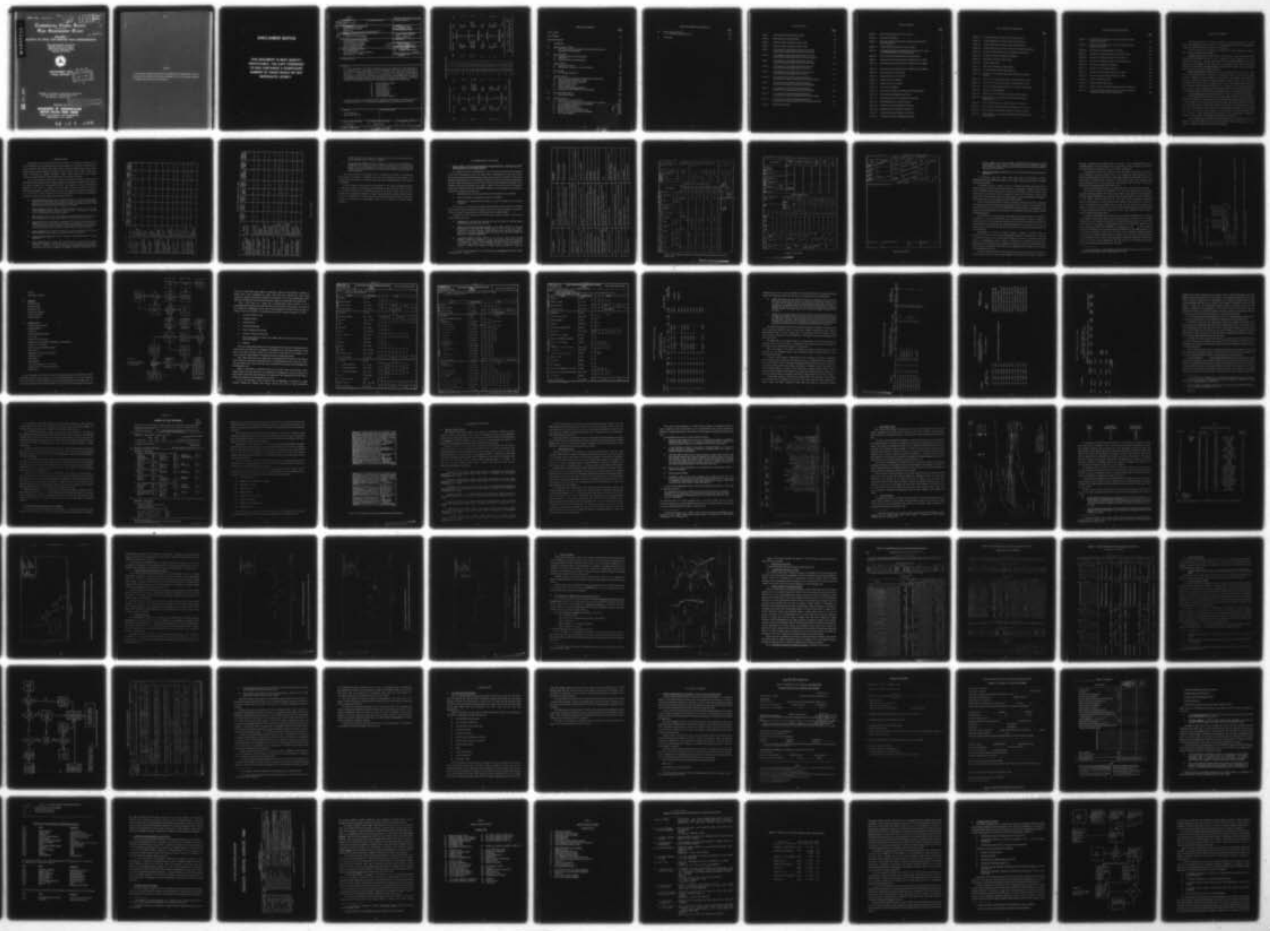
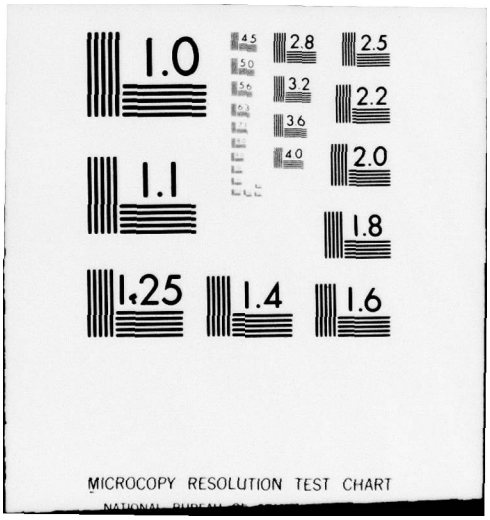
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Report No. CG-D-58-79

DDC
LEVEL III

COMMERCIAL VESSEL SAFETY RISK ASSESSMENT STUDY

V2-A077628

VOLUME I
SURVEY OF DATA FOR MARINE RISK ASSESSMENTS

Planning Research Corporation
Systems Services Company
7600 Old Springhouse Road
McLean, VA 22102

SEPTEMBER 1979
FINAL REPORT

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UNITED STATES COAST GUARD
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15. Supplementary Notes

16. Abstract

The effort discussed in this volume involved a survey and evaluation of data applicable to the evaluation of the risks involved in marine operations. This survey forms part one of a three part risk assessment study for the U. S. Coast Guard. Part two, documented in Volume II, is a survey and evaluation of risk assessment methodologies and part three, documented in Volume III, is a demonstration and evaluation of the applications of selected methodologies and data to specific risk assessments involving barge transport of hazardous chemicals. Twenty three data systems in the following catagories were reviewed:

- marine safety activities,
- marine pollution,
- marine traffic,
- vessel repair costs,
- vessel accidents,
- personnel injuries,
- vessel population, and
- vessel violation injuries.

Discussions of each system include, where appropriate information is available, sources of the data, procedures for collecting and recording the data, and potential error sources.

17. Key Words	18. Distribution Statement
Risk Assessment Marine Data Systems	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	151	

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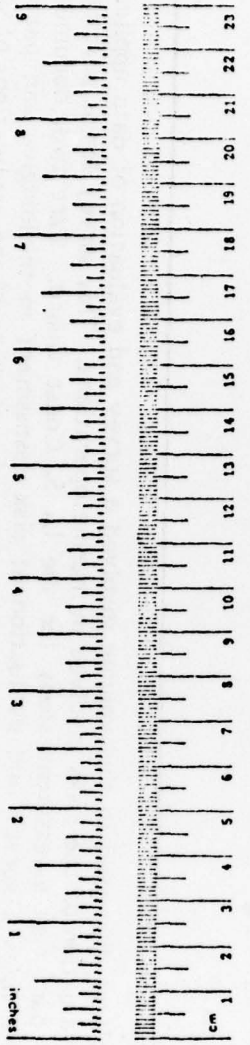
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures. Price $2.25. SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

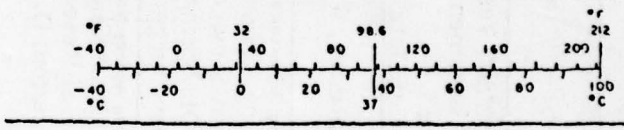


TABLE OF CONTENTS

		Page
List of Tables		v
List of Figures		vii
Executive Summary		1
I.	Introduction	5
II.	Marine Safety Activities	9
	A. Port Safety and Security/Marine Environmental Protection Quarterly Activities Report	9
III.	Marine Pollution	19
	A. Pollution Incident Reporting System	19
	B. TOVALOP	33
	C. Center for Short-Lived Phenomena	35
IV.	Marine Traffic	39
	A. Vessel Traffic Data	39
	B. Waterborne Commerce of the United States	54
V.	Repair Costs	67
	A. U.S. Salvage Association	67
VI.	Vessel Accidents	69
	A. Inter-Governmental Maritime Consultative Organization	69
	B. Liberian Bureau of Maritime Affairs	75
	C. Liverpool Underwriters Association	78
	D. Tanker Advisory Center	78
	E. Tanker Casualty File	86
	F. Vessel Casualty Reporting System	94
	G. Comparison of the VCRS and TCF Data Bases	106
VII.	Vessel Personnel Injuries	119
	A. Marine Index Bureau	119
VIII.	Vessel Population	121
	A. Analysis of World Tanker Fleet	121
	B. List of Foreign Flag Vessels Carrying Letters of Compliance	121
	C. List of Inspected Tank Barges and Tankships	123
	D. Lloyd's Shipping Register	127
	E. Merchant Fleets of the World	129
	F. Merchant Vessels of the United States	129
	G. Record of the American Bureau of Shipping	132
	H. The Tanker Register	135

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TABLE OF CONTENTS (CONTINUED)

		Page
IX.	Vessel Violation History	137
	A. Port Safety Reporting System	137
X.	Conclusions	147

LIST OF TABLES

		Page
Table 1.	Close Encounters for Governors Island.	46
Table 2.	Speed Data for Governors Island.	48
Table 3.	Code for Tanker Casualties, Casualty Type.	81
Table 4.	Code for Tanker Casualties, Casualty Type.	82
Table 5.	A Comparison of the Tankers Casualty File with the Vessel Casualty Reporting System by Location Type.	108
Table 6.	A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Year of Casualty.	109
Table 7.	A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Casualty Type.	110
Table 8.	A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Location.	111
Table 9.	A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System for Spills.	112
Table 10.	A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File on Year of Casualty.	114
Table 11.	A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Water Body.	115
Table 12.	A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Vessel Size.	116
Table 13.	A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Type of Casualty.	117
Table 14.	A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Pollution Indication.	118
Table 15.	World Tank Ship Fleet.	122

LIST OF FIGURES

		Page
Figure 1.	Matrix of Data Systems Vs. Type of Data.	6
Figure 2.	Port Safety Standards.	10
Figure 3.	Port Safety and Security/Marine Environmental Protection Activities Report.	11
Figure 4.	Sample PSS/MEP Quarterly Activities Report.	16
Figure 5.	CG Nationwide Manhours Expended as Reported by CG Units on PSS/MEP Quarterly Activities Reports.	17
Figure 6.	Process by Which Data Becomes Part of PIRS File.	21
Figure 7.	Pollution Incident Reporting System (PIRS) Form CG-4890.	23
Figure 8.	Pollution Incident Reporting System (PIRS) Form CG-4890A.	24
Figure 9.	Pollution Incident Reporting System (PIRS) Form CG-4890B.	25
Figure 10.	Preliminary Edit List for PIRS.	26
Figure 11.	Update Reference List for PIRS.	28
Figure 12.	Update Error List for PIRS.	29
Figure 13.	Monthly Error List for PIRS.	30
Figure 14.	Advice of Oil Spillage.	35
Figure 15.	The Center for Short-Lived Phenomena Sample Reports.	37
Figure 16.	Vessel Density Histogram, Final Form.	42
Figure 17.	Route Identification for Philadelphia Naval Base.	44
Figure 18.	Speed Histogram for Governors Island.	49
Figure 19.	Channel Utilization Histogram, Final Form.	51
Figure 20.	Message Activity Histogram, Final Form.	52
Figure 21.	Channel Efficiency Histogram, Final Form.	53
Figure 22.	Waterborne Commerce Geographical Areas.	55

LIST OF FIGURES (CONTINUED)

		Page
Figure 23.	Sample Waterborne Commerce Information-Section 1.	57
Figure 24.	Sample Waterborne Commerce Information-Section 1.	58
Figure 25.	Sample Waterborne Commerce Information-Section 2.	59
Figure 26.	Sample Waterborne Commerce Information-National Summaries.	61
Figure 27.	Domestic Inland Traffic, Areas of Origin and Destination.	62
Figure 28.	Waterborne Commerce Data Flow Diagram.	63
Figure 29.	Waterborne Commerce Tape Layout.	64
Figure 30.	IMCO Damage Card.	70
Figure 31.	IMCO Intact Stability Casualty Record.	72
Figure 32.	Available Liberian Marine Board Reports.	77
Figure 33.	Excerpt from Liverpool Underwriters Association Casualty Returns.	79
Figure 34.	Printout of Vessel Casualty History, Tanker Advisory Center.	83
Figure 35.	Printout of U.S. Vessel Casualties, Tanker Advisory Center.	84
Figure 36.	Process by Which Data Becomes Part of Tanker Casualty File.	87
Figure 37.	Tanker Casualty Worksheet.	89
Figure 38.	Coding for Location of Ship at the Time of the Casualty.	92
Figure 39.	Process by Which Data Becomes Part of Vessel Casualty Reporting System.	96
Figure 40.	Form CG-2692; Report of Vessel Casualty or Accident.	98
Figure 41.	Form CG-924 E; Report of Personnel Inquiry or Loss of Life.	100
Figure 42.	Form CGHO-4095, Code Sheet-Marine Casualty Statistics.	102
Figure 43.	Sample Printout List of Foreign Flag Vessels Carrying Letters of Compliance.	124

LIST OF FIGURES (CONTINUED)

		Page
Figure 44.	Excerpt From United States Coast Guard Inspected Tank Barges and Tankships.	125
Figure 45.	Excerpt From United States Coast Guard Inspected Tank Barges and Tankships.	126
Figure 46.	Excerpt From Lloyd's Register of Shipping.	128
Figure 47.	Excerpt From Merchant Fleets of the United States.	130
Figure 48.	Excerpt From Bulk Carriers in the World Fleet.	131
Figure 49.	Excerpt From Merchant Vessels of the United States.	133
Figure 50.	Excerpt From Register of Shipping.	134
Figure 51.	Excerpt From the Tanker Register.	136
Figure 52.	Sample Port Safety Reporting System Printout.	138
Figure 53.	Process by Which Data Becomes part of PSRS.	140
Figure 54.	Matrix of PSRS Input Data.	142
Figure 55.	Vessel Violation Report Form.	143
Figure 56.	Sample Prinout of PSRS Boarding and Inspection Statistics.	146
Figure 57.	Criteria by Which a Casualty Becomes a Part of a Marine Pollution or Vessel Accident Data System.	148

EXECUTIVE SUMMARY

The effort discussed in this volume involved a survey and evaluation of marine traffic, vessel population, vessel accident, and marine pollution data that are applicable to evaluation of the risks involved in marine vessel operations.

This survey groups the 23 data systems reviewed into eight categories. The types of data in each group are summarized below.

Marine Activities data contain number of person-hours spent performing Coast Guard safety operations, number of marine operations, vessel violations, and vessel casualties at each port. The data system discussed is the PSS/MEP Quarterly Activities Report which was designed by the Coast Guard as a management tool. These data include information on operations involving hazardous materials, which could be useful in developing exposure levels for hazardous material spill risks.

Marine Pollution data include information on polluting incidents around the world. The systems surveyed contain information on polluting incidents in U.S. waters, tanker incidents worldwide, and major incidents involving all vessels worldwide. The evaluation of these data systems indicated that data on polluting incidents outside U.S. waters are incomplete. The primary source of pollution data is the Coast Guard's Pollution Incident Reporting System which records data on spills in U.S. waters. Other, more limited, pollution data sources have been developed by the International Tanker Owners Pollution Federation (TOVALOP data) and the Center for Short-Lived Phenomena in Cambridge, Massachusetts.

Marine Traffic Data includes information on vessel and commodity movement in U.S. ports and waterways. The primary source of these data is the U.S. Corps of Engineers statistics on Waterborne Commerce of the United States which contains data on the amount of cargo shipped, by commodity class, for each U.S. port and waterway segment. The data also include the number of vessel trips by draft for each port and waterway segment. They provide a valuable source of information on vessel exposure for development of casualty and spill rates. The other traffic data source is a set of studies on vessel movements within seven U.S. ports. These studies provide information on the vessel densities, speeds, and number of close encounters, based upon a detailed survey of each port.

Data on Repair Costs associated with vessel casualties are available from the U.S. Salvage Association. These data can provide information useful for assessing the dollar benefits of measures designed to reduce vessel casualties.

Vessel Accident data contain information on vessel casualties. Vessel accident data from six sources were evaluated. These sources are:

- Inter-Governmental Maritime Consultative Organization
- Liberian Bureau of Maritime Affairs
- Liverpool Underwriters Association
- Tanker Advisory Center
- Tanker Casualty File
- Vessel Casualty Reporting System

The last two data systems are the most useful. The Tanker Casualty File is a computer-based system that contains data on worldwide tanker casualties and oil spills based upon reports published in Lloyd's Weekly Casualty Reports. The Vessel Casualty Reporting System contains information collected by the U.S. Coast Guard on vessel casualties occurring in U.S. waters and those involving U.S. registered vessels in foreign waters. Included in this section is an analysis of the completeness of each of these two data systems based on the inclusion and exclusion of vessel casualties that should be common to both systems.

Vessel Personnel Injury data are collected by the Marine Index Bureau formed for that purpose by a group of U.S. shipowners. These data include information on injuries and illnesses of marine personnel.

Vessel Population data include lists, registers, and summaries of worldwide vessel population. The data sources identified are not intended to show all such types of information. Instead, summaries of population which are believed to be necessary for marine safety analysis and which are assumed to be accurate are included. Vessel population data sources summarized include:

- Analysis of World Tanker Fleet - Annual compilation by Sun Oil Company
- List of Foreign Flag Vessels Carrying Letters of Compliance - Compiled by the U.S. Coast Guard
- List of Inspected Tank Barges and Tankships - Compiled semi-annually by the U.S. Coast Guard
- Lloyd's Shipping Register - Published annually
- Merchant Fleets of the World - Published annually by the U.S. Maritime Administration

- Merchant Vessels of the United States - Published annually by the U.S. Coast Guard
- Record of the American Bureau of Shipping - Published annually
- The Tanker Register - Published annually by H. Clarkson and Company

The Coast Guard's Port Safety Branch has a system to record Vessel Violation Histories for all U.S. inspected vessels. This computerized system contains information on vessel characteristics, casualties, polluting incidents, boardings and inspections, and Safety of Life at Sea certification. The casualty data are from the VCRS and the pollution data from PIRS. The system allows easy access to all information on a vessel pertinent to vessel safety.

The discussions of each system include, where the appropriate information is available, sources of the data, procedures for collecting and recording the data, and potential sources of errors. Copies of data forms are included where possible.

I. INTRODUCTION

The purpose of the survey discussed in this report is to provide a summary of the data available for use in evaluating the risks and assessing safety measures associated with marine transport. Such analyses may require data on vessel casualties, vessel traffic, vessel population, and marine pollution incidents. Further, certain marine safety studies may require information on shipboard personnel injuries, vessel repair costs, marine safety activities, or vessel violations. Each of these areas is covered in this report.

It is not the purpose of this report to survey all marine data systems. Instead, only data systems which show promise of being valuable in the analysis of marine safety systems have been reviewed. The surveyed data systems are organized by type of information available in that system. A number of the data bases contain more than one type of information (see figure 1). However, for this report, the systems are organized according to the type of data for which the system was primarily designed. The types of information contained in the data systems discussed in this report include:

- Marine Safety Activities contains information about the number of person hours spent by the Coast Guard performing port safety and marine environmental protection activities. Data are available on numbers of marine operations, vessel operations, and facility and vessel casualties at the ports.

- Marine Pollution includes data on polluting incidents in the U.S. waters and vessel polluting incidents worldwide; also included is information on cleanup costs, type of pollutant, and quantity spilled.

- Marine Traffic data contain vessel density, route identification, close encounters, vessel speed, port calls, and Channel 13 utilization and efficiency data.

- Repair Costs presents information regarding cost and type of vessel repairs, time needed for repairs, and reason that repairs were necessary. This section is included because the system evaluated, U.S. Salvage Association, while primarily concerned with repair costs, contains information on the results of casualties.

- Vessel Accident data include information on vessel casualties with type and specifications of vessel, and nature, cause, and effect of casualties.

- Vessel Personnel Injury data contain records of injuries and illnesses of vessel personnel.

- Vessel Population data identify the lists, registers, and summaries of vessel population. A number of sources present lists and summaries of vessel population; those included in this report represent a sample containing information pertinent for this study. In addition, the registers included in this report do not

Figure 1. Matrix of Data Systems Versus Type of Data.

Data System	Source	Marine Activities Data	Marine Pollution Data	Marine Traffic Data	Repair Costs	Vessel Accident Data	Vessel Personnel Injury Data	Vessel Population Data	Vessel Violation Histories
Analysis of World Tanker Fleet	Sun Oil Company							X	
Center for Short-Lived Phenomena	Center for Short-Lived Phenomena, Boston		X			X			
Inter-Governmental Maritime Consultative Organization	Maritime Safety Committee, U.N.					X			
Liberian Bureau of Maritime Affairs	Liberian Bureau of Maritime Affairs					X			
List of Foreign Flag Vessels Carrying Letters of Compliance	Marine Environment & Systems, USCG							X	
List of Inspected Tank Barges and Tankships	U.S. Coast Guard							X	
Liverpool Underwriters Association	Liverpool Underwriters Association					X			
Lloyd's Shipping Register	Lloyd's of London							X	
Marine Index Bureau	Marine Index Bureau, New York						X		
Merchant Fleets of the World	Maritime Administration							X	
Merchant Vessels of the United States	U.S. Coast Guard							X	
Pollution Incident Reporting System	Marine Environment & Systems, USCG		X			X			

MATRIX OF DATA SYSTEMS VS. TYPE OF DATA

Data System	Source	Marine Activities Data	Marine Pollution Data	Marine Traffic Data	Repair Costs	Vessel Accident Data	Vessel Personnel Injury Data	Vessel Population Data	Vessel Violation Histories
Port Safety & Security/ Marine Environmental Protection Quarterly Activities Report	Port Safety Branch, USCG	X		X		X			
Port Safety Reporting System	Port Safety Branch, USCG	X	X	X		X			X
Record of the American Bureau of Shipping	American Bureau of Shipping							X	
Tanker Advisory Center	Tanker Advisory Center, NYC		X			X			
Tanker Casualty File	USCG, Office of Merchant Marine Safety		X		X	X	X		
The Tanker Register	H. Clarkson Limited, London							X	
TOVALOP	TOVALOP, London		X		X	X			
U.S. Salvage Association	U.S. Salvage Association, NY				X				
Vessel Casualty Reporting System	Information and Analysis Branch, USCG		X		X	X	X		
Vessel Traffic Data	Operations Research Inc.			X					
Waterborne Commerce of the United States	U.S. Corps of Engineers							X	

Figure 1. (continued)

include all registers; rather, they include the three sets of records which are used to identify vessels involved in casualties.

