thick layers in the lagoon, along with

(TRANSHURON OIL SPILL)

dead fish, lobsters, crabs, and other species. Some of them washed onto the beach a few days later. The spill adversely impacted the hermatypic corals, which build and protect the atoll.

ENNERDALE OIL SPILL
1 June 1970
Port Victoria, Mahe, Seychelles Islands
(04°30'S, 55°30'E)

Event:

On 1 June 1970, the British Royal Fleet auxiliary tanker Ennerdale struck a pinnacle of granite while leaving Port Victoria, Mahe, in the Seychelles Islands, and badly ruptured its hull on the starboard side. The tanker sank rapidly in 40 meters of water, with the bow remaining slightly above water for some time. The Ennerdale was carrying 41,500 tons of oil, and was en route to refuel the British Navy frigate Andromeda at sea.

Cleanup:

A tanker was retained in ballast at Bahrain pending a decision to offload oil from the Ennerdale, but adverse weather prevented the transshipping of the cargo, as well as a survey of underwater damage. The British Ministry of Defense directed the cleanup, which included attempts to contain the slick with a boom and to spray it with dispersants.

Spill:

Due to favorable winds and water currents, the oil did not cause significant contamination along the coast. On 19 June, there was still a large slick of diesel oil and aircraft fuel on the water. Oil continued to leak through the sunken tanker's air vents. It is not known how much cargo spilled. The major concern was that the slick would cause an extensive mortality among the Seychelles seabird population, which includes many endangered species.

NAPIER OIL SPILL 8 June 1973 Island of Guamblin, Chile (44°50'S, 75°00'W)

Event:

On 8 June 1973, the 35,000-DWT tanker Napier ran aground on the Island of Guamblin, 35 km off the Chonos Archipelago in Chile. The ship's radar was not functioning when the ship struck the island, which is 330 km south of Puerto Montt, the nearest port. After a severe storm on 14 June, the tanker reportedly sank. The Napier was carrying an unspecified quantity of light Bolivian crude.

Cleanup:

Because of the remoteness of the Island of Guamblin, the Chilean government decided that the most effective way to deal with the spilled oil was to burn it. On 12 June, the Chilean Air Force dropped incendiary bombs on the slick, igniting the tanker's stern. The next day, airplane pilots observed that the ship was burning.

Spill:

It was not known how much oil spilled, burned, or remained in the <u>Napier</u>. There was no reported fouling of any shorelines or coastal waters. The spill raised concern about the fate of a mussel farm located in the interior of the Chonos Archipelago. There was, however, no reported damage to the farm.

ESSO ESSEN OIL SPILL 29 April 1968 off the Peninsula Coast, South Africa (34°18'30"S, 18°20'00"E)

Event:

At 0640 LT on 29 April 1968, the West German-registered tanker Esso Essen hit a submerged object at a speed of 18 knots while headed almost due northwest 5 km off South Africa's Peninsula Coast, and ruptured 8 tanks. The weather was good with fair visibility, almost no wind, and a moderate swell. The tanker proceeded under her own power in a northwesterly direction to 20 km west of Duiker Point and then northeastward towards Table Bay. She waited more than 9 km west off Green Point Lighthouse for clearance to enter the harbor of Cape Town.

The Port Captain at Cape Town refused clearance and ordered the ship to sea. The <u>Esso Essen</u> departed the same day to drift roughly 130 km offshore, where the Port Captain inspected the damaged tanker. An estimated 15,000 tons of oil were lost, including about 4000 spilled off the Peninsula Coast. A slick 1 to 2 km wide and more than 30 km long was reported at a distance from the coast varying from 3 to 25 km. The 50,897-DWT <u>Esso Essen</u>, built in 1960, was bound for West Germany with a load of heavy Arabian oil from the Persian Gulf.

Cleanup:

Aerial surveys were initiated over most of the Peninsula Coast shoreline and waters at roughly the time that slicks were first observed. Machinery such as "slick-licker" belts was not available for removing oil from the ocean. The cleanup efforts concentrated on spraying dispersants, flown to Cape Town from the United States. The South African Minister of Industries approved the use of Esso Corexit as a dispersant, after finding that Corexit was generally less toxic than those chemicals used during the Torrey Canyon cleanup. In total, an estimated 80 to 90% of the 4000 tons of oil spilled off the Peninsula Coast washed onto beaches.

(ESSO ESSEN OIL SPILL)

Spill:

The slick, first seen extending from Scarborough to Clifton, was carried southeastward by northwesterly winds. It followed the coast until, by 1 May, the northern end had cleared Duiker Point. The first landfall was on the night of 30 April from Scarborough to a point 25 km south. On 2 May, Chapman's Bay, just north of Scarborough, was contaminated. On 3 May, oil reached Cape Point and began moving across the mouth of False Bay. On 4 and 5 May, the slick impacted Cape Hangklip and Pringle Bay, on the other side of False Bay. The oil had a frothy appearance, indicating emulsification. Thick oil was deposited above the kelp, which had been washed up by heavy seas. Beach cores showed little penetration into the sand.

The oil killed millions of sand hoppers, but that seemed to be the only massive mortality. Periwinkles, limpets, and anemones suffered appreciable mortalities. Many pelagic birds were seen oiled, but only a few gannets and cormorants were found dead. Scientists sampled the water and found no probable adverse effects to phytoplankton but moderate to high mortalities among zooplankton. By 6 May, the pollution along the Atlantic coast had diminished, except for some oil-covered rocks in Chapman's Bay.

BRAZILIAN MARINA OIL SPILL 9 January 1978 Sao Sebastiao, Brazil (23°48'S, 45°43'W)

Event:

Late at night on 9 January 1978, the Liberian-registered tanker <u>Brazilian Marina</u> struck a rock while entering a dredge channel near Sao Sebastiao, Brazil, and ruptured 2 port wing tanks with a hole 40 meters long and 1 meter wide. About 15,000 tons of crude oil spilled. The vessel, under lease to Petrobras, was entering Sao Sebastiao harbor while en route from Kuwait to the Petrobras refining facility.

Cleanup:

Under the coordination of the Sao Paulo State Environmental Control Agency, local municipalities undertook the cleanup effort, which lasted for several weeks. A 5-man USCG/EPA team provided advice to the Brazilian officials and conducted surveys of environmental damages. Cleanup efforts were largely manual, involving rakes, shovels, and straw. Officials reported particular success with Japanese pine straw. Limited use was made of vacuum machinery. The tanker's owners paid punitive fines totalling \$137,000. On 30 January, they agreed to pay damages and cleanup costs not exceeding \$500,000. On 31 January, when the insurance company assured payment, the ship was allowed to sail.

Spill:

On 10 January, the spilled oil was reportedly moving along the shoreline from Sao Paulo north towards the state of Rio de Janeiro. A layer of oil, 0.5 to 2.5 cm thick, impacted the beaches in the state of Sao Paulo, and oil slicks along the coast threatened further contamination for several weeks. Heavy rain helped disperse the slicks. On 17 January, they were observed 40 km south of Rio de Janeiro.

(BRAZILIAN MARINA OIL SPILL)

The USCG/EPA team found no serious long-term danger to marine life. Local officials estimated that short-term mortalities of sardines, shrimp, and mussels will ruin the season's harvest. Few dead fish or oiled birds were found, although it was estimated that thousands had been contaminated.

ARROW OIL SPILL 4 February 1970 Chedabucto Bay, Nova Scotia, Canada (45°27'57"N, 67°06'24"W)

Event:

At 0934 AST on 4 February 1970, the Liberian-registered tanker Arrow, carrying 3.8 million gallons of Bunker C fuel oil, ran aground on Cerberus Rock in Chedabucto Bay, Nova Scotia, in high seas and winds. Immediately upon grounding, the bottoms of the forward oil tanks ruptured, and oil began to spill into the bay. On 8 February, the tanker split in two, leaving the bow section stuck firmly on the rocks, with 6 out of its 9 tanks ruptured. The stern section, with 950,000 gallons of oil, sank on 12 February before it could be towed and sunk in deep water off the continental shelf.

By 14 February, an estimated 1.5 million gallons had spilled, making the Arrow spill the largest in Canadian history, and another 1.3 million gallons had been salvaged. Extreme cold prevented further salvage. Plans to steam-heat the oil were not carried out because the tanker's boilers were inactive. The wreck continued to leak oil, including a spill of 30,000 gallons on the night of 24 March. The 18,000-ton Arrow, owned by Sunstone Maritime Ltd., was on charter to the Imperial Oil Company. She was carrying her Venezuelan cargo to the Nova Scotia Pulp Ltd. mill at Point Tupper, Nova Scotia.

Cleanup:

A fine mesh seine-net boom was constructed about 600 meters long and 9 meters deep, with flotation about 30 to 60 cm above the surface. In combination with peat moss absorbent, this boom was effective in containing the spilled Bunker C oil in sheltered areas, but rough seas precluded the containment of oil on the open ocean. Oleophilic "slick-lickers" were deployed with success in recovering oil in sheltered areas. Where recovery was impossible, burning was attempted. Magnesium flares and glass beads were dropped on the spill to both generate and retain

(ARROW OIL SPILL)

enough heat for combustion. By 9 February, the cleanup crews had still not decided on the best way to ignite the oil, and a large amount of the oil had emulsified, reducing the probability that it would burn. Where the oil had not already emulsified beyond flammability, it was difficult to sustain combustion temperature. The Canadian Ministry of Transport, responsible for cleanup operations, reported that no dispersants or sinking agents had been used on the slick, although Imperial Oil Co. had reportedly chartered 2 planes to spray dispersants. Due to low temperatures and poor penetration into the slick, the dispersants were largely ineffective. The Ministry of Transport planned to hold both Sunstone Maritime and Imperial Oil liable for cleanup costs, estimated at \$3 million.

Spill:

During the first day after the grounding, the slick was carried north and east by 50-knot winds blowing from the south. In the first several hours, a falling tide helped initiate the seaward movement of the slick. On the second day, the wind changed and blew largely from the north for 3 to 4 days. The slick extended for 6.5 km on the open ocean, with smaller slicks remaining inside Cape Auget. After water cushions had developed in many tanks, precluding further major spillage, oil leaked only sporadically from the bow. Although no divers inspected the sunken stern, officials do not believe it leaked any oil.

In total, the spilled oil impacted 320 km of Chedabucto Bay coastline, with the larger portion on the southern shore. A rock dam constructed from Ile Madame to Cape Breton Island to combat the spill prevented contamination of the sound between the islands. On 27 February, oil washed ashore on the northern coast of Sable Island, some 200 km southeast of the Arrow. Chemical analysis traced the oil to the spilled Bunker C.

(ARROW OIL SPILL)

As a result of the spill, 10 gray seals were reported dead, with others heavily oiled and disoriented. The most heavily impacted fauna were sea birds. An estimated 2300 died in Chedabucto Bay, another 5000 dead washed onto Sable Island, and many more dead birds were probably carried south of Sable Island into the open ocean.

BORAG OIL SPILL
7 February 1977
Keelung, Taiwan
(25°12'10"N, 121°44'30"E)

Event:

At 1145 LT on 7 February 1977, the Kuwaiti-registered tanker Borag hit a reef and ran aground in the East China Sea, 3 km north of Keelung, Taiwan. The grounding ruptured 2 of the vessel's 30 tanks; other tanks leaked later. An estimated 4000 tons of the 33,068-ton cargo of crude oil spilled into the sea. A Keelung pilot was on the Borag at the time of the grounding. Of the 37 people on board, 19 were taken ashore immediately, and the others were rescued by 10 February.

On the first day, no attempt was made to refloat the tanker since the pilot feared a break-up. The next day, 3 tugs and 2 patrol vessels failed to free the <u>Borag</u> from the reef. The bow sank during the first 4 days, and the buoyant stern finally sank on 15 February. Strong winds and high waves hampered efforts to remove oil prior to the sinking. On 8 March, a dredge struck the submerged tanker and sank. The 35,351-DWT <u>Borag</u> was en route from Kuwait to a Shenao, Taiwan refinery when the grounding occurred. The cargo was owned by the Chinese Petroleum Corporation and the vessel by Hamoor Tanker Corporation.

Cleanup:

The Taiwanese Navy supervised the efforts to contain and cleanup the spilled oil, and received assistance from the Keelung Harbor Bureau, other government agencies, and industry experts. Industrial and utility plants using seawater coolant systems shut down their operations. On 8 February, the Harbor Bureau prepared a sea boom to fend the spill away from the coast. Aside from attempts to offload the cargo from the sunken ship, there were no reported efforts to recover the oil. Large amounts of dispersants were used to keep the slick out of Keelung harbor. No attempt was made to disperse the entire slick.

(BORAG OIL SPILL)

Spill:

On the first day, southwesterly gusts blew slicks away from the coast. By 11 February, the wind had shifted to a prevailing northeasterly direction, blowing oil onshore in amounts ranging from small patches to thick layers. Yeh-Lin harbor and adjacent resort areas were heavily polluted, with oil collecting in coves and behind breakwaters. Keelung harbor received progressively larger amounts of oil from 11 to 24 February, by which time fishing boats could no longer cross the 50-cm-thick rafts of oil. Smoking and welding were strictly forbidden in and around the harbor. The slicks remained offshore for almost two weeks, threatening the coolant intakes. The oil curtailed fishing off a 60-km stretch of coastline, and killed almost all the young eel in the spill area. Potential costs to the fishing industry were estimated at millions of dollars.

PACIFIC GLORY OIL SPILL 23 October 1970 off Isle of Wight, England (01°05'W, 50°40'N)

Event:

On 23 October 1970, the tankers Pacific Glory and Allegro collided in the English Channel while headed towards Rotterdam and Fawley, England, respectively, and the Pacific Glory immediately caught on fire. Thirteen of the Pacific Glory's crew were killed in the collision and fire. The Allegro sustained minor damage and proceeded to Fawley to unload its cargo. After the collision, the Pacific Glory was grounded in 5 meters of water 5 km off the Isle of Wight. Two weeks and several storms later, 20,000 tons of the Pacific Glory cargo were offloaded to another tanker. Then the grounded tanker was refloated and repaired, and 14,000 tons were loaded back onto the tanker. On 17 November, the Pacific Glory arrived in Rotterdam with 64,000 tons of her original 77,000-ton cargo. The 6000 tons that had been offloaded were also shipped to Rotterdam. In total, almost 7000 tons of oil spilled from the Pacific Glory.

Cleanup:

The British Admiralty coordinated the initial efforts to cleanup the oil. The Navy employed two Dutch government-owned ships: one specially equipped to apply dispersants and the other a dredger converted to spray chemically treated sand for sinking oil slicks. Shell Marine International, the Pacific Glory's charterer, volunteered its service during the cleanup. Since the collision was outside British territorial waters, C.Y. Tung of Hong Kong, the owner, contracted with a Dutch salvage firm on 27 October to refloat the tanker and relieve the Admiralty of the cleanup operation.

Channel tugs moving at full speed sprayed dispersants on the slicks. Wooden frames towed behind the tugs agitated the water, mixing together the oil and dispersant and thereby increasing the dispersant's effectiveness. Officials described

(PACIFIC GLORY OIL SPILL)

the dispersants and sinking agents as successful in preventing shoreline pollution. Boats with dispersants on board accompanied the <u>Pacific Glory</u> to Rotterdam.

C.Y. Tung and Shell International Petroleum Company Ltd. were both party to TOVALOP, which substantially reimbursed the British government for its efforts.

Spill:

Most of the oil which spilled from the <u>Pacific Glory</u> was diesel and fuel oil. Some burned on the water, while the rest was either dispersed or sunk before wind or current could carry it far. There was no reported pollution of the coastline, but for 3 weeks, until the damaged tanker reached Rotterdam, officials feared that she would rupture again and spill her cargo into the Channel.

OCEAN EAGLE OIL SPILL 3 March 1968 San Juan, Puerto Rico (18°30'N, 66°10'W)

Event:

At 0937 LT on 3 March 1968, the 18,524-DWT, Liberian-registered tanker Ocean Eagle ran aground in heavy seas while heading into San Juan Harbor, Puerto Rico. The captain attempted to head the tanker seaward by pivoting her on the grounded midsection. During this procedure, the 15-year-old Ocean Eagle split in half. The tanker was carrying 5.7 million gallons of crude oil from Venezuela to San Juan. The stern half, which remained intact, retained its oil, which was eventually pumped out. The spillage from the bow was estimated at 2 million gallons: 1 million by 7 March, and 1 million by 19 March.

Cleanup:

The USCG and Navy undertook a lead role in the cleanup, with the tanker owners paying for the cleanup costs. On 1 April, the bow and stern sections reportedly contained no oil, and the Army towed them to deep water to sink them.

Where oil threatened shores and beaches, cleanup crews initially used detergents. Marine scientists objected to the potentially adverse ecological effects of the detergents, and the cleanup crews switched to Ektopearl, a non-toxic, porous substance that absorbs oil and floats. The damage to the marine environment appeared slight.

Spill:

Oil spread east and west, covering a 16-km stretch and impacting public, private, and military beaches. Currents carried the oil onshore, where patches washed within 100 meters of resort hotels. By 19 March, favorable currents had carried most of the oil out to sea, and public beaches were reopened. Some oil remained in San Juan Harbor, with accumulations at La Perla and slum areas.

(OCEAN EAGLE OIL SPILL)

As of 19 March, 500 pelicans had been pulled from the oil, cleaned, and taken to rehabilitation centers. Some waders and plovers were found, but in general the bird populations were sparse. A few octopi were found dead.

VENOIL/VENPET COLLISION AND OIL SPILL 16 December 1977 near Port Elizabeth, South Africa (34°25'S, 24°05'E)

Event:

At 0938 LT on 16 December 1977, the Liberian-registered sister tankers <u>Venoil</u> and <u>Venpet</u> collided and caught fire less than 40 km off the South African coastline near Port Elizabeth. The motor vessel <u>Clan Menzies</u> successfully evacuated the entire 44-man crew of the <u>Venpet</u>. When the crew members from the <u>Venoil</u> abandoned ship, many lept into the shark-infested waters around the tanker; 38 men were rescued, and 2 were reported missing. After the collision, the ships separated from each other and both drifted in a southeasterly direction until they were taken under tow on 17 December.

The <u>Venoil</u> and <u>Venpet</u> are both owned by the Venoil Company. The <u>Venoil</u>, laden with 307,045 tons of Iranian heavy oil, was en route from Kharg Island in the Persian Gulf to Point Tupper, Nova Scotia; the <u>Venpet</u> was making a return voyage in ballast along the same route, with only cargo residues and bunker fuel on board.

Cleanup:

On 16 December, 5 coastal anti-pollution vessels arrived onscene, along with rescue boats and fire-fighting salvage tugs. The fire hampered efforts to approach the damaged tankers and offload the cargo, but the heat increased the rate of emulsification and evaporation.

As soon as the fire was extinguished on 17 December, the anti-pollution vessels started to apply dispersants to the slick. Conservation organizations were reportedly pouring dispersants on the slick with little effect. From 5 to 7 January 1978, the Venoil's cargo was safely offloaded to another tanker, the Litiopa. When the wind and swells increased, the offloading hoses were disconnected, and the vessels were kept headed into the wind by tugs.

(VENOIL/VENPET COLLISION AND OIL SPILL)

Spill:

On 17 December, press reports said that the Venoil was trailing a 100-km slick and the Venpet a small slick of undetermined size. Some of the spilled oil burned on the water near the tankers. For more than a week, the slick threatened South African resort beaches on the country's southeastern shore. On 29 December, gusting onshore winds drove a slick 11 meters wide and 14 km long onto the beaches between Kwysna and Mossel Bay, while other larger slicks remained offshore and to the south. Oil washed up near the mouth of the Gouritz River, accumulating in deposits up to 5 cm thick. On 30 December, the main slick was less than 2 km from shore. As the day progressed, southeasterly winds gusting up to 40 knots drove much of the slick onshore, and the next day, onshore winds carried oil onto Tougaart Beach north of Durban. In total, the oil impacted 100 km of beaches. The spill destroyed prawn beds, although its full environmental effect was largely unreported.

TSESIS OIL SPILL 26 October 1977 Sodetalje, Sweden (58°49'42"N, 17°43'48"E)

Event:

At 1000 LT on 26 October 1977, the 177-meter Soviet tanker Tsesis struck an uncharted, submerged rock while navigating through a narrow 480-meter-wide channel into Sodetalje, near Stockholm, Sweden. A Swedish pilot was on board when the vessel hit the rock at the edge of the channel. Navigational charts indicated a channel depth of 9.75 meters, although subsequent soundings showed a rock 8.23 meters below the water surface.

The grounding ruptured 8 cargo tanks, and the <u>Tsesis</u> began to spill oil immediately. An estimated 1600 tons of oil were lost. Initially, the Soviet captain of the <u>Tsesis</u> wanted to offload his cargo into another Soviet tanker. When that tanker arrived, its tanks proved unfit to receive the oil. The cargo was offloaded into Swedish ships. The <u>Tsesis</u> was pulled free on 31 October and anchored near the grounding site. On 4 November, the <u>Tsesis</u> proceeded slowly to a Stockholm shipyard under her own power for repairs.

Cleanup:

Swedish authorities responded quickly to the spill. The Swedish Coast Guard assumed responsibility for the cleanup operations, and the Air Force undertook helicopter overflights. Booms were deployed around the tanker, and "slick-licker" belts and suction equipment were used to recover the oil. While the weather was calm, recovery proceeded with fair success.

On 29 October and again on 1 November, strong winds and rough seas rendered the booms, skimmers, and suction equipment ineffective. Local fire brigades helped cleanup the shore. On 31 October, the Soviet captain said that Sweden should pay the cleanup costs since a Swedish pilot was aboard. Swedish law, however, requires the shipowner to pay, even when a Swedish pilot is on duty.

(TSESIS OIL SPILL)

Spill:

At the time of the grounding, the weather was relatively calm. Shortly thereafter, a westerly wind with gusts up to almost 25 knots began to alternate with a calm, and the oil started moving towards the eastern shore of the channel. Later, the wind shifted from the west to the south, and the oil began to drift north. By 28 October, a water cushion had formed inside the ruptured tanks, stopping further leakage. On 30 October, oil had washed up along about 3 km of coastline on islands in the channel to Sodetalje. The next day, the spill, covering an estimated 13.7 sq km, had impacted as many as 10 islands. Most of the oiled areas were rocky cliffs, but some ground areas were affected.

JULIANA OIL SPILL 30 November 1971 Niigata, Honshu, Japan (38°00'N, 138°40'E)

Event:

On 30 November 1971 at 1650 LT, the Liberian-registered tanker Juliana dragged her anchor in rough weather, while waiting for a pilot to guide her into Niigata harbor on the west coast of Honshu, Japan. Drifting aground just outside the harbor, the Juliana split in two, the bow coming to rest 300 meters and the stern 100 meters from shore, with a distance of 3000 meters separating the sections. All 47 crew members were rescued. The Juliana was carrying 18,000 tons of crude oil from the Persian Gulf to Niigata. In total, an estimated 4000 tons of oil spilled, and the remainder was offloaded to other boats.

Cleanup:

In Japan, at the time of the grounding, there was only enough dispersant to treat 5000 tons of oil. By 2 December, nearly 600,000 liters of dispersant had arrived in Niigata, and 60,000 liters had already been applied to the slick. By 3 December, 2 helicopters and 6 fire engines joined the 12 patrol boats applying dispersants.

Oil companies, on the recommendation of the Japanese government, placed a floating plastic boom around the slick. Initially high winds rendered the boom ineffective. On 2 December, winds subsided, and the boom was able to contain the slick. Straw mats were used to absorb the oil.

On 5 December, the tanker's sections were secured with anchors at sea and ropes onshore. A plan to place a siphon pump inside the stern section was abandoned, because rough weather made it impossible for salvage tugs and a small tanker to approach the wreck. As an alternative, a 10-cm water hose with PVC flotation collars was laid from the ship along the shore to the harbor, but bad weather also hampered this plan.

(JULIANA OIL SPILL)

Spill:

One day after the grounding, an oil slick, 20 km long and 4 km wide, had formed. Ocean currents and winds carried a large part of the slick to sea, but some oil and oil-soaked flotsom reached the shore. Officials expressed concern about the impact of the oil slick on the rich fishing grounds in the Sea of Japan. On 7 December, helicopters reported a thin oil film extending 8 km from Niigata north to the mouth of the Agano River.

Oil from the <u>Juliana</u> killed all the fish in the offshore stationary nets that local fishermen had set before the grounding. The nets were set on the sea bottom 1810 meters off Tayuhama beach in Niigata. The haul was abnormally small, and no octopi were reported.

M/V SAINT PETER OIL SPILL 4 February 1976 off coast of Colombia (01°30'N, 79°34'W)

Event:

On 4 February 1976, a fire broke out in the engine room of the 34,175-DWT Liberian-registered M/V Saint Peter while the vessel was sailing 45 km west of the Ecuadorian coast. Due to the danger of explosions, the 34-man crew abandoned ship. At the time, the tanker was bound for Peru with a cargo of 243,442 barrels of crude oil, and 6000 to 7000 barrels of bunker fuel oil. On 6 February, at 01°35'N, 79°13'W, oil was observed bubbling to the surface and spreading out into a large slick. It was assumed that the ship had drifted and then sunk near this location in more than 700 meters of water.

Cleanup:

The USCG undertook overflight surveys and predicted that sea currents and wind would disperse much of the light oil before it reached the shore. As of 19 February, no cleanup operations had been initiated. Officers from the USCG and the Canadian Coast Guard developed a cleanup plan for Colombia in case of pollution. The Ecuadorian government also asked the USCG for advice.

Spill:

On 13 February, 3 separate oil ribbons, covering a total area of approximately 124 sq km, were observed drifting toward shore. The longest ribbon was 24 km long and 15 meters wide and was still being fed by oil bubbling to the surface. As of 13 February, the slicks were about 24 km from shore. The slick characteristics indicated that the discharge had been cargo rather than fuel oil.

On 17 February, oil slicks of medium to heavy thickness, covering approximately 52 sq km, were observed 5 km from the Colombian coast. The slicks, which had spread southward into Ecuadorian waters and had streaks extending into Tumaco Harbor, reached beaches and mangrove swamps in Tumaco. There was apprehension that local tuna and shrimp industries would be adversely impacted by continuing seepage.

IRENE'S CHALLENGE OIL SPILL 18 January 1977 North Pacific Ocean (26°53'N, 173°52'W)

Event:

On 18 January 1977, the Liberian-registered tanker Irene's Challenge broke in two in the North Pacific Ocean, about 350 km east-southeast of the Midway Islands and over 1600 km west-northwest of Honolulu. On 17 January at 1700 Honolulu time, the tanker issued an SOS, which was relayed to the USCG by the Universal Conveyor, a ship in the area. The merchant ship Pacific Arrow rescued 28 of the crew of 31 and took them to Japan on 18 January. The other 3 reportedly stayed behind to prevent Irene's Challenge from sinking. They were missing and presumed dead.

The USCG dispatched 2 cutters and an airborne strike team to the scene. The two halves of the tanker remained afloat for several days, drifting southeastward 40 km from each other. They sank after 21 January. The 21,090-GWT Irene's Challenge, owned by Tsakos Shipping and Trading Co. of Piraeus, Greece, was en route from Japan to Venezuela with 3.15 million gallons of light Arabian crude oil in her 4.2-million-gallon capacity tanks.

Cleanup:

The USCG strike team arrived at 1145 GMT on 19 January to determine the feasibility of containing and recovering the spilled oil. High capacity A.D.A.P.T.S. pumps were ready for deployment from aircraft.

Spills:

An undetermined amount of the cargo spilled into the sea. The slick covered more than 400 sq km by 19 January, and was heading in an easterly direction. Seas in the area were about 2 to 3 meters with a wind at 10 to 15 knots.

HAWAIIAN PATRIOT OIL SPILL 24 February 1977 North Pacific Ocean (21°10'N, 164°00'W)

Event:

At 1040 Honolulu time on 24 February 1977, the Liberian-registered tanker <u>Hawaiian Patriot</u> caught fire and exploded in the North Pacific Ocean more than 600 km west of Honolulu. A pilot in a reconnaissance plane reported seeing smoke amidships, as the crew began to leap into the sea. The merchant ship <u>Philippine Bataan</u> rescued 38 of the 39 crewmen. One was found dead.

The <u>Hawaiian Patriot</u> burned fiercely for several hours and eventually sank. The 258-meter, 51,576-GWT tanker was owned by Indo-Pacific Carriers and was under lease to Groton Pacific Carriers. She was carrying 28.2 million gallons of light Indonesian crude oil to Honolulu.

Cleanup:

Although the USCG monitored the spill, no cleanup operations were undertaken. Some of the spilled oil burned with the ship.