- Vessel Violation History. The system discussed in this section was designed as a management tool to aid field officers at ports in deciding which vessels to board. Included in the vessel histories are vessel identification and specifications; SOLAS information; polluting and casualty incidents; boarding information; and violation histories.

This report identifies the purposes, sources, availability and content of the selected data systems. In addition, it evaluates these files for completeness and accuracy. The evaluation of some systems is incomplete because relevant information about those systems is unavailable.

The more widely used data systems are described in more detail, including the process of collecting, reviewing, computerizing, and publishing the data. Potential sources of error are indicated. In addition, a comparative analysis of two vessel casualty data systems is included. This comparison, between the Vessel Casualty Reporting System and the Tanker Casualty File, addresses the tanker casualties that should theoretically appear in both data systems and determines the percentages missed by each system for various casualty categories.

II. MARINE SAFETY ACTIVITIES

A. PORT SAFETY AND SECURITY/MARINE ENVIRONMENTAL PROTECTION (PSS/MEP) QUARTERLY ACTIVITIES REPORT

As a result of the Ports and Waterways Act of 1972 and the Federal Water Pollution Control Act Amendments of 1972, the Coast Guard's responsibilities in the areas of port safety and security and environmental protection were increased. In an effort to meet these expanded responsibilities, the Commandant established minimum performance standards for the Port Safety and Security and the Marine Environmental Protection Programs. These standards and expected frequency are shown in figure 2. The Port Safety and Security/Marine Environmental Protection (PSS/MEP) Quarterly Activities Report was designed to evaluate the standards and ensure that:

a. Acceptable safety and environmental protection programs are maintained.

b. Units are capable of complying with minimum standards.

c. Resources are provided where necessary to assure compliance with minimum standards.[1]

As of October 1, 1973, all Marine Safety Offices (MSO), Captain of the Ports (COTP), and Port Safety Stations (PSSTA) are required to file these reports. In addition, the district office must report for those areas not included in the units specified above.

All reports are to be filed on Form CG-4957 which is shown in figure 3. This form is divided into four sections:

- Heading which identifies the reporting unit and the number of vehicles, boats, and personnel associated with that unit.

- Mission Performance Standard Statistics which deals specifically with the performance of standards. This section lists, for each activity, the number completed, man-hours expended, vehicle and boat hours expended, the percentage of the standard completed during the quarter, and the total number of operations and tonnage transferred.

- Occurrence Report including number of port security cards issued, warning violations issued, and casualties, injuries, and deaths occurring during the reporting quarter. Code of Federal Regulations (CFR) violations are summarized by facilities and vessels and by violations detected by boat and vehicle. A casualty is defined to be damage to vessel, cargo, or property in excess of

---

[1] U.S. Coast Guard, Department of Transportation, Commandant, Instruction 5010.5 (Washington, D.C.: 1973), p. 1.

Figure 2. Port Safety Standards.

PSS STANDARDS	ACTION	FREQUENCY
Supervise Explosives "A"	Supervise shipboard handling, stowing, and storing operations	100% of operations
Supervise COPH	Supervise shipboard handling, stowing and storing of caroges listed in 33 CFR 124.14 (b) (1)	100% of operations
Dangerous Cargo Boardings	Board vessels/barges handling dangerous cargo	50%
Security Safety Zone Patrols	Patrol established security and safety zones	As required by District Commander
Essential Harbor Patrols	Conduct Patrols of essential harbor areas by water	Once/Day, Once/Night
Remote Harbor Patrols	Patrol remote harbor areas by water	Once/Month
Spot Check Facilities	Spot check designated waterfront facilities	Once/Month
Inspect Facilities	Inspect designated waterfront facilities	Twice/Year
Survey Facilities	Survey all waterfront facilities	Once/2 years
Vessel Movement Control Vessel Escort	Escort/Movement Control for vessels handling explosives "A" and cargoes listed in 33 CFR 124.14 (b)	100%
Accident Investigations	Investigate accidents	100% involving loss of life or Significant damage
SIV	Board/conduct surveillance of SIV	As per CG-299-1
Liaison/Contingency Plans	Maintain liaison with other agencies/develop contingency plans	Twice/Year
VTS	Establish/operate VTS	As required
Public Education	Pursue public education program	One Contact/Month

DEPARTMENT OF TRANSPORTATION U.S. COAST GUARD CG-4457 (7-71)	PORT SAFETY AND SECURITY MARINE ENVIRONMENTAL PROTECTION ACTIVITIES REPORT	CG-MEL-[illegible] GWLE 14013
ACCOUNTING CODE NO.	REPORTING UNIT: 1	QUARTER ENDING

ITEM	VEHICLES	BOATS
01 TOTAL	COL. 1	2
02 P.S.		
03 MEP		

PERSONNEL ATTACHED				
ITEM	OFFICERS	WARRANTS	ENLISTED	CIVILIANS
TOTAL	3	4	5	6
PORT SAFETY				
MEP				

SECTION I. MISSION PERFORMANCE STATISTICS

ITEM DESCRIPTION		OPERATIONS TOTAL	NUMBER COMPLETED	MAN HOURS EXPENDED	VEHICLE HOURS EXPENDED	BOAT HOURS	% OF STD	06 ↓ TONS (BARRELS SUPERVISED)
		1	2	3	4	5	6	7
04 1. PREVENTION	Vessels	COL. 1 2	3 4	5 6	7 8	9 10	11	COL 1 a. bbl b. ton
05 1.a Monitor Liquid Bulk Transfers	Barges							4 a. bbl b. ton
07 1.b Cargo Supervision	Explosives "A"	COL. 1	2	3	4	5	6	COL 1
08	33 CFR 124.14 b(1)							2
10 1.c Supervised Radioactive Material								3
11 2.a Dangerous Cargo Boardings								09
12 2.b Tank Boardings								
13 Barge Boardings								
14 2.c Security/Safety Zone Patrols		COL. 1 2	3	4	5	6	7	
15 3.a Harbor Patrols	Day	COL. 1 2	3 4	5	6	7		
16	Night							
17 3.b Remote Harbor Area Patrols								
18 4.a Facility Spot Checks	Dry	COL. 1	2	3	4	5	6	
19	Liquid Bulk							
20 4.b Facility Inspections	Dry	COL. 1	2	3	4	5		
21	Liquid Bulk							
22 4.c Facility Surveys	Dry							
23	Liquid Bulk							
24 5. Vessel Movement Control		COL 1	2	3	4	5	6	
25 6. Vessel Escorts								

Figure 3. Port Safety and Security Marine Environmental Protection Activities Report Form.

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ENCLOSURE (2) to COMDTINST 5010.5

14 SEP 1973

SECTION I. MISSION PERFORMANCE STATISTICS (Cont.)

ITEM DESCRIPTION		OPERATIONS TOTAL	NUMBER COMPLETED	MAN HOURS EXPENDED	VEHICLE HOURS EXPENDED	BOAT HOURS	% OF STD
		1	2	3	4	5	6
8. RESPONSE		COL. 1	2	3	4	5	6
26 1.a Discharge Monitoring							
27 1.b Discharge Removal							
C. INVESTIGATION AND ENFORCEMENT							
28 1.a Main Harbor Surveillance Flights							
29 b Coastal and Contiguous Zone Flights							
30 2.a Discharge Investigations	POL. Discovered						
31	POL. Not Discovered	X					
32 3. Accident Investigations							

SECTION II. OCCURRENCE REPORT

1. No. Port Security Cards Issued
33 COL. 1

2. No. Security Advisory Warnings Issued
33 2

3. Violations Detected during Patrols

ITEM	DISCHARGES		LOAD LINE		ANCHORAGES		OTHER	
	3	4	5	6	7	8	9	10
33 DAY								
34 NIGHT	COL. 1	2	3	4	5	6	7	8
35 REMOTE								

4. 33 CFR VIOLATIONS

ITEM	124		126		151		153		154		155		156	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
36 FACILITY														
37 T/V														
38 T/B														
39 M/V														

5. 46 CFR VIOLATIONS

ITEM	D		I		N		O		6. No. of Casualties a. Persons	b. Vessels
	1	2	3	4	5	6	7	8	9	10
40 VESSEL	COL. 1									

7. No. of Facility		8. No. of Vessels		9. No. of Losses (Thousand $)	
a. Deaths	b. Injuries	a. Deaths	b. Injuries	a. Facility	b. Vessels
41 COL. 1	2	3	4	5	6

10. No. of SIV.		11. Oil Transferred (bbls)	12. Other Hazardous Substances	13. Volume Oil Spilled (bbls)
a. Port calls	b. Days		bbl 2 / ton 3	
42 COL. 1	2	43 COL. 1		4

Figure 3. (continued)

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SECTION III. ADDITIONAL MAN-HOURS 14 SEP 1973

TASK	MAN-HOURS		TASK	MAN-HOURS	TASK	MAN-HOURS	
1. SIV Surveillance 44	COL. 1		5. Admin. PSS/MEP	2 3	9. Coordination	4	
2. SIV Boardings 45			6. Support PSS/MEP		10. Public Education		
3. Pre-Load Inspection 46			7. Training PSS/MEP		11. Other Enforcement		
4. Miscellaneous PSS/MEP 47	COL. 1	2	8. Unit Travel PSS/MEP	3 4	12. USCGR PSS/MEP	5	6

SECTION IV. REMARKS

REMARKS *(Use Additional Sheets, if necessary)*

DATE SUBMITTED	SIGNATURE OF C.O. OR O.I.C.	DISTRICT REVIEW	
		DATE	SIGNATURE

Figure 3. (continued)

$1,500; a death; or an injury resulting in incapacitation in excess of 72 hours. Also included in this section is the amount of oil and hazardous material transferred, the number of Special Interest Vessel (SIV) visits and the number of days the SIV's were in port.

- Additional Man-hours expended for security, administration, training, education, and travel.

To summarize, these data contain three basic types of information: man-hours expended performing standards, number of port related operations, and number of deaths, injuries and casualties.

The process by which a report is filed is not highly structured. The field units are required, within 10 days of the end of each quarter, to complete an original and four copies of Form CG-4957. One of these copies is kept at the field office, the rest are sent to the district office. The district office is required to review and if necessary correct these forms; then, within 20 days of the end of each quarter, send two copies and the original to headquarters. The other two copies are retained by the district.

If errors are detected after the report is submitted, a new Form CG-4957 is submitted to Headquarters with only those items recorded which were incorrect on the original form. In the "Remarks" section, the word "CORRECTION" should be written. At Headquarters, the reports are summarized by district and then put on TYMSHARE (the Coast Guard's computer time sharing system).

On the surface this is an accurate and complete data system because it is primarily a compilation of activities performed by Coast Guard personnel. In practice, however, a number of errors occur. The primary cause of error is the lack of a systematic procedure for recording day-to-day operations. The recording procedures vary from port to port and, as a result, accurate records will be reported from some ports while poor records will be sent from other ports.

The problem of recording man-hours whenever a number of different tasks are performed in a day is common to every organization requiring time sheets. Some units keep accurate daily records, while others make estimates at the end of the week or month. The quality of recordkeeping is also a function of workloads. As workloads increase, record-keeping accuracy often decreases. In addition, the hours recorded on time sheets reflect the number of hours an individual is expected to work, regardless of the amount of time actually spent performing an activity.

One other reporting problem is defining exactly what functions a person is performing. The Port Safety Branch at Coast Guard Headquarters indicates this has been a problem in

the past, particularly in deciding whether to classify a job as "administrative" or as "PSS/MEP support." Another example of this type of error is what constitutes a spot check in one port may be very different from a spot check in another port.

At the district level, if time is taken to review the reports, only general inaccuracies can be detected. The type of factors that can be checked are large changes from the previous reporting period in the number of hours spent performing a particular activity or in the number of violations issued. It should be noted, however, even these checks are not always performed. As with the field units, some districts take the time to check for inaccuracies and incompleteness while others do not.

Errors at Headquarters can occur in entering information into the computer system.

Four types of statistics are generated from this data base--district and national quarterly and annual statistics. The Coast Guard is able to print particular classifications of the data through TYMSHARE, e.g., the Fifth District's total violations for the four quarters of 1975. Figure 4 shows a sample printout. The Coast Guard also publishes nationwide statistics (see figure 5). The Port Safety Branch indicates these statistics are used as a means of determining what standards are not being met and where more personnel are needed. In an effort to increase the efficiency of the PSS/MEP program, the Coast Guard has used the quarterly activities statistics, as well as other sources of marine data, to produce an Operating Program Plan.[1]

In theory the PSS/MEP data system could be a valuable management tool. Unfortunately, because of the methods used in reporting information, or in some ports not reporting information at all, the data are inaccurate. An example of this inaccuracy is in the number of operations in the category of "Cargo Supervision: 33 CFR 124.14.b(1)." Based on Coast Guard information (other than PSS/MEP) for calendar year 1976 the total number of operations was 9,806; for the same time period the PSS/MEP records 6,888 operations. This means that the PSS/MEP reported only 70 percent of the operations involving hazardous chemicals. It is not known whether the other categories are more or less accurate; however, one would expect that the Coast Guard's reporting of chemicals of particular hazard would be one of the more accurate tabulations. The inaccuracies of this reporting system, both known and suspected, severely detract from its value.

---

[1]Port Safety Branch, United States Coast Guard "Port Safety and Law Enforcement FY80-89 Operating Program Plan" (Washington, D.C.: 1977).

Figure 4. Sample PSS/MEP Quarterly Activities Report.

```
C:\PRESS FT DSS OAP
DAID 199 DETACHED


   PSS MEP QUARTERLY ACTIVITIES REPORT


->QTR 1 TO 4;TBL TOTAL(FAC QTR 1 TO 4;STOTAL QTR;TBL TOTAL(FACLOSS,QTR) TOTAL(VES
LOSS,QTR)


ERROR: MISSPELLING - 4QTR
--
QTR                        X1             X2
0176                  2,147.00      18,071.00
0276                  5,467.00      27,275.00
0376                  5,113.00      15,018.00
0476                  5,373.00      28,213.00
QTR6                  7,685.00      27,292.00
TOTAL                25,785.00     115,869.00

- PV 25785*.8
20,628.00
- PV 115869*.8
93,695.20
- CMI SLEEP
TBL TOTAL(FACCAS,QTR) TOTAL(VESCAS,QTR) TOTAL(FACDTH,QTR) TOTAL(VESDTH,QTR) TOTA
L(FACINJ,QTR) TOTAL(VESINJ,QTR)



- TBL TOTAL(FACCAS,QTR) TOTAL(VESCAS,QTR) TOTAL(FACDTH,QTR) TOTAL(VESDTH,QTR) TO
TAL(FACINJ,QTR) TOTAL(VESINJ,QTR)
```

FACILITY LOSS (DOLLAR VALUE) (000)

VESSEL LOSS (000)

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CG Nationwide Manhours Expended as Reported by CG Units on PSS/MEP Quarterly Activities Reports

PREVENTION	Jul.- Sep. '76	Oct. - Dec. '76	Jan. - Mar. '77	Apr. - Jun. '77
Monitoring Liquid Bulk Transfers	11,721	11,535	13,938	16,651
Cargo Supervision	6,228	5,776	9,181	6,385
Dangerous Cargo Boardings	20,970	17,637	22,478	21,562
Tank Boardings	5,271	4,824	7,756	6,786
Barge Boardings	6,268	5,100	7,137	6,593
Security/Safety Zone Patrols	9,122	2,396	331	3,022
Harbor Patrols	63,362	64,866	61,992	69,730
Facility Spot Checks	12,661	13,115	13,831	13,523
Facility Inspections	4,200	6,076	5,525	5,558
Facility Surveys	5,895	6,429	4,689	6,001
(Total Facility Activities)	(22,756)	(25,620)	(24,045)	(25,082)
Vessel Movement Control	923	4,629	59,187	1,625
Vessel Escort	1,822	4,764	3,098	2,283

Figure 5.

III. MARINE POLLUTION

A. POLLUTION INCIDENT REPORTING SYSTEM

In 1971 the Marine Environmental Protection Program (MEP) was established as a result of the Water Quality Improvement Act of 1970. The primary responsibility of the MEP Program is to protect the marine environment from discharge of oil and other hazardous materials. The Federal Water Pollution Control Act and Executive Order 11735 require that any such discharge in U.S. waters be reported to the United States Coast Guard. The Pollution Incident Reporting System (PIRS) was established in 1971 to collect these discharge reports. The objective of the PIRS data is to provide information:

- Needed by MEP Program management to measure program effectiveness, and
- In response to inquiries from Congress, industry, academic institutions, and the public concerning marine pollution.

When PIRS was established, it only collected information relevant to the discharge itself. In 1973, this data system was expanded to include response on cleanup activities and penalty actions. The data included in each of the categories are as follows:

- Discharge
  - District number
  - Date
  - Time
  - Location by longitude and latitude
  - State
  - Water body
  - Source
  - Source identifier
  - Cause
  - Operation
  - Material
  - Quantity
  - Affected resources
  - Wind speed and direction
  - Sea height and swell direction
  - Current speed and direction

Notifier
Anticipated response

- Response
  Removal party
  Equipment used
  Personnel used
  Duration of response
  Amount recovered
  Cost of cleanup

- Penalty Action
  Penalty action initiated
  Initiating agency
  Authority
  Action taken against party
  Action date
  Referral to U.S. attorney
  Referral to Coast Guard Commandant or other agency
  Action by U.S. attorney
  Penalty fine or settlement assessed
  Imprisonment
  Suspension, revocation or probation
  Hearings or trial
  First appeal
  Second appeal
  Civil action appealed to U.S. Court
  Penalty, fine, or settlement collected
  Case closed

Figure 6 diagrams the process by which these data become part of the PIRS file. When a polluting incident occurs, it either is or is not reported. Whether or not those responsible for the spill report it usually depends on whether they believe they will be caught. The U.S. Government provides incentive to the polluter to report the spill--those caught polluting the

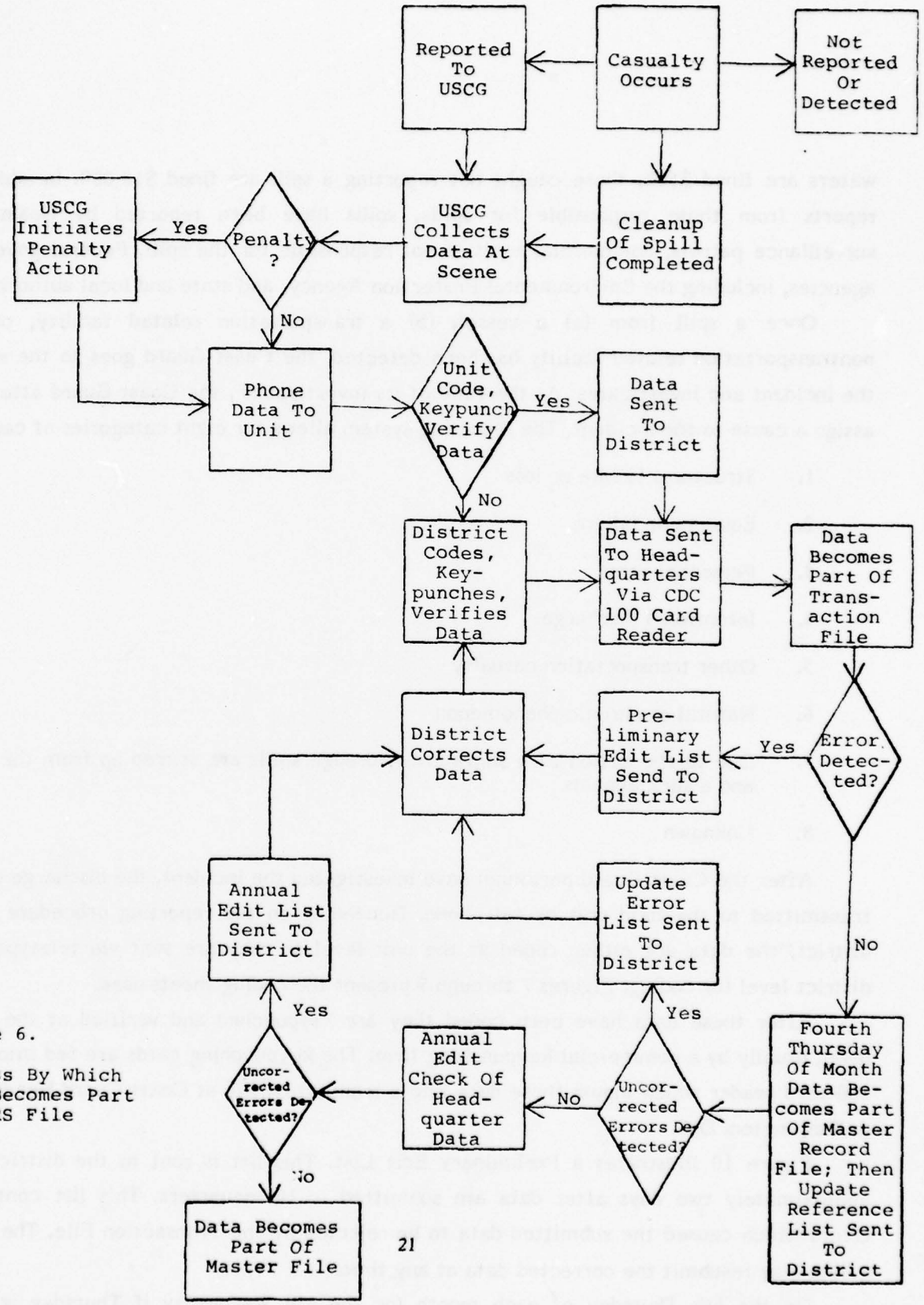


Figure 6.

Process By Which Data Becomes Part Of PIRS File

waters are fined $500, those caught not reporting a spill are fined $10,000. In addition to reports from those responsible for spills, spills have been reported by Coast Guard surveillance patrols, commercial entities not responsible for the spill, Federal government agencies, including the Environmental Protection Agency, and state and local authorities.

Once a spill from (a) a vessel, (b) a transportation related facility, or (c) a nontransportation related facility has been detected, the Coast Guard goes to the scene of the incident and investigates. At the time of its investigation, the Coast Guard attempts to assign a cause to the incident. The reporting system allows for eight categories of causes:

1. Structural failure or loss
2. Equipment failure
3. Personnel error
4. Intentional discharge
5. Other transportation casualty
6. Natural or chronic phenomenon
7. Due to the action of a ship's crew, dredge spills are stirred up from the bottom and a slick appears
8. Unknown

After the Coast Guard personnel have investigated the incident, the discharge data are transmitted to the field unit by telephone. Depending on the reporting procedure in each district, the data are either coded at the unit level or they are sent via teletype to the district level for coding. Figures 7 through 9 present the coding sheets used.

After these data have been coded they are keypunched and verified at the district level, usually by a commercial keypunching firm. The keypunching cards are fed into a CDC 100 card reader which inputs those data into a transaction file at Coast Guard Headquarters in Washington, D.C.

Figure 10 illustrates a Preliminary Edit List. This list is sent to the district office approximately two days after data are submitted to Headquarters. This list contains all errors which caused the submitted data to be rejected by the Transaction File. The district office may resubmit the corrected data at any time.

On the 4th Thursday of each month (or the 4th Wednesday if Thursday is a legal holiday), Headquarters updates their Master Record File with all valid transactions

Figure 7.

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-4890 (Rev. 12-75)	POLLUTION INCIDENT REPORTING SYSTEM (PIRS) (DISCHARGE)	INPUT TO PIRS PRE-EDIT 12210M

NOTE: 1. A - Alpha, N - Numeric (zero-fill), A/N - Alpha/Numeric
2. Columns 1 thru 16 same for both cards.

	FIELD	CARD COLUMN	DATA
RECORD ID	District	1-2 (N)	
	Sequence Number	3-7 (N)	
	Date of Incident	8 - 13 (N)	Yr. Month Day
	Transaction Code	14 - 16 (A)	ADD/COR/DEL
DISCHARGE	Card Number	17 (N)	1
	Time of Occurrence	21 - 23 (N)	Day of Week Hour of Day
	Location	24 - 33 (A/N)	
	State	34-35 (A)	
	Water Body	36 - 38 (N)	
	Source	39 - 41 (A/N)	
	Source Identifier	42 - 49 (N)	
	Cause	51-52 (A)	
	Operation	54-55 (N)	
	Material	56 - 59 (N)	
	Quantity	60 - 67 (A/N)	
	Affected Resources	69 - 74 (A/N)	
	Report Period Date	75 - 80 (N)	Yr. Month Day
	Card Number	17 (N)	2
	Wind Speed/Direction	21 - 25 (N)	Knots ^{o} True
	Sea Hgt/Swell Direction	26 - 30 (N)	Feet ^{o} True
	Current Speed/Direction	31 - 35 (N)	Knots ^{o} True
	Notifier	39-41 (A/N)	
	Anticipated Response	42 (N)	
	OPFAC Number	44 - 53 (A/N)	
	Report Period Date	75 - 80 (N)	Yr. Month Day

PREVIOUS EDITION IS OBSOLETE

Figure 8.

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-4890 A (Rev. 12-75)	POLLUTION INCIDENT REPORTING SYSTEM (PIRS) *(RESPONSE)*	INPUT TO PIRS REPORT 12210M

NOTE: 1. A - Alpha, N - Numeric (Zero-fill), A/N - Alpha-Numeric, and N/S - Numeric-Special Character.
2. Columns 1 thru 16 same on all cards.

	FIELD	CARD COLUMN	DATA
RECORD ID	District	1-2 (N)	
	Sequence Number	3 - 7 (N)	
	Date of Incident	8 - 13 (N)	Yr. Month Day
	Transaction Code	14 - 16 (A)	ADD/COR/DEL
RESPONSE	**Card Number**	17 (N)	3
	Removal Undertaken By (Party)	21 (N)	
	Equipment: Boom Materials	22 - 24 (N)	10's of feet
	Recovery Devices	25-26 (N)	
	Disposable Absorbents	27 - 30 (N)	Lbs.
	Recycleable Absorbents	31 - 33 (N)	Lbs.
	Burning Agents	34 - 36 (N)	Lbs.
	Dispersants	37 - 39 (N)	Gal.
	Herders	40 - 42 (N)	Gal.
	Sinking Agents	43-45 (N)	Lbs.
	Personnel (In man-days): CG Regular	55 - 57 (N)	
	CG Reserve	58 - 60 (N)	
	National Strike Force	61 - 63 (N)	
	EPA	64 - 66 (N)	
	Dept. of Defense	67 - 69 (N)	
	Commercial	70 - 72 (N)	
	Report Period Date	75 - 80 (N)	Yr. Month Day
	Card Number	17 (N)	4
	Personnel (Cont.): Responsible Party	21 - 23 (N)	
	Other	24 - 26 (N)	
	Duration of Response	33 - 35 (N)	Days
	Amount Recovered	36 - 43 (A/N)	
	Cost of Cleanup: Total Cost	44 - 51 (N/S) $	
	Expenditures from Pollution Fund	52 - 58 (N) $	
	Reimbursements to Pollution Fund	59 - 65 (N) $	
	Reimbursements Pending	66 - 72 (N) $	
	Incomplete Reimbursement-Reason	73 (N)	
	Report Period Date	75 - 80 (N)	Yr. Month Day

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Figure 9.

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-4890 B (Rev. 12-75)	**POLLUTION INCIDENT REPORTING SYSTEM (PIRS)** *(PENALTY ACTION)*	**INPUT TO PIRS PRE-EDIT 12210M**

NOTE: 1. A - Alpha, N - Numeric (zero-fill)
2. Columns 1 thru 16 same on all cards.
3. The following Card Numbers will be used when: No Action - Card 6, 1st action- Card 6, 2nd action - Card 7, 3rd action - Card 8, and 4th action - Card 9.

	FIELD	CARD COLUMN	DATA
RECORD ID	District	1-2 (N)	
	Sequence Number	3 - 7 (N)	
	Date of Incident	8 - 13 (N)	Yr. Month Day
	Transaction Code	14 - 16 (A)	ADD/COR/DEL
PENALTY ACTION	Card Number	17 (N)	
	Penalty Action Initiated	21-22 (N)	
	Initiating Agency	26 (N)	
	Authority	27-28 (N)	
	Action Taken Against (Party)	29 (N)	
	Action Date	30 - 33 (N)	Month Day
	Referral to U. S. Attorney	34 (N)	
	Referral to COMDT/Other Agency	35 (N)	
	Action by U. S. Attorney	36 (N)	No - 0/Yes - 1
	Penalty Penalty, Fine, or Settlement Assessed	39 - 43 (N)	
	Imprisonment	44-45 (N)	
	Suspension, Revocation, Probation	46 (A)	S/R/P
	Hearing or Trial	47 (N)	
	First Appeal	48 (N)	
	Second Appeal	49 (N)	
	Civil Action Appealed to U. S. Court	51 (N)	No - 0/Yes - 1
	Penalty, Fine, or Settlement Collected	53 - 57 (N)	
	Case Closed	58 (N)	
	Report Period Date	75 - 80 (N)	Yr. Month Day

PREVIOUS EDITION IS OBSOLETE

Figure 10. Preliminary Edit List for PIRS.

UNITED STATES COAST GUARD
POLLUTION INCIDENT REPORTING SYSTEM

12210MR10 PRELIMINARY EDIT LIST RUN DATE 75/08/19

DISTRICT	SEQ NO	REPORT DATE	TRANS CODE	CD NO	COL 21...5...30....5...40....5...50....5...60....5...70....5...80	* - FATAL ERROR X - POSSIBLE ERROR
01	00051	740302	COR	6	00 1011082611 00200 211 0 002001 740515	
01	00093	740404	COR	6	00 10110674110 00250 22 002501 750630	*REJECTED*
					**	
01	00129	740512	COR		05 1 750630	*REJECTED*
				*		
01	00161	740611	COR	6	00 10110805110 00050 211 0 000501 740515	
01	00180	740525	COR	6	00 10110729 3 00100 22 001001 750630	
01	00181	740624	COR	6	01 10210725 00100 22 001001 750630	
01	00189	740706	COR	6	00 10110729 00100 3 1 750630	
01	00257	740907	COR	6	00 10110923 00500 23 1 750630	
01	00280	741008	COR	6	03 1 740315	
01	00318	741126	COR	6	05 1 750630	
01	00334	741206	COR	6	00 10110211 03500 3 003001 750630	

submitted that month. As soon as possible after the Master Record File is updated (usually within two weeks), the district office receives two types of lists from Headquarters:

- Update Reference List (see figure 11). This list is intended to give the district the status of particular records and the condition of the file as a whole. A list for every year for which data were submitted during that month will be sent to the district. For example, if 1977 data are updated and 1978 data are added and updated, the district will receive a list for 1977 and a list for 1978. It is expected that the district will review these lists to make sure changes have been made correctly.

- Update Error List (see figure 12). This list includes the data submitted but not yet added to the Master record because of errors. It also includes elements from the Preliminary Edit List which have not yet been corrected and may include elements which "survived" the Preliminary Edit List but which still must be corrected. Any data which are recorded on the Update Error List will not be on the Master Record File and must, therefore, be resubmitted by the district.

The PIRS coding allows for data to be added, corrected, and deleted. The system uses three "transaction codes" for each of these entries. "ADD" is used when a new record is being entered. "COR" is used to change data for a particular record. To delete a record, "DEL" is used. The problems in submitting data to the PIRS file are usually associated with these three codes.

The PIRS data are once again edited on an annual basis. If errors are detected, the computer prints a list of the errors. An example of this printout can be seen in figure 13. The district is then informed of the error to be corrected.

When the cleanup of the spill is completed, the Coast Guard submits the data necessary for the "Response" form. This information follows the same process as the "Discharge" information.

A Penalty Action Report is expected from every discharge. This report is submitted when a penalty action is initiated. As the penalty action is completed, the data are added to the file. If no penalty action is initiated, the reasons behind this decision must be submitted. If a penalty action is taken by any agency other than or in addition to the Coast Guard, i.e., another Federal agency, or state or local authorities, a separate penalty report must be submitted for each agency. The Penalty Action report goes through the same process as the Discharge Report; however, the penalty information is proprietary until the case is closed.

A report goes through a number of edit checks before it becomes part of the Master File. However, the edit program is weak. The only checks made are those regarding the "ADD," "COR," and "DEL" transaction codes; also data fields are checked to ensure

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Figure 11. Update Reference List for PIRS.

UNITED STATES COAST GUARD
POLLUTION INCIDENT REPORTING SYSTEM
UPDATE REFERENCE LIST PERIOD ENDING 750626

12220PRES — PAGE 00028 — RUN DATE 75/07/29

RECORD ID OF SEQ	DATE	WATER BODY	SOURCE	CAUSE	MATL	QUANT	ANTIC RESP	REMVL BY	FUNDS EXPENDED	FUNDS REIMBURSED	NO ADMIN ACTION	AUTHORITY 6	7	8	9	TRANS PROC	CARRY OVR 180 DAYS	OPER. CASE STATUS	CGG
03 00678	750603	201	015	RG	1098	U	1				00	02				ADD		0	
03 00679	750519	203	101	BJ	1022	00000056	3				03					ADD		1	
03 00685	750605	203	102	TK	1040	00000036	1				04					ADD		1	
03 00686	750605	203	051	TK	1080	00000206	0	1			00	02				ADD		0	
03 00687	750605	207	205	BJ	1001	00000706	0	1			00	02				ADD		0	
03 00690	750607	203	501	YC	1080	00000256	1				00	02				ADD		0	
03 00692	750607	102	999	ZZ	1097	U	1				02					ADD		1	
03 00693	750529	203	999	ZZ	1080	00000306	1				02					ADD		1	
03 68686	750605															ADD		0	

Figure 12. Update Error List for PIRS.

12220PRG5

UNITED STATES COAST GUARD
POLLUTION INCIDENT REPORTING SYSTEM
UPDATE ERROR LIST

PAGE 02
RUN DATE 75/09/10

RECORD ID NO DIST	SEQ	DATE		BODY OF TRANSACTION	TYPE OF ERROR
08	03809	740706	DEL2		UNMATCHED TRANS NOT CODED ADD
08	03809	740706	DEL6		UNMATCHED TRANS NOT CODED ADD
08	04517	740628	ADD1	509R IW 00200LA402501C0018913 CQ 06100000000156	ADD RECORD MATCHES MASTER
08	04687	740629	DEL1		** RECORD SUCCESSFULLY DELETED
08	04687	740629	DEL2		UNMATCHED TRANS NOT CODED ADD
08	04687	740629	DEL3		UNMATCHED TRANS NOT CODED ADD
08	04687	740629	DEL4		UNMATCHED TRANS NOT CODED ADD
08	04687	740629	DEL6		UNMATCHED TRANS NOT CODED ADD
08	04688	740629	DEL1		** RECORD SUCCESSFULLY DELETED
08	04688	740629	DEL2		UNMATCHED TRANS NOT CODED ADD
08	04688	740629	DEL3		UNMATCHED TRANS NOT CODED ADD
08	04688	740629	DEL4		UNMATCHED TRANS NOT CODED ADD
08	04688	740629	DEL6		UNMATCHED TRANS NOT CODED ADD

Figure 13. Monthly Error List for PIRS.

12230MR10

UNITED STATES COAST GUARD
POLLUTION INCIDENT REPORTING SYSTEM

MONTHLY ERROR LIST FOR PERIOD ENDING 08-12-75 RUN DATE 75-08-15

DIST.	SEQ.NO.	REPORT DATE	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA	ITEM/ DATA
02	00718	731220	11202 2								
02	00728	731212	02103 3	05604 1004							
02	00741	731119	10002	10201							
02	00785	731010	06008 0336000G								

alphabetic and numeric characters are in alpha or numeric fields. The Program Review and Budget Staff has indicated that an edit program is now being developed which will cross-check information contained in one field against that contained in another, e.g., a vessel cannot discharge more than it has a capacity for carrying. The program will also do field checks to ensure that only permissible characters appear in each data field. This edit program is expected to be operational in the summer of 1979. At that time, 4 years of historic data will be run through the program. The hard copies of the accident reports are not kept for more than 4 years, thus data prior to that cannot be checked.

As with each data system described, errors may occur through careless coding of data at the unit or district level. It is also possible for keypunch errors to go undetected.

The PIRS file does have the advantage of having each incident investigated by the Coast Guard. The investigation will not eliminate reporting errors but it will reduce them. The investigating officer may still have to rely on information received from those at the scene of the incident, but the officer has the final say about what is reported. The areas most subject to inaccuracies are the cause and amount of pollution, because they usually are based on second-hand information and best estimates.

The PIRS file allows cleanup cost data to be reported after the cleanup has been completed. These costs, therefore, can be expected to be extremely accurate. This is an advantage over cost data in other systems where cost data are estimated and reported prior to repairs being made.

The only known estimate of the completeness of these data was made in 1975 in the MEP Performance Evaluation where it was estimated that the 1973 and 1974 PIRS data contained information about incidents involving 90 percent of all oil outflow.[1]

In the introductions to the annually published PIRS statistics[2] for the years 1971, 1972, and 1973, the statement was made that a comparison of the current year's data with "that of previous years indicates primarily that the data in succeeding years are more complete as more people become aware of the legal requirement to report discharges of oil in harmful quantities to the Coast Guard. We have no reason to believe that the number of discharges which actually occurred was any greater in the current year than in previous years."[3] The

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[1] Program Review and Budget Staff of the Marine Environmental Protection Division, U.S. Coast Guard, "Marine Environmental Protection Program: An Analysis of Mission Performance" (Washington, D.C.: 1975), p.viii.

[2] Office of Marine Environment and Systems, U.S. Coast Guard," Polluting Incidents in and Around U.S. Waters" (Washington, D.C.). p.1.

[3] Ibid., p.2.

introduction to the 1976 PIRS statistics states "it should be noted that more spills are being reported to the Coast Guard since the toll free reporting number (800-424-8802) has received increased visibility and also because there has been marked improvement in the Coast Guard's monitoring and surveillance programs which have resulted in the increased discovery of spills."[1] These statements indicate that the reporting of spills, particularly larger spills, is continuously improving and, in fact, may be nearly complete.

In addition to the annual statistics published by the Program Review and Budget Staff, this file has been extensively analyzed either by or for the Coast Guard as a means of evaluating the Marine Environmental Protection program.

While the PIRS data make up the most extensive and complete pollution reporting system in existence, a number of problems arise in using these data. There is the usual problem of keypunch error. Much of this type of error could be eliminated by a more effective edit program. One example of this is errors in the "state" column. As this column has a limited number of possible entries, it would not be difficult to verify a valid entry in this field. Another example of this type of error is coding a contributing factor which does not exist, e.g., structural failure or loss as the immediate cause with a contributing factor "C," which is not a valid entry. It would be impossible to detect all keypunch errors; however, a more effective editing program could detect many errors not being caught now.

Another problem is cases in which the cause of the spill does not match the type of operation coded. There are a number of combinations of cause and type of operation which could not occur simultaneously. This type of error could also be detected through a good edit program. Although both an immediate cause and a contributing factor are listed for each spill, in many cases it is difficult to determine the initial reason for the spill. This is particularly true with a vessel casualty, i.e., collision, grounding, ramming, etc. In such cases the immediate cause is listed as a structural failure with a contributing factor of collision, grounding, ramming, etc. But no indication is given for the initial cause of the casualty. In addition, it is somewhat misleading to call the immediate cause a structural failure. While the reason the spill took place was a structural failure, the structural failure occurred as a result of a casualty. Therefore, the contributing factor led to the immediate cause rather than the cause leading to the factor.

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[1] Office of Marine Environment and Systems, U.S. Coast Guard," Polluting Incidents in and Around U.S. Waters" (Washington, D.C.). p.3.

Besides recording actual spills, the PIRS data also records potential spills. There are two immediate problems with this policy. The first and most obvious is that it would be impossible to record all potential spills; it is difficult enough to detect spills that actually occur. The second problem is that when potential spills are recorded the total amount of cargo that the vessel was carrying is recorded as the amount of potential spillage. In actuality, it is the exception in which a spill takes place and the entire cargo is lost.

This system identifies a vessel by using its offical Coast Guard number or call sign. This method of identification makes it difficult to compare the incidents in this system with any other system, e.g., the Vessel Casualty Reporting System or the Tanker Casualty File. In cases in which the official number is given, the incident can be matched with the other data base; however, if the Coast Guard number or call sign is used, extensive research would be necessary to determine if the incident is in another data base.

The PIRS data provide a valuable file on polluting incidents, but the system could be much improved with a good editing program.

B. TOVALOP

In 1968, the International Tanker Owners Pollution Federation was formed to administer the Tanker Owners Voluntary Agreement Concerning Liability for Oil Pollution (TOVALOP). There are four main provisions to this agreement. A tanker owner

- is responsible for an oil spill caused by his ship,
- is responsible for cleaning up his ship's oil spills,
- will compensate governments for cleanup expenses they incur, and
- is liable for any spills from his ship unless he can prove he was not at fault.

In an effort to assist tanker owners to reduce pollution incidents, the Federation started its own Technical Department and Advisory Service in 1971. Whenever possible, this Department recommends steps to reduce pollution, advises on cleanup techniques, and provides onsite assistance at spills.

As an aid to the Department in the prevention of spills, TOVALOP decided, in 1972, to begin a collection of data on world-wide tankship and tank barge oil spills. TOVALOP hoped that the data would show particular weaknesses in pollution standards and identify trends, thus indicating problem areas. Initially, data were submitted by tankship owners, third party insurers, and the Protection & Indemnity (P&I) Club.

In an effort to make their findings more conclusive, TOVALOP, in 1974, asked the United States Coast Guard, the Canadian Coast Guard, Japan, the United Kingdom, and Norway to become regular data contributors and provide available spill data.

The TOVALOP data base consists of two parts: (1) particulars of the spill and (2) particulars of the vessel involved in the spill. The information contained in the spill date includes name of tanker, as well as time, location, type, quantity, costs, and cause of the spill. Figure 14 shows the data form to be filled out after a casualty has occurred. The form is sent by TOVALOP in quadruplicate to those owners and agencies willing to supply information.

As soon as a spill occurs, the first copy is sent to TOVALOP with the ship name, date, and location of the spill. The second copy is sent when more details become available; the third copy is sent with the final details; and a fourth copy is kept by the reporting agency for their own records.

The second part of the data, the particulars of the vessel involved in the spill, contains specifications of the ship, i.e., flag, weight, length, as well as information on ship ownership and type of material the ship is authorized to carry. This information is usually available in TOVALOP's own files because most tankship owners are members of the International Tanker Owners Pollution Federation.

Once TOVALOP receives the spill information, it is added to the data base. A commercial data management firm computerizes the data for TOVALOP. Some statistical analyses of these data have been done. Computed are frequency tables such as: tanker sizes and number of spills per tanker, the operation in progress at the time of spill, type of oil spilled, reason for spill, and percentage of spills in port and at sea related to size of spill. These and similar statistics can be obtained from TOVALOP in London.

While the TOVALOP data are incomplete for small tanker spills and spills in certain parts of the world, it is the only worldwide pollution incident reporting system. Lloyd's data contain information on vessel casualties and movements, with some information on spill data. However, TOVALOP was designed specifically as a source of information on polluting incidents.

C. THE CENTER FOR SHORT-LIVED PHENOMENA

The Center, located in Cambridge, Massachusetts, is a non-profit organization that provides timely information to clients on oil and hazardous chemical spills, earthquakes,

Figure 14.

ADVICE OF OIL SPILLAGE

PART 1

I D A

Parts 2 and 3 of this document should be completed and returned to us as further information becomes available.

As soon as a spill is reported complete Section A and as much of Section B and C as is possible and return Part 1 of this set to us as soon as you can.

Part 4 forms your office copy.

N.B.: 1. "Not known" should only be used if it will never be known.
2. Only one letter or figure in each box.