Spill:

The oil started leaking from the No. 2 port and stern cargo holds. It is unclear whether there was a crack or an entire missing hull plate. The spill was reported at 1639 Honolulu time on 23 February. By the time of the explosion, an estimated 5.25 million gallons of the cargo had leaked into the sea, forming a slick almost 85 km long. The rest of the cargo sank with the ship.

On 28 February, the slick was about 750 km west of Honolulu and reportedly 23 km wide and 70 km long, with the heaviest concentration of oil at the western end. On 7 March, the slick, located more than 780 km west of Honolulu, had evaporated and emulsified until it was only 32 km long and 3 km wide.

APPENDIX E: DEBARKATION PORTS

The debarkation point is usually selected by the OSC soon after he determines that pollution control equipment must be brought to the scene. He usually selects the nearest port that can handle the required equipment. It may be more convenient to stage different equipment at different points, so there may be several debarkation points. It is not necessary that the debarkation point be a port. The equipment may be staged at a convenient dock or beach. For open water spills, however, the recovery equipment (barrier, barges) is so large that a port is much more likely to be selected. A review of OSC reports on file with the USCG shows a wide variety of selections (although the precise debarkation point is not always apparent in the report). Some samples:

M/V ORIENTAL WARRIOR (5/25/72): Port of Jacksonville, FL. HANNAH BARGE 2901 (2/24/75): Breakwater at entrance to Milwaukee Harbor, accessible by road.

T/B TM-10 (7/8/74): Upper Galveston Bay.

ZOE COLOCOTRONI (3/18/73): Bahia Sucia, Cabo Rojo (southwest corner of Puerto Rico).

M/V CORINTHOS (1/31/75): Marcus Hook, PA, B.P. docks.

NO/TK TAMANO (7/22/72): Portland Harbor, Hussey Sound.

BARGE Z-102 (12/9/75): San Juan Harbor and Palo Seco area, Puerto Rico.

USNS JOSEPH MERRELL (12/29/74): Pt. San Luis, CA.

Dredge CARIBBEAN (1/11/75): Miami Harbor, FL.

T/B STC-101 (2/2/76): Reedville and Fleet Pt. MD.

(These were used by contractors as debarkation points.) SS ARGO MERCHANT (12/15/76): Woods Hole, MA.

Not all cases cited here are open water spills. (The CORIN-THOS and CARIBBEAN incidents occurred in harbors.) In none of these cases was the USCG open water boom deployed, and in only

three cases were the ADAPTS deployed (HANNAH 2901, TB Z-102, ARGO MERCHANT). While the majority of incidents were at or near major harbors, three were relatively remote from a major harbor: Cabo Rojo, P.R.; Port San Luis, CA; Reedville, MD. Because of cases such as these, it can not be assumed that the debarkation points for open water spills will always be at a major port. At the other extreme, not every harbor on the U.S. coasts (plus Puerto Rico, Hawaii, and the Virgin Islands) can accommodate the drafts of the USCG vessels likely to be needed at a debarkation point. While the minimum depth required depends on the nature of the spill, this minimum is not likely to be greater than 10 ft. because only the largest cutters (270' WMEC and 378' WHEC) and buoy tenders (180' WLB) have more than 10 ft. drafts. In further support of the 10 ft. reference point, it is noted that the debarkation point for the ARGO MERCHANT incident (Woods Hole, MA) has a channel depth in the 11-15 foot range.

A comprehensive list of ports in the study area was extracted from the <u>World Port Index</u>, Defense Mapping Agency Pub. 150, Fifth Edition (1976). This list contains about 450 ports on the U.S. Great Lakes and East, Gulf and West coasts. If a minimum channel or pier depth of 11 feet is taken as the criterion, the number of potential debarkation points in the study area is about 400.

Another criterion for selecting potential debarkation points is the existence of a lift or crane at the harbor. This would exclude debarkation points unable to load or unload very heavy equipment such as the barrier (17,000 lbs.) or the Type 0 barge (13,000 lbs.). The loading/unloading capability may be necessary unless a buoy tender is available at the debarkation point. If availability of a lift or crane is required in addition to the 11 ft. depth criterion, then the number of potential debarkation points in the study area is 149.

A third criterion for selecting potential debarkation joints is the ability to accept a USCG buoy tender, which has its own crane. The WLB/180 and WLM/175 have 14 and 12 feet drafts, respectively while the WLM/157, WLM/133, WLI/100 and WLI/65 require

7, 9, 5, and 4 feet depths, respectively. Therefore, these last four may use the 400 ports that have 11 feet minimum depth. The WLB/180 and WLM/157, however, would be restricted to ports that have 15 feet minimum depth. There are approximately 342 such ports.

This appendix lists those U.S. and Puerto Rican ports in the World Port Index, 1976 edition, that have lifts or cranes. Pierside and channel depths are also given. Unfortunately, this reference does not give crane capacities, or a breakdown of lift capacities below 24 tons. The codes employed are as follows:

1st Column

ULO = United States Lake Ontario

ULE = United States Lake Erie

ULH = United States Lake Huron

ULM = United States Lake Michigan

ULS = United States Lake Superior

UEC = United States East Coast

UGC = United States Gulf Coast

PR = Puerto Rico

UWC = United States West Coast

2nd Column = Index Number of Reference

3rd Column = Name of Port

4th Column = Country of Port

5th Column = North Latitude, DDMM

6th Column = West Longitude DDDMM

7th Column: Port Size

L = Large

M = Medium

S = Small

V = Very Small

8th Column: Harbor type

CN = Coastal Natural

CB = Coastal Breakwater

CT = Coastal Tide Gate

RN = River Natural

RB = River Basin

RT = River Tide Gate

LC = Canal or Lake

OR = Open Roadstead

TH = Typhoon Harbor

9th Column: Type of protection afforded

E = Excellent

G = Good

F = Fair

P = Poor

N = None

10th Column: Channel Depth (Feet)

A = 76-over

B = 71 - 75

C = 66-70

D = 61-65

E = 56-60

F = 51-55

G = 46-50

H = 41-45

J = 36-40

K = 31 - 35

L = 26-30

M = 21-25

..

N = 16-20

0 = 11-15

P = 6-10

Q = 0-5

11th Column: Anchorage Depth (Feet)

See codes for 8th column.

12th Column: Cargo Pier Depth (Feet)

See codes for 8th column.

13th Column: Cranes

y = one or more cranes

blank = no cranes

14th Column: Lifts

y = one or more lifts

blank = no lifts

In order to aid visualization of the distribution of debarkation facilities of interest to the pollution response problem, two plots were prepared.

Figure E-1: Debarkation ports with more than 10 feet draft in channel and pier areas and a lift or crane.

Figure E-2: Debarkation ports with more than 15 feet draft in channel and pier areas.

Reference: Pub. 150 "World Port Index," Fifth Edition, 1976, Defense Mapping Agency Hydrographic Center, Code NVP3, Washington DC 20390.

POTENTIAL DEBARKATION POINS

1											- '				
ULE 3430 BUFFALO	1	2	3	4	5	6	7	8 9	10	11	12	131	14	-	
U.E 3450 BUFFALO	ULO	3170	OSWEGO	US	4328								Y		
	ULO	3200	ROCHESTER	US	4316	7736	S	RN	EM	M			Y		
ULE 3400 CONNEAUT	ULE	3430	BUPFALO	US	4253	7853	L	CB	EL	M	L	Y	Y		
ULE 3470 ASHTABULA	ULE	3450	ERIE	US	4209	8006	S	CN	EL		H	Y	Y		
ULE 3490 CLEVELAND	ULE	3460	CONNEAUT	US	4158	8033	S	RN	EM	L	H	Y	Y		
ULE 3500 LORAIN	ULE	3470	ASHTABULA	US	4154										
ULE 3560 TOLEDO	ULE	3490	CLEVELAND	US	4130								Y		
ULE 3570 NONROE	ULE	3500	LORAIN			8211	S	RN	EL	J	L	Y			
ULH	OLE.	3560													
ULH	ULE	3570	MONROE												
ULH															
ULH	ULH														
ULH 4520 MACKINAN CITY US 4547 8443 V LC P N N N Y Y ULH 4670 LUDINGTON US 4357 8627 S LC E L L N Y ULH 4690 MUSKEGON US 4314 8616 S LC G L K H Y Y ULH 4800 CHICAGO US 4314 8616 S LC G L K H Y Y ULH 4800 MILWAUKEE US 4302 8753 M RM G L N N Y Y ULS 5450 SUPERIOR US 46431 8801 S RN G H L N Y Y ULS 5450 SUPERIOR US 4644 9204 M CN E N L L Y Y ULS 5450 SUPERIOR US 4644 9204 M CN E N L L Y Y ULS 5460 DULUTH US 4666 9206 M CN E N L L Y Y US 6600 MACHIAS US 4431 8801 S RN G H L N Y Y US 6600 MACHIAS US 4444 6659 V CN F H H M Y Y US 6610 LUBEC US 4452 6659 V CN F H H M Y Y US 6610 LUBEC US 4452 6659 V CN F N H M Y Y US 6610 LUBEC US 4453 6728 V RN G P K O Y Y US 6610 LUBEC US 4453 6728 V RN G P K O Y Y US 6610 LUBEC US 4453 6728 V RN G P K O Y Y US 6610 LUBEC US 4453 6728 V RN G P K O Y Y US 6610 NORTHERST HARBOR US 4418 6817 V CN F O D P Y Y US 6610 NORTHERST HARBOR US 4418 6817 V CN F O P Y Y US 6610 STONINGTON US 4409 6840 V CN G K H O Y Y US 6610 STONINGTON US 4409 6840 V CN G K N O Y Y US 6650 ROCKLAND US 4406 6906 V CM G N N O Y Y US 6700 ROCKLAND US 4406 6906 V CM G N N O Y Y US 6700 ROCKLAND US 4351 6938 S CN G H H O Y Y US 6700 ROCKLAND US 4351 6938 S CN G H H O Y Y US 6710 ROBINHOOD US 4351 6938 S CN G H H O Y Y US 6710 ROBINHOOD US 4360 7015 R CM E K L J Y Y US 6710 R CM E	ULH														
ULM	ULH			US	4326	8356	S	RN	EN	N	M	Y	Y_		er transfer en
ULM	ULH														
ULM	OLM	4670	LUDINGTON												
ULM 4860 MILWAUKEE US 4302 8753 M RN G L N N Y Y ULM 4940 GREEN BAY US 4431 8801 S RN G L N N Y Y ULS 5450 SUPERIOR US 4644 9204 M CN E N L L Y Y UEC 6600 EASTPORT US 4454 6659 V CN E N L L Y Y UEC 6600 EASTPORT US 4454 6659 V CN E N L L Y Y UEC 6630 MACHIAS US 4443 66728 V RN G P K O Y Y UEC 6710 NORTHEAST HARBOR US 4443 6728 V RN G P K O Y Y UEC 6720 SOUTHWEST HARBOR US 4418 6817 V CN P O O P Y Y UEC 6730 MOUNT DESERT US 4422 6820 V CN F M M P Y Y UEC 6810 STONINGTON US 4409 6840 V CN G N M O Y Y UEC 6860 ROCKLAMD US 4409 6840 V CN G N M O Y Y UEC 7040 EAST BOOTHBAY US 4351 6938 S CN G M H O Y Y UEC 7050 BOOTHBAY HARBOR US 4351 6938 S CN G M H O Y Y UEC 7050 BOOTHBAY HARBOR US 4351 6938 S CN G M H O Y Y UEC 7150 PORTLAND US 4340 7015 M CW E K L J X Y UEC 7230 MARBLEREAD US 4236 7040 S CN G M M N Y Y UEC 7220 BEYERLY US 4232 7053 Y CN G M M Y Y UEC 7230 MARBLEREAD US 4230 7051 V CN G M M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7350 HARBLEREAD US 4231 7053 Y CN G M M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7350 PLYHOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 PLYHOUTH US 4157 7040 V CN F M O Y Y UEC 7350 PLYHOUTH US 4157 7040 V CN F P P P Y Y UEC 7350 PLYHOUTH US 4157 7040 V CN F P P P Y Y UEC 7480 NOANK US 4133 7037 V CN F P P P Y Y UEC 7480 NOANK US 4137 7037 V CN F P P P Y Y UEC 7500 NEW LONDON US 4127 7036 Y CN F P P P Y Y UEC 7480 NOANK US 4119 7159 Y CN F P P P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 4121 7223 V RN G U O P Y Y UEC 7500 NEW LONDON US 41	ULM														
ULM	ULM			US	4153	8736									
ULS		4860	MILWAUKEE												
ULS	ULM														
UBC		10:10:00	SUPERIOR	US	4644										
UEC 6610 LUBEC US 4452 6659 V CN G O O P Y		The second second second second		US	4646										
UEC 6630 MACHIAS US 4443 6728 V RN G P K O Y Y UEC 6710 MORTHEAST HARBOR US 4417 6819 V CN P O D P Y Y UEC 6720 SOUTHWEST HARBOR US 4417 6819 V CN F O D P Y Y UEC 6730 MOUNT DESERT US 4422 6820 V CN P M H P Y Y UEC 6810 STONINGTON US 4409 6840 V CN G N N O Y Y UEC 6960 ROCKLAND US 4406 6906 V CB G N N O Y Y UEC 7040 EAST BOOTHBAY US 4352 6935 V CN F N H O Y Y UEC 7050 BOOTHBAY HARBOR US 4351 6938 S CN G M H O Y Y UEC 7050 BOOTHBAY HARBOR US 4351 6938 S CN G M H O Y Y UEC 7050 BOOTHBAY HARBOR US 4351 6944 V RN G H N O Y Y UEC 7150 PORTLAND US 4340 7015 M CN E K L J Y Y UEC 7220 BRYERLY US 4236 7040 S CN G M H Y Y UEC 7220 BRYERLY US 4236 7040 S CN G M H Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N H Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N H Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7230 FALMOUTH US 4157 7040 V CN P N O O Y Y UEC 7310 HYANNIS US 4133 7037 V CN P P P P Y Y UEC 7320 FALMOUTH US 4157 7040 V CN P D O O Y UEC 7320 FALMOUTH US 4157 7040 V CN P P P P Y Y UEC 7320 FALMOUTH US 4157 7040 V CN P P P P Y Y UEC 7480 NOANK US 4127 7036 Y CB G N H N Y UEC 7500 NEW LONDON US 4121 7129 Y CN P P O O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7500 NEW LONDON US 4121 7205 V RN G M H N Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STAMFORD US 4102 7333 V RN G N O V			EASTPORT												
UEC 6710 NORTHEAST HARBOR US 4418 6817 V CN F O O P Y Y UEC 6720 SOUTHWEST HARBOR US 4417 6819 V CN G K H O Y Y UEC 6730 MOUNT DESERT US 4422 6820 V CN F M M P Y Y UEC 6810 STONINGTON US 4409 6840 V CN G N N O Y Y UEC 6960 ROCKLAND US 4406 6906 V CB G N M N Y Y UEC 7040 EAST BOOTHBAY US 4352 6935 V CN F N H O Y Y UEC 7050 BOOTHBAY HARBOB US 4351 6938 S CN G H H O Y Y UEC 7070 ROBINHOOD US 4351 6938 S CN G H H O Y Y UEC 7070 ROBINHOOD US 4340 7015 M CM E K L J Y Y UEC 7150 PORTLAND US 4340 7015 M CM E K L J Y Y UEC 7210 GLOUCESTER US 4236 7040 S CN G M M M Y Y UEC 7220 BEYERLY US 4232 7053 Y CN G M M M Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M M M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7260 PLYHOUTH US 4157 7040 V CN F M O O Y Y UEC 7310 HANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALHOUTH US 4137 7037 V CN F P P P Y Y UEC 7350 YIMEYARD HAYEM US 4127 7036 Y CB G N M M Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7500 NEW LONDON US 4121 7205 S RN G N M M Y UEC 7500 NEW LONDON US 4121 7205 S RN G N M M Y UEC 7570 BRIDGEPORT US 4111 7223 V RN G Q O P Y Y UEC 7570 BRIDGEPORT US 4110 73311 N CB E L H K Y UEC 7500 STAMFORD US 4110 73311 N CB E L H K Y UEC 7600 STAMFORD US 4102 7333 V RN G N O O Y				US	4452										
UEC				10.000											
UEC 6730 MOUNT DESERT US 4422 6820 V CN F M M P Y Y UEC 6810 STONINGTON US 4409 6840 V CN G N N O Y Y UEC 6960 ROCKLAND US 4406 6906 V CB G N N N Y Y UEC 7040 EAST BOOTHBAY US 4352 6935 V CN F N H O Y Y UEC 7050 BOOTHBAY HARBOR US 4351 6938 S CN G M H O Y Y UEC 7070 ROBINHOOD US 4351 6938 S CN G M H O Y Y UEC 7150 PORTLAND US 4340 7015 N CN E K L J Y Y UEC 7210 GLOUCESTER US 4236 7040 S CN G M M N Y Y UEC 7220 BEVERLY US 4232 7053 V CN G M M N Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N N Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N N Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN F N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 VINEYARD MAYEN US 4127 7036 Y CR G M M N Y UEC 7420 PROVIDENCE US 4148 7124 M RN G L K J Y Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7550 NEW HAVEN US 4131 7205 V RN G M N H Y UEC 7570 BRIDGEPORT US 4131 7205 V RN G M H H Y UEC 7570 BRIDGEPORT US 4111 7223 V RN G Q O P Y Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STAMFORD US 4102 7333 V RN G N O O															
UEC 6960 STONINGTON US 4409 6840 V CN G N N O Y Y															
UEC 6960 ROCKLAND	A CONTRACTOR OF THE PERSON NAMED IN														
UEC 7040 EAST BOOTHBAY US 4352 6935 V CN F N H O Y Y UEC 7050 BOOTHBAY HARBOB US 4351 6938 S CN G M H O Y Y UEC 7070 ROBINHOOD US 4351 6944 V RN G H N O Y Y UEC 7150 PORTLAND US 4340 7015 M CN E K L J Y Y UEC 7210 GLOUCESTER US 4236 7040 S CN G M M M Y Y UEC 7220 BRYERLY US 4232 7053 V CN G M M M Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN F N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 VINEYARD HAVEN US 4133 7037 V CN F P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 V CB G N M N Y UEC 7480 NOANK US 4148 7124 N RN G L K J Y Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y UEC 7510 NORWICH US 4131 7205 V RN G N N Y UEC 7550 NEW LONDON US 4121 7205 S RN G K K K Y UEC 7550 NEW LONDON US 4121 7223 V RN G Q O P Y Y UEC 7550 NEW HAVEN US 4131 7205 V RN G N N Y UEC 7550 NEW HAVEN US 4121 7223 V RN G Q O P Y Y UEC 7570 BRIDGEPORT US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 N CB E L N K Y UEC 7570 BRIDGEPORT US 4110 7311 N CB E L N K Y UEC 7500 STANFORD US 4102 7333 V RN G N O O Y															
UEC 7050 BOOTHBAY HARBOR US 4351 6938 S CN G N H O Y Y															
UEC 7070 ROBINHOOD US 4351 6944 V RN G H N O Y Y UEC 7150 PORTLAND US 4340 7015 N CM E K L J X Y UEC 7210 GLOUCESTER US 4236 7040 S CN G M M N Y Y UEC 7220 BEVERLY US 4232 7053 V CN G M M N Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN P N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 PALMOUTH US 4133 7037 V CN P P P P Y Y UEC 7350 VINEYARD HAVEN US 4133 7037 V CN P P P P Y Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 V CN P P O O X UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 V RN G M H M M Y UEC 7550 NEW LONDON US 4121 7223 V RN G Q O P Y Y UEC 7570 BRIDGEPORT US 4110 7311 N CB E L M K Y UEC 7570 BRIDGEPORT US 4110 7311 N CB E L M K Y UEC 7570 BRIDGEPORT US 4110 7311 N CB E L M K Y UEC 7600 STAMFORD US 4102 7333 V RN G M O O Y															
UEC 7150 PORTLAND US 4340 7015 N CN E K L J X Y UEC 7210 GLOUCESTER US 4236 7040 S CN G M M M Y Y UEC 7220 BRYERLY US 4232 7053 Y CN G M M M Y Y UEC 7230 MARBLEHEAD US 4230 7051 Y CN G M N M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 Y CN F N O O Y Y UEC 7310 HYANNIS US 4139 7017 Y CN E O O O Y UEC 7320 FALHOUTH US 4133 7037 Y CN F P P Y Y UEC 7350 YINEYARD HAYEN US 4127 7036 Y CB G N M Y UEC 7420 PROVIDENCE US 4148 7124 M RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CN F P O O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M H M Y UEC 7520 ESSEX US 4114 7255 S CB G K N K Y Y UEC 7570 BRIDGEPORT US 4110 7311 M CB E L H K Y UEC 7570 BRIDGEPORT US 4110 7331 M CB E L H K Y UEC 7600 STAMPORD US 4102 7333 Y RN G N O O Y	The Person of th														
UEC 7210 GLOUCESTER US 4236 7040 S CN G N M N Y Y UEC 7220 BEVERLY US 4232 7053 Y CN G N M N Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G N N N Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN F N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 Y CB G N M N Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CN F P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4110 7311 M CB E L M K Y UEC 7570 BRIDGEPORT US 4110 7311 M CB E L M K Y UEC 7570 BRIDGEPORT US 4102 7333 Y RN G N O O Y															
UEC 7220 BEVERLY US 4232 7053 V CN G M M M Y Y UEC 7230 MARBLEHEAD US 4230 7051 V CN G M M M Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN F N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 VIMEYARD HAVEN US 4127 7036 Y CB G N M M Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CM F P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7570 BRIDGEPORT US 4102 7333 Y RN G N O O Y															
UEC 7230 MARBLEHEAD US 4230 7051 V CN G M N N Y Y UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN P N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN P P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 Y CB G N M B Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CN P P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K R Y UEC 7510 NORWICH US 4131 7205 V RN G M M Y UEC 7520 ESSEX US 4121 7223 V RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7570 BRIDGEPORT US 4110 7331 H CB E L H K Y UEC 7600 STAMPORD US 4102 7333 V RN G N O O Y															
UEC 7250 BOSTON US 4221 7103 L CN E J H H Y Y UEC 7280 PLYMOUTH US 4157 7040 V CN P N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN P P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 Y CB G N M N Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CM P P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 Y RN G N O O Y					4232										
UEC 7280 PLYMOUTH US 4157 7040 V CN P N O O Y Y UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 PALMOUTH US 4133 7037 V CN P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 Y CB G N M M Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CN P P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 Y RN G N O O Y															
UEC 7310 HYANNIS US 4139 7017 V CN E O O O Y UEC 7320 FALMOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 Y CB G N M N Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CN F P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M N M Y UEC 7520 ESSEX US 4121 7223 V RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 V RN G N O O Y															
UEC 7320 FALMOUTH US 4133 7037 V CN F P P P Y Y UEC 7350 VINEYARD HAVEN US 4127 7036 Y CB G N M N Y UEC 7420 PROVIDENCE US 4148 7124 N RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CN F P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M N M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 Y RN G N O O Y															
DEC 7350 VINEYARD HAVEN US 4127 7036 V CB G N M N Y UEC 7420 PROVIDENCE US 4148 7124 M RN G L K J Y Y DEC 7480 NOANK US 4119 7159 V CM P P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y DEC 7510 NORWICH US 4131 7205 V RN G M M M Y UEC 7520 ESSEX US 4121 7223 V RN G Q O P Y Y DEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 M CB E L M K Y UEC 7600 STAMPORD US 4102 7333 V RN G N O O Y				20	4133										
UEC 7420 PROVIDENCE US 4148 7124 M RN G L K J Y Y UEC 7480 NOANK US 4119 7159 Y CM P P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 Y RN G M M M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 Y RN G N O O Y															
UEC 7480 NOANK US 4119 7159 Y CN P P Q O Y UEC 7500 NEW LONDON US 4121 7205 S RN G K K R Y UEC 7510 NORWICH US 4131 7205 Y RN G M M M Y UEC 7520 ESSEX US 4121 7223 Y RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 Y RN G N O O Y													_		
UEC 7500 NEW LONDON US 4121 7205 S RN G K K K Y Y UEC 7510 NORWICH US 4131 7205 V RN G M M H Y UEC 7520 ESSEX US 4121 7223 V RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 V RN G N O O Y													y		
DEC 7510 NORWICH US 4131 7205 V RN G M M M Y DEC 7520 ESSEX US 4121 7223 V RN G Q O P Y Y DEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y Y UEC 7570 BRIDGEPORT US 4110 7311 M CB E L M K Y UEC 7600 STAMPORD US 4102 7333 V RN G N O O Y													Ŷ		
UEC 7520 ESSEX US 4121 7223 V RN G Q O P Y Y UEC 7550 NEW HAVEN US 4114 7255 S CB G K N K Y Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 V RN G N O O Y													_		
DEC 7550 NEW HAVEN US 4114 7255 S CB G K N K T Y UEC 7570 BRIDGEPORT US 4110 7311 H CB E L H K Y UEC 7600 STANFORD US 4102 7333 V RN G N O O Y															
UEC 7570 BRIDGEPORT US 4110 7311 N CB E L N K Y UEC 7600 STANFORD US 4102 7333 V RN G N O O Y						7255	S	CB	GK	N	K	ì	Y		
UEC 7600 STANFORD US 4102 7333 V RN G N O O Y															
												Y			
The state of the s	0.00	, 050					_				_	•	-		