SECTION A (Basic Data) Complete items 2 to 6

1. Advice Number № 111436

2. Date of Incident — DAY [ ][ ] MONTH [ ][ ] YEAR [ ][ ]

3. Local time [ ][ ] hours (24 hr. clock)

4. Name of Tanker

5. Port/Position Incident Occurred ..... Leave blank

6a. If buoy mooring spill put X in box [M]

6b. If NO oil entered water put X in box [D]

SECTION B (Spill Data)

7. Operation in Progress/Circumstances (put X in one box only)

Loading	A	Bunkering	B	Deballasting	C
Discharging	D	Ballasting	E	Pumping Bilges	F
Cleaning Tanks	G	Internal Transfers	H	Intentional discharge	I
Stranding/grounding	J	Collision	K		
Not known	L	Other, specify	M		

8. Type of Oil (put X in one box only)

Crude	A	Bunker	B	Bilges	C
Fuel (cargo)	D	*White product*	E	Tank washings	F
Lube oil	G	Bitumen	H		
Not known	I	Other, specify	J		

9. Quantity Spilt (put X in one box only)

Trace	A	Less than ½ bl.	B	½-5 bls.	C
5-50 bls.	D	50-5,000 bls.	E	Over 5,000 bls.	F
Not known	G				

10. Reason for Spill (put X in one box only)

Hull failure	A	Equipment/ material failure	B	Human error	C
Hull defect	D	Incident denied	E	Shore fault	F
Not known	G	Other, specify	H		

11. Cause—Equipment/Material element (put X in one box only)

Defective pipeline	A	Hose failure	B	Loading arm failure	C
Open valve	D	Leaking valve	E	Manifold failure	F
Sea suction	G	None	H		
Not known	I	Other, specify	J		

12. Cause—Human element (put X in one box only)

Improper supervision	A	Improper procedure	B	Inattention	C
Lack of Communication	D	None	E		
Not known	F	Other, specify	G		

SECTION C (Cost Data)

13. Costs (in U.S. Dollars)

If actual costs known enter in appropriate box/s
If not known leave box/s blank
If zero cost enter 0 in box/s
If estimate available enter amount and put X in E box

Clean Up Cost		E
Third Party Cost		E
Fine Cost		E

WHEN COMPLETED RETURN
To: THE INTERNATIONAL TANKER OWNERS POLLUTION FEDERATION LIMITED
41-43 MINCING LANE, LONDON, EC3R 7AE.

B., M. & CO., June 1975

volcanic actions, hurricanes, and other significant man-made or natural phenomena throughout the world. Its clients include oil companies, universities, and government agencies. The Center was originally associated with the Smithsonian Institution but has been independent since 1976.

The spill data they collect includes major spills from all sources: pipelines, vessel casualties, vessel operations, terminals, production facilities, etc. The data are qualitative and include narrative reports on each incident describing the incident and follow-up actions. Figure 15 contains samples of two such reports.

Information on major spills is sent to the Center by various correspondents throughout the world who have a general interest in environmental quality. Many of these correspondents are associated with universities. Upon learning of a major spill from a correspondent or other sources, the Center obtains further information on the incident from persons familiar with the situation, namely from Coast Guard safety officers and state environmental quality officials.

Most of the spills recorded--about 80 percent--are in U.S. waters because of the larger number of correspondents in this country. The Center also keeps files on histories of vessels that have been involved in spill incidents.

In 1975 the Center developed, for the Environmental Protection Agency and the American Petroleum Institute, a prototype of a computerized storage and retrieval system for the spill data called the Directory of Spills. Elements recorded include:

- vessel identification,
- origin and destination of the voyage,
- location of the spill,
- cause of the spill,
- material spilled,
- amount of material spilled,
- impact of the spill,
- details of the cleanup, and
- reporting source.

Most of this data is retained in narrative form as in the spill reports. The prototype was completed, but the system has not yet been implemented in an operational mode.

EVENT	IPAN 17-78	*DOMAR 6601* COLLISION AND OIL SPILL	5 FEBRUARY 1978	2833

On 31 January 1978, at about 0400 local time (LT), the US freighter *Ionian Seahorse* struck the 100-meter barge *Domar 6601*, which was moored to Hunt Oil Co. Platform 63-A, approximately 19 km south of Point Au Fer, Louisiana, and ruptured the barge's No. 6 port tank, causing all 795,000 liters of No. 6 fuel oil inside the tank to spill into the Gulf of Mexico. The *Domar 6601*, owned by Domar Transportation Ltd. of Morgan City, Louisiana, was under tow by the tug *Domar Commander* from Port Arthur, Texas to St. Rose, Louisiana, while the *Ionian Seahorse*, owned by Seahorse Inc. of Morgan City, was en route to South Marsh Island off the Louisiana coast. The barge had been tied to Platform 63-A when the *Domar Commander* began taking on water in the rough seas. Upon impact, the *Ionian Seahorse* ripped a hole 4 meters long and 3 meters wide in the barge's hull. The 56-meter freighter incurred a small hole, less than one meter wide, above the waterline on the starboard bow. The freighter continued under its own power to Morgan City for repairs.

US Coast Guard (USCG) officials ordered the *Domar 6601* to remain moored to Platform 63-A because rough seas made it dangerous to try a tow. A commercial diver reported that the barge had incurred no damage other than the ruptured tank. On 3 February, at 0900 LT, the *Domar Commander* began towing the barge to New Orleans, 450 km away, where steam heating facilities were available for liquefying the oil that had congealed in the barge's tanks due to unusually cold ambient temperatures. On 5 February, at about 2100 LT, the barge arrived in New Orleans, and after 24 hours of steam-heating, the cargo was offloaded. According to the USCG, alumina pads had been placed in the ruptured tank prior to the heating, and as the oil melted in the tank, it was immediately absorbed by the pads. As a result, no oil spilled from the ruptured tank into the Mississippi during the heating.

The rough weather prevented government officials from monitoring the spill until 2 days after the collision. On 7 February, a plane from Maritime Services Inc. of New Orleans, cleanup contractors hired by Domar Transporation, sighted a slick 1.6 km southwest of the collision site, measuring about 50 meters wide and 8 km long, with a sheen extending another 8 km. According to the USCG, on 3 February, no oil slick was observed in the collision area, the heavy oil had presumably congealed and sunk. The USCG is currently investigating the collision.

EVENT NOTIFICATION REPORT

CATEGORY	POLLUTION
EVENT DATE	31 JANUARY 1978
LOCATION	south of Point Au Fer, Louisiana, USA in Gulf of Mexico (29°10.3'N, 90°32'W)
SOURCE	Lt. J/G G.R. McEachin Eighth District, US Coast Guard 4640 Urquhart Street New Orleans, Louisiana 70117, USA

The Center for Short-Lived Phenomena
184 Mt. Auburn Street
Cambridge, Massachusetts 02138/U.S.A.
Phone (617) 868-3310/TWX 710-320-0074

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EVENT	IPAN 15-78	GIBBS TERMINAL OIL SPILL	2 FEBRUARY 1978	2830

On 15 January 1978, at about 1845 local time, while pumping No. 2 fuel oil from a 12,720,000-liter storage tank to a loading facility, workers at a Gibbs Oil Co. terminal in Revere, Massachusetts discovered oil seeping into a drainage ditch on the property. According to a Gibbs official, an underground pipe, which was supposedly disconnected from the pumping system when new piping was laid, apparently ruptured when oil passed through it during the pumping operation. Oil leaked from the pipe into an underground catch basin and then backed up into a drainage ditch, running 30 meters into Chelsea Creek which flows 3 kilometers south into Boston Harbor. The drainage ditch filled with an estimated 212,000 liters of oil.

An incoming tide and onshore winds confined the oil to the ditch, and within the first few hours after the spill's discovery, Jet Line Services Inc. of Braintree, Massachusetts, the contractor hired by Gibbs, was able to recover 132,500 liters of oil with four 150,000-liter vacuum trucks. This oil was returned to storage facilities at the Gibbs terminal for reprocessing. During the ebb tide, an estimated 34,000 liters of oil escaped from the ditch and, before Jet Line could install containment booms, flowed into the north end of Chelsea Creek and then into Boston Harbor. Jet Line continued to pump off the oil remaining in the ditch, and transported approximately 100,000 liters of an oil-water mixture from the ditch to its Stoughton, Massachusetts facility for storage before final transport to reprocessing outlets in New York and New Jersey.

Almost all the oil in the ditch was removed within 48 hours of its discovery. According to Peter Dore of the Massachusetts Department of Water Pollution Control (MDWPC), favorable tides and winds helped contain the oil, thereby reducing the impact of the spill on Chelsea Creek. Jet Line has placed a boom at the outlet of the ditch to contain any additional oil leaching from the ground around the ditch. The boom will remain in place until officials from the US Coast Guard and the MDWPC decide that the spill cleanup has been completed. Gibbs Oil estimates that the cleanup will cost about $50,000.

EVENT NOTIFICATION REPORT

CATEGORY	POLLUTION
EVENT DATE	15 JANUARY 1978
LOCATION	Revere, Massachusetts, USA (42°25'N, 71°01'W)
SOURCE	Peter Dore, Senior Sanitary Engineer Massachusetts Department of Water Pollution Control 600 Washington Street, Room 350 Boston, Massachusetts 02111, USA Lt. Commander Joseph Marotta Marine Safety Office First District, US Coast Guard Commercial Street Boston, Massachusetts 02109, USA

The Center for Short-Lived Phenomena
184 Mt. Auburn Street
Cambridge, Massachusetts 02138/U.S.A.
Phone (617) 868-3310/TWX 710-320-0074

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Figure 15. The Center for Short-Lived Phenomena Sample Reports.

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IV. MARINE TRAFFIC DATA

A. VESSEL TRAFFIC DATA

The "Vessel Traffic Data" reports were prepared by Operations Research, Incorporated, for the U.S. Coast Guard. These studies were designed to report vessel population, routes, and communications activity in seven U.S. port areas. The seven areas studied were: (1) Chesapeake Bay,[1] (2) Delaware Bay,[2] (3) the Gulf Coast Intercoastal Waters,[3] (4) Houston,[4] (5) Long Island,[5] (6) New Orleans,[6] and (7) New York Harbor.[7]

Data from each of these areas were recorded from Coast Guard vans for approximately one week. Each site was studied during 1974 or 1975. Two types of raw data--radar and communications--were collected for each area. Using 16 mm color movie film, time lapsed photographs of a radar Planned Position Indicator (PPI)--a cathode ray oscilloscope that gives a presentation of the area around a center point--were taken. The exposure time was keyed by the radar, making a 360° rotation (approximately 4.5 seconds). The data--time in hours, minutes and seconds, a range scale indication, and visibility code--were presented on each frame.

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[1] Operations Research, Inc., "Vessel Traffic Data for Chesapeake Bay Area," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1975).

[2] Operations Research, Inc., "Vessel Traffic Data for Delaware Bay Area," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1976).

[3] Operations Research, Inc., "Vessel Traffic Data for Gulf Intercoastal Waterway," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1976).

[4] Operations Research, Inc., "Vessel Traffic Data for Houston," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1975)

[5] Operations Research, Inc., "Vessel Traffic Data, Long Island Sound," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1976).

[6] Operations Research, Inc., "Vessel Traffic Data--Port of New Orleans," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1975).

[7] Operations Research, Inc., "Vessel Traffic Data--New York Harbor," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1975).

A C120 tape cassette was used to record communication data. Channel 13 of the VHF/FM Maritime Mobile Band was recorded on one track, and Channel 16 plus a time code was recorded on the second track. If no messages were being transmitted on Channel 16, the time code was recorded at one-second intervals. Both the radar films and the communication records used the same clock.

Each study reports seven different types of information: (1) Vessel Density, (2) Vessel Route Identification, (3) Vessel Speed, (4) Close Encounters, (5) Communication Channel Message Activity, (6) Communication Channel Utilization, and (7) Communication Channel Efficiency. A discussion of each of these data sets follows.

1. Vessel Density Area

These data consist of the number and type of vessels present within the radar coverage. These counts were taken at regular time intervals, which were less than or equal to the average vessel transit time of the site being examined. Vessels were classified as large, medium, small, tug with tow, etc. This size classification is based on the judgment of the person or persons counting vessels. It would, therefore, be difficult to duplicate the data, establish trends in subsequent years, or compare results to other vessel density studies.

Before vessels could be counted, certain preliminary steps were necessary. Using a chart of the area to be analyzed against the radar film, the radar position, and general features of the land and water were identified. Because vessel classification (large, medium, and small) was relative to each site, criteria had to be determined for each specification. This was done primarily through observation of the vessels transiting the area. One rule of thumb used was if a tug with a tow was observed at the site, the tug size was used as the upper bound for the small category.

As mentioned above, vessel counts were made at intervals less than or equal to the average transit time. A number of vessels were clocked in order to determine that average. A shorter-than-average transit time may have been used because intervals were spaced to begin and end on the hour. At sites where traffic was especially heavy, two people counted vessels; otherwise, one person was assigned this task. Also, the site was divided into more than one segment when traffic patterns were judged to be extremely complex. The number of segments used at each site is documented in the report on that site. To count the number of vessels at any one time, the radar film was run for five minutes before the count was taken. This five minute preview enabled the analyst to distinguish between moving and stationary objects on the radar screen.

The result of this procedure is a vessel density histogram, an example of which is shown in figure 16. Each vessel density count is represented by a bar which is divided into segments of length proportional to the number of various types of vessels contributing to the total.

The possible sources of error in final tabulation include:

- Shadows on the radar screen. Because it is difficult and sometimes impossible to determine what vessel is in the shadow, an attempt is made to identify the number and type of vessels by watching them enter and exit the shadow.
- A high intensity of return at the center of the radar picture can distort the picture and make it difficult to determine individual vessels. This problem is handled the same way as shadows.
- Side lobe effects, which create spurious images on radar scope and can cause poor bearing resolution and fading of targets, and multiple returns, which cause false targets, result in two echoes on the PPI which are separated in angle but are at the same range. The "Vessel Traffic Data" report states that an attempt was made to exclude these extra targets; however, no indication was given of how these attempts were made or how successful they were.
- Noise on the radar, particularly noise resulting from bad weather, distorts or hides certain vessels.
- Miscounting the vessels.
- Including a vessel in the wrong category. This problem may be due to (a) differing returns due to ship movements, (b) differing returns due to radar range, (c) behavioral classification, vessel type classifications based on distinctions other than size, which relies on analytical judgement.

In regard to the magnitude of error in this count, Operations Research, Inc., has made the following statement:

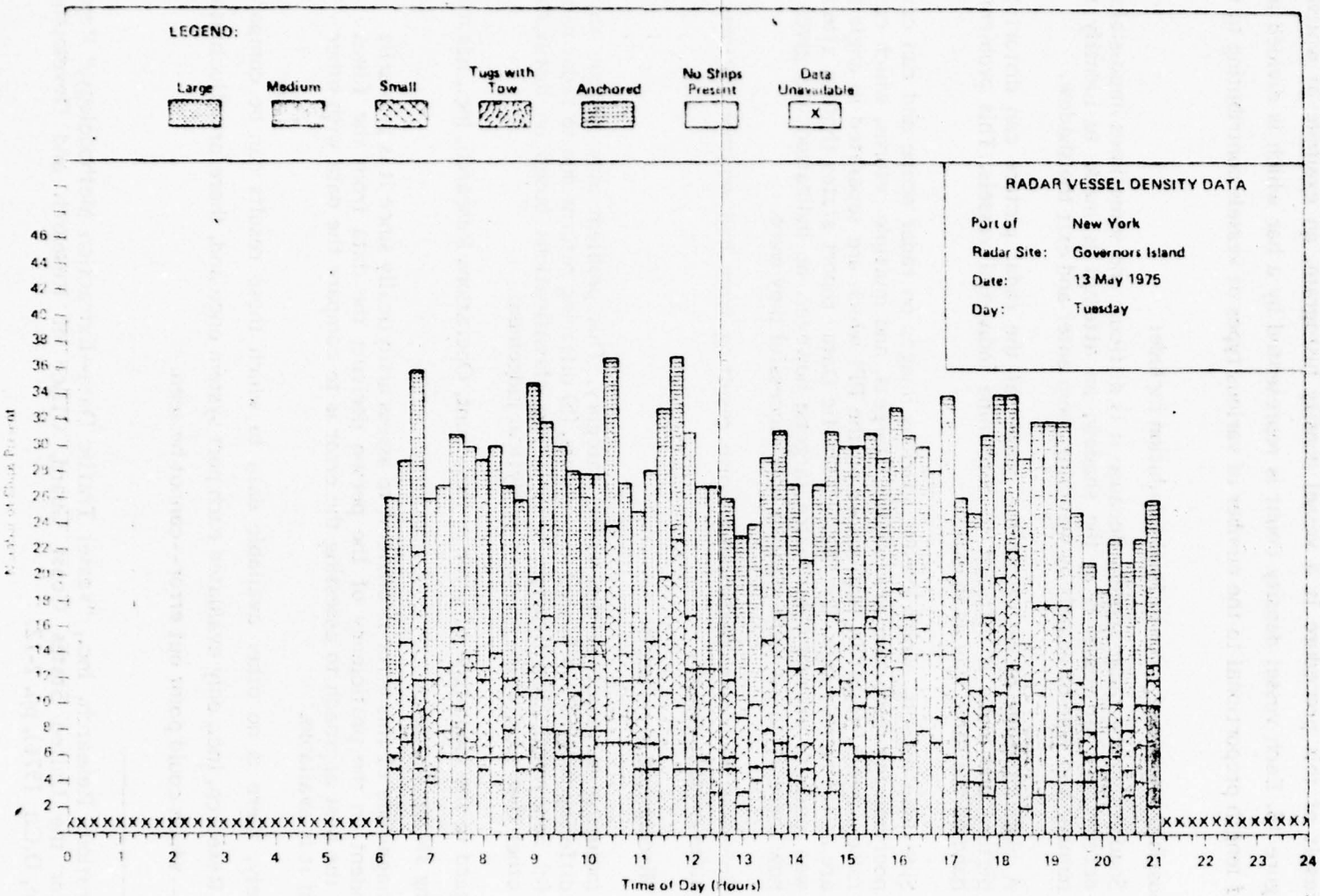
> The magnitude of this error is difficult to assess analytically since it is primarily dependent on the proficiency of the person deriving the data from the films. Thus, the best approach to assessing the error is to compare the data with other data if it is available.[1]

Unfortunately, there is no other available data to which these results can be compared. Operations Research, Inc., only evaluated each port system once and, therefore, fluctuations in the data--which could point out error--cannot be seen.

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[1]Operations Research, Inc., "Vessel Traffic Data--Extraction Methodology," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1976), pp. 2-12.

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Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

VESSEL DENSITY HISTOGRAM, FINAL FORM

Figure 16.

2. Route Identification

For a peak traffic period, the route identification section mapped the routes of all vessels transiting the site under study. Additional maps were charted if unusual traffic patterns existed in a particular area or if traffic patterns differed significantly during the day.

The routes were identified by beginning the radar film at the time interval selected and tracing the path of a vessel as it appeared, transited, and finally disappeared from the screen. This process was repeated for each vessel. A different colored pen was used to trace the route of the different types of vessels. An arrow at the end of each pictured transit indicated the direction in which the vessel was moving. In the reports, this process was repeated until a maximum number of vessels was recorded or a maximum time period had been observed. The "maximum" was based on the judgment of those mapping the routes. The specifics for each site are documented in the report for that site.

Each port's route diagram, an example of which can be found in figure 17, shows the following information: (a) all significant locations, (b) shadow areas observed, (c) vessels at anchor observed, (d) types of vessels present in the port, (e) name of site, (f) total number of vessels present, and (g) day and number of hours covered.

Errors similar to those encountered in counting vessel density and classifying vessel types may have occurred with route identification. Additional errors may have been introduced in the tracing of the vessel route, due to human errors associated with transferring data from one source to another. Camera and projector distortions may have caused the traced route to be slightly off the actual course. However, it should be noted that these charts were not intended to be precise on a point-by-point basis; rather, they were presented to indicate the approximate route or routes vessels can be expected to follow.

3. Close Encounters

Although this section is entitled "Close Encounters," the analysis counted events labeled vessel encounters and its subset, close encounters. Before any analysis was done, "close encounters" and "encounters" were defined. To determine close encounters, the following limits and radar scales were used.[1]

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[1] Operations Research, Inc., "Vessel Traffic Data-Extraction Methodology," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1976), pp. 2-32.

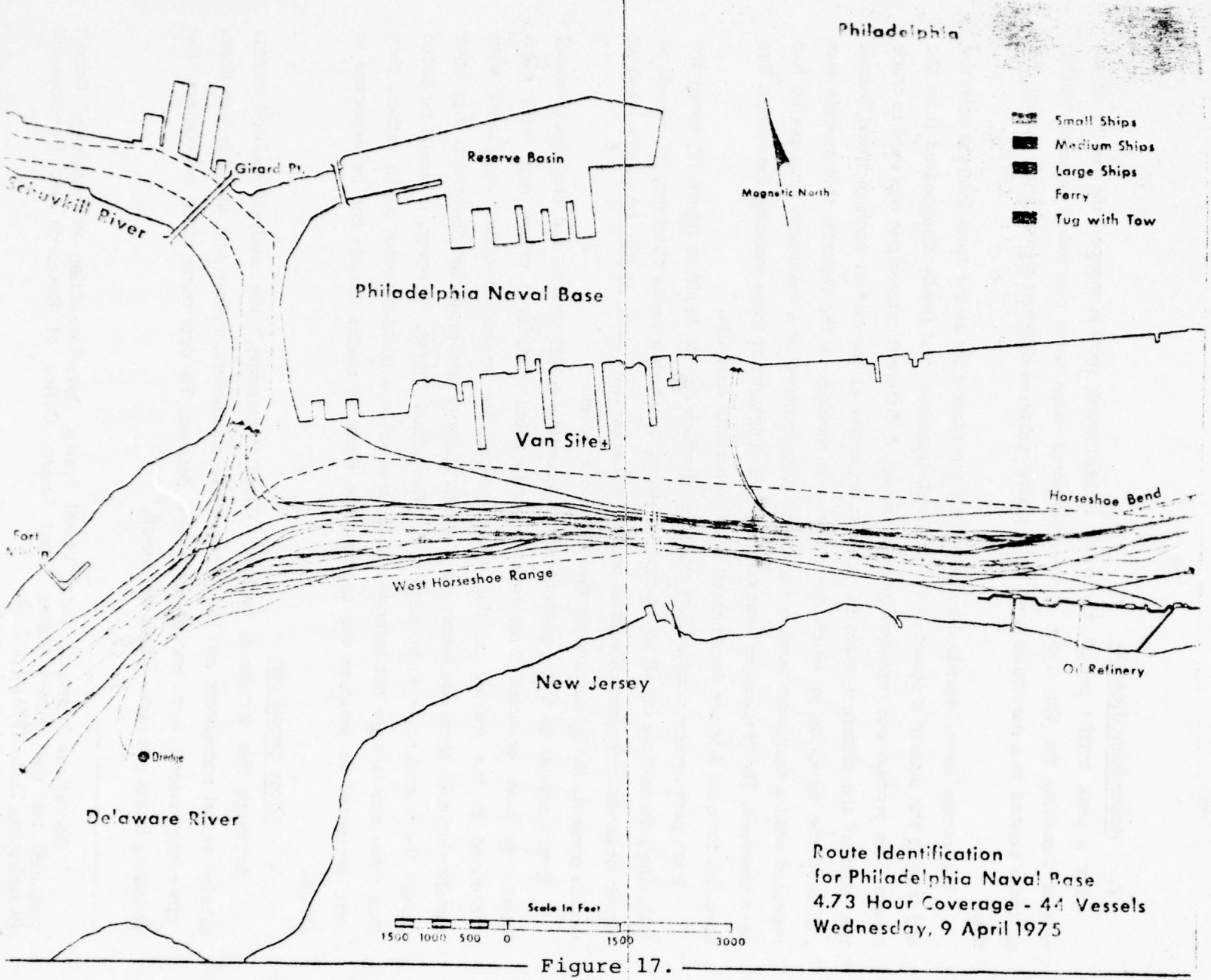


Figure 17.