UBC 7600 NANHATTAN US 4042 7401 L RN E H H Y Y UBC 7750 ALBANY US 4239 7345 S RN G K J Y Y UBC 7750 ALBANY US 4239 7345 S RN G K K K Y Y UBC 7750 DEGRATER US 4049 7359 Y RN G K K K Y Y UBC 7760 WERMAKEN US 4049 7401 S RN G H K Y Y UBC 7760 WERMAKEN US 4044 7401 M RN G H K Y Y UBC 7760 DERSEY CITY US 4043 7402 M RN G H K Y Y UBC 7780 DERSEY CITY US 4043 7402 M RN G H K Y Y UBC 7310 NEWARK US 4042 7409 N RB G H K Y Y UBC 7310 NEWARK US 4042 7409 N RB G J J Y Y UBC 7310 NEWARK US 4042 7404 C R G H J Y Y UBC 7380 STRELETON SI US 4038 7404 C R G H J Y Y UBC 7840 TORRKINSYILLE SI US 4038 7404 C R G H J Y Y UBC 7850 PORT RICHINON SI US 4039 7408 S C R J J K Y UBC 7860 MARINERS HARBOR SI US 4036 7408 S C R J J K Y UBC 7870 GUILPORT SI US 4038 7404 C R H J Y UBC 7895 BAYBAY US 4038 7412 S RN G K K L Y UBC 7895 BAYBAY US 4038 7412 S RN G K K L Y UBC 7895 BAYBAY US 4038 7412 S RN G K K L Y UBC 8080 CHESTER US 3934 7533 H R G N H Y Y UBC 8080 CHESTER US 3951 7508 H R G J K Y UBC 8100 BURLINGTON US 3036 7420 V R G P P P Y UBC 8100 BURLINGTON US 4038 7412 V R G N M Y Y UBC 8100 BURLINGTON US 4038 7420 V R G N M Y Y UBC 8100 BURLINGTON US 4035 7508 H R G J J Y UBC 8100 BURLINGTON US 4035 7508 H R G N M Y Y UBC 8100 BURLINGTON US 4035 7508 H R G N M Y Y UBC 8200 BURLINGTON US 3059 7629 V R G N Y Y UBC 8200 BURLINGTON US 3058 7629 V R G N N														
USC 7720 ALBANY	UEC	7640	MANHATTAN	US	4042	7401	L	RN	E	H	H	H	Y	Y
UBC	UEC	7650	YONKERS	US	4056	7354	S	RN	E	P	P	N		Y
URC 7760 WEEHAWKEN US 4046 7401 RN G H H K Y Y US 4075 7770 HORDOKEN US 4045 7401 M RN G H H K Y Y US 4042 7709 JERSEY CITY US 4043 7402 M RN G H H K Y Y US 4041 7406 M RN G K H H Y Y US 4041 7406 M RN G K K L Y Y US 4041 7408 S CN G J J K Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y	UEC	7720	ALRANY	US	4239	7345	M	RN	G	K	J	L	Y	Y
USC 7770 HOBOKEN US 4045 7401 M EN G H H K Y Y USC 7780 JERSEY CITY US 4043 7402 N EN G H H K Y Y USC 7790 BAYONE US 4041 7406 M EN G K H H Y Y USC 7810 NEWARK US 4042 7409 M EN G K H H Y Y USC 7810 NEWARK US 4042 7409 M EN G K H H Y Y USC 7820 ELIZABETHPOPT US 4039 7411 S CN G J J K Y Y USC 7830 STAPLETON SI US 4038 7404 CN G H H J Y Y USC 7830 STAPLETON SI US 4038 7404 CN G H H J Y Y USC 7850 PORT RICHMOND SI US 4038 7404 CN G H H J Y Y USC 7850 PORT RICHMOND SI US 4038 7404 CN G H H J Y Y USC 7850 PORT RICHMOND SI US 4038 7410 S CN G J J K Y Y USC 7850 PORT SOCONY US 4039 7408 S CN G J J K Y Y USC 7850 PORT SOCONY US 4038 7410 S CN G J J K Y Y USC 7850 PORT SOCONY US 4038 7410 S CN G J J K Y Y USC 7850 PORT SOCONY US 4038 7412 S RN G J K K L Y Y USC 8010 TUCKERTON US 3936 7412 V RN G K K L Y Y USC 8010 TUCKERTON US 3936 7420 V RN G F P P Y USC 8050 WILLINGTON US 3936 7420 V RN G F P P Y USC 8050 WILLINGTON US 3951 7551 L RN G J J K Y Y USC 8100 PORT SOCONY US 3951 7552 L RN G J J K Y Y USC 8100 PORT SOCONY US 3951 7552 L RN G J J X Y Y USC 8100 PORT SOCONY US 3957 7508 K RN G N M H Y Y USC 8100 PORT SOCONY US 3957 7508 K RN G N M Y Y USC 8100 PORT SOCONY US 3957 7508 K RN G N M Y Y USC 8100 PORT SOCONY US 3957 7508 K RN G N N M Y Y USC 8100 PORT SOCONY US 3931 7552 L RN G J J X Y Y USC 8100 PORT SOCONY US 3931 7552 L RN G J J X Y Y USC 8200 PORT SOCONY US 3931 7555 V RN G N N M Y Y USC 8200 PORT SOCONY US 3931 7555 V RN G N N M Y Y USC 8200 PORT SOCONY US 3931 7555 V RN G N N M Y Y USC 8200 PORT SOCONY US 3932 7605 V RN G N K O Y USC 8200 PORT SOCONY US 33649 7618 S RN E H M J Y Y USC 8200 PORT SOCONY US 33649 7618 S RN E H M J Y Y USC 8200 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8300 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8300 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8300 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8500 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8500 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8500 PORT SOCONY US 3372 7725 S RN G L L N Y Y USC 8500 PORT SOCONY US 33	UEC	7.750.	EDGEWATER	US	4049	7359	y	RN	G	K	K	M.	Y.	Y
URC	a BC	7760	WEEHAWKEN	US	4046	7401	S	RN	G	H	H	K	Y	Y
USC 7790 BAYONNE US 4041 7406 M RN G K H H Y Y USC 7810 NEWARK US 4042 7409 N RB G L J J Y Y USC 7810 STAPLETON SI US 4039 7411 S CN G J J K Y Y USC 7830 STAPLETON SI US 4038 7404 CN G H H J Y Y USC 7840 TORKINSVILLE SI US 4038 7404 CN G H H J Y Y USC 7850 PORT RICHHOND SI US 4038 7404 M CN G H H J Y Y USC 7860 NARINERS HARBOR SI US 4038 7410 S CN G J J L Y Y USC 7860 NARINERS HARBOR SI US 4038 7410 S CN G J J K Y Y USC 7860 PORT SICHOND SI US 4038 7410 S CN G J J K Y Y USC 7860 PORT SICHOND SI US 4038 7410 S CN G J J K Y Y USC 7860 PORT SICHOND SI US 4038 7410 S CN G J J K Y Y USC 7860 PORT SICHOND SI US 4038 7410 S CN G J J K Y Y USC 8010 TUCKERTON US 4038 7415 S RN G K K L Y Y USC 8010 TUCKERTON US 3936 7420 V RN G K K L Y Y USC 8010 TUCKERTON US 3936 7420 V RN G K K L Y Y USC 8050 MILHINGTON US 3944 7533 M RN G M H Y Y USC 8050 MILHINGTON US 3947 7538 H RN G M H Y Y USC 8050 MILHINGTON US 3951 7521 L RN G J J K Y Y USC 8060 MILHINGTON US 3957 7508 L RN G J J X Y Y USC 8100 THE PORT SI US 3951 7521 L RN G J J Y Y USC 8100 THE PORT SI US 3957 7508 L RN G J J Y Y USC 8100 THE PORT SI US 3951 7521 L RN G J J Y Y USC 8100 THE PORT SI US 3957 7508 L RN G J J Y Y USC 8100 THE PORT SI US 3951 7521 L RN G J J Y Y USC 8100 THE PORT SI US 3951 7521 L RN G J J Y Y USC 8100 THE PORT SI US 3951 7508 L RN G J J Y Y USC 8100 THE PORT SI US 3951 7508 L RN G J J Y Y USC 8100 THE PORT SI US 3951 7508 L RN G N N Y Y USC 8200 HAYRE DE GRACE US 3932 7605 V RN G N N Y Y USC 8200 HAYRE DE GRACE US 3932 7605 V RN G N N Y Y USC 8200 PORTSMOUTH US 3649 7618 S RN E H M J Y Y USC 8200 PORTSMOUTH US 3649 7618 S RN E H M J Y Y USC 8200 PORTSMOUTH US 3649 7618 S RN E H M J Y Y USC 8200 PORTSMOUTH US 3649 7618 S RN E H M J Y Y USC 8200 PORTSMOUTH US 3649 7618 S RN E H M J Y Y USC 8200 PORTSMOUTH US 3649 7618 S RN E H M J Y Y USC 8300 PORT SOVAL US 3322 77755 S RN G L L N Y Y USC 8500 PORT SOVAL US 3322 77755 S RN G L L N Y Y USC 8500 PORT SOVAL US 3322 77755 S RN G L L N Y Y USC 8500 PORT SOVAL US 3322 77755 S RN G L L N Y Y USC 8500 PORT	UEC	7770	HOBOKEN	US	4045	7401	M	RN	G	H	H	K	Y	Y
URC 7810 NEMARK US 4042 7409 N RB G L J J Y Y URC 7820 ELIZABETHPOFT US 4038 7401 S CN G J J K Y Y URC 7830 STAPLETON SI US 4038 7404 CN G H H J Y Y URC 7840 TOMPKINSVILLE SI US 4038 7404 CN G H H J Y Y URC 7850 PORT RICHMOND SI US 4038 7408 S CN G J J L Y Y URC 7860 MARINERS HARBOR SI US 4038 7410 S CN G J J K Y Y URC 7860 MARINERS HARBOR SI US 4038 7410 S CN G J J K Y Y URC 7870 QUIFPORT SI US 4038 7410 S CN G J J K Y Y URC 7890 PORT SOCONY US 4038 7412 S RN G J J K Y Y URC 7895 BAYWAY US 4038 7412 S RN G J J K Y Y URC 7895 BAYWAY US 4038 7412 V RN G K K L Y Y URC 8010 TUCKERTON US 3936 7420 V RN G F P P Y URC 8050 WILHINGTON US 3936 7420 V RN G F P P Y URC 8050 WILHINGTON US 3944 7533 N RN G N M H Y Y URC 8110 PHILADELPHIA US 3957 7508 L RN G J J J K Y Y URC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y URC 8100 KANDEN US 4003 7452 V RN G O N N Y Y URC 8100 TRENTON US 4005 7452 V RN G O N N Y Y URC 8100 TRENTON US 4005 7452 V RN G O N N Y Y URC 8100 TRENTON US 4005 7452 V RN G O N N Y Y URC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y URC 8209 PORTSHOUTH US 3649 7618 S RN E H H J Y Y URC 8209 PORTSHOUTH US 3649 7618 S RN E H H J Y Y URC 8209 PORTSHOUTH US 3649 7618 S RN E H H J Y Y URC 8300 NORPOLK US 3727 7725 S RN G L L N Y Y URC 8300 NORPOLK US 3732 7725 V RN G N K O Y URC 8300 NORPOLK US 3727 7725 S RN G L L N Y Y URC 8300 NORPOLK US 3727 7725 S RN G L L N Y Y URC 8300 NEWPORT NEWS US 3658 7626 H CN G H H J J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H H J J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8500 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8510 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8510 PORTSHOUTH US 3649 7618 S RN E H N J Y Y URC 8510 PORTSHOUTH US 3658 7626 H N N Y Y Y	UEC	7780	JERSEY CITY	บร	4043	7402	M	RN	G	H	H	K	Y	Y
URC	UEC	7790	BAYONNE	US	4041	7406	M	RN	G	K	H	H	Y	Y
URC 7840 TOMPKINSYILLE SI US 4038 7404 CN G H H J Y Y URC 7850 PORT RICHMOND SI US 4038 7404 M CN G H H J Y Y URC 7850 PORT RICHMOND SI US 4039 7408 S CN G J J L Y Y URC 7860 MARIMERS HARBOR SI US 4038 7410 S CN G J J L Y Y URC 7870 QUIPPORT SI US 4038 7410 S CN G J J K Y Y URC 7870 PORT SOCONY US 4038 7412 S RN G J J K Y Y URC 8010 TUCKERTON US 4038 7412 V RN G K K L Y Y URC 8010 TUCKERTON US 3936 7420 V RN G K K L Y Y URC 8010 TUCKERTON US 3936 7420 V RN G F P P Y URC 8050 WILMINGTON US 3944 7533 M RN G N M H Y Y URC 8060 WILMINGTON US 3951 7521 L RN G J J K Y Y URC 8010 PHILADELPHIA US 3957 7508 L RN G J J J Y Y URC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y URC 8100 TRENTON US 4005 7452 V RN G O N N Y Y URC 8100 TRENTON US 4005 7452 V RN G O N N Y Y URC 8100 TRENTON US 4005 7452 V RN G O N N Y Y URC 8100 TRENTON US 4005 7452 V RN G O N O Y URC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y URC 8220 HAVRE DE GRACE US 3932 7605 V RN G O N O Y URC 8290 PORTSMOUTH US 3651 7618 L RN E H J J Y Y URC 8290 PORTSMOUTH US 3651 7618 L RN E H J J Y Y URC 8290 PORTSMOUTH US 3651 7618 L RN E H H J J Y Y URC 8300 RUPPORT NEWS US 3651 7618 L RN E H H J J Y Y URC 8300 RUPPORT NEWS US 3658 7628 W RN G O K K K Y Y URC 8500 CHARLESTON US 3732 7725 S RN G L L N Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L N Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L N Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L N Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L L Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L L Y Y URC 8500 CHARLESTON US 3747 7725 RN G K K K Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L L Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L L Y Y URC 8500 CHARLESTON US 3747 7725 S RN G L L L Y Y URC 8500 CHARLESTON US 3747 7725 RN G L L K Y Y URC 8600 PORT ROYAL US 3229 8041 V RN G N K Y Y T URC 8600 CHARLESTON US 3749 7755 S CN G K K K Y Y URC 8600 PORT ROYAL US 3229 8041 V RN G N K Y Y Y URC 8600 PORT ROYAL US 3229 8041 V RN G L L K Y Y URC 8600 PORT ROYAL US 3229 8041 V RN G L L K Y Y URC 8600 PORT ROYAL US 30	UEC	7810	NEWARK	US	4042	7409	M	RB	G	L	J	J	Y	Y
URC	URC	7820	ELIZABETHPORT	US	4039	7411	S	CN	G	J	J	K	Y	Y
UEC 7850 PORT RICHHOND SI US 4038 7408 S CN G J J L Y Y UEC 7860 MARINERS HABBOR SI US 4038 7410 S CN G J J K Y Y UEC 7870 GULPPORT SI US 4038 7412 S RN G J J K Y Y UEC 7890 PORT SOCONY US 4038 7412 S RN G J J K Y Y UEC 7895 BAYWAY US 4038 7412 S RN G J J K Y Y UEC 8010 TUCKERTON US 3936 7412 V RN G K K L Y Y UEC 8010 TUCKERTON US 3936 7420 V RN G P P P Y UEC 8050 WILMINGTON US 3936 7420 V RN G P P P Y UEC 8010 TUCKERTON US 3936 7420 V RN G J J K Y Y UEC 8010 TUCKERTON US 3951 7521 L RN G J J K Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y UEC 8140 BURLINGTON US 4005 7452 V RN G O N N Y Y UEC 8160 TRENTON US 4005 7452 V RN G O N N Y Y UEC 8160 TRENTON US 4005 7452 V RN G O N N Y Y UEC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y UEC 8225 ANNAPOLIS US 3859 7629 V RN G N N H Y Y UEC 8220 HAVRE DE GRACE US 3936 7635 L RN G J L J Y Y UEC 8290 PORTSMOUTH US 3651 7618 L RN E H H J Y Y UEC 8290 PORTSMOUTH US 3651 7618 L RN E H H J Y Y UEC 8290 PORTSMOUTH US 3651 7618 L RN E H H J Y Y UEC 8300 NEWPORT NEWS US 3658 7629 V RN G N N N Y I UEC 8300 NEWPORT NEWS US 3655 7750 RN G L L N Y Y UEC 8310 NEWPORT NEWS US 3658 7629 W RN G N N N Y I UEC 8300 NEWPORT NEWS US 3658 7629 W RN G N N N Y I UEC 8300 NEWPORT NEWS US 3658 7629 W RN G N N N Y I UEC 8500 CHARLESTON US 3727 7725 S RN G L L N Y Y UEC 8500 CHARLESTON US 3727 7725 S RN G L L N Y Y UEC 8500 CHARLESTON US 3727 7725 S RN G L L N Y Y UEC 8500 CHARLESTON US 3727 7755 S CN G K K K Y Y UEC 8610 PORT ROYAL US 3222 8041 W RN G N N N Y I UEC 8600 PORT REWELL US 3205 8105 N RN G K K K Y Y UEC 8610 PORT ROYAL US 3222 8041 W RN G N K K Y Y UEC 8600 PORT WEST US 3669 7618 S RN G L L L K Y Y UEC 8600 PORT WEST US 3669 7670 N RN G K K K Y Y UEC 8600 PORT WEST US 3669 7670 N RN G K K K Y Y UEC 8600 PORT WEST US 3600 PORT SOUND US 3732 7725 V RN G D N N Y I Y Y UEC 8600 PORT SOUND US 3732 7725 V RN G D N N Y I Y Y UEC 8600 PORT SOUND US 3732 7725 V RN G D N N Y I Y Y UEC 8600 PORT SOUND US 3732 7725 V RN G D N N Y I Y	UEC	7830	STAPLETON SI	US	4038	7404		CN	G	H	H	J	Y	Y
UEC 7860 MARINERS HARBOR SI US 4038 7410 S CN G J J K Y Y UEC 7870 GULPPORT SI US 4038 7412 S RN G J J K Y Y Y UEC 7895 BAYWAY US 4033 7415 S RN G K K L Y Y UEC 8010 TUCKERTON US 4038 7412 V RN G K K L Y Y UEC 8010 TUCKERTON US 3936 7420 V RN G K K L Y Y UEC 8050 WILNINGTON US 3936 7420 V RN G M H H Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J K Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J K Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y UEC 8130 CANDEN US 4005 7452 V RN G O N N Y Y UEC 8140 BURLINGTON US 4005 7452 V RN G O N N Y Y UEC 8140 BURLINGTON US 4005 7452 V RN G O N N Y Y UEC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y UEC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y UEC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y UEC 8225 ANNAPOLIS US 3859 7629 V RN G N K O Y UEC 8280 NORPOLK US 3865 7626 M CN G H H J Y Y UEC 8280 NORPOLK US 3865 7626 M CN G H H J Y Y UEC 8280 NORPOLK US 3651 7618 L RN E H H J Y Y UEC 8318 WARNICK US 3727 7725 S RN G L L N Y Y UEC 8318 WARNICK US 3727 7725 V RN G N N N Y Y UEC 8310 NORPOLK US 3658 7626 M CN G H H J Y Y UEC 8470 WILNINGTON US 3414 7757 H RN G K K K Y Y UEC 8500 CHARLESTON US 3732 7725 V RN G N N N Y Y UEC 8500 CHARLESTON US 3727 7725 S RN G L L N Y Y UEC 8500 CHARLESTON US 3727 7725 S RN G L L N Y Y UEC 8500 CHARLESTON US 3227 8041 V RN G H N L Y Y UEC 8500 CHARLESTON US 3227 8041 V RN G H N L Y Y UEC 8500 CHARLESTON US 3227 8041 V RN G H N L Y Y UEC 8500 CHARLESTON US 3227 7725 S CN G L L L Y Y UEC 8600 PORT ROYAL US 3205 8105 M RN G K K K Y Y UEC 8610 PALM BEACH US 3646 8003 V CN G L P L Y Y UEC 8600 CHARLESTON US 3227 7725 S CN G L L K Y Y UEC 8610 PALM BEACH US 3019 8139 M RN E K M K Y Y UEC 8610 PALM BEACH US 3029 8139 M RN E K M K Y Y UEC 8610 PALM BEACH US 3029 8041 V RN G M N L Y Y UEC 8640 NIAMI US 3205 8105 M RN G K M K Y Y UEC 8640 NIAMI US 3207 8107 N C G L L K Y Y UEC 8670 CARDEN US 2929 8941 V RN G P P Y Y UEC 8600 ROY DER CORDEN US 3021 8950 S CB G K L K Y Y UEC 8670 CARDEN US 2929 8941 V RN G P P Y Y UEC 8600 GRAND ISLE US	UEC	7840	TOMPKINSVILLE SI	US	4038									
UEC	UEC	7850	PORT RICHMOND SI	US	4039	7408	S	CN	G	J	J	L	Y	Y
UEC	UEC	7860	MARINERS HARBOR SI	US	4038									
USC 7895 BAYWAY	UEC	7870	GULFPORT SI	US	4038	7412	S	RN	G	J	J	K	Y	Y
UEC 8010 TUCKERTON US 3936 7420 V RN G P P P Y UEC 8050 WILMINGTON US 3944 7533 H RN G N H Y Y UEC 8060 CHESTER US 3951 7521 L RN G J J K Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J K Y Y UEC 8140 BURLINGTON US 4005 7452 V RN G O N N Y Y UEC 8140 BURLINGTON US 4005 7452 V RN G O N N Y Y UEC 8160 TRENTON US 4012 7446 V RN G N N H Y X UEC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y UEC 8210 BALTIHORE US 3916 7635 L RN G J L J Y Y UEC 8225 ANNAPOLIS US 3859 7629 V RN G N K O Y UEC 8225 ANNAPOLIS US 3651 7618 L RN E H N J Y Y UEC 8290 PORTSHOUTH US 3649 7618 S RN E H N J Y Y UEC 8290 PORTSHOUTH US 3658 7626 M CN G H N J Y Y UEC 8310 NEWPORT NEWS US 3658 7626 M CN G H N J Y Y UEC 8310 RARWICK US 3727 7725 S RN G L L N Y Y UEC 8320 RICHHOND US 3732 7725 V RN G N N N Y Y UEC 8470 WILMINGTON US 3414 7757 N RN G K K X Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G N N N Y Y UEC 8530 SAVANNAH US 3220 8105 M RN G K K X Y UEC 8530 SAVANNAH US 3227 7955 S CN G K K K Y Y UEC 8530 JACKSONYILLE US 3109 8130 M RN G K H K Y Y UEC 8500 JACKSONYILLE US 3109 8130 M RN G K H K Y Y UEC 8610 PALM BEACH US 2646 8003 V CN G L L L Y Y UEC 8640 MIANI US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8670 TAMPA US 2755 8227 H CN G K H K Y Y UEC 8680 PORT SULPHUE US 3016 8907 V R G G K H K Y Y UEC 8690 GRAND USLE US 2914 9000 V CW G P P Q Y Y	UEC	7890	PORT SOCONY	US	4033	7415	S	RN	G	K	K	L	Y	Y
UEC 8050 WILMINGTON US 3944 7533 M RN G N M H Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y UEC 8110 PHILADELPHIA US 3957 7508 L RN G J J J Y Y UEC 8140 BURLINGTON US 4005 7452 V RN G O N N Y Y UEC 8160 TRENTON US 4005 7452 V RN G O N N Y Y UEC 8200 HAVRE DE GRACE US 3932 7605 V RN G O N O Y UEC 8210 BALTIMORE US 3916 7635 L RN G J L J Y Y UEC 8220 HAVRE DE GRACE US 3932 7605 V RN G N K O Y UEC 8280 NORPOLK US 3859 7629 V RN G N K O Y UEC 8280 NORPOLK US 3659 7629 V RN G N K O Y UEC 8280 NORPOLK US 3651 7618 L RN E H M J Y Y UEC 8290 PORTSMOUTH US 3649 7618 S RN E H M J Y Y UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H M J Y Y UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H M J Y Y UEC 8310 NEWPORT NEWS US 3727 7725 S RN G L L N Y Y UEC 8320 RICHHOND US 3732 7725 V RN G N N N Y Y UEC 8470 WILMINGTON US 3114 7757 M RN G K K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G N N N Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G N N Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K K K Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K K K Y Y UEC 850 DRUNSHICK US 3109 8130 S RN G L L L Y Y UEC 8610 PALN BEACH US 2646 8003 V CN G L P L Y Y UEC 8610 PALN BEACH US 2646 8003 V CN G L P L Y Y UEC 8640 NANI US 3227 8041 V RN G N K K Y Y UEC 8610 PALN BEACH US 2646 8003 V CN G L P L Y Y UEC 8640 NANI US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L L K Y Y UEC 8670 TAMPA US 2547 8011 S CN G L D K Y Y UEC 8670 TAMPA US 2547 8011 S CN G C G P P Y Y UEC 8680 PORT SULPHUR US 3021 8859 T L N G G K H K Y Y UEC 8670 TAMPA US 2547 8011 S CN G C G P P Y Y UEC 8670 TAMPA US 2547 8011 S CN G C G P P Y UEC 8670 PORT SULPHUR US 3021 8859 T L N G G K H K Y Y UEC 8670 PORT SULPHUR US 3041 8807 L RN G G K H K Y Y UEC 86	DEC					7412	V	RN	G	K	K	L	Y	Y
UEC	UEC	8010	TUCKERTON	US	3936	7420	V	RN	G	P	P	P		Y
UEC	UEC			US	3944	7533	M	RN	G	M	M	H	Y	Y
UEC	UEC	8080	CHESTER	US	3951									
UEC	UEC	8110	PHILADELPHIA	US		7508	L	RN	G	J	J	J	Y	Y
UEC	UEC													
UEC		8140				7452	٧	RN	G	0	M	N	T	Y
UEC	UEC	8 160	TRENTON	US	4012	7446	V	RN	G	N	N	M	Y	Y
UEC 8210 BALTIMORE US 3916 7635 L RN G J L J Y Y UEC 8280 NORPOLK US 3651 7618 L RN E H M J Y Y UEC 8290 PORTSMOUTH US 3649 7618 S RN E H M J Y Y UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H M J Y Y UEC 8318 WARWICK US 3727 7725 S RN G L L N Y Y UEC 8470 WILMINGTON US 37414 7757 M RN G K K K Y Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G M N L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8560 JACKSONVILLE US 3019 8139 M RN E K M K Y Y UEC 8640 MIAMI US 2646 8003 V CN G L P L Y Y UEC 8640 MIAMI US 2646 8001 V CN G L P L Y Y UEC 8660 KEY WEST US 2646 8007 M CN G L P L Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L K K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8770 MOBILE US 3011 8807 L RN G P P Q Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J R J Y Y UGC 8860 NEW ORLEANS US 2929 8941 V RN G J R J Y Y UGC 8860 NEW ORLEANS US 2929 8941 V RN G J R J Y Y UGC 8860 NEW ORLEANS US 2929 8941 V RN G J R J Y Y UGC 8870 BATON ROUGE US 3027 9006 S RN G K H K Y Y UGC 8870 BATON ROUGE US 3027 9006 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y		8200	HAVRE DE GRACE			7605	V	RN	G	0	N	0		Y
UEC 825 ANNAPOLIS US 3859 7629 V RN G N K O Y UEC 8280 NORFOLK US 3651 7618 L RN E H M J Y Y UEC 8290 PORTSMOUTH US 3649 7618 S RN E H M J Y Y UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H M J Y Y UEC 8318 WARWICK US 3727 7725 S RN G L L N Y Y UEC 8320 RICHMOND US 3732 7725 V RN G N N N Y Y UEC 8470 WILMINGTON US 3414 7757 M RN G K K K Y Y UEC 8500 CHARLESTON US 3247 7795 S CN G K K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G M M L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8580 JACKSONVILLE US 3019 8130 S RN G L L L Y Y UEC 8640 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8640 MIAHI US 2547 8011 S CN G L L K Y Y UEC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8680 PORT SULPHUR US 3021 8807 L RN G J K J Y Y UGC 8680 PORT SULPHUR US 3021 8807 V CC G P P P Y UGC 8680 PORT SULPHUR US 2929 8941 V RN G J H H Y UGC 8670 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y	UEC	8210	BALTIMORE	US	3916	7635	L	RN	G	J	L	J	Y	Y
UEC 8280 NORFOLK US 3651 7618 L RN E H M J Y Y UEC 8290 PORTSMOUTH US 3649 7618 S RN E H M J Y Y UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H M J Y Y UEC 8318 WARWICK US 3727 7725 S RN G L L N Y Y UEC 8320 RICHMOND US 3732 7725 V RN G N N N Y Y UEC 8470 WILMINGTON US 3414 7757 M RN G K K K Y Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G M N L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8580 JACKSONVILLE US 3019 8139 M RN E K M K Y Y UEC 8640 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8640 MIAHI US 2547 8011 S CN G L L K Y Y UEC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UEC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UEC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UEC 8670 TAMPA US 2943 8459 V RN G P P Q Y Y UEC 8800 GULPPORT US 3021 8905 S CB G K L K Y Y UEC 8800 GULPPORT US 3021 8905 S CB G K L K Y Y UEC 8800 GULPPORT US 3021 8905 S CB G K L K Y Y UEC 8800 GULPPORT US 3021 8905 S CB G K L K Y Y UEC 8830 PORT SULPHUR US 2929 8941 V RN G J R H Y UEC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UEC 8900 GRAND ISLE US 2914 9000 V CN G P P Q Y Y						7629	٧	RN	G	N	K	0	Y	
UEC 8290 PORTSMOUTH US 3649 7618 S RN E H J Y UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H J Y UEC 8310 RICHMOND US 3727 7725 S RN G L N Y UEC 8470 WILMINGTON US 3414 7757 RN G K K Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K Y UEC 8510 PORT ROYAL US 3222 8041 Y N G H K Y Y UEC 8550 BRUNSWICK US 3109 8139 R R K K Y Y UEC 8560 JACKSONVILLE US 2646														Y
UEC 8300 NEWPORT NEWS US 3658 7626 M CN G H M J Y Y UEC 8318 WARWICK US 3727 7725 S RN G L L N Y Y UEC 8320 RICHMOND US 3732 7725 V RN G N N N Y Y UEC 8470 WILNINGTON US 3732 7725 V RN G N N N Y Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G M N L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8580 JACKSONVILLE US 3019 8130 S RN G L L L Y Y UEC 8660 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8630 PORT EVERGLADES US 2606 8007 M CN G J J J Y Y UEC 8640 MIAHI US 2547 8011 S CN G L L K Y Y UEC 8660 KEY WEST US 2433 8149 S CN G L L K Y Y UEC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UEC 8770 MOBILE US 3041 8807 L RN G Y N Y Y UEC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UEC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UEC 8810 SLIDELL US 3016 8947 V LC G P P P Y UEC 8830 PORT SULPHUR US 2943 8459 V RN G P P Q Y Y UEC 8830 PORT SULPHUR US 2929 8941 V RN G J H J Y UEC 8860 NEW ORLEANS US 2929 8941 V RN G J H J Y UEC 8860 NEW ORLEANS US 2927 9003 L RN E J A J Y Y UEC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UEC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y														
UEC 8318 WARWICK US 3727 7725 S RN G L L N Y Y UEC 8320 RICHMOND US 3732 7725 Y RN G N N N Y Y UEC 8470 WILMINGTON US 3414 7757 N RN G K K K Y Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K K Y Y UEC 8510 PORT ROYAL US 3222 8041 Y RN G N N L Y Y UEC 8530 SAVANNAH US 3222 8041 Y RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8550 JACKSONVILLE US 3019 8139 N RN E K N K Y Y UEC 8580 JACKSONVILLE US 3019 8139 N RN E K N K Y Y UEC 8610 PALM BEACH US 2646 8003 Y CN G L P L Y Y UEC 8630 PORT EVERGLADES US 2646 8007 N CN G L N K Y Y UEC 8640 MIAHI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 H CN G K N K Y Y UGC														
UEC 8320 RICHMOND US 3732 7725 V RN G N N N Y Y UEC 8470 WILMINGTON US 3414 7757 M RN G K K K Y Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K K Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G M N L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSHICK US 3109 8130 S RN G K L L L Y Y UEC 8580 JACKSONVILLE US 3019 8139 M RN E K M K Y Y UEC 8610 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8630 PORT EVERGLADES US 2606 8007 M CN G J J J Y Y UEC 8640 MIAMI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8810 SLIDELL US 3041 8807 L RN G J K J Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J H H Y UGC 8860 NEW ORLEANS US 2929 8941 V RN G J H H Y UGC 8870 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y														
UEC 8470 WILMINGTON US 3414 7757 M N G K K Y UEC 8500 CHARLESTON US 3247 7955 S CN G K K Y UEC 8510 PORT ROYAL US 3222 8041 Y N G N L Y UEC 8530 SAVANNAH US 3205 8105 M N G K K Y Y UEC 8550 BRUNSWICK US 3109 8130 R N K K Y Y UEC 8560 JACKSONVILLE US 3019 8139 M R E K K Y Y UEC 8660 P L Y Y UEC 8660 P L Y Y UEC 8660 KEY WEST US 2433 8149														
UEC 8500 CHARLESTON US 3247 7955 S CN G K K X Y Y UEC 8510 PORT ROYAL US 3222 8041 V RN G M N L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8580 JACKSONVILLE US 3019 8139 M RN E K M K Y Y UEC 8610 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8630 PORT EVERGLADES US 2646 8007 M CN G J J J Y Y UEC 8640 MIAHI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8730 APALACHICOLA US 2943 8459 V RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULPPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J H H Y UGC 8830 PORT SULPHUR US 2927 9003 L RN E J A J Y Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y <														
UEC 8510 PORT ROYAL US 3222 8041 V RN G M N L Y Y UEC 8530 SAVANNAH US 3205 8105 M RN G K H K Y Y UEC 8550 BRUNSWICK US 3109 8130 S RN G L L L Y Y UEC 8580 JACKSONVILLE US 3019 8139 M RN E K M K Y Y UEC 8610 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8630 PORT RYERGLADES US 2646 8007 M CN G J J J Y Y UEC 8640 MIAMI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8770 MOBILE US 3021 8905 S CB G K L K Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J H H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y	UEC			US	3247									
UEC 8530 SAVANNAH US 3205 8105 M N G K K Y UEC 8550 BRUNSWICK US 3109 8130 S R G L L Y Y UEC 8580 JACKSONVILLE US 3019 8139 M R E K K Y Y UEC 8610 PALM BEACH US 2646 8003 Y C G L P L Y Y UEC 8630 PORT EVERGLADES US 2606 8007 M C G L K Y Y UEC 8640 MIAHI US 2547 8011 S C G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S C G K K Y Y UGC 870 APALACHICOLA US 2943 8459 Y <td></td>														
UEC 8550 BRUNSWICK US 3109 8130 SRNGLLLYY UEC 8580 JACKSONVILLE US 3019 8139 MRNEKMKYY UEC 8610 PALM BEACH US 2646 8003 V CNGLPLYY UEC 8630 PORT EVERGLADES US 2606 8007 M CNGLPLYY UEC 8640 MIAHI US 2547 8011 S CNGLLKYY UGC 8660 KEY WEST US 2433 8149 S CNGLNKYY UGC 8670 TAMPA US 2755 8227 M CNGKNKYY UGC 8730 APALACHICOLA US 2943 8459 Y RNGPPQYY UGC 8770 MOBILE US 3041 8807 L RNGJKYY Y UGC 8800 GULFPORT US 3021 8905 S CBGKLKYY Y UGC 8830 PORT SULPHUR US 2929 8941 Y RNGJRHY Y UGC 8860 NEW ORLEANS US 2957 9003 L RN	UEC	8530	SAVANNAH			8105	M	RN	G	K	H	K	Y	Y
UEC 8580 JACKSONVILLE US 3019 8139 M RN E K M K Y Y UEC 8610 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8630 PORT EVERGLADES US 2606 8007 M CN G J J J Y Y UEC 8640 MIAMI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8730 APALACHICOLA US 2943 8459 Y RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J R H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y	UEC													
UEC 8610 PALM BEACH US 2646 8003 V CN G L P L Y Y UEC 8630 PORT EVERGLADES US 2606 8007 H CN G J J J Y Y UEC 8640 MIAMI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 H CN G K N K Y Y UGC 8730 APALACHICOLA US 2943 8459 Y RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 Y RN G J R H Y Y UGC 8860 NEW ORLEANS US <		8580	JACKSONVILLE			8139	M	RN	E	K	M	K	T	Y
DEC				บร	2646									
UEC 8640 MIAHI US 2547 8011 S CN G L L K Y Y UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8730 APALACHICOLA US 2943 8459 Y RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J R H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y				US	2606									
UGC 8660 KEY WEST US 2433 8149 S CN G L N K Y Y UGC 8670 TAMPA US 2755 8227 H CN G K N K Y Y UGC 8730 APALACHICOLA US 2943 8459 Y RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 Y RN G J H H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 Y CN G P P Q Y Y	DEC					8011	S	CN	G	L	L	K	Y	Y
UGC 8670 TAMPA US 2755 8227 M CN G K M K Y Y UGC 8730 APALACHICOLA US 2943 8459 Y RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 Y RN G J R H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 Y CN G P P Q Y Y	UGC	8660	KEY WEST	US	2433									
UGC 8730 APALACHICOLA US 2943 8459 Y RN G P P Q Y Y UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 Y RN G J R H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y						8227	M	CN	G	K	H	K	T	Y
UGC 8770 MOBILE US 3041 8807 L RN G J K J Y Y UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J H H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y	UGC	8730	APALACHICOLA	US	2943	8459	Y	RN	G	P	P	Q	Y	Y
UGC 8800 GULFPORT US 3021 8905 S CB G K L K Y Y UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J R H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y							_	-	-	-	-	-		
UGC 8810 SLIDELL US 3016 8947 V LC G P P P Y UGC 8830 PORT SULPHUR US 2929 8941 V RN G J R H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y														
UGC 8830 PORT SULPHUR US 2929 8941 V RN G J H H Y UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y														
UGC 8860 NEW ORLEANS US 2957 9003 L RN E J A J Y Y UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y													I	_
UGC 8970 BATON ROUGE US 3027 9106 S RN G K H K Y Y UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y														
UGC 8990 GRAND ISLE US 2914 9000 V CN G P P Q Y Y														
		8990	GRAND ISLE											
	UGC													

POTENTIAL DEBARKATION POINT

UGC	9040 LAKE CHARLES 9080 PORT ARTHUR	US 3013 9315 S RN G J L J Y Y
UGC	9080 PORT ARTHUR	US 2950 9358 M LC G J J J Y Y
UGC	9140 BEAUMONT	US 3005 9405 M RN G J L J Y Y
UGC	9150 GALVESTON	US 2919 9447 L CN G J L K Y Y
UGC	9160 TEXAS CITY	US 2923 9455 S CN G K L K Y Y
UGC	9240 HOUSTON	US 3005 9405 M RN G J L J Y Y US 2919 9447 L CN G J L K Y Y US 2923 9455 S CN G K L K Y Y US 2945 9517 L RN G J K K Y Y
nec	9250 PREEPORT	DS 2857 9520 V RN G K L J Y Y
UGC	9250 FREEPORT 9300 CORPUS CHRISTI 9340 BROWNSVILLE	US 2749 9724 M CN G J K K Y Y
UGC	9340 BROWNSVILLE	US 2557 9724 S LC G K K K Y Y
PR	11110 SAN JUAN	RQ 1828 6607 M CN E K L K Y Y
PR	11170 ENSENADA HONDA	RO 1814 6538 S CN E J K K Y Y
PR	11170 ENSENADA HONDA 11260 PONCE	RO 1759 6637 S CN F L N L Y Y
PR	11280 GUANICA	RO 1758 6655 S CN E K M K Y Y
UWC	16010 SAN DIEGO	OS 3243 11711 H CN E J J K Y Y
UWC	16070 LONG BEACH	US 3346 11811 M CB E F K E Y Y
UNC	16080 LOS ANGELES	US 3345 71815 L CB E G K E Y Y
UWC	16120 PORT HUENENE	US 3409 11912 V CB E K L L Y Y
UWC	16270 SANTA CRUZ	US 3658 12201 V CN F P L L Y Y
UNC	16300 SAN FRANCISCO	US 3749 12225 L CN E G L J Y Y
UWC	16330 ALAMEDA	US 3747 12216 S CN E L Y Y
OMC	16340 OAKLAND	RQ 1759 6637 S CN F L N L Y Y RQ 1758 6655 S CN E K M K Y Y US 3243 11711 M CN E J J K Y Y US 3346 11811 M CB E F K E Y Y US 3345 11815 L CB E G K E Y Y US 3409 11912 V CB E K L L Y Y US 3658 12201 V CN F P L L Y Y US 3749 12225 L CN E G L J Y Y US 3747 12216 S CN E L L Y Y US 3749 12220 L CN E L L Y Y US 3806 12216 S CN E L L Y Y US 3803 12213 V CN E K M Y US 3809 12142 V RN E L M Y US 3809 12142 V RN E L M Y US 3805 12130 S RN E L L Y US 4612 12350 S RN E H K Y Y US 4631 12240 L RN E L K Y Y US 4538 12241 M RN E L K Y Y US 4641 12345 V RN E L M Y US 4655 12407 V RN E M N Y Y
UMC	16410 MARE ISLAND	US 3806 12216 S CN E L L Y Y
OMC	16440 CROCKETT	US 3003 12213 V CN E K M Y
UNC	16520 STOCKTON	US 3757 12118 S RN E L L Y Y
UWC	16540 RIO VISTA	US 3809 12142 V RN E L M Y
UMC	16590 SACRAMENTO	US 3835 12130 S RN E L L Y
UWC	16850 ASTORIA	US 4612 12350 S RN B H K Y Y
DAC	16900 LONGVIEW	US 4608 12256 S RN E L K Y Y
UWC	16940 PORTLAND	US 4531 12240 L RN E L L K Y Y
OMC	16950 VANCOUVER	US 4538 12241 M RN E L K Y Y
OMC	17030 WILLAPA HARBOR	US 4641 12345 V EN E L M Y Y
UWC	17040 WESTHAVEN COVE	US 4655 12407 V RN E M N Y Y
OMC	17060 ABERDEEN	US 4659 12349 S RN E L K Y Y
UWC	17080 HOQUIAN	US 4658 12354 S RN R L K Y Y
DAC	17120 PORT ANGELES	US 4807 12326 S CN G D H G Y Y
OMC	17160 PORT TOWNSEND	0S 4807 12245 S CN G P G N Y Y
UWC	17430 BREMERTON	US 4734 12239 H CN E H H H Y Y
UWC	17440 PORT ORCHARD	US 4/32 12238 V CN E K K K I
OMC	17700 TACOHA	US 4/1/ 12225 H CN E A A G Y Y
DAC	17730 SEATTLE	US 4/36 12220 L CN E K A A Y Y
OAC	17700 HUNILIEU	US 4/5/ 12218 V CN E J J J I I
OMC	17020 PRIDLY BARROR	10 4000 12213 3 CH E L R J I I
OMC	17920 FRIDAL BARBUR	15 4637 12310 V CN P T V V
DAC	18040 ANACOPTES	US 4641 12345 V EN E L M Y Y US 4655 12407 V RN E M N Y Y US 4659 12349 S RN E L K Y Y US 4658 12354 S RN E L K Y Y US 4807 12326 S CN G D H G Y Y US 4807 12245 S CN G P G N Y Y US 4734 12239 M CN E H H H Y Y US 4732 12238 V CN E K K K Y US 4736 12220 L CN E K A A Y Y US 4757 12218 V CN E J J J Y Y US 4800 12213 S CN E L K J Y Y US 4837 12310 V CN E L Y Y US 4831 12237 S CN E F J Y Y US 4845 12230 S CN E K K Y Y
UNC	10050 REALURIES	10 4015 12237 3 CM B F U I I
UNC	19030 DEFT THOUSE	U3 4043 1223U 3 CR E R R I I

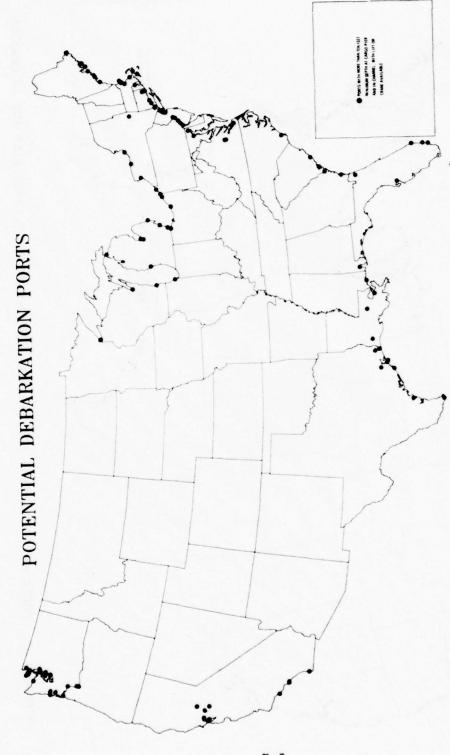


FIGURE E-1. PORTS WITH MORE THAN TEN FEET MINIMUM DEPTH AT CARGO PIER AND IN CHANNEL, AND HAVING A LIFT OR CRANE AVAILABLE



PORTS WITH MORE THAN FIFTEEN FEET MINIMUM DEPTH AT CARGO PIER AND IN CHANNEL FIGURE E-2.

APPENDIX F:

LOAD/RANGE TRADEOFF CURVES FOR THE HH3-F AND HC130 AIRCRAFT

This Appendix presents approximate curves for trading off payload and range for the HH3-F helicopter and the Lockheed Hercules Models HC130B and HC130H. The approximations are based on discussions with USCG search and rescue personnel (G-OSR-2) and the operating manuals of the aircraft involved. The curves and equations are not accurate enough for planning a specific mission, but will suffice for system analysis.

HH3-F HELICOPTER

Three limitations on range and payload are taken into account for the HH3-F. They are:

- a. The gross weight of the HH3-F cannot exceed 22,050 lbs. at any time during the flight. The gross weight is a maximum at takeoff in the missions to be considered.
- b. The gross weight cannot exceed a value, MGWHOGE, when the aircraft is hovering out of the ground effect. The value assumed here is 20,200 lb., corresponding to 22°C air temperature and sea level pressure.
- c. The fuel carried cannot exceed the normal tank capacity of the HH3--about 4200 lb. for JP-4.

Additional fuel cannot be carried without modification and reduction in interior space for the payload.

These three limitations may be expressed as inequalities involving the payload, L, the mission range, R, and other mission and aircraft parameters:

$$L \leq MGW - W_{AC} - F_R - f_O \frac{R}{V_O} - f_H t_H - f_R \frac{R}{V_R}$$
 (1)

$$L \leq MGWHOGE - W_{AC} - F_R - f_h t_h - f_r \frac{R}{V_R}$$
 (2)

$$F_R + f_o \frac{R}{V_o} + f_H t_H + f_R \frac{R}{V_R} \le C_T$$
 (3)

where

MGW = maximum gross weight, 1bs.

MGWHOGE = maximum gross weight when hovering out of ground effect, 1bs.

WAC = weight of empty aircraft plus crew, lbs.

 F_p = weight of fuel reserve, 1bs.

f_o,f_H,f_R = fuel consumption in outbound travel, hovering, and return travel, lbs/hr

 V_{Q}, V_{P} = speed outbound and returning, knots

t_H = hovering time, hrs.

C_T = fuel tank capacity, 1bs.

The values for the above parameters will, in general, depend on the mission. Three missions are considered; the values of the parameters assumed for each are tabulated in Table F-1, and the resultant L-R limits are plotted in Figure F-1.

Mission 1: One-Way, Internal Payload

This mission is to transport cargo from base to base; i.e., takeoff, straight line flight, landing. The hovering restriction, b., does not apply. It is assumed that the payload is carried internally; i.e., equipment and/or personnel are loaded into the cargo area and not removed until landing. A crew of four is assumed, at 200 lbs. per crew member. The fuel reserve is adequate for 20 minutes, based on USCG practice.

As seen in Figure F-1, the zero-range payload is 6350 lbs., and the max-range payload is 2600 lb. The maximum range is 410 n.mi.

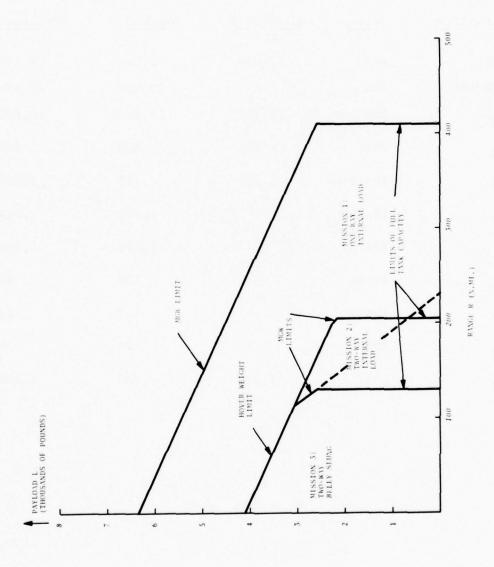


FIGURE F-1 PAYLOAD-RANGE RELATIONS FOR HH3F HELICOPTER

TABLE F-1 PARAMETERS FOR THREE HH3-F MISSIONS

Parameter	<u>Units</u>	Mission 1	Mission 2	Mission 3
MGW	1bs	22,050	22,050	22,050
MGWHOGE	1bs		20,200	20,200
WAC	1bs	15,300	15,300	15,300
F_{R}	1bs	400	400	400
\mathbf{f}_0	lbs/hr	1,200	1,200	1,000
f _H	lbs/hr		1,200	1,200
f_R	lbs/hr	•	1,200	1,200
v_0	knots	130	130	60
V _R	knots		130	130
t _H	hrs		20	20
$C_{\overline{T}}$	1bs	4,200	4,200	4,200

Mission 2: Two-Way, Internal Payload

In this mission, the helicopter proceeds from its base to the spill site, where it hovers for 20 minutes while the payload is lowered out of the cargo door, and then returns to its takeoff base.

As seen in Figure F-1, the hovering weight limit restricts the payload for almost all ranges up to the fuel tank capacity range. MGW is a limiting factor only for the ranges 200 n.mi. to 205 n.mi. It will be noted that at the maximum range of 205 n.mi., the maximum payload is just 1/2 of that for the one-way mission of equal range. This fraction is higher at shorter ranges, rising to 65% at zero range.

Mission 3: Two-Way, Belly Sling Payload

If the load is slung under the belly the speed on the outbound leg is reduced to 60 knots and fuel consumption to 1000 lbs/hr, according to USCG experience. The hovering weight limit and return leg are the same as in Mission 2, where the payload is internal. Because of the increased fuel consumption on the outbound leg (16.7 lbs/n.mi. compared to 9.2 lbs/n.mi.) the fuel tank capacity limits mission 3 to 130 n.mi., or 75 n.mi. less than if the cargo were carried internally. As in the case of the internal cargo mission, the belly sling method is limited in range primarily by the cruising speed rather than the MGW limit.

HC 130 FIXED WING

The USCG maintains two versions of the HC130 aircraft. The H-version has greater range and a higher maximum gross weight. Operational parameters for the two versions are shown in Table F-2. These parameters are based on common USCG practice.

In determining the maximum payload-range combinations for the Cl30, account must be taken of the fuel and gross weight limitations, of the fuel reserve requirements, and of the weight of the auxiliary tanks themselves.

TABLE F-2 PARAMETERS FOR TWO HC130 AIRCRAFT

	HC130-B	HC130-H
Cruise speed, kts	290	300
Fuel consumption, $1bs/hr^{(1)}$	4,500	5,000
Minimum operating wt, 1bs	70,000	70,000
Nominal operating wt, $1bs^{(2)}$	85,000	90,000
Wing fuel capacity, 1bs	45,000 ⁽³⁾	45,000
External tank capacity, 1bs	a bela i	18,000
Reserve fuel required, 1bs	- 45% min	or 10% of total -
Weight of external tanks, 1bs		2,000

⁽¹⁾ Based on JP4 weight fuel, 6.5 lbs/US gal.

⁽²⁾ Approximate weight of equipped aircraft, exclusive of fuel and payload and external tanks.

⁽³⁾ Including auxiliary tanks.

HC130-B

Figure F-2 shows the maximum gross aircraft weight, less fuel, as a function of the total fuel weight. (The gross aircraft weight, less fuel, is the nominal operating weight plus payload.) It may not exceed the values shown in Figure F-2 at any point in the flight in order to stay within the recommended 2.5G maneuver factor. Since the gross weight, less fuel, is constant during a flight, while the fuel weight decreases with time, (not necessarily to zero) the operating point moves on the chart from right to left on a horizontal line segment of length equal to the fuel expended, at a distance above the x-axis equal to the gross weight less fuel.

Using the chart of Figure F-2, it is possible to determine the maximum achieveable gross weight, less fuel, as a function of the mission range. The latter is defined as the one-way distance from takeoff to landing. The result is shown in Figure F-3. The reserve and nominal fuel consumption and speed shown in Table F-2 were employed in constructing Figure F-3.

Finally, the payload is determined by subtracting aircraft operating weight (nominally 90,000 lbs. for the HC130-B) from the Vertical axis of Figure F-3 for the selected range.

HC130-H

The payload-range relation for the H-version is obtained in the same way as for the B-version. The combinations of gross weight, less fuel, and total fuel that lie under the lines of Figure F-4 are permissible at load factors up to 2.25G in the H-version. The corresponding ranges, allowing for the fuel reserves, speed, and fuel consumption rates shown in Table F-2 are plotted in Figure F-5. As is the case of the B-version, the nominal operating weight of about 90,000 lbs. must be subtracted from the gross weight less fuel. Finally, 2000 lbs. must be subtracted from the payload if the aircraft is fitted with external tanks.

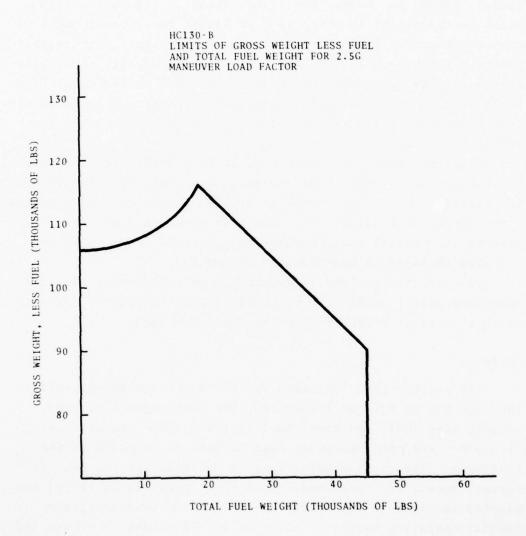


FIGURE F-2 GROSS WEIGHT-FUEL RESTRICTIONS FOR HC130-B AIRCRAFT

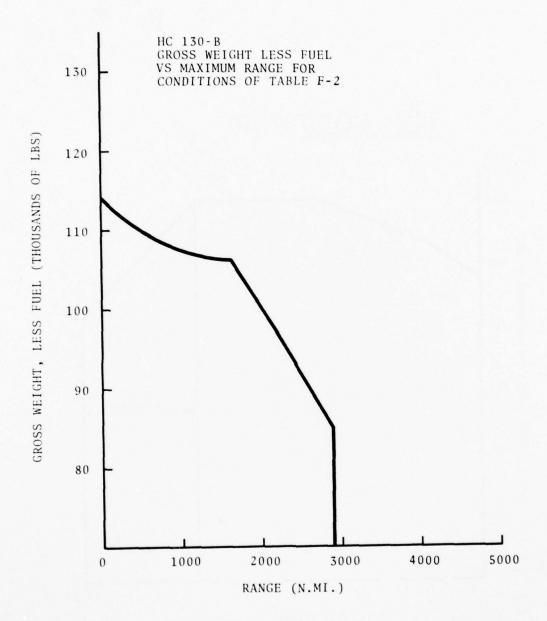


FIGURE F-3 GROSS WEIGHT-RANGE RELATIONS FOR HC130-B AIRCRAFT

HC130-H LIMITS OF GROSS WEIGHT LESS FUEL AND TOTAL FUEL WEIGHT FOR 2.25G MANEUVER LOAD FACTOR

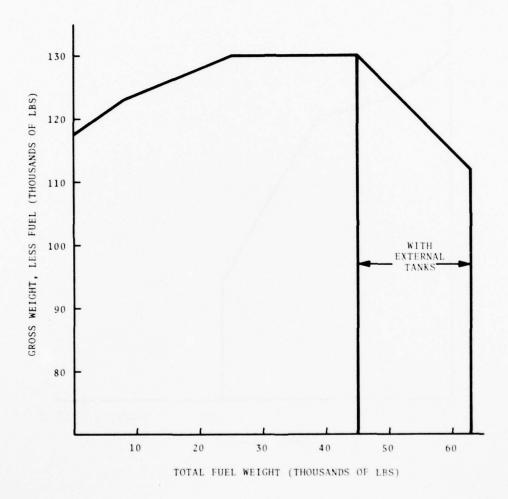
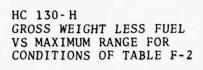


FIGURE F-4 GROSS WEIGHT-FUEL RESTRICTIONS FOR HC130-H AIRCRAFT



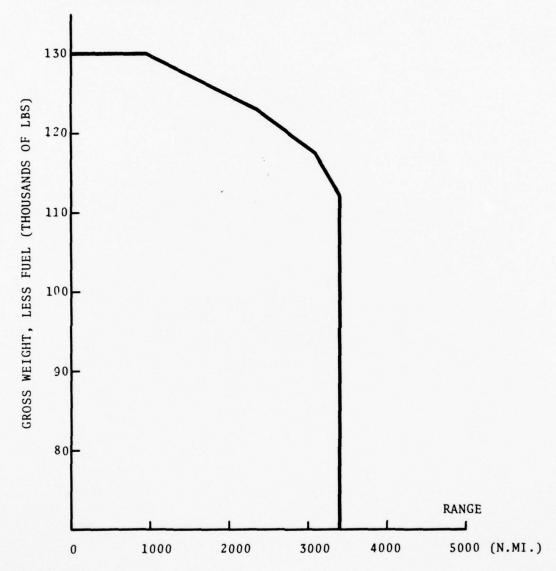


FIGURE F-5 GROSS WEIGHT-RANGE RELATION FOR HC130-H AIRCRAFT

APPENDIX G:
CURRENT U.S. MILITARY HEAVY HELICOPTER CHARACTERISTICS
BOEING VERTOL MODELS 114 AND 234 (CHINOOK SERIES)

The Chinook CH-47 is a U.S. Army, all-weather, medium transport helicopter. The latest U.S. version is the CH-47C, for which the following data apply under 4 conditions of operation, A, B, C, and F (ferry)

	Α	В	С	F		
Weight empty, 1bs Payload, 1bs, internal)	21,464 11,650	21,464 6,400	21,633 21,700	21,162		
T-O weight, 1bs Cruise speed, kts Mission radius	38,500 139 100(1	33,000 137 100(1)	45,400 114 20(1)	133 1,156 ⁽²⁾		
Appx. fuel consumption, 1bs/hr2500						
Cabin length, ft/in						

- A: T-O gross weight = design gross weight
- B: T-O gross weight = gross weight to hover out of ground effect at 6,000 ft and 95°F
- C: T-O gross weight = gross weight to hover out of ground effect at sea level, International Standard Atmosphere

⁽¹⁾ Maximum distance from base before return, with 10% reserve

⁽²⁾ One-way distance, 10% reserve.

Source: Jane's All the World's Aircraft, 1976-1977

UTTAS - UTILITY TACTICAL TRANSPORT AIRCRAFT SYSTEM

The U.S. Army will replace the UN-1H Iroquois assault transport by this twin turbine combat assault squad transport in the late 1970's. The following data are for the Boeing YUH-61A version:

	YUH-61A
Weight empty, 1bs	9,750
Max payload, 1bs	5,924
Max useable fuel, 1bs	2,288
Cruising speed, kts	145
Range at cruise speed, n. mi. (1)	321
Mission T-O weight, 1bs	15,157
Max T-O weight, 1bs	19,700
Cabin length, ft.in.	12'8"
max width, ft.in.	7'2"
max height, ft.in.	4'6"
Volume, cubic ft.	412

(1) 30 minute reserves

SIKORSKY-64 SKYCRANE

Weight empty, 1bs

This heavy lift twin turbine helicopter was intended as a troop transport, minesweeper, cargo and missile transporter, anti-submarine aircraft, and field hospital. It has designations CH-54A, (U.S. Army, 1963), CH-54B (U.S. Army, 1968), plus commercial versions.