Source: Operations Research, Inc., "Vessel Traffic Data--Delaware Bay Area," 1975.

Radar Scale	Site Radius (Nautical Miles)	Close Encounters Limit (Yards)
6	12	400
5	6	300
4	3	200
3	1.5	150
2	.75	100

An encounter on the other hand is less precise. "An encounter occurs when one vessel enters the vicinity of another in such a way that it passes, crosses, or overtakes the other. The concept of vicinity may vary from site to site depending on traffic patterns, route constructions, vessel speeds, and density. Identifying encounter thus becomes judgmental. However, in practice, the identifying of encounter at a given site by use of radar film is quite a natural process and usually an encounter situation is self-evident."[1] Although an encounter situation is described as "self-evident," the definition is so arbitrary as to make the actual counting of encounters difficult to duplicate. Therefore, the results of any analysis using these figures as a base become questionable.

In calculating close encounters the number of yards which determine a close encounter was first converted to inches for the radar scale being used. Then close encounters were counted by using a ruler against the film. Counting continued until the total reached 50 or 24 hours of coverage were observed, whichever came first.

The results were compiled into a table giving date, time, distance in yards at point of closest approach, size of vessels, manner of approach for each close encounter, a statement of length of coverage period, and total encounters of the period. Table 1 illustrates a close encounter table.

Because of the amount of measurement and the precision necessary, the chance of error in this section is greater than that of other sections. Some possible sources of error include:

- Determining the closest point of approach. Because each film frame is 4 to 5 seconds apart, it is possible that this closest point occurs between frames. The amount of error possible depends on the vessel speed. For example, if two vessels are approaching from the opposite direction at 30 knots, the maximum error is 4.2 yards.

- Locating the center point from which point distance is measured of approaching vessels. This error can depend on radar scale, radar intensity, and the size of encountering vessels.

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[1] Operations Research, Inc., "Vessel Traffic Data-Extraction Methodology," Report prepared for the United States Coast Guard, Office of Research and Development (Washington, D.C.: 1976), pp. 2-31.

Table 1

Close Encounters for Governors Island

Vessel #	Day	Time		Distance	Size	Manner of Approach*
		Hours	Minutes	Yards		
1	Tuesday	06	14	100	1 large, 1 small	P
2	13 May	06	15	200	1 large, 1 small	P
3	1975	06	19	200	2 small	O
4		06	19	100	2 large	P
5		06	21	100	2 large	P
6		06	24	< 100	2 small	P
7		06	26	100	1 large, 1 small	P
8		06	26	< 100	1 large, 1 medium	P
9		06	28	< 100	2 large	P
10		06	29	100	2 medium	P
11		06	32	100	1 large, 1 medium	C
12		06	32	< 100	1 large, 1 medium	P
13		06	33	150	2 large	P
14		06	35	< 100	2 large	P
15		06	35	< 100	2 small	P
16		06	35	< 100	2 large	P
17		06	36	< 100	1 medium, 1 small	P
18		06	37	< 100	1 large, 1 small	P
19		06	39	< 100	1 medium, 1 small	P
20		06	39	150	1 large, 1 small	O
21		06	40	< 100	1 large, 1 small	P
22		06	41	150	1 large, 1 small	P
23		06	41	< 100	2 large	P
24		06	42	< 100	1 large, 1 medium	O
25		06	45	< 100	1 medium, 1 small	P
26		06	46	< 100	1 large, 1 small	O
27		06	47	150	1 large, 1 medium	P
28		06	49	< 100	2 large	P
29		06	49	< 100	2 large	P
30		06	51	< 100	1 large, 1 small	P

*P = Passing
O = Overtaking
C = Crossing

Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

- Measuring the distance between approaching vessels. This is a factor of the size of the smallest measurement on the ruler being used.

- All those possible errors listed in vessel density counts and type of classifications. However, because encounters involve two ships the chance of the same type of error applying to both vessels is low. As a result, the error on close encounters may be diminished.

4. Vessel Speed

In order to measure vessel speed both time and distance were measured. Time was measured directly from the clock displayed on the radar film. Distance was measured in one of four ways depending on the site:

- Landmark method. If distinctive landmarks could be identified, the distance between the landmarks was measured and used.

- Triangulation method. This was used when measurement for two sites and the angle between them could be determined from the radar.

- Combination of landmark and triangulation methods.

- Overlayed transparencies. If it was not possible to use one of the methods mentioned above, transparencies with distance rings and radial lines of predetermined size were prepared and overlayed to measure distance.

The results of these analyses are displayed in a table of speed data, giving vessel size, location, and time of speed sample for each speed calculated. Also presented is a histogram showing the distribution of the speed sample with vessel speed in knots along the abscissa and the number of ships along the ordinate. Site, sample size, and date are given in each example, as shown in table 2 and figure 18.

In measuring vessel speed, the sources of error are similar to those discussed in previous sections. Time is displayed on each radar frame, but because there is a 4-5 second interval between frames, there can be as much as a $\pm$ 4-5 seconds difference between the two time readings. When landmarks are used to measure distance, the time at which the ship reaches the landmark is based on visual information which can be faulty, so error may occur.

In measuring distance, the center of the vessel is used as a marking point. Determining precisely where this center is located is subject to error.

If the triangulation method is used, the center location of the radar image must be found. The center was located by tracing two radials from the outer ring along two bearings of the PPI. The intersection of these two radials was plotted as the center. Wherever possible, this was verified using two different bearings. However, using the formula RSin θ

Table 2

Speed Data for Governors Island

Vessel #	Vessel Size	Average Speed in Knots	Location*	Day	Time Hr.	Time Min.
1	large	7	A	Tuesday	06	13
2	large	7	B	13 May	06	17
3	large	8	A	1975	06	20
4	large	4	C		06	25
5	large	5	A		06	32
6	medium	13	C		06	43
7	large	6	F		07	17
8	tug with tow	7	F		07	21
9	medium	5	F		07	24
10	large	9	D		07	25
11	large	7	G		07	34
12	medium	10	D		07	46
13	large	4	C		07	59
14	medium	7	A		08	06
15	medium	10	H		08	11
16	medium	11	D		08	37
17	medium	7	H		08	51
18	medium	9	I		09	04
19	medium	9	F		09	07
20	medium	16	F		09	22
21	tug with tow	9	D		09	34
22	medium	12	F		09	34
23	medium	11	D		09	39
24	medium	10	J		09	40
25	medium	10	D		09	41
26	small	12	J		10	00
27	large	4	B		10	01
28	large	4	F		10	01
57	medium	13	D		14	51
58	medium	11	K		14	53
59	medium	7	G		14	55
60	large	4	G		14	59
61	large	10	C		15	01
62	medium	11	G		15	06
63	small	13	G		15	14
64	small	12	G		15	15

* A - Between the Narrows and Constable Hook Reach
B - Between the Narrows and Hudson River
C - Between the Narrows and Upper Bay
D - Between Constable Hook Reach and Buttermilk Channel
E - Between the Narrows and Buttermilk Channel
F - Between Upper Bay and Hudson River
G - Hudson River
H - Between Constable Hook Reach and Upper Bay
I - Between Buttermilk Channel and Upper Bay
J - Upper Bay
K - Between Constable Hook Reach and Hudson River

Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

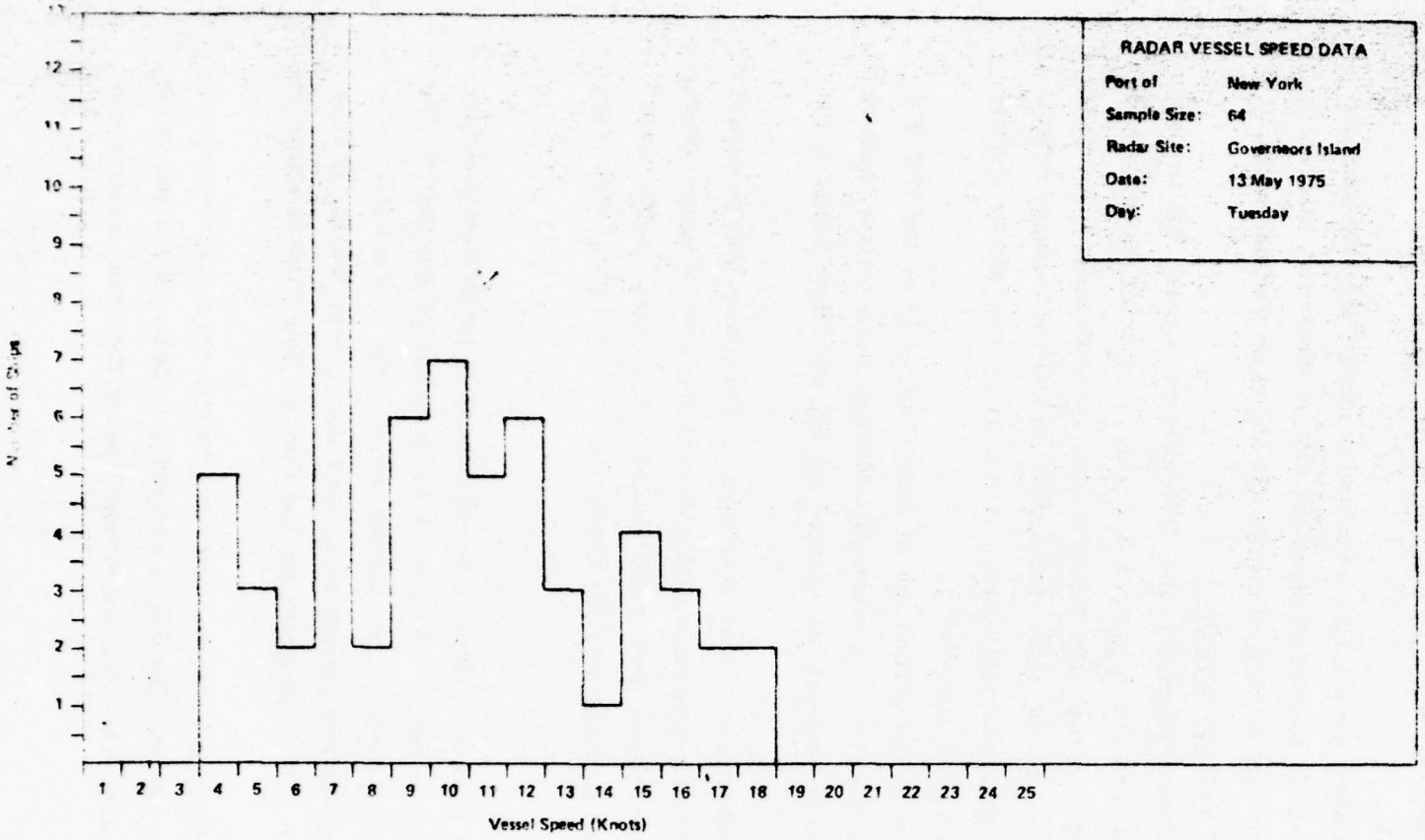


Figure 18. Speed Histogram for Governors Island.

Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

to determine error where R = the length of the radial and θ = angular error in the radial, the worst case error can be as large as 210 yards. (This is assuming a maximum error of 0.5 degrees in θ and using 12 nm for R.).

Error can also be introduced when the distance measured is smaller than the smallest division on the rule used. Other possible sources of error are picture distortion, inaccurate identification of landmarks, or inaccurate drawing of circles and angles on transparencies.

5. Channel Utilization and Message Activity

The United States Coast Guard Research and Development Center at Groton, Connecticut, developed an automated recording system. The interface circuit accepts audio input from a receiver or an analog magnetic tape recorder and timing data from a digital clock. Output is a paper tape record of the time of transmission and the message length. Using the paper tape output from this recording system, it is possible to measure channel utilization and message activity at a given site.

Channel utilization is defined as the percentage of time Channel 13 of the VHF/FM Maritime Mobile Band is in use as recorded at a given site. Message activity is a count of the number of messages on the same channel, per sample period, with each break in the squelch counted as one message.

The paper tape from the week each site was monitored for the studies was processed through a mini-computer. The computer generated histograms of the time of transmission and of message length. These histograms were replotted for the "Vessel Traffic Data" reports. The channel utilization and message activity histograms for the Port of New York are shown in figures 19 and 20.

6. Channel Efficiency

A valid message on Channel 13 is one judged to be conforming to the Bridge-to-Bridge Radiotelephone Act, which allows the use of Channel 13 for purposes of navigation. The percentage of valid messages to total messages per sample period is the channel efficiency. After monitoring Channel 13 for 15-minute periods every hour during peak traffic, channel efficiency histograms were plotted. The histogram for the Port of New York is shown in figure 21 as an example.

The source of error in this chart is in determining what constitutes a valid message of navigation. As in any area where human judgment is necessary to determine a yes or no answer, there are a number of times when two individuals making the same decision may have different answers.

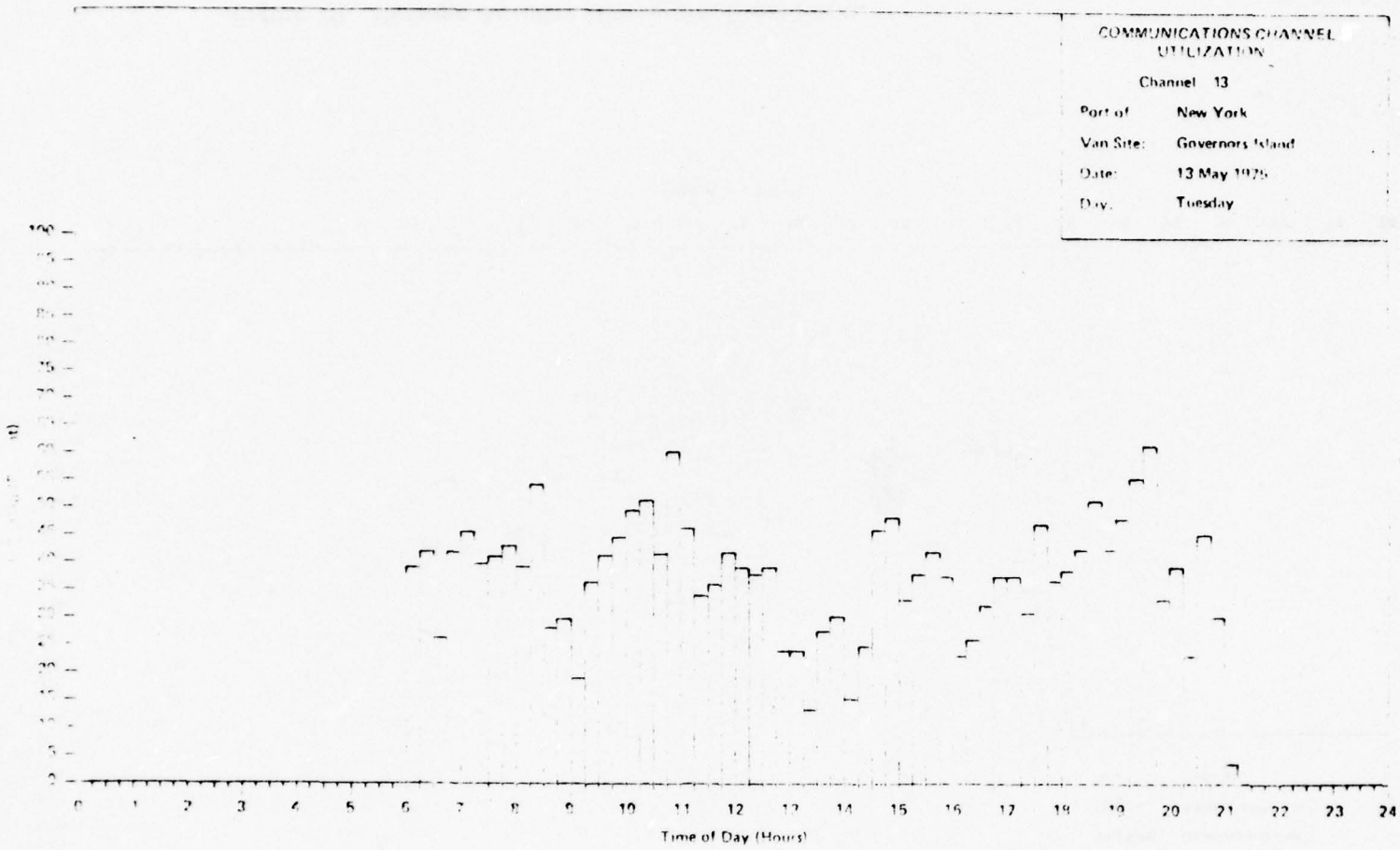


Figure 19. Channel Utilization Histogram, Final Form.

Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

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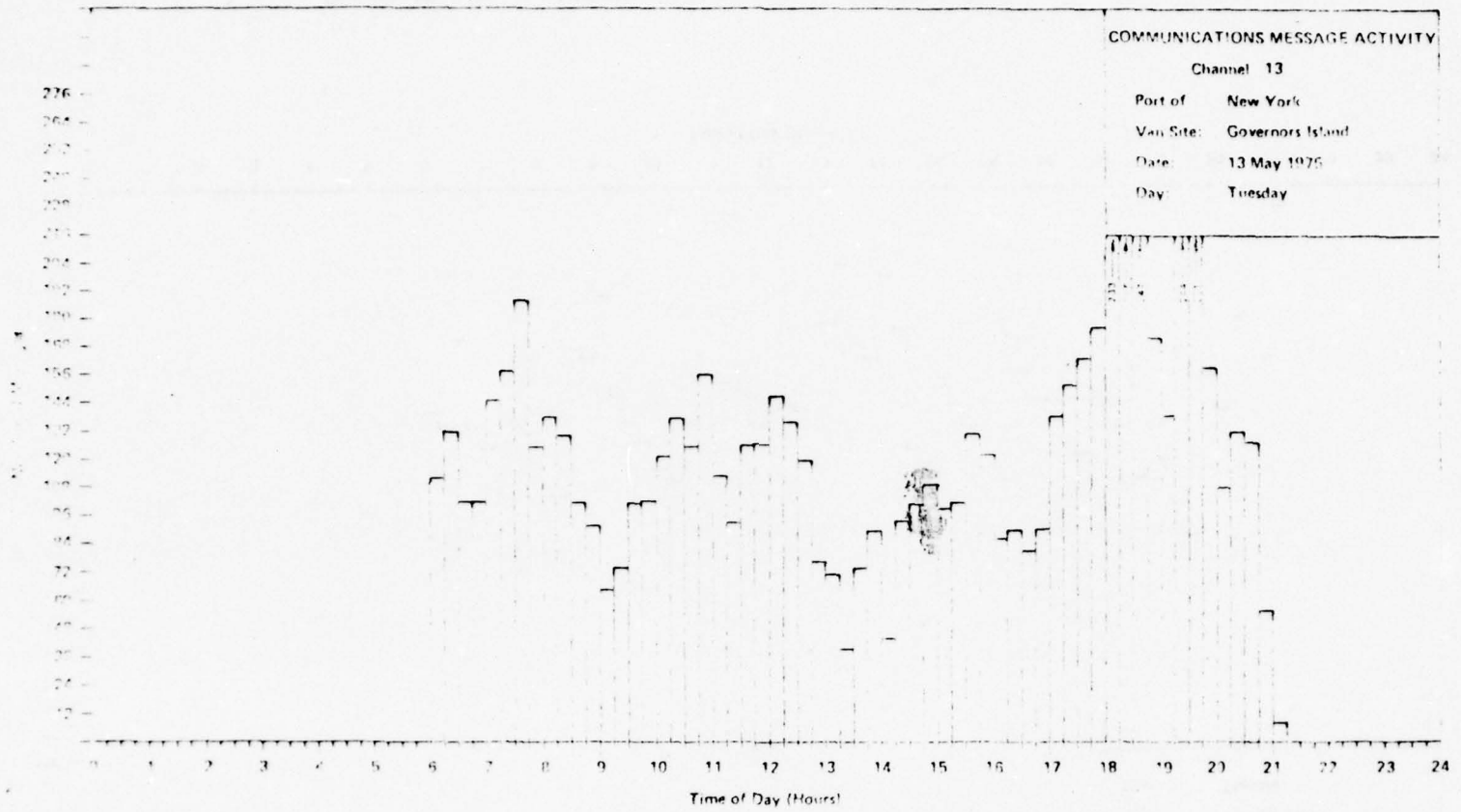


Figure 20. Message Activity Histogram, Final Form.

Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

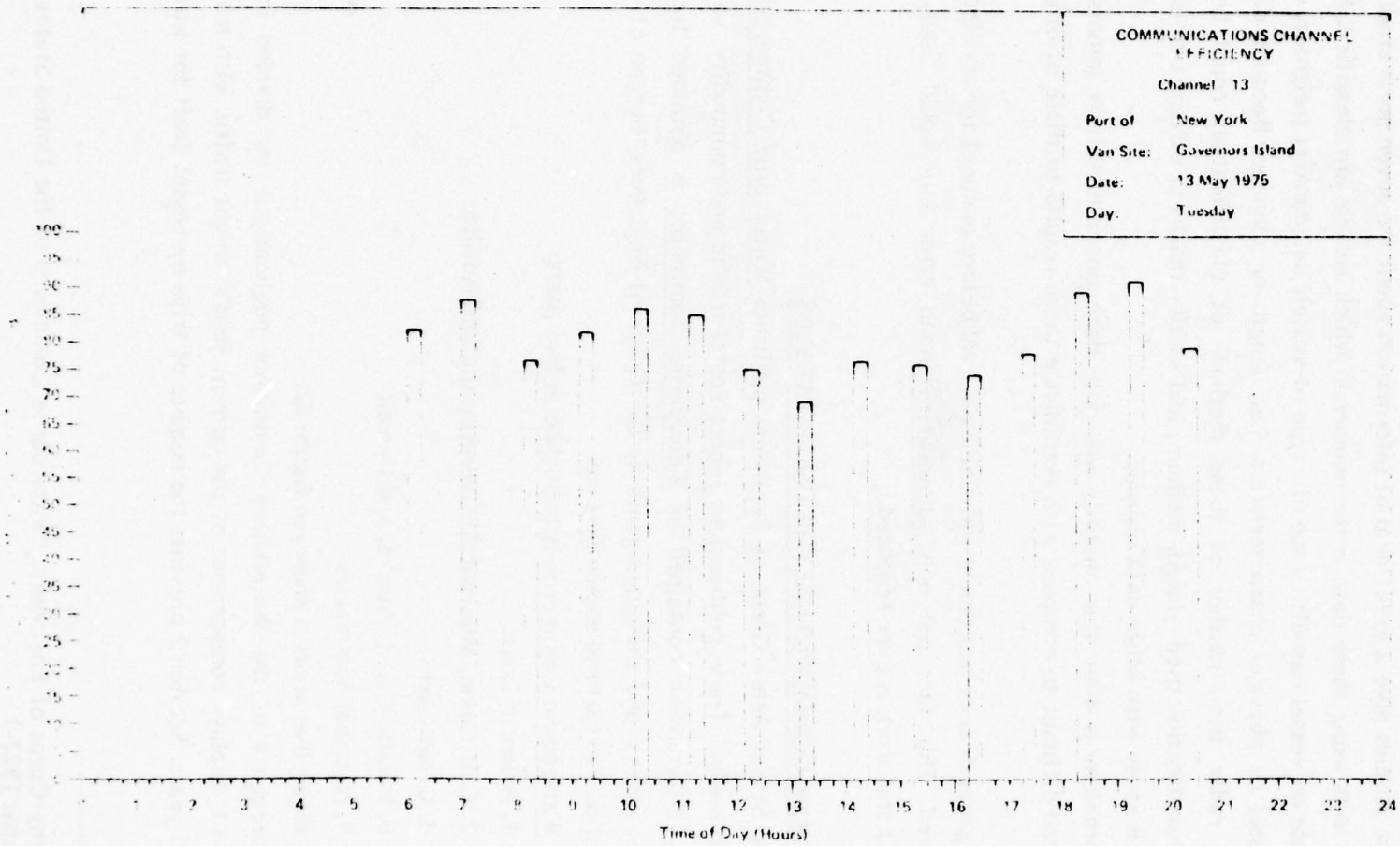


Figure 21. Channel Efficiency Histogram, Final Form.

Source: Operations Research, Inc., "Vessel Traffic Data--New York Harbor," 1975.

7. General Problems

While these studies give a great deal of information about the seven ports studied, one of the problems with using these data is the manner in which vessels are classified. Most of the data available on vessel casualties specify type of vessel, i.e., tanker, freighter, etc., or classify the vessel by physical characteristics, i.e., length or tonnage. Because data are collected from radar film, neither of these methods of classification could be used. However, the classification used--large, medium, and small--makes it difficult to compare the results of this study with other data sources.

Another problem is that this analysis was only done once; thus it is impossible to observe trends and difficult to compare with confidence these results to those of other data sources.

Finally, a great deal of judgement must be exercised before many of these calculations can be performed. This fact not only allows for human error but would likely cause inconsistencies if this work is ever repeated.

B. WATERBORNE COMMERCE OF THE UNITED STATES

The United States Army Corps of Engineers publishes Waterborne Commerce of the United States annually.[1] These publications report vessel traffic and commodity movement on U.S. waters. Information contained in Waterborne Commerce is obtained from ship owners, masters, clerks, and shipping agents by the Corps of Engineers, Bureau of Census, and the Immigration and Naturalization Service.

Each year Waterborne Commerce is published in five parts:

Part 1. Atlantic Coast

Part 2. Gulf Coast, Mississippi River System, and Antilles

Part 3. Great Lakes

Part 4. Pacific Coast, Alaska, and Hawaii

Part 5. National Summaries

A map outlining these five areas is shown in figure 22.

Parts 1 through 4 of the Waterborne Commerce publications are divided into two sections. Section 1 displays comparisons of the current year's freight traffic with traffic for the preceding 10 years. Section 2 presents the number of trips by vessel draft for waterways and harbors.

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[1] U.S. Army Corps of Engineers, "Waterborne Commerce of the United States," (New Orleans, Louisiana: 1922-).

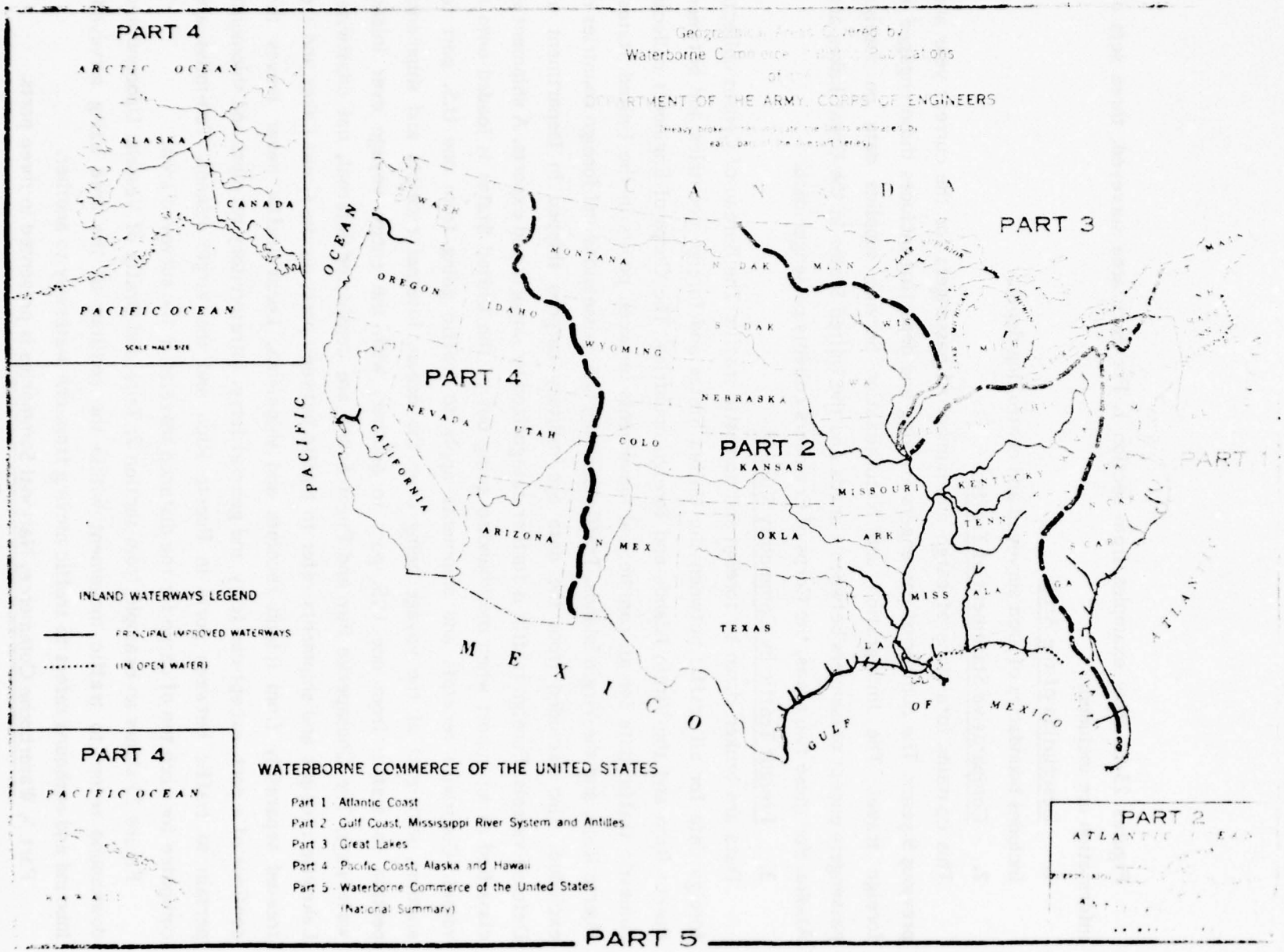


Figure 22. Waterborne Commerce Geographical Areas.

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Figures 23-24 show examples from section 1. For each area surveyed, three sets of information are included:

1. Description of the Area

Includes boundaries of area surveyed and controlling depth.

2. Comparative Statement of Traffic

This contains total tons of cargo and number of passengers for the current year and previous 9 years. The number of passengers arriving and departing includes those engaged in foreign travel. The Immigration and Naturalization Service supplies data on foreign passengers except passengers between Canada and the United States in the Great Lakes and Alaska. For these two areas, the Corps of Engineers collects passenger data.

3. Freight Traffic by Commodity Shipped

Data are broken down by foreign and domestic traffic. The Bureau of Census collects foreign data for all traffic between the United States and foreign countries and between Puerto Rico and the Virgin Islands and foreign countries. The Corps of Engineers collects domestic traffic data for all commercial movements between points in the United States, Puerto Rico, and the Virgin Islands. Traffic between U.S. possessions and foreign countries is excluded. Also excluded from the data are military cargoes shipped in Department of Defense vessels. Foreign traffic is further categorized by imports and exports. A shipment is classified as an import when merchandise going out of the United States is loaded onto a vessel. Coastwise receipts and shipments apply to traffic going from one U.S. port to another, with part of the voyage being over the ocean. Internal receipts and shipments pertain to traffic from one U.S. port to another, with the entire voyage over inland waterways. The Chesapeake Bay and Puget Sound are considered internal, not coastwise. Lakewise receipts and shipments refer to traffic between ports on the Great Lakes and are treated separately from inland receipts and shipments. Local traffic never leaves the confines of a port, except car ferry and general ferry. Intraterritory receipts and shipments pertain to traffic between ports in Puerto Rico and the Virgin Islands. Ton-miles are computed for each ton of cargo for the distance traveled in the surveyed area.

Figure 25 shows an example from section 2: Trips and Drafts of Vessels. Upbound and downbound refers to traffic movement within the confines of the area being surveyed. Inbound and outbound refers to traffic moving from one waterway to another.

Part 5, Waterborne Commerce, National Summaries is presented in three parts.

Figure 23. Sample Waterborne Commerce Information-Section 1.

CHRISTIANSTED HARBOR, ST. CROIX, V. I.

SECTION INCLUDES: FROM 16-FOOT DEPTH IN CARIBBEAN SEA AN APPROACH CHANNEL APPROXIMATELY 1 1/4 MILES LONG INCLUDING A TURNING BASIN 800 FEET LONG IN GALLOWS BAY AT THE SITE OF THE DEEPWATER TERMINAL, AND THENCE TO AND ALONG THE WATERFRONT AT CHRISTIANSTED. CONTROLLING DEPTH: 16 FEET IN APPROACH CHANNEL AND TURNING BASIN; 8 FEET ALONG WATERFRONT. PROJECT DEPTH: 16 FEET IN APPROACH CHANNEL AND TURNING BASIN.

COMPARATIVE STATEMENT OF TRAFFIC

YEAR	TONS	PASSENGERS	YEAR	TONS	PASSENGERS
1967	91,206	2,623	1972	298,727	2,247
1968	142,837	245	1973	400,122	9,979
1969	171,715	399	1974	542,722	
1970	312,918	236	1975	473,127	4,161
1971	316,637	3,566	1976	582,618	1,646

NOTE: PASSENGER TOTALS ABOVE CONSISTS OF PASSENGERS FROM AND TO PORTS OUTSIDE OF VIRGIN ISLANDS.

FREIGHT TRAFFIC, 1976

(SHORT TONS)

COMMODITY	TOTAL	FOREIGN		DOMESTIC			
				COASTWISE		INTRATERRITORY	
		IMPORTS	EXPORTS	RECEIPTS	SHIPMENTS	RECEIPTS	SHIPMENTS
TOTAL	582,618	222,147	19,385	4,830	74	242,979	93,203
0104 OATS	47	47					
0105 RICE	985					985	
0129 FIELD CROPS, NEC	7	7					
0131 FRESH FRUITS AND TREE NUTS	12,589	3				12,586	
0132 BANANAS AND PLANTAINS	241	241					
0141 FRESH AND FROZEN VEGETABLES	12,796	121				12,675	
0151 ANIMALS AND PRODUCTS, NEC	14	14					
0191 MISCELLANEOUS FARM PRODUCTS	3	3					
0561 FOREST PRODUCTS, NEC	5	5					
0911 FRESH FISH, EXCEPT SHELLFISH	28	28					
1311 CRUDE PETROLEUM	61,412						61,412
1442 SAND, GRAVEL, CRUSHED ROCK	10,121	1,992	8,129				
1479 NATURAL FERTILIZER MATS, NEC	19	19					
2011 MEAT, FRESH, CHILLED, FROZEN	18,493	95				18,390	8
2013 MEAT AND PRODUCTS, NEC	173	173					
2021 DAIRY PRODUCTS, NEC	620	1				619	
2022 DRIED MILK AND CREAM	700	700					
2031 FISH AND SHELLFISH, PREPARED	180	180					
2034 VEGETABLES AND PREP, NEC	27	27					
2039 PREP FRUIT AND VEG JUICE, NEC	22	9				13	
2041 WHEAT FLOUR AND SEMOLINA	9	9					
2042 PREPARED ANIMAL FEEDS	1,394	3	15			1,376	
2049 GRAIN MILL PRODUCTS, NEC	1,003	4				999	
2061 SUGAR	1,418	2				1,416	
2062 MOLASSES	5,082					5,082	
2081 ALCOHOLIC BEVERAGES	17,041	779	95			11,338	4,829
2091 VEGETABLE OILS, MARG, SHORT	2	2					
2094 GROCERIES	407					407	
2099 MISCELLANEOUS FOOD PRODUCTS	32,005	41	1			31,940	23
2211 BASIC TEXTILE PRODUCTS	34	30	1			3	
2212 TEXTILE FIBERS, NEC	4,383					1,088	3,295
2311 APPAREL	22	12				10	
2411 LOGS	75		75				
2416 WOOD CHIPS; STAVES, MOLDINGS	2	2					
2421 LUMBER	759	457	1	293		8	
2435 VENEER, PLYWOOD, WORKED WOOD	54	52	2				
2491 WOOD MANUFACTURES, NEC	57	52	1			4	
2511 FURNITURE AND FIXTURES	7,943	17	1			7,022	903
2631 PAPER AND PAPERBOARD	5	5					
2691 PULP AND PAPER PRODUCTS, NEC	1,277	5	72			1,187	13
2812 DYES, PIGMENT, TANNING MATS	10	10					
2813 ALCOHOLS	2,227						2,227
2817 BENZENE AND TOLUENE	7,968						7,968
2819 SULPHURIC ACID	1,656					1,656	
2819 BASIC CHEMICALS AND PROD, NEC	6,987		11			1,265	5,711
2821 PLASTIC MATERIALS	4	2	1			1	
2834 DRUGS	9	8	1				
2841 SOAP	944	1				943	
2851 PAINTS	1,565					1,565	
2891 MISCELLANEOUS CHEMICAL PROD	97	5	2			90	
2911 GASOLINE	88,754	88,754					
2914 DISTILLATE FUEL OIL	15,519					15,519	
2915 RESIDUAL FUEL OIL	186,755	120,320				66,435	
2916 LUBRICATING OILS AND GREASES	73					73	
2951 ASPHALT, TAR, AND PITCHES	4,472					4,472	
2952 ASPHALT BUILDING MATERIALS	23					23	
2992 PETROLEUM AND COAL PROD, NEC	16					16	
3011 RUBBER AND MISC PLASTICS PROD	1,607	13	3			1,591	
3111 LEATHER AND LEATHER PRODUCTS	29	27				2	
3211 GLASS AND GLASS PRODUCTS	20	1	1			18	
3241 HYDRAULIC CEMENT	30,373	3,427	9,950			16,996	
3251 STRUCTURAL CLAY PRODUCTS	669	460					209
3271 LIME	3,764	2,455				1,309	
3291 MISC NONMETALLIC MINERAL PROD	3,582	12	44			3,526	
3312 COKE, PET ASPHALTS, SOLVENTS	19		19				
3316 IRON AND STEEL PRIMARY FORMS	91	91					
3317 IRON, STEEL SHAPES, EXC SHEET	1,108	261	44			748	55
3318 IRON AND STEEL PLATES, SHEETS	36	36					
3319 IRON AND STEEL PIPE AND TUBE	32	10				22	
3399 IRON AND STEEL PRODUCTS, NEC	9	9					
3411 NONFERROUS METALS, NEC	1	1					
3533 LEAD AND ZINC, UNWORKED	116	116					
3534 ALUMINUM AND ALLOYS, UNWORKED	17	17					

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Figure 24. Sample Waterborne Commerce Information-Section 1.

CHICAGO, ILL., DISTRICT

GREEN BAY HARBOR, WIS.

SECTION INCLUDES: OUTER CHANNEL, CHANNEL THROUGH THE CITY OF GREEN BAY AND UPPER RIVER CHANNEL TO CITY OF DE PERE. CONTROLLING AND PROJECT DEPTHS: 24 FEET IN OUTER CHANNEL TO GRASSY ISLAND; 24 FEET IN THE ENTRANCE CHANNEL AND RIVER CHANNEL TO A POINT 1,700 FEET UPSTREAM FROM THE C. & N. W. R. R. BRIDGE; 24 FEET IN THE TURNING BASIN AT THE MOUTH OF THE FOX RIVER; 22 FEET IN THE TURNING BASIN ABOVE THE C. & N. W. R. R. BRIDGE; 18 FEET IN THE UPPER RIVER CHANNEL AND TURNING BASIN AT THE CITY OF DE PERE.

COMPARATIVE STATEMENT OF TRAFFIC

YEAR	TONS	YEAR	TONS
1966	2,664,342	1971	2,767,287
1967	2,875,461	1972	2,821,604
1968	2,564,795	1973	2,727,596
1969	2,812,943	1974	2,531,487
1970	2,790,837	1975	2,609,177

FREIGHT TRAFFIC, 1975

(SHORT TONS)

COMMODITY	TOTAL	FOREIGN				DOMESTIC			
		OVERSEAS		CANADIAN		LAKEWISE		INTERNAL	LOCAL
		IMPORTS	EXPORTS	IMPORTS	EXPORTS	RECEIPTS	SHIPMENTS	RECEIPTS	
TOTAL	2,609,177	51,032	60,869	201,895	35	2,289,489	3,089	110	1,658
0152 BARLEY AND RYE	105,168			105,168					
0161 ANIMALS AND PRODUCTS, NEC	31			31					
1121 COAL AND LIGNITE	1,589,621					1,589,621			
1411 LIMESTONE	141,755					141,755			
1442 SAND, GRAVEL, CRUSHED ROCK	8,594					8,594			
1499 NONMETALLIC MINERALS, NEC	83,741			25,720		58,021			
1911 ORDNANCE AND ACCESSORIES	1,658								1,658
2011 MEAT, FRESH, CHILLED, FROZEN	512		512						
2014 TALLOW, ANIMAL FATS AND OILS	20,587		20,587						
2015 ANIMAL BY-PRODUCTS, NEC	2,767		2,767						
2022 DRIED MILK AND CREAM	6,015		6,015						
2039 PREP FRUIT AND VEG JUICE, NEC	33		33						
2041 WHEAT FLOUR AND SEMOLINA	7,764		7,764						
2049 GRAIN MILL PRODUCTS, NEC	19,493		19,493						
2081 ALCOHOLIC BEVERAGES	28			28					
2099 MISCELLANEOUS FOOD PRODUCTS	1,954		1,954						
2431 VENEER, PLYWOOD, WORKED WOOD	32,849	32,849							
2611 PULP	73,347	14,371		58,976					
2621 STANDARD NEWSPRINT PAPER	461		461						
2711 PRINTED MATTER	1		1						
2819 BASIC CHEMICALS AND PROD, NEC	3,325	3,325							
2911 GASOLINE	13,111			3,972		8,479	660		
2914 DISTILLATE FUEL OIL	96,229					94,047	2,182		
2915 RESIDUAL FUEL OIL	36,726					36,726			
2918 ASPHALT, TAR, AND PITCHES	73,172					73,172			
3241 BUILDING CEMENT	287,033			8,000		279,033			
3299 MISC NONMETALLIC MINERAL PROD	4	4							
3317 IRON AND STEEL PIPE AND TUBE	77	77							
3319 IRON AND STEEL PRODUCTS, NEC	32	32							
3411 FABRICATED METAL PRODUCTS	197	196	1						
3511 MACHINERY, EXCEPT ELECTRICAL	771	171	455		35			110	
3711 MOTOR VEHICLES, PARTS, EQUIP	826		826						
4112 COMMODITIES, NEC	295	7				41	247		

STURGEON BAY AND LAKE MICHIGAN SHIP CANAL, WIS.