19,234

0 1 7 7	
Max T-O weight, 1bs	42,000
Max payload, 1bs	20,000
Max fuel, 1bs (@ 6.5 1b/gal)	8,580
Typical Mission (One-Way)	
T-O weight, 1bs	38,000
Cruise speed, kts	91
Fuel, 1bs	8,580
payload, 1bs	10,000
Range, with 10% reserve, n.mi.	200
Payload Dimensions (Internal dimensions of external pod)	
Length	27'5"
Width	8'10"
Height	6'6"

CH-53A SEA STALLION (U.S. NAVY) 2-TURBINE

The first of these heavy assault transport helicopters was delivered in 1966. Versions are: CH-53A, RH-53A, HH-53B, HH-53C, HH-53 Pave Low III (USAF), CH-53D, RH-53D, plus non-military versions. Data for the CH-53D:

Weight empty, 1bs	23,485
Mission T-O weight, 1bs	36,400
Max T-O weight, 1bs	42,000
Cruising speed, kts	150
Fuel, 1bs, with 10% reserve	4,076
Range at 4,076 1b fuel, 150 kts	223 n. mi.
Payload @ 223 n. mi. range, 1bs	8,839
Cabin, length	30'0"
max width	7'6"
max height	6'6"

CH-53E (U.S. NAVY) 3-TURBINE

This is a three-engine version of the S-65A. The U.S. Navy plans to use the CH-53E for vertical on-board delivery operations, to support mobile construction battalions, and to remove damaged aircraft from decks.

Weight empty, 1bs	32,048
Typical mission	
T-O weight, 1bs	56,000
Cruising speed, kts	150
Range, n.mi.	266
Internal payload at 100 n.mi. range, 1bs.	30,000

Cabin

Length	30'0"
Width at Maximum	7'6"
Height at Maximum	6'6"

NOTE: The following aircraft evolved from the U.S. Navy SH-3A Sea King, first ordered in 1957 and flown in 1959; their performance characteristics are not dissimilar enough from the USCG HH3F to warrant separate tabulation. Sikorsky designations S-61A, S-61B, S-61F, S-61R; Military Designations RH-3A, SH-3A, CH-124, HH-3A, VH-3A, SH-3G, SH-3H, S-61R, CH-3C, CH-3E.

APPENDIX H: AVAILABILITY OF USCG TOWING VESSELS

It is necessary to develop the statistics of the time required to make available at a USCG coastal equipment storage site one of the USCG cutters or boats that is suitable for towing the FSD or similar hull, loaded with pollution control equipment, to a debarkation point, or directly to a spill.

SELECTION OF VESSELS

In selecting USCG vessels suitable for towing duty on short notice, vessels less than 40 feet long were excluded. Although it is possible that some vessels less than 40 feet long can perform this duty, the only test information available (Reference 7.1, PE-24) is for the UTB/41. This reference merely states that the 41 foot UTB successfully towed the loaded FSD at 12 knots on several occasions.

Not all USCG vessels of 40 foot length or greater were included in the calculations. Icebreakers (WAGB), Reserve Training Cutters (WTR), Construction Tenders (WLIC), River Buoy Tenders (WLR), Lightships (604, 612, 613), Training Cutters (WIX) and Oceanographic Cutters (WAGO) were judged not suitable or not generally available for pollution response duty. Of those that are included some are not usually underway along the full length of District coasts, and have been treated with a nominal coastline distance D, as explained below.

The use of the 378 WHEC for pollution response is slightly compromised by its draft (21 feet) which makes it unsuitable for some ports. Nevertheless, the FSD and similar towed vessels are more likely to be stationed with pollution control equipment at the larger ports where draft is not a serious limitation on use of the 378 WHEC. Hence, the 378 has been included in the list.

DATA AND MODELS

The availability models to be described were tailored to existing data. The data are derived from the Annual Abstract of Operations for 1975, Reference H-1. These volumes are compiled from forms CG-3273A (aircraft), CG-3273B (boats), CG-3273C (cutters), as per Commandant Instruction 3123.7E. The data were provided by USCG G-OP; the 1975 report was the latest available in documented form. It provides adequately accurate statistics for our purposes, because cutter and boat deployments have not changed substantially since 1975.

The Abstract of Operations gives, for each cutter type, the annual hours underway, the hours in Bravo-6 standby, the hours in other standby, and the hours in maintenance. For boats, there is given the annual hours underway, the hours in standby, the hours in maintenance, and the hours in storage. The following approximations are made:

- (a) Cutters and boats in maintenance or storage are unavailable.
- (b) Cutters in Bravo-6 or less status are available, on the average, in 3 hours.
- (c) Cutters in standby other than Bravo-6 are available, on the average, in 6 hours.
- (d) Boats in standby status are available, on the average, in 3 hours.
- (e) Boats or cutters underway are uniformly distributed along the coastline of their District, and, upon receipt of request for towing assistance, immediately proceed at full speed to the equipment (sled) location.
- (f) The possible sled/equipment locations are uniformly distributed along the coastline of the district.

From assumptions (e) and (f) one can determine the probability distribution of the availability time for a vessel under way in terms of D, the length of the District coastline, and V, the maximum speed of return of the vessel to the site. The distribution

is shown in Figure H-1(c), where it is seen that the probability the vessel will return in t hours is just $P = 2Vt/D - (Vt/D)^2$. If there are N similar vessels distributed along the coast, then the probability that one or more will be available in t hours is $1 - (1 - P)^N$ or $1 - (1 - Vt/D)^{2N}$.

Further assumptions are now made regarding the availability of cutters on Bravo-6 status, on Bravo-X status (where $x \ge 6$) and boats on standby status. The distribution of availability time for three cases is assumed to be shown in Figure H-3. These diagrams essentially, quantify the uncertainties expressed in assumptions (b), (c) and (d).

From the preceding it can be seen that the probability that one or more <u>cutters</u> will be available in t hours or less is $P_c(t)$:

$$P_c(t) = 1 - (1 - P_{uc})^{N_{uc}} (1 - P_6)^{N_6} (1 - P_X)^{N_X}$$
 (1)

where P_{uc} , P_6 , and P_x are the probability functions of t shown in Figures H-1(c), H-2(a) and H-2(b) for cutters underway, on Bravo-6 status, and on standby other than Bravo-6. Similarly, the probability that one or more boats will be available in t hours or less is

$$P_B(t) = 1 - (1 - P_{uB})^{N_{uB}} (1 - P_S)^{N_S}$$
 (2)

where P_{uB} and P_{S} are the probability functions of t shown in Figures H-1(c) and H-3(c) for boats underway and in standby status.

In (1) and (2), the numbers ${\rm N}_{uC},~{\rm N}_{uB},~{\rm N}_{6},$ etc., have the following meanings:

 $N_{\rm uC}$ = Average number of cutters of the given type, speed V, underway at any time in the District

 N_6 = Average number of cutters of given type, on Bravo-6 status, at any one port of the district

 N_X = Same as N_6 , but for Bravo-X status

x = distance of equipment site along coast; y = distance of vessel underway along coast

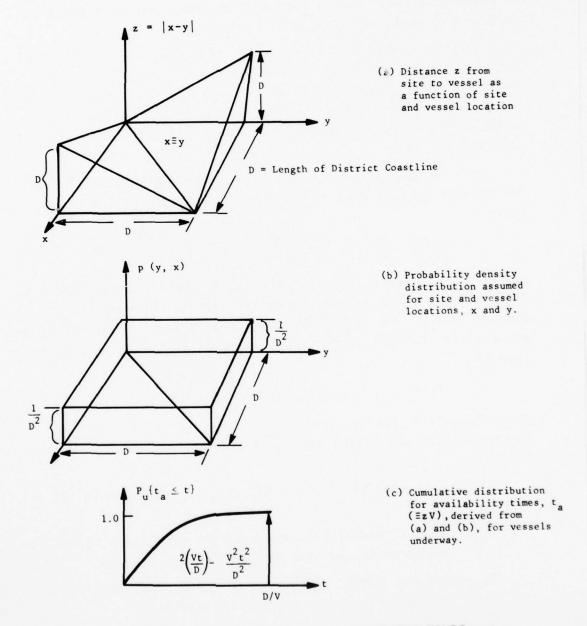
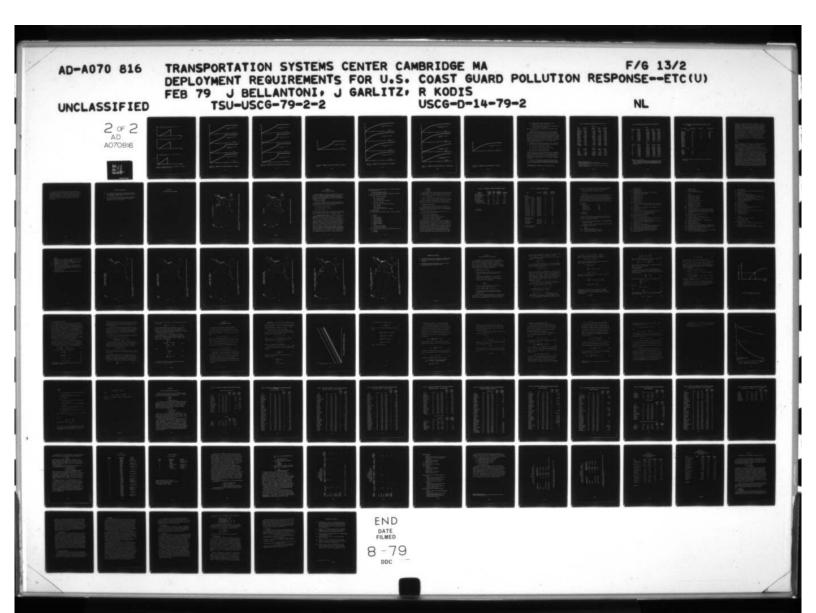
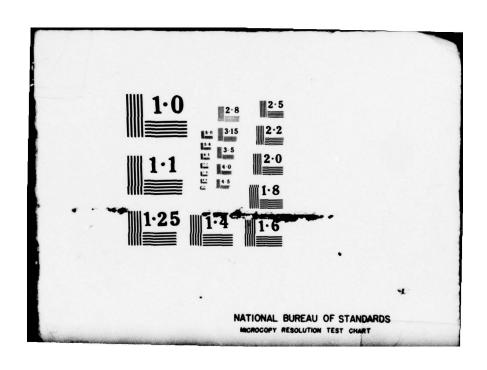
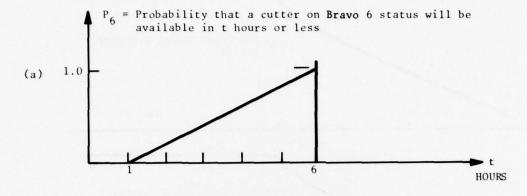
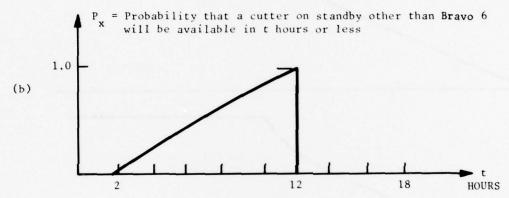


FIGURE H-1. DISTRIBUTION OF AVAILABILITY TIMES FOR VESSELS UNDERWAY









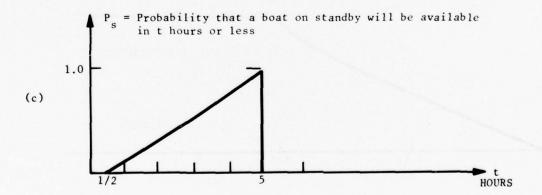


FIGURE H-2. ASSUMED DISTRIBUTION OF AVAILABILITY TIMES FOR BOATS AND CUTTERS ON READY STATUS

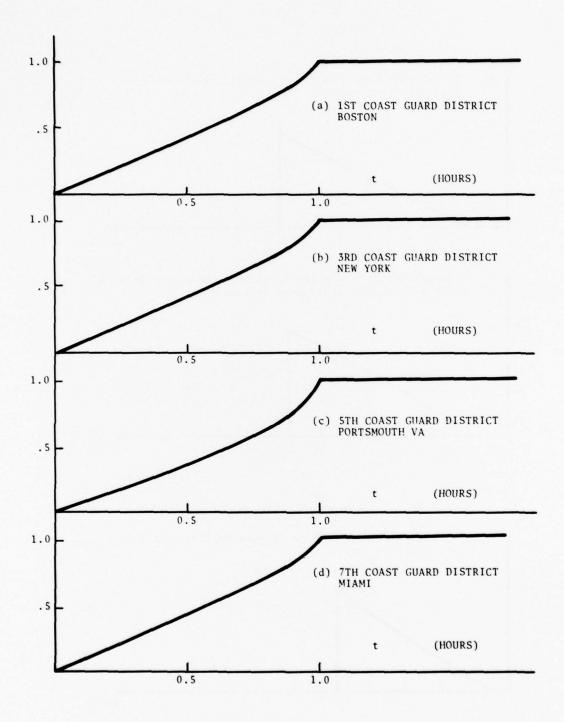


FIGURE H-3. PROBABILITY OF CUTTER AVAILABILITY IN t HOURS OR LESS (a-d).

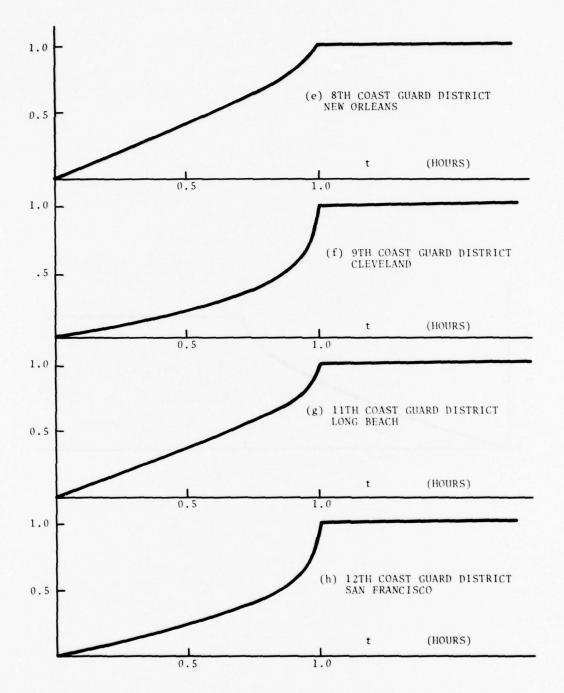


FIGURE H-3. PROBABILITY OF CUTTER AVAILABILITY IN t HOURS OR LESS (e-h).

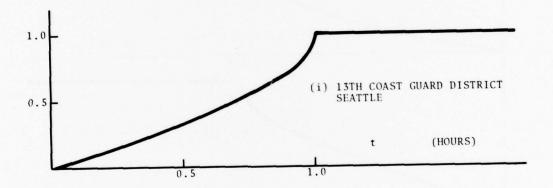


FIGURE H-3. PROBABILITY OF CUTTER AVAILABILITY IN t HOURS OR LESS (i)

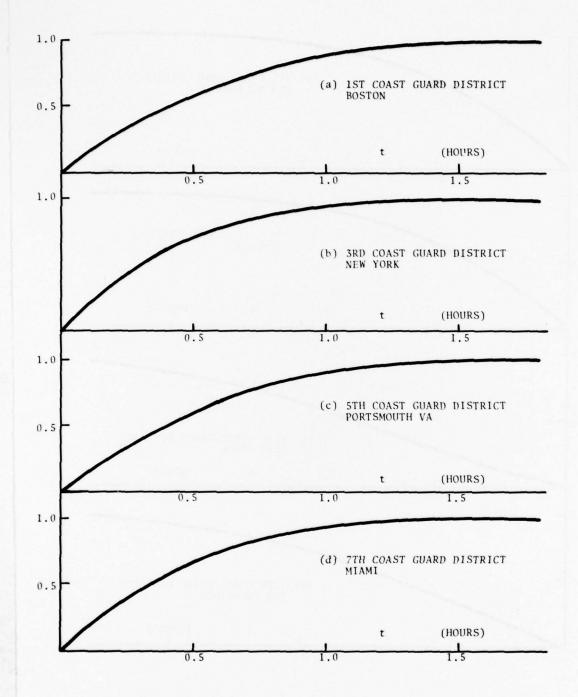


FIGURE H-4. PROBABILITY OF BOAT AVAILABILITY IN t HOURS OR LESS (a-d).

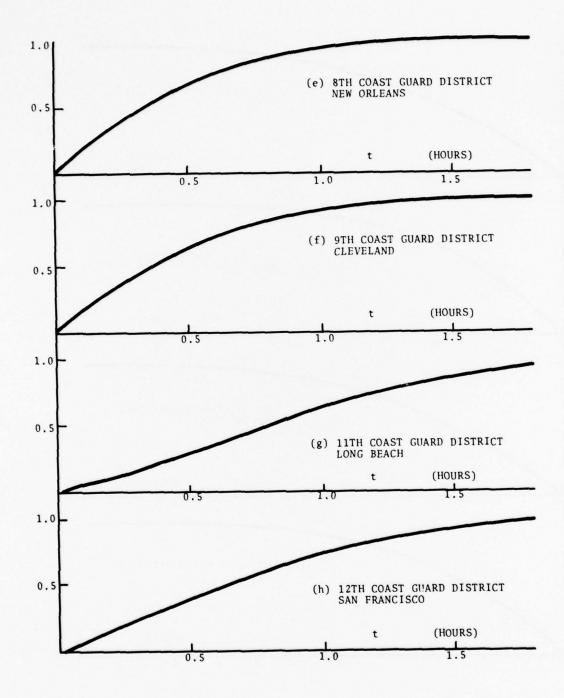


FIGURE H-4. PROBABILITY OF BOAT AVAILABILITY IN t HOURS OR LESS (e-h)

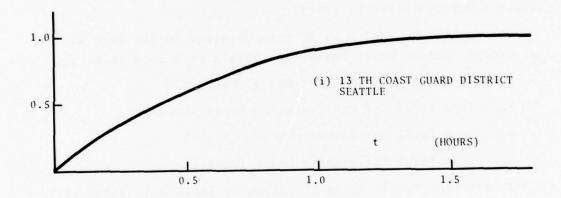


FIGURE H-4. PROBABILTY OF BOAT AVAILABILTY IN t HOURS OR LESS (i)

- $N_{u\,B}^{}$ = Average number of boats of given type, speed V, underway at any time in the District
- N_S = Average number of boats of given type, on standby status, at any one port of the district.

Note: Port is used above to designate a US Coast Guard coastal station or base.

The number ${\rm N_{uC}}$ is obtained from the Abstract of Operations by taking the resource hours* of the US Coast Guard Type Totals (p 75 ff) by cutter type and multiplying it by the ratio of total District resource hours to total USCG resource hours, for all types of cutters. This procedure was necessary because District resource hour totals by type are not available in the Abstract. The type-specific resource hours, pro rated to the District, is then divided by 8760, the number of hours in 1975, to get average number of cutters underway in the District.

The numbers N₆, N_{χ}, N_{uB}, N_s were obtained in the same way as N_{uC}, except that US Coast Guard Type Totals were used as follows

N₆: Type Total for Standby Hours (Cutters)

 N_{χ} : Type Total for Other Standby Hours (Cutters)

 N_{uB} : Type Total for Resource Hours (Boats)

 N_S : Type Total for Standby Hours (Boats)

The various Type Totals above are shown in Table H-1, along with totals for maintenance and storage. The ratio used to pro-rate to Districts in each case was the ratio of total District hours to total USCG hours for the type of utilization involved (Standby, Other Standby, Storage, Underway, etc.). These data are given in Table H-2.

The vessel speeds and District coastal lengths employed are given in Table H-3. Several approximations were made, in addition to those described above: (1) In order to obtain the number

^{*}A resource hour is synonymous with an underway hour here.

TABLE H-1 USCG VESSEL UTILIZATION FOR FY1975 (1) BY TYPE

CUTTERS

Cutter Type	Underway Hours	Bravo-6 Hours	Bravo-X Hours	Maintain Hours
WHEC/327 WHEC/378 WMEC/210 WMEC/213 WMEC/205 WMEC/143 WMEC/- WPB/95 WPB/82 WLB/180 WLM/177 WLM/157 WLM/157 WLM/157 WLM/157 WLM/157 WLM/165 WLI/100 WLI/100 WLI/74 WLI/65 WYTM/110 WYTL/65	14,517 37,023 37,522 1,581 3,919 3,900 2,912 15,047 41,333 47,819 5,313 5,104 6,948 7,015 1,425 3,219 4,983 9,130 13,633	1,231 1,881 36,230 4,803 10,433 9,070 2,102 116,558 276,283 75,414 4,139 15,151 15,480 12,094 41 4,356 16,647 57,835 40,292	3,015 12,395 26,635 280 671 0 1,049 16,577 44,735 78,068 15,648 13,426 24,124 21,912 13,527 6,694 20,802 13,896 49,866	25,037 53,823 39,852 2,095 11,256 4,550 2,697 46,713 101,923 72,695 9,940 10,119 14,768 13,747 2,527 3,251 10,128 33,019 27,609
WYTM/UNK	219	0	8,507	34
		BOATS		
Boat Type	Underway Hours	Standby Hours	Maintain. Hours	Storage Hours
BU/40 BU/45 MLB/41 MLB/52 UTB/40 OTH/>40 (4)	727 9,758 42,909 1,333 69,099 48,199	9,740 115,414 702,834 30,434 864,567 385,408	637 17,065 125,180 5,481 214,174 79,887	6,008 19,883 46,216 0 251,605 38,435

⁽¹⁾ Source: Reference H-1.
(2) The Reference has two entries for WLI/100.
(3) Total Accounting hours for the type is the sum of the four entries on the line.

⁽⁴⁾ Type not specified. Apparently includes such types as ANB/65, BUSL/46, UTB/41, Bu/52.

TABLE H-2 VESSEL UTILIZATION FOR FY1975 (1) BY DISTRICT (2)

CUTTERS

District No.	Underway Hours	Bravo-6 Hours	Bravo-X Hours	Maintain. Hours
1	39,239	56,360	68,060	72,861
3	35,916	95,240	54,817	85,767
3 5 7	28,967	100,864	21,540	70,873
7	38,968	91,155	73,825	61,059
8	36,511	95,514	59,248	54,007
9	17,133	51,812	24,337	29,380
11	24,035	65,669	4,129	22,255
12	18,540	70,029	10,546	32,285
13	27,256	42,695	47,483	45,755
14	10,458	9,865	13,998	25,759
17	22,807	57,225	14,606	32,621
	299,830	736,428	392,589	532,622
		BOATS		
District	Underway	Standby	Maintain.	Storage
<u>No</u>	Hours	Hours	Hours	Hours
1	34,127	639,853	132,996	362,832
	48,793	884,753	214,042	247,436
3 5 7	35,846	714,281	106,267	66,281
7	42,706	701,652	153,851	119,965
8	41,685	877,840	110,176	135,322
9	37,960	1,192,138	70,481	580,914
11	12,934	176,022	45,470	80,696
12	18,291	378,915	48,007	72,077
13	36,324	590,334	83,109	350,071
14	4,750	65,477	20,561	22,975
17	4,467	46,304	11,365	18,321
	317,883	6,267,569	996,325	,056,890

⁽¹⁾ Source: Reference H-1.
(2) The 2nd District was excluded because a large number of the vessels in that District have been excluded from our vessel list. The vessels of Table H-1 are predominantly coastal vessels. Headquarters utilization has been excluded for the same reason.

TABLE H-3 USCG CUTTER AND BOAT SPEEDS USCG DISTRICT COASTAL LENGTHS

Vessel Type	Max Speed	d, V District	Distance, D ⁽¹⁾
	CUTTERS		
WHEC/327 WHEC/378 WMEC/210 WMEC/213 WMEC/205 WMEC/143 WMEC/- WPB/95 WPB/82 WLB/180 WLM/177 WML/157 WLM/133 WLI/100 WLI/100 WLI/100 WLI/74 WLI/65 WYTM/110 WYTL/65 WYTM/UNK	28 km 28 16 16 16 16 16 16 20 24 13 12 13 10 10 10 10 10 10 10 10 10 10 10	nots 1 3 5 7 8 9 11 12 13	925 n.mi. 525 600 1100 1100 2500 250 650 700
	BOATS		
BU/40 BU/45 MLB/44 MLB/52 UTB/40 OTH/>40	10 10 14 11 26 15		

 $^{^{(1)}}$ Approximate length of coast when traversed, at about 25 miles from shore.

of vessels on standby at the FSD site, the numbers of standby vessels N_6 , N_x and N_S were divided by the number of Coast Guard installations in the District at which the vessels are stationed (Reference H-2. The assumption implicit here is the fact that the waterborne sleds will be stationed with equal likelihood at such USCG installations. This assumption is good except where there are only one or two installations in the District that harbor the specific vessel type. To compensate for those few cases, the number of installations in a District having a specific vessel type was incremented by one. (2) The length of coastline D, patrolled was taken to be 100 n.mi. for small buoy tenders (WLI/74 and WLI/65), 50 n.mi. for all the boats, and 10 n.mi. for harbor tugs; the values of Table 7-C.3 were used in all other cases.

RESULTS

The probability $P_C(t)$ that one or more cutters will be available at the equipment site in t hours or less is plotted in Figures H-3 (a) through (i) for Districts 1 through 13. Similarly, the probabilities $P_B(t)$ for boats is plotted in Figure H-4 (a) through (i). The probability that either a cutter or a boat is available in t hours or less is $1 - (1 - P_C(t))$. $(1 - P_B(t))$.

The curves shown in Figure H-3 indicate that a cutter is always available in one hour or less at all storage sites. However, this conclusion rests on the somewhat arbitrary assumption that Coast Guard harbor tugs (WYTM's and WYTL's) are among the available ocean-going cutters. If these tugs are assumed to operate over a range of 10 n. miles from each site and to have a maximum speed of 10 knots, it follows that one of them should always be available within one hour, regardless of the availability of other large vessels. Although these are reasonable assumptions for many East and Gulf Coast ports, they are not valid for the West Coast since no CG tugs are stationed there. For this reason the cutter availability curves for the 11th, 12th and 13th Districts (Figure H-3) do not represent the actual situation at West Coast ports.

It can be concluded from this analysis that while there is a high probability of a boat being available within one hour, the corresponding probability for cutters is more difficult to estimate using the present method. An accurate estimate of cutter availability can be obtained only by a port-by-port analysis using actual vessel assignments for data and models tailored to each control area.

REFERENCES FOR APPENDIX H

- H-1. U.S. Department of Transportation, Transportation Computer Center, Report No. 04595Q, Abstract of Operations Fiscal Year 1975, September 30, 1975. 2 Vols.
- H-2. U.S. Coast Guard SAF Facility Location Booklet, published by FLAG PLOT for use in conjunction with morning operations highlights, current as of 1 July 1977.

APPENDIX I:

COAST GUARD AND DOD AIR BASES



FIGURE I-1 U.S. COAST GUARD BASES, STATIONS, A/N STATIONS AND LORAN STATIONS IN THE 48 STATES

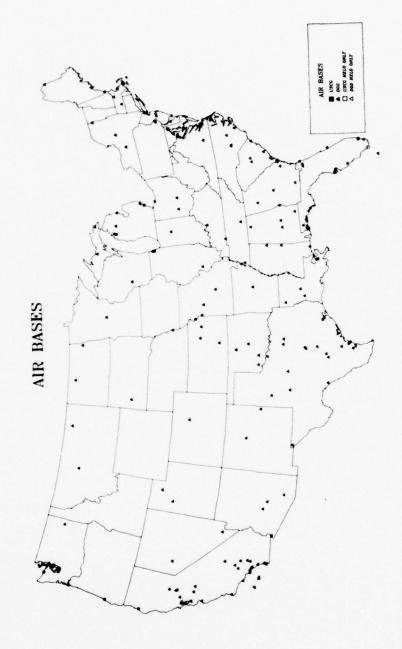


FIGURE I-2 USCG AND DOD AIR BASES IN THE 48 STATES

APPENDIX J:

SPILL POTENTIAL DATA BASE

The spill potential data base was assembled from (1) the U.S. Army Corp. of Engineer's "Waterborne Commerce of the United States", 1976, (2) USGS estimates of future OCS leases and data on current (1977) OCS production, and (3) spill rates obtained in Section 3 of this report.

1. ACOE PORT OIL MOVEMENT

Reference J-1 contains ACOE CY 1976 data on domestic waterborne petroleum movements, plus Bureau of the Census data on oil imports and exports. The data are classified by

- (1) Waterway, channel, or port
- (2) Type of petroleum or product
- (3) Type of traffic.

Selection of data was made, based on these three classifications, so as to most nearly represent the oil movement of concern to the study. The selection was based on the following criteria.

(1) Waterway, channel or port: The ACOE data represents oil movements, rather than oil landed or shipped. This is not inappropriate to the estimation of spill potential, since many spills occur in passage through channels due to groundings, collisions and rammings. However the study area does not encompass movements on the Mississippi River System above Baton Rouge, the Intracoastal waterways, and inland lakes and rivers, except the Great Lakes. In addition, many coastal rivers and creeks carry almost insignificant amounts of petroleum, mainly light oils, and can be ignored. A complete list of exclusions from Parts 1 through 4 of Reference J-1 is given at the end of this Appendix. All other movements of the 1976 ACOE data were included in the spill potential data base. Exclusions of over 1,000,000 tons of petroleum/year are noted in the list, as well as exclusions of

between 100,000 and 1,000,000 tons/year. All other exclusions are less than 100,000 tons.

(2) Type of petroleum or product

Data were tabulated for two general categories of petroleum using the following ACOE type codes

- a. Heavy and Crude, comprising:
 - 1311 Crude Petroleum
 - 2915 Residual fuel oil
 - 2916 Lubricating oils and greases
- b. Light Oils, comprising:
 - 2911 Gasoline, including natural gasoline
 - 2912 Jet fuel
 - 2913 Kerosene
 - 2914 Distillate fuel oil
 - 2917 Naphtha, mineral spirits, solvents,

(3) Type of Traffic

The ACOE and Bureau of Census traffic at ports is classified as:

- a. Imports
- b. Exports
- c. Coastal Receipts
- d. Coastal Shipments
- e. Internal Receipts
- f. Internal Shipments
- g. Lakewise Receipts
- h. Lakewise Shipments
- i. Local
- j. Intraterritorial Receipts
- k. Intraterritorial Shipments

River, channel and Waterway Traffic is classified as above, or as:

- 1. Upbound
- m. Downbound

- n. Inbound
- o. Outbound
- p. Through.

These categories were extracted separately (for the waterways and petroleum types of (1) and (2)) and then grouped as follows:

Group 2, Internal and Local, comprising types e,f,i,1,m,p.

Traffic at some of the smaller ports is broken down by petroleum type (2) but not by traffic type (3). They are listed simply as total tonnage. Such totals were classified as Group 2.

2. ESTIMATES OF OCS PRODUCTION

The expected total reserves and production life of East Coast, Gulf Coast and West Coast OCS areas were extracted from References 3-8, 3-9, 3-10, 3-11, 3-13, and J-2, and estimates for 1985 made as follows (Table J-1).

For future well fields the annual production shown was assumed to be distributed evenly over

- 13 well fields in Georges Bank
- 4 well fields in Baltimore Canyon
- 8 well fields in South East Georgia Embayment
- 14 well fields in Eastern & Western Gulf
- 6 well fields in Southern California.

based on the number of lease sites planned. Their geographic distribution was as shown in Section 3, Figures 3-19, 3-20, 3-21, 3-22, 3-23, and 3-24. The present well fields were assumed to continue to produce, although both a shift in location and production level is likely. Nevertheless the existing sites, and production shown in the Table were taken as an approximation to the situation in 1985 with regard to present wellfields. Their locations were extracted from Reference J-2 and inserted into the spill potential data base. The estimated total reserves of the present fields were also extracted from reference J-2 and

TABLE J-1: ESTIMATED 1985 ANNUAL OCS PRODUCTION (TONS)

L LOCATION	RESERVES TOTAL	YEARS LIFE	ANNUAL PRODUCTION	REFERENCE
Georges Bank (1)*	68.x10 ⁶	25	3.1x10 ⁶	3.8
Baltimore Canyon (1)	135.	25	5.4	3.9
S.E. Georgia (1)	90.	25	3.6	3.10
Eastern Gulf Western Gulf (1)	10.	25	0.4	3.11
Louisiana (present)	265.1	25	10.5	8-A.2
S. California (1)	85	25	3.4	3.13
S. California (present)			12	8-A.2
	960	25	38.4	

^{*(1)} Proposed

TABLE J-2: EXISTING OCS WELL FIELDS (1)

FIELD		LAT/LON ⁽²⁾	1976 PRODUCTION 10 ⁶ BBL/YR	RESERVES AS OF 1/77 10 ⁶ BBL
Louisiana				
Bay Marchand	B1k 2	2905/9010	22	176
Eugene I.	B1k 330	2840/9142	31	132
Eugene I.	B1k 276	2849/9133	3	111
Grand I.	B1k 16	2903/8955	8	119
Grand I.	B1k 43	2900/8950	15	174
Main Pass	B1k 41	2924/8900	1	120
Main Pass	B1k 69	2915/8905	5	58
Ship Shore	B1k 207	2832/9105	6	119
South Pass	B1k 24	2900/8920	11	95
South Pass	B1k 27	2855/8925	6	111
South Pass	B1k 62	2900/8900	4	132
South Pass	B1k 65	2900/8900	7	128
Timbalier Ba	y B1k 30	2401/9016	2	92
West Delta	B1k 30	2910/8936	17	103
West Delta	B1k 73	2855/8945	10	143
West Delta	B1k 58	2900/8950	8	130
Southern Calif	ornia			
Dos Cuadros		3420/11935	12	93
Santa Ynez		3418/12022	0	-
Huntington B	each	3340/11805	15	120
Wilmington		3346/11811	60	610

⁽¹⁾ Source: Reference J-2

⁽²⁾ Approximate only.

pro-rated over a 25 year period to get the annual production shown in Table J-1 which averages about half of present production.

The present wellfields are listed in Table J-2.

3. SPILL RATES

The spill rates for port oil movements and OCS production were calculated in Section 3 of this report. The spill rates for transient tankers, deepwater ports and lightering were found to be an order of magnitude less than those for port movements and the OCS, and hence were not included in the data base. The port and OCS spill rates employed are as follows (spills per million tons):

Port Movement

Greater New York	.0212
Delaware Bay	.0627
Louisiana Coast	.0682
North Texas Coast	.0193
All other areas	.0314

OCS Production

All fields	.0271
All licius	.02/1

The annual oil movement and production tonnages projected from the sources cited above were multiplied by these spill rates to obtain the spill potential data base.

- 4. LIST OF PORTS AND WATERWAYS FROM REF. J-1 EXCLUDED FROM SPILL POTENTIAL DATA BASE
- * indicates 100,000 to 1,000,000 tons/year; ** indicates over 1,000,000 tons of petroleum/year.

- ** 1. Federal Lock; Troy, N.Y.
- ** 2. New York State Barge Canal System, NY
- ** 3. Narrows of Lake Champlain, NY and VT

PART 1 (Cont'd)

- * 4. Burlington Harbor, VT
- * 5. Plattsburgh, NY
- ** 6. Inland Waterway from Delaware R. to Chesapeake Bay-Chesapeake and Delaware Canal
 - * 7. Mantua Creek, N.J.
 - * 8. Big Timber Creek, N.J.
 - 9. Cohansey River, N.J.
 - 10. Oldman's Creek, N.J.
 - 11. Cooper River, N.J.
 - 12. Chaptank River, N.J.
 - 13. Warwick River, MD
 - * 14. Atlantic Intracoastal Waterway Between Norfolk, Va and the St. John's River, Fla. (Norfolk District) via Great Bridge Loch Route.
 - * 15. Roanoke River, N.C. (Albermarly Sound, Plymouth, NC)
 - 16. Pamlico and Tar Rivers, N.C.
 - 17. Neuse River, NC
 - 18. Atlantic Intracoastal Waterway between Norfolk VA and the St. John's River, Fla. (Wilmington District)
 - 19. Cape Fear River, (except Wilmington Harbor), NC
 - * 20. Cape Fear River above Wilmington
 - * 21. Northeast Cape Fear River
 - 22. Smith's Greek (Pamlico County) NC
 - * 23. Atlantic Intracoastal Waterway between Norfolk VA and the St. John's River (Charleston District)
 - 24. Atlantic Intracoastal Waterway between Norfolk Va and the St. John's River, Fla (Savannah District)
 - 25. Satilla River, Ga.
 - * 26. Savannah River below Augusta, Ga.
- * 27. Atlantic Intra coastal Waterway between Norfolk, Va and the St. John's River, Fla. (Jacksonville District)
- ** 28. St Johns River Fla, Jacksonville to Lake Harney
- ** 29. Intra coastal Waterway, Jacksonville to Miami, Fla.
 - 30. Intra coastal Waterway, Miami to Key West, Fla.
- *30.5 Rice Creek Fla.

PART 1 (Cont'd)

- 31. Canapitsit Channel MA
- 32. Cross Rip Shoals, Nantucket MA

- * 1. Vicksburg, Miss., District
 - 2. Memphis, Tenn., District
 - 3. St. Louis, MO., District
 - 4. St Paul, Minn., District
- ** 5. Little Rock, Arkansas, District
- * 6. Missouri River Division,
- * 7. Nashville, Tenn., District
 - 8. Lousiville, KY, District
- * 9. Huntington, W. Va., District
- ** 10. Pittsburgh, Pa., District
- ** 11. Ohio River Division
- ** 12. Gulf Intracoastal Waterway (Applachee Bay to Mexico)
 (Between Apalachee Bay, Fla., and the Mexican Border)
- * 13. Intracoastal Waterway, Caloosahatchee River to Anclote River Fla.
- * 14. Black Warrior and Tombigbee Rivers, Ala.
- * 14.5 La Grange Bayou Fla.
 - 15. Mississippi River Gulf Outlet, La.
 - 16. Waterway from Empire, La., to Gulf of Mexico
 - 17. Barataria Bay Waterway, La.
- * 18. Bayou Lafourche and Lafourche Jump Waterway, La.
 - 19. Bayou Terrebonne, La.
- * 20. Bayou Little Caillou, La.
- ** 21. Houna Navigation Caval, La.
 - 22. Waterway from Intracoastal Waterway to Bayou Dulac, La.
- ** 23. Mississippi River (Except Baton Rouge, and New Orleans)
- ** 24. Atchafalaya River, La. above Morgan City, La.
- * 25. Red River below Fulton, Ark.
- ** 26. Gulf Intracoastal Waterway, Morgan City Port Allen Route
 - 27. Petit Anse, Tigre and Carlin Bayous, La.

PART 2 (Cont'd)

- ** 28. Lake Charles Deep Water Channel Intracoastal Waterway, La.
 - 29. Bayou Teche, La.
 - 30. Mermentau River, La.
 - 31. Bayou Teche and Vermillion River, La.
 - * 32. Mermentau River, Bayous Nezpique and Des Cannes, La.
 - 33. Bayous: Dupre, Segnette Waterway, La. Loutre, St. Malo, vs Closkey, Big Pigeon, Little Pigeon.
 - 34. Chefuncta and Bogue Falia Rivers, Franklin Canal, Fresh water Bayou, Vinton Waterway,
 - 35. Lake Pontchartrain
 - * 36. Johnson's Bayou
- ** 37. Chocolate Bayou, Tex.
- * 38. San Bernard River, Tex.
 - 39. Colorado River and Flood Discharge Channels, Tex.
- * 40. Tributary Arroyo Colorado, Tex.
 - 41. Port Mansfield, Tex.
 - 42. Chicago, Ill. District. (Port of Chicago is tabulated)
 - 43. Blackwater River, Fla.
 - 44. Gulf County Canal, Fla.
 - 45. La Grange Bayou, Fla.

- ** 1. Illinois River, Illinois Waterway
 - 2. St. Marys River, Mich
 - 3. St. Clair River, Mich,
 - 4. Channels in Lake St. Claire
- ** 5. Detroit River, Mich. (includes port of Detroit, which is tabulated)
- * 6. Gray's Reef Passage, Mich (all through)
 - 7. Sturgeon Bay and Lake Michigan Ship Canal (through)

- ** 1. Through Traffic in San Pablo Bay & Mare Island Strait (St. Joaquin River and Stockton are included)
- ** 2. Through Traffic in Carquiny Strait, and Suisan Bay Channel
- * 3. Columbia River and Tributaries above McNary Loch & Dam
- * 4. Snake River, Oreg. and Idaho.
- ** 5. Columbia River and Willamette River except Astoria, St. Helens, Longview, Vancouver Kalama, Portland, and other ports on Columbia and Willamette up to McNary Loch & Dam
 - 6. Clatskanie River, Oreg.
 - 7. Hoquiam River, Wash.
 - 8. Waterway connecting Port Townsend Bay and Oak Bay, Wash.

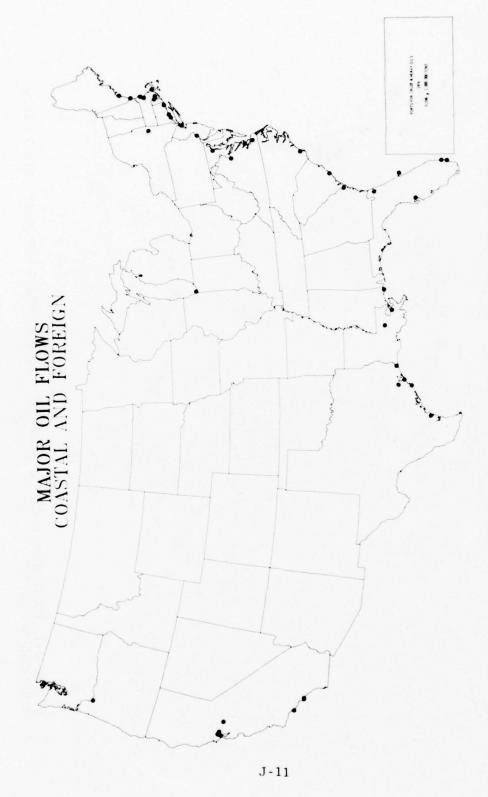


FIGURE J-1 PORTS WITH OVER 1 MILLION TONS FLOW OF CRUDE AND HEAVY OILS IN 1976 (COASTAL AND FOREIGN)



FIGURE J-2 PORTS WITH OVER 1 MILLION TONS FLOW OF CRUDE AND HEAVY OILS IN 1976 (INTERNAL AND LOCAL)

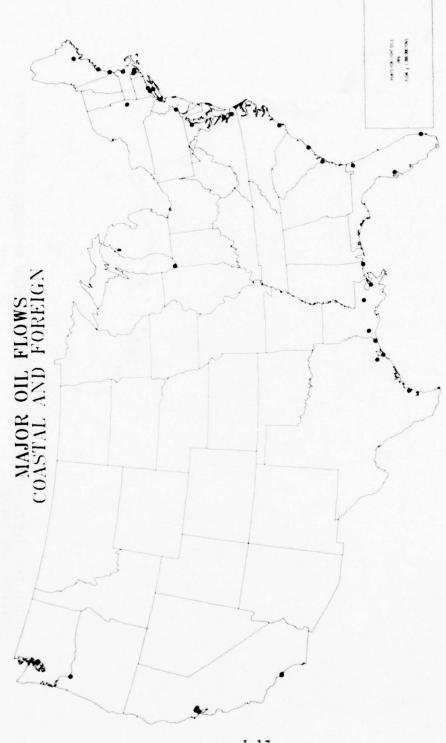


FIGURE J-3 PORTS WITH OVER 1 MILLION TONS FLOW OF LIGHT OILS IN 1976 (COASTAL AND FOREIGN)

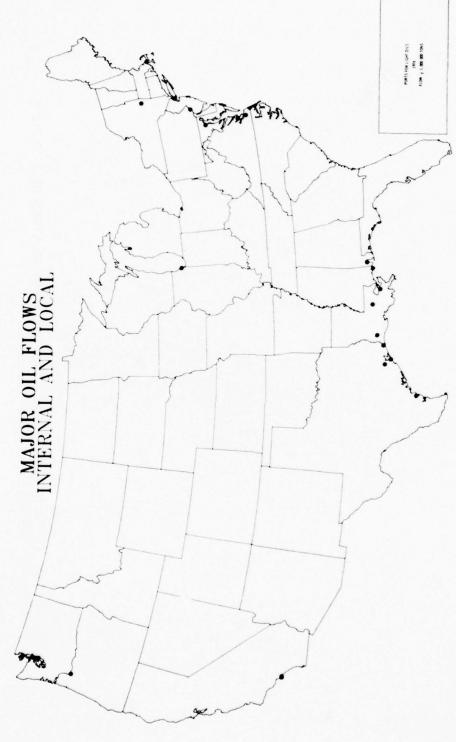


FIGURE J-4 PORTS WITH OVER 1 MILLION TONS FLOW OF LIGHT OILS IN 1976 (INTERNAL AND LOCAL)

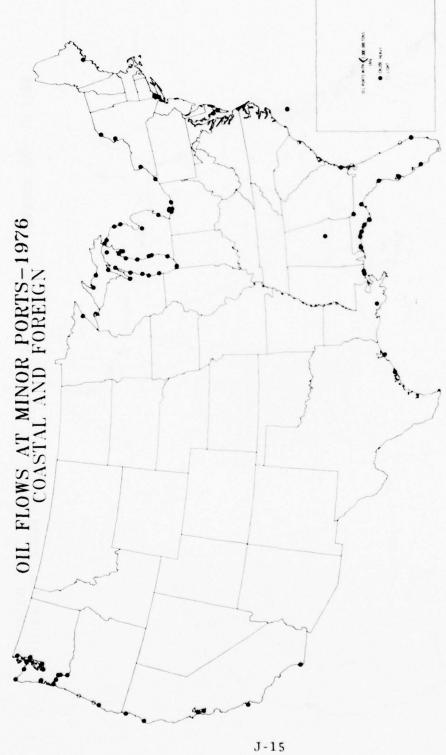


FIGURE J-5 PORTS WITH TOTAL OIL FLOW OF LESS THAN 1 MILLION TONS IN 1976 (COASTAL AND FOREIGN)

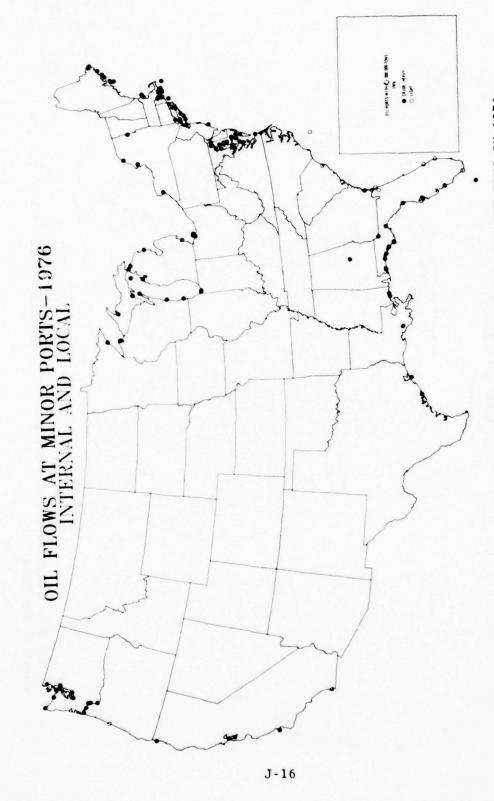


FIGURE J-6 PORTS WITH TOTAL OIL FLOW OF LESS THAN 1 MILLION TONS IN 1976 (INTERNAL AND LOCAL)

REFERENCES FOR APPENDIX J.

- J-1. Department of the Army, Corps of Engineers, "Waterborne Commerce of the United States", Calendar Year 1976, Parts 1 through 4.
- J-2. International Petroleum Encyclopedia, 1977, Vol. 10, The Petroleum Publishing Co., Tulsa, OK. 74101.

APPENDIX K

POLLUTION RESPONSE ALLOCATION MODEL

This Appendix derives the optimum levels of oil pollution recovery capability to be allocated to each of N equipment storage sites when the total capability is limited. The i^{th} site, i = 1,2,3,...,N, is to be assigned an amount of equipment with oil recovery capability s_i , measured in gallons, which will be brought to bear upon any spill that occurs in the geographic region served by that equipment site. The major assumptions are:

- 1. The regions do not overlap.
- 2. Spills occur one at a time.
- The distributions of the number and volume of spills in a year are independent and are known for each region.
- 4. The amount of oil recovered at a spill is no greater than the recovery capability s_i of the region in which it occurs, plus a fraction a_{ij} of the capability of each other site j. Symbolically,

$$r_i = \sum_{j=1}^{N} a_{ij} s_j$$

where r_i is the maximum amount of oil recovered at a spill in region i. (Note that $a_{ij}=1$.)

- 5. The total capability $\sum_{i=1}^{N} s_i$ is limited.
- The optimum deployment is that which maximizes the expected value of the total amount of oil recovered from all spills.

With the above assumptions, the problem is to assign the site capabilities \mathbf{s}_i so as to maximize the amount of oil recovered in a year, subject to the equipment limit 5. and the assistance from

region to region as assumed in 4. To do so, it is necessary first to devise a model for the recovery operation, as follows:

If the amount of oil spilled in an incident is x, the amount recovered, ρ , is assumed to be

$$\rho = \begin{cases}
 x & \text{if } x \leq r_i \\
 r_i & \text{if } x > r_i
\end{cases}$$
(1)

This is an elaboration of assumption 4. and is only approximately true. In any spill, no matter how small, some of the oil escapes recovery. A more realistic model is

$$\rho_{i}(x) = \begin{cases} \alpha x & \text{for } x \leq r_{i} \\ \alpha r_{i} & \text{if } x > r_{i}, \end{cases}$$
 (2)

where α is the fraction of oil recovered on a single spill. Even this model describes the situation poorly since ρ is a random function of x. The important question is how the amount recovered varies from region to region. In that respect both models (1) and (2) embody the reasonable assumption that the amounts recovered differ from region to region only in the limits r_i of recovery capabilities of the regions. Hence, the model (1) will be employed for simplicity.

The above model applies to a single spill in the region. When there are exactly n spills in the region, of sizes x_1 , x_2 , x_3 , ..., x_n , the total amount recovered will be

$$\rho_{\mathbf{i}}(x_1) + \rho_{\mathbf{i}}(x_2) + \rho_{\mathbf{i}}(x_3) + \dots + \rho_{\mathbf{i}}(x_n).$$

The average value of this sum is $\overline{R}_i(n)$:

$$\overline{R}_{i}(n) = \int_{0}^{\infty} dx_{1} \int_{0}^{\infty} dx_{2} \int_{0}^{\infty} dx_{3} \dots \int_{0}^{\infty} dx_{n}$$
(3)

$$\left[\rho_{i}(x_{1}) + \rho_{i}(x_{2}) + \dots + \rho_{i}(x_{n})\right] f_{i}(x_{1}, x_{2}, \dots, x_{n}),$$

where f_i (x_1 , x_2 , x_3 , ..., x_n) is the joint density of the n spill volumes. By assumption 3, the spill volumes x_1 , x_2 , x_3 , ..., x_n are independent of n, and hence of each other, so that

$$f_i(x_1, x_2, ..., x_n) = f_i(x_1) f_i(x_2) ... f_i(x_n),$$

where $f_i(x)$ is the volume distribution of a single spill in region i. When this is substituted into (3), one has

$$\overline{R}_{i}(n) = \int_{0}^{\infty} n \rho_{i}(x) f_{i}(x) dx.$$

Finally, this may be averaged over all possible n, to obtain the expected amount \overline{R}_i recovered in region i:

$$\overline{R}_{i} = \sum_{n=0}^{\infty} p_{i}(n) \overline{R}_{i}(n)$$

$$= \sum_{n=0}^{\infty} n p_{i}(n) \int_{0}^{\infty} \rho_{i}(x) f_{i}(x) dx$$

$$= \overline{n}_{i} \int_{0}^{\infty} \rho_{i}(x) f_{i}(x) dx \qquad (4)$$

where $p_i(n)$ is the probability of exactly n spills in the region. Substituting (1) for $\rho_i(x)$ gives

$$\overline{R}_{i} = n_{i} \left[\int_{0}^{r_{i}} x f_{i}(x) dx + \int_{r_{i}}^{\infty} r_{i} f_{i}(x) dx \right]$$

$$= \overline{n}_{i} \left[r_{i} - \int_{0}^{r_{i}} F_{i}(x) dx \right]$$

(5)

where $F_i(x)$ is the cumulative distribution of spill volume (corresponding to $f_i(x)$). The last expression is obtained by integration by parts. The total amount recovered has an expected value R given by

$$\overline{R} = \sum_{i=1}^{N} \overline{R}_{i}$$

$$= \sum_{i=1}^{N} \overline{n}_{i} \left[r_{i} - \int_{0}^{r_{i}} F_{i}(x) dx \right].$$
 (6)

There is to be maximized by selection of the s_i values, subject to $s_i \ge 0$, i=1,2,3,...,N and to the constraint:

$$\sum_{i=1}^{N} s_{i} \leq K, \text{ where } r_{i} = \sum_{j=1}^{N} a_{ij} s_{j}$$
 (7)

Here K is the total capability limit. The equality sign may be assumed without loss of generality.

CASE 1, NO ASSISTANCE

In this case s_i = r_i , and the problem may be solved by introduction of a constant λ which is used to multiply the constraint (7), taken as equality, and appending the product to \overline{R} , to form the function H:

$$H = \overline{R} + \lambda \left[\sum_{i=1}^{N} r_{i} - K \right].$$
 (8)

The necessary conditions for a maximum (see Reference 1) are:

$$\frac{\partial H}{\partial r_i} = 0, i=1, \dots, N$$
 (9)

$$\frac{\partial H}{\partial \lambda} = 0, \tag{10}$$

which give

$$\overline{n}_{i} \left(1 - F_{i}(r_{i}) \right) + \lambda = 0 \tag{11}$$

and

$$\sum_{i=1}^{N} r_{i} = K . {(12)}$$

These equations may be solved by a simple iterative procedure. From (11) one obtains

$$F_{i}(r_{i}) = 1 + \left(\lambda/\overline{n}_{i}\right) \tag{13}$$

or

$$r_i = F_i^{-1} \left(1 + \frac{\lambda}{n}\right) \tag{14}$$

Thus, by choosing λ , the r_i may be obtained from (14), or graphically as shown in Fig. K-1. The sum $\sum\limits_{i=1}^{N} r_i$ is then compared to K to determine if (12) is satisfied. If not, increasing (or decreasing) λ will increase (or decrease) that sum until it equals K. The success of this process derives from the monotony of the cumulative distribution functions $F_i(x)$. In detail, the process is as follows:

- 1. Select a small, negative value for $\boldsymbol{\lambda}$
- 2. Calculate $1 + \lambda/\overline{n}_i$ for i = 1, 2, 3, ..., N
- 3. Find r_i , $i = 1, 2, 3, \ldots, N$ from (14) or graphically
- 4. Calculate TEST = $\sum_{i=1}^{\infty} r_i$
- 5. If TEST > K, decrease λ by a small amount δ , and go to 2. Otherwise, STOP.

Note that $\lambda < 0$ and $\delta > 0$. Decreasing λ by an amount δ , in step 5., amounts to replacing λ by $\lambda - \delta$.

When the process terminates the resulting set of response capabilities s_i , i = 1, 2, 3, ..., N will be the optimum allocation of the total available capability to the N regions, under the given assumptions, with no assistance among sites.

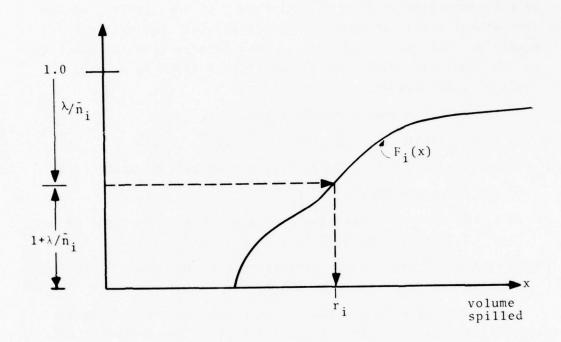


FIGURE K-1 GRAPHICAL SOLUTION OF (14)

CASE 2, ASSISTANCE AMONG SITES

If a fraction a_{ij} of the capability of site j is brought to the assistance of site i, where $i \neq j$, then the matrix a_{ij} is no longer the identity matrix. The above procedure may be employed to obtain the net regional capabilities r_i and then the unassisted site capabilities s_i obtained from (7) by inverting the matrix a_{ij} . But the resulting site capabilities, s_i , are often negative. To avoid such an unrealistic answer it is desirable to select the s_i directly, subject to the constraint $s_i \geq 0$, so that \overline{R} of (6) will be a maximum. The constraint (7) must be satisfied as well. The (assisted) regional capabilities r_i must also be calculated, but only as intermediate quantities because they relate the independent variables s_i to the objective function (6). A slight generalization of this problem replaces the constraints $s_i \geq 0$ by $s_i \geq m_i$, where m_i are given minimum site capabilities.