SECTION INCLUDES: ENTIRE CANAL AND CONNECTING WATERS BETWEEN LAKE MICHIGAN AND GREEN BAY, THROUGH THE CITY OF STURGEON BAY, WIS. CONTROLLING AND PROJECT DEPTHS: 23 FEET IN LAKE MICHIGAN ENTRANCE TO CANAL, 22 FEET IN REVETTED CANAL AND IN CHANNEL THROUGH STURGEON BAY AND 20 FEET IN TURNING BASIN.

COMPARATIVE STATEMENT OF TRAFFIC

YEAR	TONS	PASSENGERS	YEAR	TONS	PASSENGERS
1966	259,634	2,991	1971	436,135	5,528
1967	289,401	4,484	1972	215,650	4,684
1968	298,411	5,164	1973	266,910	5,454
1969	374,665	3,582	1974	200,345	5,238
1970	268,554	6,239	1975	326,249	4,964

FREIGHT TRAFFIC, 1975

DOMESTIC

(SHORT TONS)

COMMODITY	TOTAL	LAKEWISE			
		RECEIPTS	SHIPMENTS	THROUGH NORTHBOUND	NORTHBOUND
TOTAL	326,249	3,173	41	322,876	159
0911 FRESH FISH, EXCEPT SHELLFISH	159				159
1121 COAL AND LIGNITE	169,516			169,516	
1411 LIMESTONE	13,941			13,941	
1442 SAND, GRAVEL, CRUSHED ROCK	8,592			8,592	

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Figure 25. Sample Waterborne Commerce Information-Section 2.

GALVESTON, TEX., DISTRICT

TRIPS AND DRAFTS OF VESSELS

DRAFT (FEET)											
PORT ARTHUR, TEX.--(CONTINUED)				INBOUND						OUTBOUND	
30	10	30	1		1	42	30	63		4	97
29	10	31			1	42	13	41		35	89
28	15	21				36	27	73		12	112
27	16	21				37	20	93	1	1	115
26	13	26			1	40	33	182		1	216
25	23	33				56	45	84	1	5	135
24	33	57	1			91	39	70	1	14	124
23	35	58			4	97	19	41		8	68
22	45	88			3	136	33	42		1	77
21	41	126	2		1	170	30	31		1	62
20	42	134			2	178	36	43	1	3	83
19	48	75	2		7	132	28	21	2	14	65
18 AND LESS	219	296	4,295	509	2,144	7,423	140	75	4,313	619	2,182	7,329
TOTAL	586	1,678	4,305	509	2,164	9,242	627	1,625	4,320	620	2,282	9,474
SABINE PASS HARBOR, TEX.				INBOUND						OUTBOUND	
40	2	37				39	2	10			12
39	7	143				150	8	24			32
38	5	222				227	16	38			54
37	4	83				87	9	38			47
36	2	44				46	14	34			48
35	3	50				53	26	120			146
34	2	27				29	11	132		1	144
33	2	21				23	13	86			99
32	4	25				29	26	115	1		142
31	5	20				25	9	127			136
30	10	27			1	38	30	87		4	121
29	10	25				35	13	45		35	93
28	15	24				39	27	74		12	113
27	16	21				37	20	91		1	112
26	13	22				35	33	185		1	219
25	23	33				56	45	86		4	135
24	33	55	1			89	39	64	1	12	116
23	35	51			4	90	19	43		7	69
22	45	92			3	140	33	36		1	71
21	41	121	2			164	29	33		1	63
20	42	128			1	171	37	44	1		82
19	48	80	2		7	137	28	20	2	12	62
18 AND LESS	1,060	245	876	43	506	2,730	949	82	956	48	446	2,481
TOTAL	1,427	1,596	881	43	522	4,469	1,456	1,614	861	49	537	4,517
ANAHUAC CHANNEL, TEX.				NORTHBOUND						SOUTHBOUND	
8			9	14	1	24			4	197	201
7			157	8		165			157	52	209
6			18	26		44			1		1
5			17			17			22		22
4	65					65	65				65
2					252	252			1	41	2	44
TOTAL	65		201	48	253	567	65		185	41	251	542
TRINITY RIVER, CHANNEL TO LIBERTY, TEX.				UPBOUND						DOWNBOUND	
9			9		1	10			4	197	201
8				3		3					
7			146	8		154			146	52	198
6			19	26		45			5		5
5			17			17			22		22
2					252	252				33	2	35
TOTAL			191	37	253	481			177	33	251	461
CEDAR BAYOU, TEX.				UPBOUND						DOWNBOUND	
10				47	6	53					
9				30		30				181		181
8			37	100		137			37	3		40
7			279	24		303			281	35		316
6			10	23		33			10	6		16
5										2		2
4				8		8				14		14
3				4		4				1		1
2				175		175			3	180	6	189
TOTAL			326	411	6	743			331	422	6	759
HOUSTON SHIP CHANNEL, TEX.				INBOUND						OUTBOUND	
40	7	41				48	13	32			45
39	2	120				122	19	92			111
38	9	135				144	16	85		4	105
37	2	35				37	15	51		3	69
36	7	37	2			46	30	38	1	2	71
35	10	33				43	24	66		1	91
34	12	31				43	68	75		1	144
33	26	34				60	31	60		1	92
32	46	24				70	109	63		5	177
31	40	37				83	93	49			142
30	43	43				96	114	91	1	1	157

1. National Summaries

This section contains historic vessel traffic and commerce, both foreign and domestic for all coastal ports, Great Lakes, selected areas, and the total U.S. In addition, U.S. ton-mileage is presented. In this section, ton-mileage is computed for inland waterways and the Great Lakes only (see figure 26).

2. Domestic Inland Traffic--Areas of Origin and Destination of Principal Commodities

Commodity data between inland waterways and between inland waterways and the Great Lakes are shown by major commodity groups and by major ports (see figure 27).

3. Water Carriage Ton-Miles

This section presents ton-mileage, tons, and average haul commerce data for coastwise, lakewise, internal, and local traffic. It also presents ton-mileage by commodity for the current year with divisions for regulated, exempt-for-hire and private shipping service. These three categories of service are defined as "(1) Regulated, which is common and contract carriage subject to economic regulation by the Interstate Commerce Commission; (2) Exempt, for hire, carriage which is exempt from regulation by the Commission because of specific provisions in Part III Interstate Commerce Act; and (3) Private, which represents the movement of property of the water carrier in the vessel it operates; this category is also exempt from regulation by the Commission."[1]

The process by which data are collected for this publication is diagrammed in figure 28. Domestic ship owners submit Form 3925 to the Corps of Engineers' District Office, indicating the vessel name, type, origin, destination, commodity being shipped, commodity volume, commodity value, and type of service. The District Office codes these data on the form shown in figure 29 and sends the coding sheets to the main office in New Orleans where they are keypunched and put on computer tape.

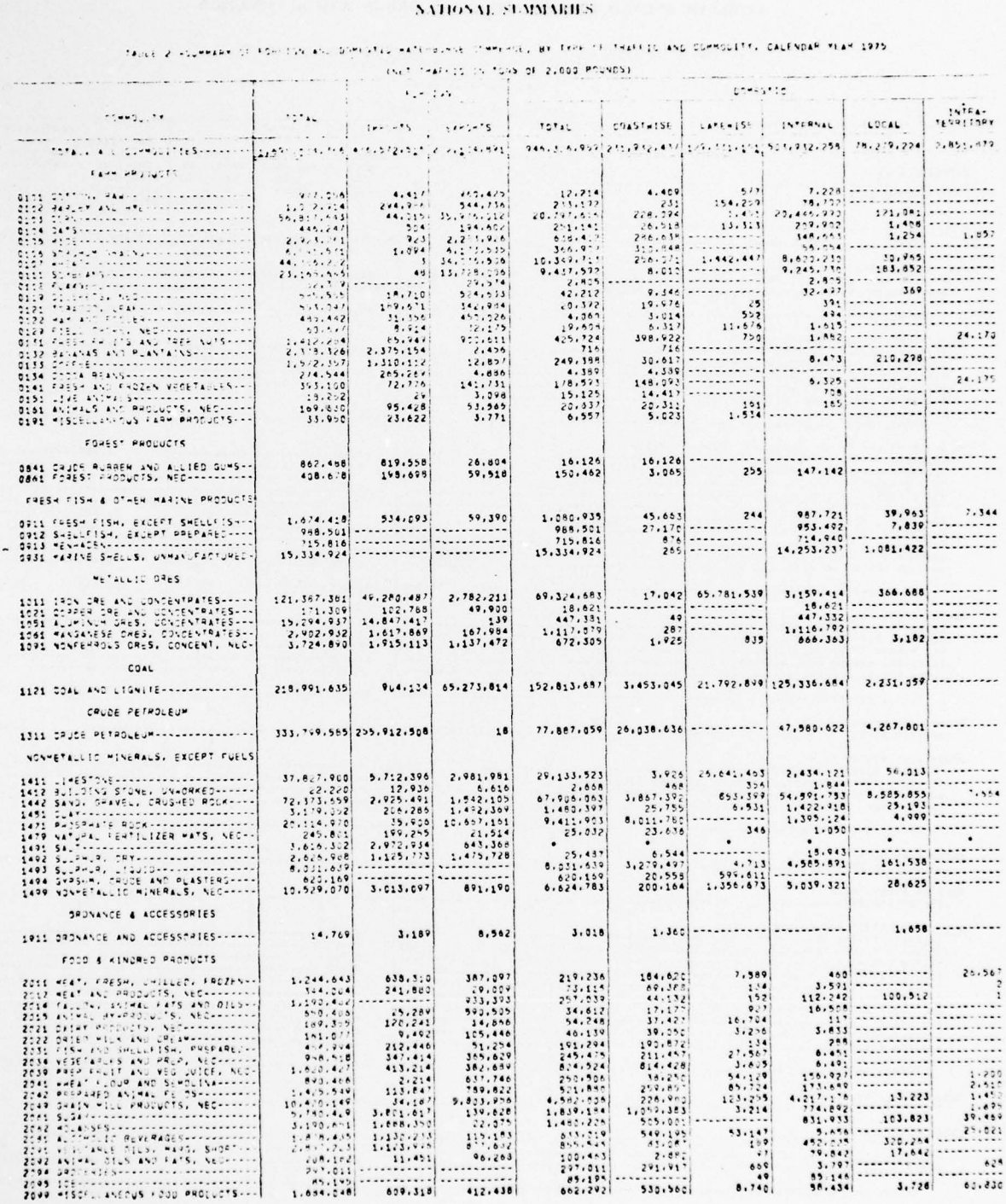
All information on foreign vessels is obtained by the Census Bureau at the customs entrance. The Census Bureau sends the District Office the following information:

- All import data;
- All data on vessels going to Canada and carrying shipments valued at $2,000 and greater;
- Ten percent of the data on vessels going to Canada carrying shipments valued at $251 to $1,999;

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[1] U.S. Army Corps of Engineers, "Waterborne Commerce of the United States," (New Orleans, Louisiana: 1976), p. vii.

Figure 26. Sample Waterborne Commerce Information-National Summaries.



NATIONAL SUMMARIES

TABLE 2 SUMMARY OF FOREIGN AND DOMESTIC WATERBORNE COMMERCE, BY TYPE OF TRAFFIC AND COMMODITY, CALENDAR YEAR 1975

(NET TRAFFIC IN TONS OF 2,000 POUNDS)

COMMODITY	TOTAL	FOREIGN		DOMESTIC					
		IMPORTS	EXPORTS	TOTAL	COASTWISE	LAKEWISE	INTERNAL	LOCAL	INTRA-TERRITORY
TOTAL, ALL COMMODITIES	2,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FARM PRODUCTS									
0111 COTTON, RAW	907,048	4,417	440,473	12,214	4,469	577	7,228	----------	----------
0112 BARLEY AND MALT	1,[illegible]	244,974	544,736	211,139	232	154,290	38,702	----------	----------
0113 CORN	56,857,443	44,035	35,976,212	20,797,654	228,294	1,401	20,466,992	121,081	----------
0114 OATS	446,247	524	194,452	251,141	26,518	13,313	209,902	1,498	----------
0115 RICE	2,[illegible]	963	2,[illegible]	656,439	----------	----------	148,643	1,254	1,857
0116 SOYBEAN [illegible]	[illegible]	1,094	[illegible]	366,977	313,848	----------	52,854	----------	----------
0117 WHEAT	44,[illegible]	3	34,[illegible]	10,369,711	256,271	1,442,447	8,622,210	10,765	----------
0119 SOYBEANS	23,[illegible]	48	13,[illegible]	9,457,592	8,010	----------	9,245,730	183,852	----------
0121 FLAXSEED	[illegible]	----------	----------	29,574	2,805	----------	2,875	----------	----------
0129 COTTONSEED, NEC	[illegible]	18,710	[illegible]	42,212	9,346	----------	32,427	369	----------
0131 TOBACCO, LEAF	[illegible]	169,671	142,984	20,322	19,976	25	321	----------	----------
0132 HAY AND FODDER	489,462	31,356	458,026	4,060	3,014	552	434	----------	----------
0139 FIBER CROPS, NEC	[illegible]	8,924	[illegible]	19,604	6,317	11,676	1,615	----------	----------
0151 FRESH FRUITS AND TREE NUTS	1,412,284	85,947	900,611	425,724	398,922	790	1,882	----------	24,170
0152 BANANAS AND PLANTAINS	2,[illegible]	2,375,154	2,436	716	716	----------	----------	----------	----------
0153 COFFEE	1,[illegible]	1,310,[illegible]	12,857	249,398	30,617	----------	8,473	210,298	----------
0154 COCOA BEANS	274,544	265,264	4,886	4,389	4,389	----------	----------	----------	----------
0161 FRESH AND FROZEN VEGETABLES	353,100	72,776	141,731	178,593	148,093	----------	9,525	----------	24,175
0151 LIVE ANIMALS	[illegible]	29	3,998	15,125	14,413	----------	728	----------	----------
0191 ANIMALS AND PRODUCTS, NEC	169,830	95,428	53,569	20,937	20,312	193	185	----------	----------
0191 MISCELLANEOUS FARM PRODUCTS	33,950	23,622	3,771	6,557	5,023	1,534	----------	----------	----------
FOREST PRODUCTS									
0841 CRUDE RUBBER AND ALLIED GUMS	862,488	819,558	26,804	16,126	16,126	----------	----------	----------	----------
0841 FOREST PRODUCTS, NEC	408,678	148,698	59,518	150,462	3,065	255	147,142	----------	----------
FRESH FISH & OTHER MARINE PRODUCTS									
0911 FRESH FISH, EXCEPT SHELLFISH	1,674,418	534,093	59,390	1,080,935	45,663	244	987,721	39,963	7,344
0912 SHELLFISH, EXCEPT PREPARED	988,501	----------	----------	988,501	27,170	----------	953,492	7,839	----------
0913 MENHADEN	715,816	----------	----------	715,816	876	----------	714,940	----------	----------
0931 MARINE SHELLS, UNMANUFACTURED	15,334,924	----------	----------	15,334,924	265	----------	14,253,237	1,081,422	----------
METALLIC ORES									
1011 IRON ORE AND CONCENTRATES	121,367,381	49,280,487	2,782,211	69,324,683	17,042	65,781,539	3,159,414	366,688	----------
1021 COPPER ORE AND CONCENTRATES	171,309	102,788	49,930	18,621	----------	----------	18,621	----------	----------
1051 ALUMINUM ORES, CONCENTRATES	15,294,937	14,847,417	139	447,381	49	----------	447,332	----------	----------
1061 MANGANESE ORES, CONCENTRATES	2,902,932	1,617,869	167,984	1,117,079	287	----------	1,116,792	----------	----------
1091 NONFERROUS ORES, CONCENT, NEC	3,724,890	1,915,113	1,137,472	672,305	1,925	839	866,363	3,182	----------
COAL									
1121 COAL AND LIGNITE	218,991,635	904,124	65,273,814	152,813,697	3,453,045	21,792,899	125,336,684	2,231,059	----------
CRUDE PETROLEUM									
1311 CRUDE PETROLEUM	333,799,585	295,912,508	18	77,887,059	26,038,636	----------	47,980,622	4,267,801	----------
NONMETALLIC MINERALS, EXCEPT FUELS									
1411 LIMESTONE	37,827,900	5,712,396	2,981,981	29,133,523	3,926	25,641,463	2,434,121	56,013	----------
1412 BUILDING STONE, UNWORKED	[illegible]	12,936	6,616	2,658	468	394	1,844	----------	----------
1442 SAND, GRAVEL, CRUSHED ROCK	72,173,559	2,925,491	1,542,105	67,906,063	3,867,392	853,399	54,991,733	8,585,855	[illegible]
1451 CLAY	3,179,392	206,286	1,492,369	1,480,397	25,755	6,931	1,422,918	29,193	----------
1471 PHOSPHATE ROCK	20,[illegible]	35,906	10,667,191	9,411,903	8,011,780	----------	1,395,124	4,999	----------
1479 NATURAL FERTILIZER MATS, NEC	245,811	199,295	21,514	25,032	23,638	346	1,050	----------	----------
1491 SALT	3,616,302	2,972,934	643,368	*	*	*	*	*	*
1492 SULPHUR, DRY	2,628,908	1,125,773	1,475,728	25,487	6,544	----------	15,943	----------	----------
1493 SULPHUR, LIQUID	8,031,639	----------	----------	8,031,639	3,279,497	4,713	4,585,891	161,538	----------
1494 GYPSUM, CRUDE AND PLASTERS	620,169	----------	----------	620,159	20,555	599,611	----------	----------	----------
1499 NONMETALLIC MINERALS, NEC	10,529,070	3,013,097	891,190	6,624,783	200,164	1,356,673	5,039,321	28,625	----------
ORDNANCE & ACCESSORIES									
1911 ORDNANCE AND ACCESSORIES	14,769	3,189	8,562	3,018	1,360	----------	----------	1,658	----------
FOOD & KINDRED PRODUCTS									
2011 MEAT, FRESH, CHILLED, FROZEN	1,244,643	838,510	387,097	219,236	184,620	7,989	460	----------	26,567
2012 MEAT AND PRODUCTS, NEC	144,004	241,860	29,009	73,115	69,368	134	3,591	----------	2
2014 FATS, ANIMAL FATS AND OILS	1,[illegible]	----------	933,393	257,039	44,132	152	112,242	100,512	1
2015 ANIMAL BYPRODUCTS, NEC	590,405	25,289	590,505	34,612	17,177	927	16,508	----------	----------
2021 DAIRY PRODUCTS, NEC	189,359	120,241	14,866	54,248	37,427	16,704	117	----------	----------
2022 DRIED MILK AND CREAM	141,077	9,492	105,446	46,139	39,050	3,236	3,833	----------	----------
2031 FISH AND SHELLFISH, PREPARED	464,994	212,446	51,256	191,294	190,872	134	288	----------	----------
2034 VEGETABLES AND PREP, NEC	948,518	347,414	365,629	245,475	211,457	27,586	6,451	----------	----------
2039 PREP FRUIT AND VEG JUICE, NEC	1,620,427	413,214	382,689	824,524	814,428	3,605	6,491	----------	----------
2041 WHEAT FLOUR AND SEMOLINA	893,466	2,214	637,746	253,506	36,250	54,149	156,927	----------	1,220
2042 PREPARED ANIMAL FEEDS	1,[illegible]	113,847	789,822	521,895	252,807	85,324	173,649	----------	2,417
2049 GRAIN MILL PRODUCTS, NEC	10,[illegible]	34,167	9,803,956	4,582,035	226,903	123,295	4,217,574	13,223	1,450
2051 BREAD	[illegible]	[illegible]	[illegible]	1,819,194	1,599,383	3,214	214,892	----------	1,695
2061 SUGAR	[illegible]	3,801,617	139,628	1,455,226	505,001	----------	831,933	103,823	39,469
2062 MOLASSES	3,190,[illegible]	1,888,350	22,[illegible]	633,229	549,195	53,147	9,456	----------	25,021
2085 ALCOHOLIC BEVERAGES	[illegible]	1,130,[illegible]	119,183	855,424	45,287	109	452,028	320,264	----------
2091 VEGETABLE OILS, MAYO, SHORT	2,[illegible]	1,[illegible]	81,632	100,463	2,882	71	98,842	17,642	----------
2092 ANIMAL OILS AND FATS, NEC	[illegible]	11,451	96,263	237,011	241,917	609	3,797	----------	629
2094 PROTEINS	[illegible]	----------	----------	85,194	----------	49	85,144	----------	----------
2095 ICE	[illegible]	----------	----------	662,292	530,960	8,740	98,434	3,728	60,430
2099 MISCELLANEOUS FOOD PRODUCTS	1,684,048	809,318	412,438						

* SALT INCLUDED IN NONMETALLIC MINERALS, NEC, TO AVOID DISCLOSURE OF INDIVIDUAL COMPANY OPERATIONS.

Figure 27.