The problem just described is a common one in mathematical programming. The solution is obtained by a process not unlike that in the previous case. The constraint (7) is multiplied by a constant λ and the constraints $s_{\frac{1}{R}} \geq m_{\frac{1}{R}}$ are multiplied by constants $\mu_{\frac{1}{R}}$. Both products are added to \overline{R} to form the Hamiltonian H:

$$H = \overline{R} + \lambda \left(\sum_{i=1}^{N} s_i - K \right) + \sum_{i=1}^{N} \mu_i \left(s_i - m_i \right)$$
 (15)

The necessary conditions for a maximum* are:

$$\frac{\partial H}{\partial \lambda} = \sum_{i=1}^{N} s_i - K = 0$$
 (16)

$$\frac{\partial H}{\partial s_i} = \frac{\partial \overline{R}}{\partial s_i} + \lambda + \mu_i = 0 \tag{17}$$

$$\mu_i = 0 \text{ for } s_i > m_i$$
 (18)

$$\mu_{i} \geq 0 \text{ for } s_{i} = m_{i} \tag{19}$$

A.E. Bryson and Y-C. Ho, "Applied Optimal Control," Blaisdell Publishing Co., 1969, p. 27.

The sites are divided into two sets; one for which the constraints (18) hold (sites with more than the minimum capability) and one for which the constraints (19) hold (sites with exactly the minimum capability).

A practical procedure for achieving the optimum allocation was devised for this problem without explicit use of the equations (16), (17), (18), (19). It is based on the monotonic nature of the objective function, i.e., increasing any site capability s_i cannot decrease the average total amount recovered, \overline{R} . The procedure is as follows:

To start, the total capability K is divided evenly among the N sites. (This is possible provided K/N \geq $m_{\rm i}$)

Then, the derivatives α_i are calculated:

$$\alpha_{i} = \frac{\partial \overline{R}}{\partial s_{i}} = \sum_{i=1}^{N} \overline{n}_{i} \ a_{ij} \left(1 - F_{i}(r_{i}) \right)$$
 (20)

Next, the capability s_i is reduced by an incremental amount δ for the site with the minimum α_i , and an equal increment ϵ is added to the site with the largest value of α_i , provided the reduction does not bring s_i below the minimum m_i . This will change \overline{R} by an amount $\delta \overline{R}$, approximately,

$$\delta \overline{R} = \left(\alpha_{\text{max}} - \alpha_{\text{min}}\right) \delta$$

Finally, the derivatives are recalculated and the process repeated until all sites that are not at their minimum capability have the same value of α .

In effect, this process relocates equipment from sites of lower effectiveness (lower α) to sites of higher effectiveness (higher α). Since equal amounts are added and subtracted at each step, the total capability constraint (16) is always satisfied. At termination, condition (17) is satisfied for all sites: for sites with $s_i > m_i$ (condition (18)), one has $\mu_i = 0$ and therefore

$$\frac{\partial H}{\partial s_i} = \alpha_i + \lambda = 0 \tag{21}$$

where $\lambda = \alpha_{max}$; for sites with $s_i = m_i$, (condition (19)), one has μ_i such that

$$\frac{\partial H}{\partial s_i} = \alpha_i + \lambda + \mu_i = 0 \tag{22}$$

It will be observed that λ here is negative, just as in the previous case. In fact, when no site is at its minimum μ_i = 0 for all i and the present case reduces to the previous. As in the previous case, the procedure terminates because as s_i increases α_i generally decreases and \overline{R} increases.

The major difficulty in carrying out the procedure is selecting the step size δ . It was found that a second-order gradient (Newton-Raphson) technique worked satisfactorily for about 20 sites, provided the step was limited to about 0.1 K/N. Specifically, δ was calculated as

$$\delta = \min_{\text{of}} \begin{cases} K/10N \\ (\overline{\alpha} - \alpha_{\min})/\beta_{\min} \\ (\alpha_{\max} - \overline{\alpha})/\beta_{\max} \\ s_i - m_i \end{cases}$$
 (23)

where

$$\overline{\alpha} = \sum_{i=1}^{N} \alpha_i / N \tag{24}$$

$$\beta_i = -\partial \alpha_i/\partial s_i$$

$$= \sum_{j=1}^{N} \overline{n}_{j} \alpha_{ji}^{2} f_{j}(r_{j})$$
 (25)

The subscripts max or min indicate the values of i for which $s_i > m_i$ and α_i is maximum or minimum.

APPENDIX L:

SPILL PROBABILITY MODELS

PROBABILITY OF LARGE SPILLS - GENERAL DISTRIBUTION

In this section we derive the probability that in any one year one or more oil spills in U.S. waters will be larger than x gallons in magnitude. The result, P(x), will turn out to be

$$P(x) = \bar{n}(1 - F(x)),$$
 (1)

where \bar{n} is the average number of spills per year in U.S. waters, and F(x) is the probability of a spill being x gallons or less. The approximation is good if x represents a large spill, i.e., one large enough so that F(x) is close to 1. More precisely, the error E in the approximation is about

$$f^{2} (\sigma^{2} + (\tilde{n})^{2} - \tilde{n})/2,$$
 (2)

where f = 1-F(x) and σ^2 is the variance of n.

Two observations may be made regarding this result.

Observation 1. The estimate depends on the distribution F(x) of spill size, but on only the mean n of the distribution of the number of spills. As will be seen in its derivation, the estimate is valid whether or not the spill number is distributed according to Poisson, Negative Binomial, or other law, as long as the mean and variance of the number of spills are known.

Observation 2. The error (2) may be substantial, relative to the estimate (1), if \bar{n} is more than, say, 10.0 and f greater than about .05. Figure L-1 is a plot of the percent error in the estimate as a function of \bar{n} for f=.01 and for $\sigma^2/\bar{n}=0.25,\ 0.50,\ 1.0,\ 2.0,\ 5.0$ and 10.0.

To derive the result, let \mathbf{f}_n be the probability that one or more spills have exceeded the specified volume, given that exactly n spills have occurred. Then

$$f_{n+1} = f_n + f - ff_n \tag{3}$$

where f = $f_1 \approx 1$ - F(x). The product term ff_n is small, suggesting that f_n may be approximated by nf. Let

$$f_n = nf - e_n, (4)$$

where \mathbf{e}_{n} is the error in the approximation.

The probability f_n applies to exactly n spills. Considering all possible values for n gives the desired probability, P(=P(x)):

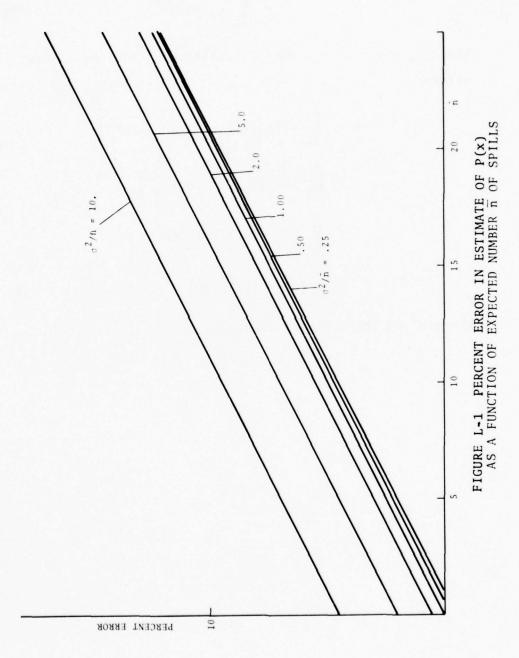
$$P = \sum_{n=0}^{\infty} f_n p(n)$$
 (5)

where p(n) is the probability of exactly n spills in the interval. From (4),

$$P = \sum_{n=0}^{\infty} nf \ p(n) - E$$

$$= \bar{n}f - E$$

$$= \bar{n} (1 - F(x)) - E$$
(6)



as stated initially, where the error in P is E:

$$E = \sum_{n=0}^{\infty} e_n p(n)$$
 (7)

where e_0 = 0. To evaluate E, substitute (4) into (3) to obtain

$$E = \sum_{n=1}^{\infty} p(n) \left[(1-f) e_{n-1} + (n-1) f^{2} \right]$$

$$\leq \sum_{n=1}^{\infty} p(n) \left[e_{n-1} + (n-1) f^{2} \right]$$

$$\leq \sum_{n=1}^{\infty} p(n) (n-1) (n) f^{2} / 2.$$

$$\leq \frac{f^{2}}{2} \left(\sigma^{2} + (\bar{n})^{2} - \bar{n} \right)$$
(8)

where σ^2 is the variance of n.

2. PROBABILITY OF LARGE SPILLS - POISSON DISTRIBUTION

If one is willing to assume that the spill number is Poisson distributed, and independent of spill size, then an exact answer to the large spill question is easily obtained. If n spills occur in an interval T then they constitute n Bernoulli trials, each with probability f(x) that it will exceed the level x. The probability that exactly k of these n spills will exceed x gallons is therefore Binomially distributed:

$$B(k/n) = \binom{n}{k} \left[f(x) \right]^k \left[1 - f(x) \right]^{n-k}. \tag{9}$$

When all possible values of n are considered, one has the probability $P_k(x)$ that exactly k spills will exceed the value x:

$$P_{k}(x) = \sum_{n=k}^{\infty} B(k/n) p(n),$$
 (10)

where p(n) is the probability of n spills in the interval T. If, now, one assumes that p(n) is a Poisson distribution, i.e.,

$$p(n) = (\lambda T)^n e^{-\lambda T}/n!$$
 (11)

he obtains the following from (10) and (9) for $n \ge k$:

$$P_{k}(x) = \frac{\left[f(x)\right]^{k} e^{-\lambda T} (\lambda T)^{k}}{k!} \sum_{n=k}^{\infty} \frac{\left[\lambda T \left(1 - f(x)\right)\right]^{n-k}}{(n-k)!}$$

$$= \left[\lambda T f(x)\right]^{k} e^{-\lambda T f(x)} / k! \tag{12}$$

which indicates that the number of spills larger than x gallons is <u>also</u> Poisson distributed, with intensity parameter $\lambda f(x)$, if the total number of spills is Poisson distributed with parameter λ .

From (12) it follows that the probability of one or more spills of size greater than x is P:

$$P = 1 - P_{o}(x)$$

$$= 1 - e^{-\lambda T f(x)}$$

$$= \lambda T f(x) - (\lambda T f(x))^{2}/2! + \cdots$$
(13)

When only the first term is taken, one obtains the approximation (1) previously arrived at:

$$P = nf(x), \qquad (14)$$

where \bar{n} = λT and f(x) = (1 - F(x)). In this case the error E is bounded by the first term discarded in the alternating series:

$$E < f^2 \bar{n}^2/2$$
 (15)

3. PROBABILITY OF SIMULTANEOUS LARGE SPILLS

In this section we derive the probability that one or more spills greater than y gallons will occur while recovery efforts are still in progress for a spill of size x gallons. This result has implications for the selection of storage levels for pollution response equipment.

First it is necessary to estimate the probability of a spill of size between x gallons and $x + \Delta x$ gallons. This is h(x)

$$h(x) = F(x+\Delta x) - F(x). \tag{16}$$

If n spills occur the probability that exactly k of them will be between x and x + Δx is

$$B(k/n) = {n \choose k} [h(x)]^k [1 - h(x)]^{n-k}, \qquad (17)$$

just as in (9) above. By an argument similar to that employed for (9) - (12) above, one may determine the probability that exactly k spills are in the range x to $x + \Delta x$, with a result analogous to (12):

$$P_{k}(x) = \left[\lambda T \ h(x)\right]^{k} e^{-\lambda T h(x)} / k!. \tag{18}$$

As in (11) it has been assumed that spill number is Poisson distributed. In the present case, however, it is more convenient to interpret T and λ as time and spills per unit time, rather than as throughput and spills per unit throughput.

Next it is necessary to assume that some relation $\delta(x)$ exists between spill duration δ and spill size x.*

The duration of a spill is taken as the time during which USCG pollution response equipment is required to cope with it. In general, the larger x, the larger will be $\delta(x)$. The probability of a spill of more than y gallons occurring within $\delta(x)$ times units from the start of one of size x gallons is obtained from (12) by replacing T by $\delta(x)$ and f(x) by f(y), to get q:

$$q = 1 - e^{-\lambda \delta(x) f(y)} (\equiv q(x,y))$$

$$\cong \lambda \delta(x) f(y), \text{ if } \lambda \delta(x) f(y) << 1.$$
(19)

If there are exactly k spills of size x, with probability given by (18), then the probability that j of them $(j \le k)$ will be simultaneous with spills larger than y is Q(j/k):

$$Q(j/k) = {k \choose j} q^{j} (1-q)^{k-j}, \qquad (20)$$

and the net probability of j spills of size greater than y, simultaneous with spills of size x, is

$$S(j,y,x) = \sum_{k=0}^{\infty} Q(j/k) P_k(x), j \ge k,$$
 (21)

By a spill of size x is meant a spill in the size range x to $x + \Delta x$.

Substituting (18) and (20) into (21) gives, after a calculation similar to that of (12),

$$S(j,y,x) = \left[\lambda T\omega(x,y)\right]^{j} e^{-\lambda T\omega(x,y)}/j!$$
 (22)

where

$$\omega(x,y) = h(x) \left(1 - e^{-\lambda \delta(x) f(y)}\right)$$
 (23)

If the probability is small of a second spill of size y or greater occurring in the interval $\delta(x)$, then the approximation in (19) may be used, giving

$$\omega(x,y) \cong \lambda h(x) \delta(x) f(y)$$
 (24)

- 1. It should be noted that j here is not the number of spills occurring simultaneously, but the number of times that simultaneous spills occur, i.e., the number of times in the period T that one or more spills of size greater than y occur during a spill of size x.
- 2. It should also be noted that the calculation is not restricted to large spills if the exact form (23) is used instead of the approximation (24). Moreover, (24) is a good approximation as long as λ $\delta(x)f(y)$ is small, which can occur if (a) the spill rate λ is small, or (b) the duration $\delta(x)$ of the first spill is small, or (c) the second spill size, y, is so large that the probability f(y) of its occurrence is small, or if (d) some combination of (a), (b) and (c) occurs.

The function S(j, y, x) is plotted in Figure L-2, for $\lambda =$ 20 spills/year, T=1 year, $\Delta x = \infty$, $x = y \ge 50,000$ gallons, F(x) from Figure 3-5, and $\delta(x) = 5$ days.

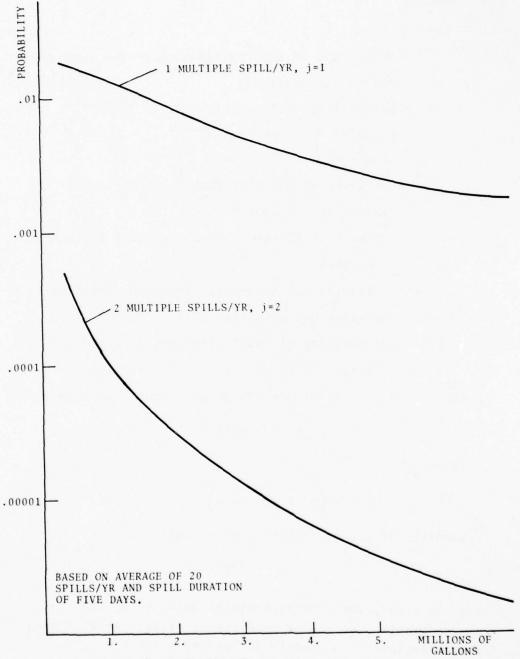


FIGURE L-2 PROBABILITY OF MULTIPLE SPILLS

4. SUMMARY

Let

 \bar{n} = mean value of the distribution of the number of spills in interval T

F(x) = probability that any given spill will be x gallons or less

f(x) = 1 - F(x)

 σ^2 = variance of the distribution of the number of spills in interval T

 λ = Poisson spill rate, spills per unit throughput (or time)

T = Poisson spill interval, throughput (or time)

 $\delta(x) = duration of spill size x$

h(x) = probability of spill size between x and x + Δx = $F(x+\Delta x) - F(x)$

Then the probability of a spill greater than x in interval T is

$$\bar{n}$$
 (1 - F(x))

with error

$$f^2\left(\sigma^2 + (\bar{n})^2 - \bar{n}\right)/2$$

regardless of the distribution of n, and

$$1 - e^{-\lambda Tf(x)}$$

with no error, for a Poisson distribution of n. Further, the probability of one or more spills of size greater than y simultaneous with a spill of between x and $x + \Delta x$ is

$$\left[\lambda_{T\omega}(x,y)\right]^{j} e^{-\lambda T\omega(x,y)}/j!$$

where

$$\omega(x,y) = h(x) \left(1 - e^{-\lambda \delta(x) f(y)}\right)$$

and where j is the number of times in T that simultaneous spills occur.

APPENDIX M:

NON-COAST GUARD EQUIPMENT CAPABILITIES

Appendix M contains a discussion and presentation of geographical locations and performance capabilities of the following selective pieces of pollution response equipment:

- 1. Booms
- 2. Skimmers
- 3. Pumps
- 4. Storage Containers

The capabilities presented herein are predicated upon a knowledge of the extent of existing equipment inventories and some reasonable assumption s concerning the availability and performance degradation that reflect pseudo-real-world situations. Emphasis is placed upon Non-Coast Guard equipment inventories such as those owned and operated by:

- 1. U.S. Navy
- 2. Private Companies
- 3. Cooperatives
- 4. States, Cities, and Towns

Emphasis was also placed upon equipment stored at locations close to the shoreline of the states including the Great Lakes. Close means within approximately 100 miles. All other inland locations were deleted from the established inventories.

The bulk of the equipment information was derived from a data base entitled, Spill-Cleanup Inventory, developed by the Coast Guard at headquarters. It, in turn, was compiled from data supplied by the existing strike teams, MSO's and CTOP's. TSC then collapsed this data base further by aggregating all non-federal government owned equipment at or near previously specified port cities. In short, this then becomes the total amount of capability that can be called up and deployed subsequent to a notification at a spill, grounding, etc. The resulting collapsed data base is given on Table M-1.

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT

TRANSFER-LIGHTERING SYSTEMS

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL PUMP CAPACITY GPM	TOTAL STORAGE IN GALLONS
PEABODY	MA	4229	7058	3	900	
JOHNSTON	RI	4149	7128	1	100	300
NEW HAVEN	CT	4119	7254	5	1,320	40,000
BALTIMORE	MD	3916	7636	1	500	2,930
WILMINGTON	NC	7755	3415	1	300	
TAMPA	FL	2757	8226	1		2,500
FLOUR BLUFF	TX	2736	9717	1		630
CORPUS CHRISTI	TX	2755	9731	3	45	94,500
MILWAUKEE	WI	4300	8755	1	600	6,000
ST JOSEPH	MI	4206	8628	1	75	300
OREGON	ОН	4137	8329	48	3,510	366,000
LONG BEACH	CA	3343	11817	2		
CONCORD	CA	3739	12216	1		
PORTLAND	OR	4534	12243	1	1,000	

TANKSHIPS

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL CAPACITY IN GALLONS
BOSTON	MA	4223	7102	6	59,500
DETROIT	MI	4216	8307	2	1,260,000
SEATTLE	WA	4735	12221	1	3,500

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT (CONTINUED)

PUMPS WITH CAPACITY > 200 GPM

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL PUMP CAPACITY GPM
STOUGHTON	MA	4215	7107	13	5,500
BOSTON	MA	4221	7102	23	11,390
GLOUCESTER	MA	4238	7035	3	1,500
BRIDGEWATER	MA	4139	7014	8	3,150
FALMOUTH	MA	4131	7037	8	2,240
BANGOR	ME	4448	5846	2	400
PORTLAND	ME	4338	7017	8	10,160
GRAY	ME	4342	7012	1	260
SOMERSET	MA	4230	7111	4	960
JOHNSTON	RI	4149	7128	3	1,500
DUBUQUE	IL	4230	9030	6	360
ROCK ISLAND	IL	4130	9030	2	200
SPRING PARK	MN	4500	9310	1	380
EAU CLAIRE	WI	4450	9212	3	1,485
SPOONER	WI	4555	9155	1	385
SPRING PARK	MN	4450	9337	2	380
WOOD RIVER	IL	3854	9006	1	340
HARTFORD	IL	3845	9008	1	300
GRANITE CITY	IL	3842	9010	3	700
RENSSELAER	NY	4239	7344	2	575
WEST HAVEN	CT	4117	7256	1	350
BAYONNE	NJ	4040	7406	12	8,380
NEWARK	NJ	4044	7405	1	300
LONG ISLAND CY	NY	4045	7358	2	400
NEWARK	NJ	4042	7047	1	600
VERPLANK	NY	4115	7458	1	350
EDISON	NJ	4420	7430	10	2,600
CLAYTON	NJ	3940	7509	2	500
BALTIMORE	MD	3914	7636	42	21,555

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT

PUMPS WITH CAPACITY > 200 GPM (CONTINUED)

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL PUMP CAPACITY GPM
NORFOLK	VA	3650	7617	4	2,200
CHARLESTON	SC	3250	7958	2	3,600
MIAMI	FL	2526	8020	4	1,243
FT LAUDERDALE	FL	2604	8012	1	200
SAVANNAH	GA	3204	8105	7	3,550
BRUNSWICK	GA	3109	8129	1	250
CAGUAS	PR	1826	6606	6	225
CAGUAS	PR	1826	6606	5	2,750
CAGUAS	PR	1826	6606	5	1,500
HOUSTON	TX	2940	9515	15	300
HOUSTON	TX	2944	9508	21	187,250
GULFPORT	MS	3023	8906	1	380
MIDFIELD	AL	3328	8655	1	200
VENICE	LA	2916	8929	1	200
NEW ORLEANS	LA	2936	9043	8	1,600
MORGAN CITY	LA	2941	9113	1	300
HARVEY	LA	3000	9002	167	260,000
HARAHAN	LA	2925	9012	1	1,725
HOUMA	LA	2936	9043	15	3,000
WESTWEGO	LA	3000	9002	1	1,000
PORT ARTHUR	TX	2949	9354	7	9,500
LAKE CHARLES	LA	3010	9319	2	440
BEAUMONT	TX	3002	9402	2	1,200
SULPHUR	LA	3014	9323	13	2,900
PORT NECHES	TX	2959	9358	2	15,000
NEDERLAND	TX	2957	9400	13	2,660
CICERO	IL	4150	8746	8	4,710
CHICAGO	IL	4143	8733	13	27,310
LOCKPORT	IL	4140	8803	1	1,300
FINLAY	IL	4125	8850	1	700

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL PUMP CAPACITY GPM
LEMONT	IL	4140	8800	3	880
FINLAY	IL	4125	8850	1	900
BLUE ISLAND	IL	4140	8741	1	300
LEMONT	IL	4140	8801	3	900
BRIDGEVIEW	IL	4145	8748	1	1,200
FINLAY	IL	4125	8850	1	700
TRENTON	MI	4208	83135	31	25,055
BAY CITY	MI	4337	83505	1	1,500
ECORSE	MI	4215	8309	2	1,280
MOUNT CLEMENS	MI	4235	82472	8	2,860
DETROIT	MI	4217	83070	4 .	12,800
KAWKAWLIN	MI	4340	8353	1	1,500
ROSEVILLE	MI	4230	82576	1	360
INKSTER	MI	4218	8320	7	2,940
WAYNE	MI	4217	8324	2	1,000
FERNDALE	MI	4228	8306	3	1,020
BAYFIELD	WI	4750	9105	1	250
HOUGHTON	MI	4707	8835	3	2,400
SUPERIOR	WI	4642	9202	10	3,400
HOLLAND	MI	4243	8607	1	1,000
FRUITPORT	MI	4307	8610	3	965
PENTWATER	MI	4345	8625	6	2,615
MUSKEGON	MI	4313	8620	40	17,395
FRUITPORT	MI	4307	8610	3	600
RAPID RIVER	MI	4445	8557	9	3,400
PLAINWELL	MI	4227	8538	3	3,600
FRANKFORT	MI	4440	8615	3	900
ELBERTA	MI	4438	8615	1	200
ST JOSEPH	MI	4206	8628	5	1,500
OXNARD	CA	3410	11911	4	950

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL PUMP CAPACITY GPM
VENTURA	CA	3424	11930	1	500
LONG BEACH	CA	3347	11813	8	2,360
NATIONAL CITY	CA	3240	11706	20	5,000
MONTEREY	CA	3637	12154	6	1,350
SAN LUIS OBIS	CA	3509	12046	1	600
MORRO BAY	CA	3522	12052	2	500
CROCKETT	CA	3803	12213	5	1,200
PITTSBURG	CA	3801	12151	2	4,000
BENICIA	CA	3802	12208	3	1,500
OAKLAND	CA	3746	12213	3	600
ANTIOCH	CA	3800	12146	4	6,000
MARTINEX	CA	3808	12208	13	7,500
SO SAN FRAN	CA	3738	12223	28	8,600
EMERYVILLE	CA	3750	12218	5	1,650
PORTLAND	OR	4534	12243	6	7,430
SEATTLE	WA	4740	1220	14	10,450
FEDERAL WAY	WA	4720	12222	2	600

OPEN-WATER SKIMMERS

		EQUIPM	IENT LOC	TOTAL NUMBER OF	TOTAL RECOVERY CAPACITY
CITY	STATE	LAT	LONG	UNITS	IN GPM
MOSS LANDING	CA	3648	12147	1	10
CONCORD	CA	3739	12216	1	
RODEO	CA	3803	12215	1	
MARTINEZ	CA			1	40
SAN FRANCISCO	CA	3747	12223	4	206
EMERYVILLE	CA	3750	12218	2	200
PORTLAND	OR	4534	12243	10	1,621

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT

OPEN-WATER SKIMMERS (CONTINUED)

		EQUIPME	NT LOC	TOTAL NUMBER OF	TOTAL RECOVERY CAPACITY
CITY	STATE	LAT	LONG	UNITS	IN GPM
ANACORTES	WA	4831	12236	3	290
FERNDALE	WA	4852	12245	1	265
BELLINGHAM	WA	4846	12230	1	
HONOLULU	HI	1944	15503	1	30
PEABODY	MA	4229	7058	1	750
PORLAND	ME	4342	7012	1	25
DAVISVILLE	RI	4136	7125	4	2,000
FINDLAY	ОН	4102	8340	4	
NEW HAVEN	CT	4119	7254	1	200
BROOKLYN	NY	4040	7401	1	
ELIZABETH	NH	4039	7411	2	
MIAMI	FL	2548	8013	5	208
FT LAUDERDALE	FL	2605	8007	2	205
BRUNSWICK	GA	3109	8129	1	40
SAVANNAH	GA	3205	8106	1	600
YABACOA	PR	1803	6550	1	20
SAN JUAN	PR	1828	6607	5	60
SAN JUAN	PR	1826	6606	1	40
FLOUR BLUFF	TX	2736	9717	1	500
BAYTOWN	TX	2943	9501	2	70
VENICE	LA	2916	8929	1	
INTERCOASTAL	LA	2947	9209	1	
NEW ORLEANS	LA	2936	9043	5	
BELLE CHASE	LA	3000	9002	2	588
SULPHUR	LA	3014	9323	2	400
WADDINGTON	NY	4452	7512	2	1,000
WAYNE	MI	4217	8324	1	300
MOUNT CLEMENS	MI	4235	82472	5	2,100
BAY CITY	MI	4337	83505	1	100
VENTURA	CA	3424	11954	6	650
LOS ANGELES	CA	3423	12003	1	15
SANTA BARBARA	CA	3424	11930	16	5,643

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT BARGES (CONTINUED)

				TOTAL NUMBER OF	TOTAL CAPACITY IN
CITY	STATE	LAT	LONG	UNITS	GALS
STOUGHTON	MA	4215	7107	2	17,500
EAST BOSTON	MA	4222	7102	7	53,905
FALMOUTH	MA	4131	7037	4	
MENEMSHA	MA	4123	7050	1	15,000
CHELSEA	MA	4127	7036	3	210,000
FALMOUTH	MA	4131	7037	5	
CHARLESTOWN	MA	4223	7103	20	600,000
SO PORTLAND	ME	4342	7012	1	
PORTLAND	ME	4345	7012	13	804,000
KITTERY	ME	4305	7045	1	75,000
LAWRENCEBURG	IN	3901	8450	1	
LOUISVILLE	KY	3818	8540	1	5,000
MEMPHIS	TN	3505	9006	1	
ST PAUL	MN	4450	9310	1	600
CAPE GIRARDNA	MO	3718	8930	1	879,900
MILFORD	CT	4113	7302	2	
PHILADELPHIA	PA	3953	7511	10	33,967,240
CAMDEN	NJ	3958	7505	2	
NORFOLK	VA	3650	7617	1	60,000
CHARLESTON	SC	3251	7957	6	116,510
JACKSONVILLE	FL	3019	8139	2	829,500
FT LAUDERDALE	FL	2605	8007	2	1,000
SAVANNAH	GA	3205	8106	4	1,078,000
PONCE	PR	1758	6637	3	1,533,000
GUAYAMA	PR	1756	6608	1	1,176,000
TAMPA	FL	2757	8226	5	
CORPUS CHRISTI	TX	2749	9724	3	504
HOUSTON	TX	2943	9513	2	55
MOBILE	AL	3042	8802	1	
ABBEVILLE	LA	2947	9209	30	

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT BARGES (CONTINUED)

CITY	CTATE	LAT	LONG	TOTAL NUMBER OF	TOTAL CAPACITY IN GALS
CITY	STATE	LAT	LONG	UNITS	GALS
BELLE CHASE	LA	3000	9002	6	
NEW ORLEANS	LA	2916	8957	2	4,200
INTERCOASTAL	LA	2947	9209	2	4,200
MORGAN CITY	LA	2941	9113	3	
HOUMA	LA	2936	9043	7	
BERWICK	LA	2941	9113	12	
VENICE	LA	2916	8929	2	192,570
PORT ARTHUR	TX	2952	9356	4	22,000
CHICAGO	IL	4143	8733	3	
CICERO	IL	4150	8746	1	
LEMONT	IL	4140	8801	1	1,000
CLEVELAND	ОН	4131	81415	3	6,000,000
DETROIT	MI	4217	83070	2	6,400
MOUNT CLEMENS	MI	4235	82472	1	4,000
SUPERIOR	WI	4649	9202	5	
DULUTH	MN	4647	9205	2	1,400
SUPERIOR	WI	4649	9202	5	78,000
MUSKEGON	MI	4312	8620	29	15,000
FRANKFORT	MI	4440	8615	2	
RAPID RIVER	MI	4445	8537	3	
FERRYSBURG	MI	4305	8620	8	
ST JOSEPH	MI	4205	8630	4	
FRUITPORT	MI	4307	8610	1	15,000
FERRYSBURG	MI	4305	8610	3	
OREGON	ОН	4140	8328		
SANTA BARBARA	CA	3408	11912	1	329,280
NATIONAL CITY	CA	3240	11706	3	680,400
MOSS LANDING	CA	3648	12147	1	748
ALAMEDA	CA	3747	12217	2	1,320
SAN FRANCISCO	CA	3747	12223	2	175,968

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT BARGES (CONTINUED)

CITY	STATE	LAT	LONG	TOTAL NUMBER OF UNITS	TOTAL CAPACITY IN GALS
RICHMOND	CA	3754	12222	12	
EMERYVILLE	CA	3750	12218	1	
BELLINGHAM	WA	4846	12230	1	3,200
SEATTLE	WA	4740	12220	1	

RUBBER BLADDERS

				TOTAL NUMBER OF	TOTAL CAPACITY IN
CITY	STATE	LAT	LONG	UNITS	GALS
MIAMI	FL	2548	8013	3	1,500
BRUNSWICK	GA	3112	8133	2	20,000
BELLE CHASE	LA	3000	9002	2	10,000
FINLAY	IL	4150	8850	1	12,000
MORRIS	- IL	4123	8823	1	1,000
ECORSE	MI	4215	8309	1	500
LOS ANGELES	CA	3523	12003	1	1,200
SANTA BARBARA	CA	3424	11930	8	17,200
EUREKA	CA	4046	12412	1	2,500
RICHMOND	CA	3754	12222	2	1,250
CONCORD	CA	3739	12216	2	
PORTLAND	OR	4534	12243	5	9,000

OFFSHORE BOOMS (WAVE HEIGHTS > 3 FT.)

CITY	STATE	LAT	LONG	TOTAL LENGTH FEET	TOTAL NUMBER OF UNITS
GLOUCESTER	MA	4238	7035	300	6
PEABODY	MA	4229	7058	612	1
BEVERLY	MA	4233	7053	600	12

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT
OFFSHORE BOOMS (WAVE HEIGHTS > 3 FT.) (CONTINUED)

CITY	STATE	LAT	LONG	TOTAL LENGTH FEET	TOTAL NUMBER OF UNITS
LONGISLAND	ME	4342	7004	750	1
DAVISVILLE	RI	4136	7125	1,000	10
TIVERTON	RI	4138	7114	2,000	20
BAYONNE	NJ	4039	7407	5,000	100
PERTH AMBOY	NJ	4031	7415	1,000	40
ELIZABETH	NJ	4039	7411	2,500	50
JACKSONVILLE	FL			1,730	1
FT LAUDERDALE	FL	2605	8007	10,500	3
SAVANNAH	GA	3204	8105	1,500	30
BRUNSWICK	GA	3112	8132	750	18
ST PERTERSBURG	FL	2751	8236	800	8
BOCA GRAND	FL	2738	8233	1,410	44
CORPUS CHRISTI	TX	2749	9724	540	1
HOUSTON	TX	2940	9515	6,000	190
MOBILE	AL	3045	8803	2,000	40
PANAMA CITY	LA	3009	8536	1,640	82
BATON ROUGE	LA	3030	9110	102	48
NEW ORLEANS	LA	3000	9002	1,500	30
CHICAGO	IL	4141	8733	930	9
RIVER ROUGE	MI	4216	83080	350	7
MILWAUKEE	WI	4300	8755	200	4
TOLEDO	ОН	4139	8332	400	4
SANTA BARBARA	CA	3424	11941	3,600	12
VENTURA	CA	3420	11938	2,800	11
LOS ANGELES	CA	3423	12003	1,400	2
MORRO BAY	CA	3522	12052	30,000	1
SAN LUIS OBISBO	CA	3510	12044	1,300	26
PITTSBURG	CA	3802	12253	1,800	2
HERCULES	CA	3801	12216	2,200	1
SEATTLE	WA	4735	12221	9,750	71
BELLINGHAM	WA	4845	12230	7,000	60

TABLE M-1 NON-FEDERAL GOVERNMENT POLLUTION RESPONSE EQUIPMENT
OFFSHORE BOOMS (WAVE HEIGHTS > 3 FT.) (CONTINUED)

CITY	STATE	LAT	LONG	TOTAL LENGTH FEET	TOTAL NUMBER OF UNITS
RENTON	WA	4729	12212	1,200	2
FERNDALE	WA	4852	12245	4,640	62
MUKILTEO	WA	4756	12217	1,500	3
TACOMA	WA	4716	12225	300	3
MANCHESTER	WA	4733	12234	2,100	42
PORT ANGELS	WA	4846	12326	1,000	10
OAK HARBOR	WA	4810	12236	600	1

The capabilities of U.S. Navy equipment - predominantly barges, skimmers, and booms were derived from information supplied by:

- 1. Navfac
- 2. Navsea

The locations and equipment levels shown on Table 9C-2 are, however, tentative at the present time. Since there is an abundance of harbor booms, the number of feet of Navy booms was not included. The barges and skimmers are attractive candidates for recovery operations.

The following three pieces of equipment were added to the total available capability from the Navy inventory:

- 1. JBF 3001 Skimmer
- 2. Mark Class V Skimmer
- 3. Ship's Waste Offload Barge (SWOB)

These are essentially harbor and coastal equipment, however, under reasonably good environmental conditions they can be employed in open waters. A small skimmer, if it can survive, has better wave-following characteristics than a large heavier one with correspondingly higher moments of inertia, etc., but its ability to survive is doubtful unless accompanied or protected by a larger vessel.

The Dip 3001 skimmer is a self-contained skimming system. It is designed to harvest oil in the open harbor with waves up to two feet in height. It can also operate effectively in between piers or in a stationary mode at the apex of a boom catenary configuration. This unit is approximately 25 feet long and 10 feet wide. Articulating sweeps extend the skimming width to 15 feet. It is diesel powered with two screws for propulsion. All pumping, propulsion, and belt functions are hydraulically operated. One thousand gallons of storage capacity is provided on board for collected oil.

TABLE M-2
U.S. NAVY EQUIPMENT

NUMBER	DESCRIPTION	LOCATION
1	Skimmer*	Earle, NJ
1	Skimmer	Portsmouth, NH
2	SWOB**	11 11
1	Skimmer	Newport, RI
1	Skimmer	New London, CT
1	SWOB	11 11
1	Skimmer	Philadelphia, PA
2	SWOB	
8	SWOB	Norfolk, VA
2	Skimmer	
1	SWOB	Portsmouth, VA
1	Skimmer	и и
3	SWOB	Little Creek, VA
1	Skimmer	
4	SWOB	Charleston, SC
2	Skimmer	
1	Skimmer	Pensacola, FL
1	Skimmer	Mayport, FL
1	Skimmer	Pascagoula, FL
3	Skimmer	San Diego, CA
7	SWOP	
3	SWOB	Long Beach, CA
1	Skimmer	" "
1	Skimmer	Panama City, FL
1	Skimmer	Almeda, CA
1	Skimmer	Vallejo, CA
1	SWOB	n n
1	Skimmer	Richmond, CA
3	SWOB	
1	Skimmer	Keyport, WA
1	Skimmer	Bancor, WA

TABLE M-2 (CONT'D)

U.S. NAVY EQUIPMENT

NUMBER	DESCRIPTION	LOCATION
1	Skimmer	Manchester, WA
5	SWOB	Bremerton, WA
1	Skimmer	" "
4	Skimmer (Mod)*	Yorktown, VA
4	Skimmer	Yorktown, VA
4	Skimmer	Stockton, CA
4	Skimmer (Mod)	Stockton, CA

^{*}JBF-3001 Skimmer, up to 100 gal./min.

^{**}Ship's Waste Offload Barge (SWOB), 75,000 gal.

^{***}Marco Class V Skimmer 300 gpm (Mod) Modified Class V Skimmer

The Marco Class V Skimmer is a similar device having about the same applications. The Navy plans to modify some of their Class V Skimmers. They will be subdivided into three sections requiring reassembly at the scene of the spill. The sections will be bolted together (4 bolts) and will require no plumbing, electrical connections, etc. This approach circumvents the need for special permits for over-the-road transportation. These permits are not obtainable during the evening or weekends. Also, large expansive cargo carrying aircraft are not needed since two C-130's can carry the three Marco Skimmer sections.

The SWOB is a large floating tank with offloading pumps. The purpose of the SWOB is to collect oily waste. It is essentially a non-self-propelled floating tank 106 feet long by 26 feet wide having a storage capacity of 75,000 gallons. The onboard diesel prime mover supplies power to two electrically driven 160 gpm offloading pumps. The pumps are for only offloading the SWOB. The SWOB can accept waste flow rates up to 400 gpm. Four 50 foot lengths of 2-1/2 inch hose together with hose handling equipment are provided with each barge. A tug or comparable vessel is required for movement of the SWOB. The SWOB is a possible candidate storage of pollutants subsequent to skimming or lightering operations.

TSC limited the comprehensive U.S.C.G. Spill Cleanup Inventory to the following:

- 1. Heavy duty offshore booms
- 2. Open-water skimmers
- 3. Pumps, transfer/lightering systems
- 4. Barges, tankships, and rubber bladders

The derived capabilities are considered a function of the following characteristics:

- Total feet of available offshore booms for:
 - A. Sea state (0-3 ft.)
 - B. Sea state (over 3 ft.)
- 2. Total gallons capacity of available:
 - A. Barges
 - B. Tankships
 - C. Bladders
- 3. Maximum recovery rate (gpm) of skimmers*
- 4. Storage (gal.) and pumping rates (gpm) of:
 - A. Pumps*
 - B. Transfer/lightering systems

All hand-held skimmers and vacuum types were deleted.

The amount of pollutant or oil to be recovered or offloaded respectively, the location, and some primitive form of scenario (time intervals over which specified recovery operations are performed) must be established to facilitate the estimate of required equipment capability levels. This together with the estimate of the actual levels indicated in the inventories will point out areas where there are excessive amounts of capability or deficiencies. The equipment capability levels contained herein are based upon a subjective judgement of the availability of equipment and some factor for degrading performance to account for the influence of average environmental conditions and product types.

Availability is the fraction of the response equipment that is operational and/or not diverted to the performance of other services from which revenue is derived.

Since the maximum performance of skimmers and pumps is usually specified, it is assumed that the above-mentioned inventories contain maximum values. Tables M-3 and 4 are tabulations of the factors that were employed to yield more realistic values. The following is a description of the primitive scenarios employed. **Iimited to units that exceed or are equal to 200 gpm.

TABLE M-3
NON-COAST GUARD
HARBOR EQUIPMENT CAPABILITY
PERFORMANCE CHARACTERISTICS

PERIOD OF OPERATION HRS.		88	88	7.8	7 8
% * ENCOUNTERED		35	•	t	
% of OIL RECOVERED		5.5	•		
% OPERATING AVERAGE CAPABILITY % of OIL % * HOURS/DAY % OF MAX.		08	09	:	
% OPERATING HOURS/DAY	100	67	9.5	:	:
AVAILABILITY	0.8	0.8	56.	0.8	8.0
EQUIPMENT TYPE	Воошѕ	Skimmers	Pumps	Storage for Skimming	Storage for Offloading

*Percent of operating time pollutant is actually pumped or skimmed.

TABLE M-4
NON-COAST GUARD
OPEN-WATER EQUIPMENT CAPABILITY
PERFORMANCE CHARACTERISTICS

Pumping operation:

A. Harbors

Pumping starts 8 hours after notification. Pumping ends 4 days after notification.

B. Open Waters

Pumping starts on 10th hour Pumping ends on 5th day

Containment operation

Capability not time dependent Skimming operation:

A. Harbors

Skimming starts on 8th hour Skimming ends on 4th day

B. Open waters
Skimming starts

Skimming starts on 10th hour Skimming ends on 3rd day.

Storage associated with offloading operations:

A. Harbor

Dracones put into service on 8th hour Dracones removed on 18th hour Barges put into service on 18th hour Barges removed on the 4th day

B. Open Water

Dracones put into service on 10th hour Dracones removed on 30th hour Barges put into service on 30th hour Barges removed on 5th day

Storage associated with skimming operations:

A. Harbor

Same as storage under offloading operations

B. Open Water

Dracones put into service on 10th hour Dracones removed on 30th hour Barges put into service on 30th hour Barges removed on 3rd day.

In order to calculate the spill response capabilities of equipment available to each site of Configuration 5 from organizations other than the Coast Guard, we define the following quantities at each of n locations close to the site in question:

 S_n = maximum skimming capability (gals/hr.) P_n = maximum pumping capability (gals/hr.) Q_n = floating storage capacity (gals.) C_n = boom containment capacity (gals.) $\sim (2/3 L_n) \times 10^3$, where L_n = boom length (ft.)

The relation between containment capacity and boom length was arrived at by selecting a nominal harbor spill size and boom effectiveness. Thus, on the assumption that 3,000 feet of boom can contain 2,000,000 gallons of oil, $L_{\rm n}$ feet of boom have been assigned a nominal capacity equal to the integral part of $L_{\rm n}/3$,000 times 2,000,000 gallons.* The total response capability available to each site is proportional to the sum for the n locations nearest to each site. Complete formulas for harbor and open-water equipment are given in Tables M-5 and M-6. Numerical results for each site of Configuration 5 are given in Tables M-7 and M-8.

^{*}Two million gallons of oil is approximately half the cargo of a tanker of 10,000 gross tons.

TABLE M-5
NON-COAST GUARD HARBOR EQUIPMENT
FORMULAS FOR TOTAL CAPABILITY AT EACH SI

Y AT EACH SITE BILITY1 P. M-20) (gallons) (gallons)	FORMULAS FOR TOTAL CAPABILITY AT EACH SITE $\frac{\text{TOTAL CAPABILITY}^1}{(\text{SCENARIO PP. M-20})}$ $S = 7.26 \sum_{n=1}^{\infty} S_n (\text{gallons})$ $P = 46.1 \sum_{n=1}^{\infty} P_n (\text{gallons})$ torage $Q = 0.80 \sum_{n=1}^{\infty} Q_n (\text{gallons})$	FORMULAS EQUIPMENT TYPE Skimmers Pumps Floating Storage
$C = 0.80 \sum_{n} C_{n} = (0.53 \sum_{n} L_{n}) \times 10^{3}$ (gallons)	$C = 0.80 \sum_{n} C_{n} =$	Boom Containment
(gallons)	$Q = 0.80 \sum_{n} Q_{n}$	Floating Storage
(gallons)	$P = 46.1 \sum_{n} P_{n}$	Pumps
(gallons)	$S = 7.26 \sum_{n} S_{n}$	Skimmers
BILITY1 P. M-20)	TOTAL CAPA (SCENARIO P	EQUIPMENT TYPE
Y AT EACH SITE	FOR TOTAL CAPABILIT	FORMULAS

1. Numerical factors are obtained by multiplying the factors on the corresponding line of Table M-3.

TABLE M-6
NON-COAST GUARD OPEN WATER EQUIPMENT
FORMULAS FOR TOTAL CAPABILITY AT EACH SITE

TOTAL CAPABILITY1 (SCENARIO PP. M-20)	$S = 5.47 \sum_{n} S_n$ (gallons)	$P = 47.0 \sum_{n} P_{n} $ (gallons)	$Q = 0.80 \sum_{n} Q_{n} (gallons)$	None
EQUIPMENT TYPE	Skimmers	Pumps	Floating Storage	Boom Containment

Numerical factors are obtained by multiplying the factors on the corresponding lines of Table M-4. 1.

TABLE M-7
NON-COAST GUARD
HARBOR EQUIPMENT CAPABILITY*
(KILOGALLONS)

SITE	BOOMS	PUMPS	SKIMMERS	STORAGE
Philadelphia, PA	25,588	67,335	43.4	27,296
New Orleans, LA	11,598	735,968	255	15
New York, N.Y.	12,767	38,651	43.4	92
San Francisco, CA	53,514	103,950	1,170	385
Galveston, TX	178	7,150	0	0.044
Los Angeles, CA	7,733	13,502	347	1,422
Pascagoula, MS	11,598	2,145	130	153
Sabine, TX	11,159	79,860	173	17.6
Port Aransas, TX	11,598	0	217	1,587
Boston, MA	4,111	102,052	1,280	621
Portsmouth, VA	11,598	15,950	1,302	621
Seattle, WA	15,491	50,820	434	1,545
Clearwater, FL	5,537	14,418	304	6,213
Chicago, IL	6,451	350,460	0	

^{*}Adjusted

TABLE M-8
NON-COAST GUARD
OPEN-WATER EQUIPMENT CAPABILITY*
(KILOGALLONS)

SITE	BOOMS PUM	PS SKIMMER	S STORAGE
Philadelphia, PA	69,0	48 32.5	27,296
New Orleans, LA	754,7	02 191	6.7
New York, NY	39,6	35 32.5	92
San Francisco, CA	106,5	96 877	382
Galveston, TX	7,3	32 0	0.044
Los Angeles, CA	13,8	46 260	1,407
Pascagoula, MS	6,0	48 97.5	154
Sabine, TX	81,8	92 130	17.6
Port Aransas, TX		0 162.5	0.88
Boston, MA	104,6	50 959	1,587
Portsmouth, VA	16,3	56 975	621
Seattle, WA	52,1	13 325	305
Clearwater, FL	14,7	85 227	1,529
Chicago, IL	359,3	80 0	6,201

^{*}Adjusted

APPENDIX N:

A BRIEF REVIEW OF THE BEHAVIOR OF SURFACE OIL SLICKS

When petroleum or petroleum products are spilled on the surface of the sea a complex set of physical changes takes place that are determined by the composition of the oil, the state of the sea, and the prevailing atmospheric conditions. All these factors combine to influence two major processes:

- 1) Oil movement
- 2) Oil weathering

The movement of the oil may be either on the surface of the water by spreading and by transport through the action of wind and current, or it may be down into the water column by mixing and subvection due to waves. Weathering is used here to designate the complex of physical, chemical and biological processes that affect the composition of a surface oil slick exposed to a marine environment. Of these the most prominent is the evaporation of the lighter fractions of the oil leaving a residue which interacts with the sea water to form heavy viscous "pancakes" and "tar balls" some of which sink beneath the surface and some of which float. All of these processes are strongly influenced by the amount of oil spilled and its physical and chemical properties.

A variety of empirical and analytical studies have been made of the movement and transformation of oil on the surface of the sea. Many of these have been reviewed and evaluated in Ref. N-1, which is the basic source of material for this discussion.

1.1 OIL MOVEMENT

1.1.1 Wind Induced

The wind at the ocean's surface affects the movement of oil through the generation of surface waves and through the shear stress induced on the slick surface. Neither of these mechanisms is well understood. No analysis of wave-induced transport has yet been made (1977) that has yielded realistic results, nor is it known how the effects of wind and waves influence each other. Wind induced motions are usually considered in isolation through a so-called "wind factor" which has been empirically approximated as 3% of the wind speed in the direction of the wind vector. This approach, in itself only a very rough approximation, leaves aside the equally large effects of waves and the detailed spatial and temporal fluctuations of the wind so that the confidence level of analytical results is rather low.

1.1.2 Current Induced

Calculation of the effects of surface and subsurface ocean currents is in an even less satisfactory state than those of the wind since there are many components of such currents, none of which has been adequately modeled. These include: wind-induced currents, large scale ocean currents, currents induced by bottom effects and tidal currents. There are no simple factors that can account for all of these and none can be ignored without large error. Attempts at modeling oil slick movements using available statistics of ocean winds and currents have produced random walk patterns that sometimes trend in the right direction but are grossly inaccurate with respect to the place and time of arrival at any particular point. Furthermore, as the slick approaches shallow waters, the bottom effect is strong, but as yet indeterminate.

1.1.3 Subsurface Transport

Subsurface transport seems to be largely the result of dissolution and dispersion due to wave action. No more than a few percent of the slick is removed by these mechanisms, which are much less important than evaporation in reducing the volume of the oil slick. There is very little data on either of these processes.

1.1.4 Spreading

Oil slick spreading is defined as the movement of oil on the surface of the water relative to the center of mass of the slick. This movement is governed by gravitational, viscous and surface tension forces and by the processes that change the mass of oil in the slick. All of these forces are different for different components of the oil so that some spread much faster than others, with the result that the oil tends to fractionate into viscous clumps (pancakes) within thinner patches of more rapidly spreading components. These pancakes may cover only 10 percent or less of the area encompassed by the oil (Reference N-1, pp. 4-32).

An additional complication is that analytical spreading models assume radial spreading whereas actual slicks are distorted by wind, currents, and the pressure of new oil leaking from the source. The result is that predictions from spreading models and observations of actual slicks usually do not agree very well. For example, Blokker's spreading model (Reference N-2) predicts that in 24 hrs. the area of a crude oil slick will increase by a factor of 4, while some observations (Reference N-3) indicate that the increase is by a factor of 100.

Reference N-4 points out that most pure hydrocarbons do not spread spontaneously by surface forces. "Only aromatic and aliphatic hydrocarbons more volatile than n-nonane have positive spreading coefficients while none of the cyclic hydrocarbons will spread by surface forces." This may provide partial explanation of observations by Jeffrey (Reference N-5) and Hollinger and Manella (1973) which "have shown that with time one or more patches of thick oil (several millimeters thick) were surrounded by a much larger area of thin film, (less than 4 micrometers). Approximately 90 percent of the oil volume was located in these thicker layers that occupied only 10 percent of the visible slicked area of the sea." Reference N-1 also notes this phenomenon, as observed in the 1975 San Francisco Bay spill, where observations show that the area actually covered with oil may be only about 10 percent of the area spanned by the oil around its center of mass.

It is interesting to note the time of pancake formation in Jeffrey's experiment (2-2 1/2 days) agrees very well with the evaporation time for an average crude, as discussed in 1.2.1 below. If the mechanisms are coincident, then pancake thickness would be approximately that of a 1 or 2 day old slick.

1.2 OIL WEATHERING

The weathering of an oil slick is the result of evaporation, emulsification, and chemical and biological changes. Reasonably accurate models of these processes exist only for evaporation and even in this case the effects on evaporation of wind speed, temperature, and solar radiation are not well understood.

1.2.1 Evaporation

For a constant volume of oil, the rate of evaporation increases as the surface area increases and the slick thickness decreases due to spreading. Evaporation is also enhanced by sea turbulence which results from higher wind speeds and produces faster spreading and the ejection of oil from the surface as sprays and aerosols.

Analytical models of evaporation assume a slick of uniform thickness, perfectly mixed in all of its components, lying on a calm sea at 20° C with no wind - clearly an idealized situation. Nevertheless, calculations based on this model give a lower bound for evaporation and indicate that as much as 30% of the initial volume of crude oil may evaporate in 2-33 hours (Reference N-2).

Reference N-5 shows a chart (reproduced in Reference N-1) of percent remaining vs. weathering time for the components of crude oil. The evaporation rate of each component depends on its concentration, which varies as lighter components evaporate off. Hence the entire set of volatile components of the crude oil must be taken into account in calculating its evaporation rates. As far as can be determined such estimates have not been made for the crudes likely to transit US waters in the future, for the sea conditions there prevalent.

An "average" crude was determined by Koons (Reference N-6) to consist of

Gasoline $(C_5 - C_{10}) - 30\%$ Kerosene $(C_{10} - C_{12}) - 10\%$ Light Distillate $(C_{12} - C_{20}) - 15\%$ Heavy Distillate $(C_{20} - C_{40}) - 25\%$ Residium $(C_{40+}) - 20\%$

The evaporation of the lighter molecules, up to C_{14} , is approximately uninfluenced by the heavier ones, and they experience an exponential decay in concentration. As given in References N-1 and N-6, the times required for 90% evaporation are:

 ${}^{<C}_{11}$: 8.7 hours ${}^{C}_{12}$: 16.4 hours ${}^{C}_{13}$: 2 to 2.5 days ${}^{C}_{14}$: 5 days

A composite curve is given in Figure 10-5 of the report.

1.2.2 Emulsification

One of the most important and least understood of the processes affecting an oil slick at sea is the formation of water-in-oil emulsion. These emulsions may contain up to 80% water and may be 2 orders of magnitude more viscous than the oil alone. They spread more slowly and are less susceptible to weathering. When the water content is high they become semi-solid and grease-like (chocolate mousse). Emulsification is a weathering process that occurs 1-3 days after a spill. Its formation and subsequent fate are matters of conjecture. Whether chocolate mousse can be skimmed from the sea surface and pumped into storage containers is problematic. In any case, the recovered product may be mostly water.

The data of Reference N-6 are valuable as an approximation of the water-in-oil emulsion characteristics. They show that changes in viscosity and density are closely related to the changes in the amount of water in the oil, and are greater for oil undergoing natural weathering than for oil in sealed containers. For Kuwait crude and Iranian heavy crude, viscosity increased from 16 cs to about 316 in one day and to about 800 in

2 days of natural weathering. At the same time, however, Arabian light crude increased in viscosity from about 8 cs at the start to about 56. cs in 1 day and to about 80 cs in 2 days. In 7 to 21 days the Kuwait and Iranian oils had viscoisties in the 5,000 to 20,000 cs range, and the Arabian light had viscosities in the 500 to 5,000 cs range. Obviously, more experimentation is needed to cover the cases of concern for oil recovery.

2.0 CONCLUSIONS

It seems clear from the above that neither analytic or observational models of oil slick behavior are far enough advanced to warrant a detailed study of its impact on spill recovery operations. However, a few crude approximations may be of some use:

- 1) The center of mass of the slick moves in the direction and at the speed of the resultant of the local current vector and 3% of the local wind vector.
- 2) The linear dimension of the oiled area increases by a factor of 2 to 10 between 1 hour and 1 day after the slick has formed.
- 3) The volume of (crude) oil decreases by 30% or more after a few days through evaporation.
- 4) In turbulent seas this decrease may be negated by emulsification and formation of a "chocolate mousse" which would seriously impede recovery operations.

REFERENCES FOR APPENDIX N

- N-1. Stolzenbach, K.D., et al., "A Review and Evaluation of Basic Techniques for Predicting the Behavior of Surface Oil Slicks," Report No. MITSG 77-8, MIT Sea Grant Program, Massachusetts Institute of Technology, Cambridge, MA, 02139, March 1977
- N-2. Blokker, P.C., "Spreading and Evaporation of Petroleum Products on Water," in Proceedings of the Fourth International Harbor Conference, Antwerp, Belgium, 1964.
- N-3. Hoult, D.P. 1972 "Oil Spreading on the Sea," Annual Review of Fluid Mechanics. 59-64.
- N-4. National Academy of Sciences, Airlie House Workshop, May 1973, pp 43-44.
- N-5. Kreider, R.E., 1971 "Identification of Oil Leaks and Spills," Proceedings of Joint Conference on Prevention and Control of Oil Spills, Washington, D. C.
- N-6. Nagata, S., and G. Kondo, "Photo-Oxidation of Crude Oils," Proceedings of the 1977 Oil Spill Conference, March 8-10, 1977, New Orleans, LA, American Petroleum Institute, 2101 L Street, N.W., Washington, D.C. 20037