DOMESTIC INLAND TRAFFIC, AREAS OF ORIGIN AND DESTINATION

TABLE 8-01 DOMESTIC INLAND MOVEMENTS OF CHEMICALS AND RELATED PRODUCTS
SHIPPING AREA BY RECEIVING AREA

CALENDAR YEAR 1975

(IN TONS OF 2,000 POUNDS)

SHIPPING AREA / RECEIVING AREA	COAL TAR (CODE 2911)	BENZENE AND TOLUENE (CODE 2917)	SULPHURIC ACID (CODE 2816)	ALCOHOLS (CODE 2813)	SODIUM HYDROXIDE (CAUSTIC SODA) (CODE 2812)	CHEMICALS AND CHEMICAL SPECIALTIES (CODES 2815, 2819, 2851, 2861, 2869)	FERTILIZERS AND FERTILIZER MATERIALS (CODES 1471, 1479, 2871, 2872, 2873, 2874)
TOTAL, ALL SHIPPING AREAS	2,455,311	2,977,767	2,753,217	2,300,550	3,135,305	12,120,209	6,512,494
PORT OF NEW YORK, N.Y. AND N.J./							
PORT OF NEW YORK, N.Y. AND N.J.	3,512	4,302	29,106	22,667	42,350	23,219	----------
UPPER HUDSON RIVER, N.Y.	1,062	5,320	----------	----------	4,693	----------	----------
TOTAL, SHIPPING AREA	4,574	9,622	29,106	22,667	47,043	23,219	----------
DELAWARE RIVER, NEW JERSEY SIDE/							
DELAWARE RIVER, NEW JERSEY SIDE	----------	21,937	38,635	----------	17,492	4,523	----------
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE	2,423	6,472	26,345	----------	----------	1,175	----------
MANTUA CREEK, N.J.	----------	----------	2,650	----------	----------	----------	----------
SCHUYLKILL RIVER, PA.	----------	----------	----------	----------	----------	7,298	----------
BALTIMORE HARBOR AND CHANNELS, MD.	----------	----------	76,000	----------	----------	----------	----------
TOTAL, SHIPPING AREA	2,423	28,409	143,630	----------	17,492	12,996	----------
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE/							
DELAWARE RIVER, NEW JERSEY SIDE	775	22,148	19,305	----------	----------	8,950	----------
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE	674	775	2,450	----------	----------	----------	----------
MANTUA CREEK, N.J.	----------	----------	500	----------	----------	----------	----------
BIG TIMBER CREEK, N.J.	----------	----------	77,000	----------	----------	----------	1,400
MISPILLION RIVER, DEL.	----------	----------	----------	----------	----------	21,991	----------
SCHUYLKILL RIVER, PA.	----------	1,425	----------	----------	----------	1,125	4,300
BALTIMORE HARBOR AND CHANNELS, MD.	----------	10,238	32,500	----------	41,907	----------	----------
RAPPAHANNOCK RIVER, VA.	----------	----------	----------	----------	----------	18,900	----------
JAMES RIVER, VA.	----------	[illegible]	36,470	----------	3,000	1,649	----------
HAMPTON ROADS, VA.	----------	----------	3,090	----------	----------	----------	----------
TOTAL, SHIPPING AREA	1,449	34,586	171,275	----------	44,907	112,615	5,700
MANTUA CREEK, N.J./							
DELAWARE RIVER, NEW JERSEY SIDE	----------	----------	18,650	----------	5,765	3,985	----------
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE	----------	----------	3,800	----------	----------	----------	----------
BIG TIMBER CREEK, N.J.	----------	----------	6,900	----------	----------	----------	----------
BALTIMORE HARBOR AND CHANNELS, MD.	----------	----------	24,550	----------	----------	----------	----------
JAMES RIVER, VA.	----------	----------	4,200	----------	----------	----------	----------
TOTAL, SHIPPING AREA	----------	----------	58,200	----------	5,765	3,985	----------
MISPILLION RIVER, DEL./							
HAMPTON ROADS, VA.	----------	----------	----------	----------	----------	----------	1,500
SCHUYLKILL RIVER, PA./							
DELAWARE RIVER, NEW JERSEY SIDE	----------	1,979	----------	----------	----------	----------	----------
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE	----------	1,600	----------	----------	----------	166,556	----------
SCHUYLKILL RIVER, PA.	----------	----------	----------	----------	----------	26,550	----------
JAMES RIVER, VA.	----------	----------	----------	----------	----------	----------	----------
TOTAL, SHIPPING AREA	----------	3,579	----------	----------	----------	193,106	----------
CHESAPEAKE BAY/							
CHESAPEAKE BAY	----------	----------	----------	----------	----------	----------	1,400
CHESTER RIVER, MD./							
CHESAPEAKE BAY	----------	----------	----------	----------	1,800	----------	----------
BALTIMORE HARBOR AND CHANNELS, MD./							
DELAWARE RIVER, NEW JERSEY SIDE	----------	7,215	11,675	----------	----------	8,950	----------
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE	----------	2,320	5,800	----------	----------	----------	----------
MANTUA CREEK, N.J.	----------	----------	23,550	----------	----------	----------	----------
BIG TIMBER CREEK, N.J.	----------	----------	2,000	----------	----------	----------	8,401
CHESAPEAKE BAY	----------	----------	----------	----------	----------	----------	400
CHOPTANK RIVER, MD.	----------	----------	----------	----------	----------	----------	----------
BALTIMORE HARBOR AND CHANNELS, MD.	----------	----------	127,034	----------	----------	----------	2,795
YORK RIVER, VA.	----------	----------	----------	----------	----------	----------	----------
JAMES RIVER, VA.	----------	----------	6,400	----------	----------	----------	----------
HAMPTON ROADS, VA.	----------	----------	1,600	----------	----------	----------	----------
TOTAL, SHIPPING AREA	----------	9,535	178,059	----------	----------	8,950	11,596
MOBJACK BAY, VA./							
CHESAPEAKE BAY	----------	----------	----------	----------	----------	----------	1,600
JAMES RIVER, VA./							
DELAWARE RIVER, PENNSYLVANIA AND DELAWARE SIDE	----------	----------	----------	----------	----------	2,800	----------
CHESAPEAKE BAY	----------	----------	----------	----------	----------	----------	925
HAMPTON ROADS, VA.	----------	----------	1,000	----------	----------	----------	127,691
TOTAL, SHIPPING AREA	----------	----------	1,000	----------	----------	2,800	128,616
HAMPTON ROADS, VA./							
CHESAPEAKE BAY	----------	----------	----------	----------	----------	----------	2,695
BALTIMORE HARBOR AND CHANNELS, MD.	----------	----------	----------	----------	----------	----------	1,460
JAMES RIVER, VA.	----------	----------	6,300	----------	----------	5,400	----------
CAPE FEAR RIVER, N.C.	----------	----------	1,500	----------	5,510	----------	----------
TOTAL, SHIPPING AREA	----------	----------	7,800	----------	5,510	5,400	4,455

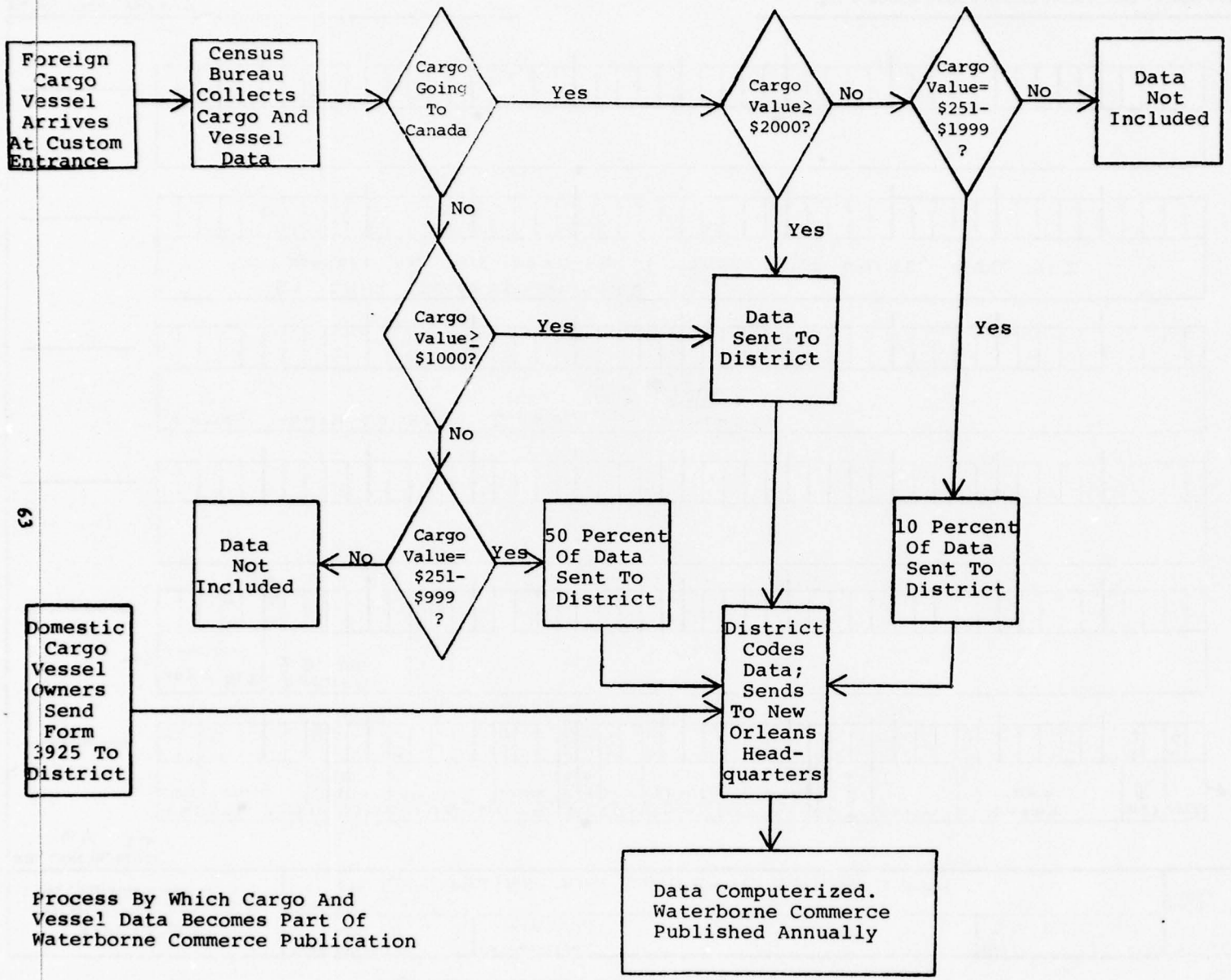
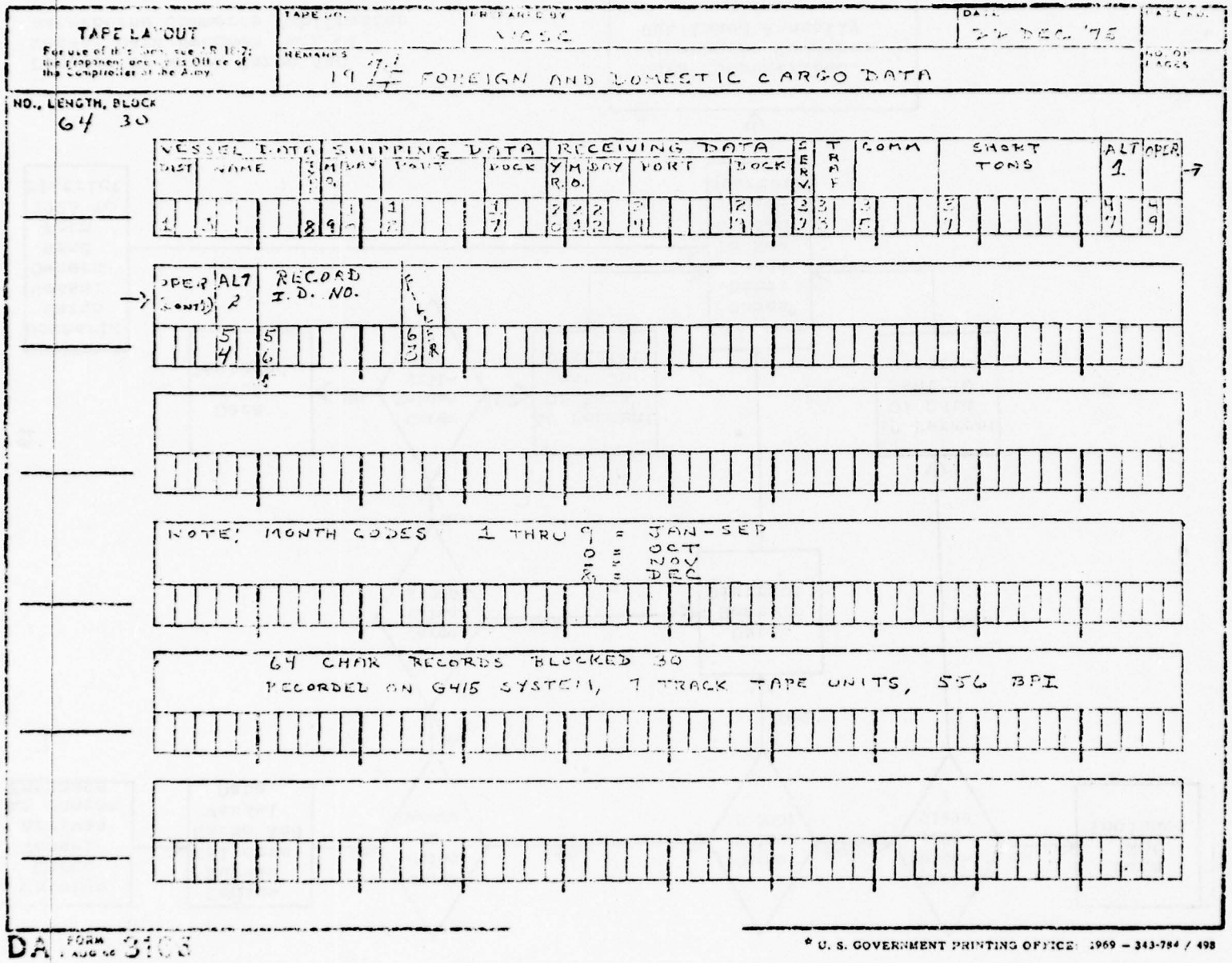


Figure 28. Waterborne Commerce Data Flow Diagram.

Figure 29. Waterborne Commerce Tape Layout Form.



TAPE LAYOUT

For use of this form, see AR 18-7; the proponent agency is Office of the Comptroller of the Army

TAPE NO.

PREPARED BY: WCSC

DATE: 24 DEC '75

REMARKS: 1974 FOREIGN AND DOMESTIC CARGO DATA

NO. OF PAGES

NO., LENGTH, BLOCK: 64 30

	VESSEL DATA			SHIPPING DATA				RECEIVING DATA										
	DIST	NAME	STR	MO.	DAY	PORT	DOCK	YR.	MO.	DAY	PORT	DOCK	SERV.	TRF	COMM	SHORT TONS	ALT 1.	OPER
	1	3	8	9	11	17	17	20	21	23	24	29	30	31	35	37	47	49
	OPER (CONT'D)	ALT 2	RECORD I.D. NO.															
	54	56																

NOTE: MONTH CODES 1 THRU 9 = JAN-SEP
0 = OCT
& = NOV
@ = DEC

64 CHAR RECORDS BLOCKED 30
RECORDED ON G415 SYSTEM, 7 TRACK TAPE UNITS, 556 BPI

64

DA FORM 3103

* U. S. GOVERNMENT PRINTING OFFICE: 1969 — 343-784 / 498

- All export data on vessels carrying shipments valued at $1,000 and greater, going to all foreign countries except Canada; and
- Fifty percent of the data on vessels carrying shipments valued at $251 to $999 going to all foreign countries except Canada.

The District Office codes these data and sends the coding sheets to the main office in New Orleans where estimates are made on the remainder of exports to foreign countries and all data are computerized. The result of this process is the annual Waterborne Commerce statistics.

Several errors may occur between the time a company decides to send a vessel on a voyage and the Waterborne Commerce statistics are produced. A ship owner may not send information regarding his vessel's movement to the District Office. The River and Harbor Act of 1922 acts as an impetus, but it is no guarantee that the information will be sent. The Act states in part: "that owners, agents, masters, and clerks of vessels and other craft plying upon the navigable waters of the United States, and all individuals and corporations engaged in transporting their own goods upon the navigable waters of the United States, shall furnish such statements relative to vessels, passengers, freight and tonnage as may be required by the Secretary of War. . ."[1] A $100 fine is charged if these data are not supplied.

Intransit merchandise presents another source for error. It is defined "by the Bureau of the Census as merchandise coming into the United States from a foreign country and shipped to a foreign country without having been entered as an import."[2] If intransit merchandise is transferred from one ship to another in a U.S. port, it is classified by Waterborne Commerce as an import when it is unloaded and as an export when it is loaded onto another vessel; therefore, the merchandise is counted twice.

Double counting may also occur if an American vessel is engaged in both foreign and domestic shipping on the same voyage. It is counted by the Corps of Engineers as domestic traffic and by the Census Bureau as foreign traffic.

The Corps of Engineers has found another problem in the coding of commodity data at the district level. When the district office receives information on the commodity being shipped, it is often not on the Corps of Engineers' list of commodities and should be coded in

---

[1] U.S. Congress, "River and Harbor Act," (Washington, D.C.: 1922), Section II.

[2] U.S. Army Corps of Engineers, "Waterborne Commerce of the United States," (New Orleans, Louisiana: 1976), p. v.

a "miscellaneous" category associated with a class of commodities, e.g., "miscellaneous farm products." However, the clerk doing the coding at the District Office may now know into which class of commodity the merchandise falls. Often the coder guesses the commodity class and errs in that guess; this error is not caught.

The usual problem of inaccurate codings and keypunching of data also exists in this system. There is, however, no evidence that the problem is more or less severe in these data than in any other data system.

At least three improvements could be made in this data system. First, the import and export of intransit merchandise should be labeled as such; second, American vessels carrying foreign merchandise should be counted by either the Corps of Engineers or the Census Bureau, but not both; and third, either ship owners should be asked to code commodities based on the Corps of Engineers coding system or coders should be encouraged to be certain of the commodity class before coding it.

In spite of any problems with these data, they are the primary source of information on waterborne commercial transport in this country.

V. REPAIR COSTS

A. U.S. SALVAGE ASSOCIATION

The U.S. Salvage Association surveys damaged vessels for the American Hull Syndicate, an insurance firm which provides coverage for approximately 2,000 U.S. and foreign vessels. As a result, the Association is a primary source of vessel hull and machinery repair cost data. These cost data are valuable because the repair costs are collected from vessel owners after repairs have been completed. Since 1971, these cost data have been computerized.

Repair information is on all types of vessels, about half of which are of foreign flag and half U.S. registered. Included in the data are:

- time needed to repair vessels,
- price of needed machinery,
- shipyard where repairs were done,
- reason for repairs,
- location of casualty,
- extensive costs in hundreds of dollars,
- whether ship is afloat or in drydock,
- affected ship element,
- fleet,
- repair analysis data,
- type of vessel, and
- total repair costs.

The U.S. Salvage Association surveys a damaged vessel at the request of the American Hull Syndicate. The owners of the surveyed vessel send reports on repair costs to U.S. Salvage Association after repairs have been completed. The Association then codes and computerizes this information. In addition to the computerized data, original repair reports, annual data listings, and annual data summaries may be purchased from U.S. Salvage Association. The annual summaries show number of vessels repaired by type of vessel at the

total and average repair costs for that vessel type. Total and average repair cost and average repair time are shown by affected ship element and by type of breakdown. Other summaries or breakdowns of data for which computerized information is available may be purchased from the Association.

The usual type of input errors can be expected with these data, i.e., inaccurate coding or keypunching. However, except for possible input errors, the costs of repairs can be expected to be extremely accurate because they are not reported until repairs have been completed.

The Information and Analysis Branch of the U.S. Coast Guard has attempted to match vessel repair costs from their system to the casualties reported in the VCRS data. This has proved to be very difficult because the only information common to both systems is type of vessel, nature of casualty, and year of casualty.

The data in this system are valuable because they provide accurate information on repair costs and time of repairs by type of casualty.

VI. VESSEL ACCIDENTS

A. INTER-GOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION

The Inter-governmental Maritime Consultative Organization (IMCO) is a specialized agency of the United Nations concerned with international maritime affairs. As a result of its interests, IMCO has collected two data files to provide information regarding ship design and as an aid to understanding and minimizing damage in vessel casualties. The files contain data from IMCO Damage Cards and Intact Stability Casualty Records.

In July, 1976, the Maritime Safety Committee of IMCO began publishing semi-annually a list of serious casualties.[1] The information in these lists is extracted from the Casualty Returns of the Liverpool Underwriter's Association and should not be confused with IMCO's Damage Cards.

Both the Damage Cards and the Casualty Records were submitted to IMCO on a voluntary basis by member nations. The data are available for the years 1962 through 1965. After 1965 IMCO received only a smattering of casualty reports, primarily because IMCO did not place any emphasis on this activity. An attempt is now being made to revive this accident reporting system.

Figures 30 and 31 are the data forms used to file these reports. The Damage Cards record the particulars of collisions with other vessels or fixed objects. These cards provide information regarding the hull dimensions, dimensions and location of the damage, and circumstances surrounding the casualty, i.e., weather, ship speed and angle of collision, cargo damage, and injuries.

The Intact Stability Casualty Record contains information regarding vessel casualties other than collisions or rammings. The type of information recorded on this form is similar to that contained on the Damage Cards except that more information is available about the physical characteristics of the vessel both before and after the casualty.

Both of these data files contain information on vessels other than:

Ships of war,

Cargo ships less than 500 gross tons,

---

[1] Maritime Safety Committee, IMCO, "Investigation into Serious Casualties, List of Casualties," (London: 1976-1977).

Figure 30. IMCO Damage Card.

INTER-GOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION

DAMAGE CARD .....

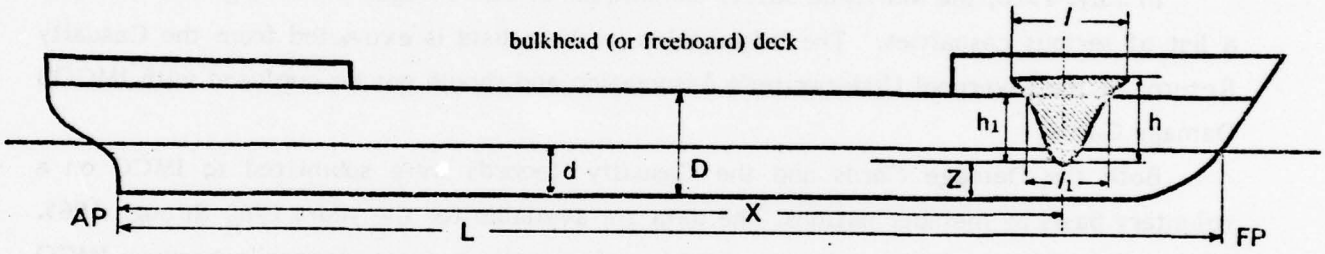
Date and place(o) of casualty ..... Nature of casualty (collision, stranding, etc.) .....

Damaged Ship

Name(o) (or number) ..... Type* (passenger, cargo, bulk cargo, oil tanker, fishing vessel, etc.) .....

Length between perpendiculars* L ..... Moulded breadth* B ..... Moulded depth* D .....

Draught before damage: amidships d = ... (or fore ..... and aft .....)



Dimensions and location of damage (see sketch above)

Distance from AP to centre of damage* X = ...

Distance from base line to the lower point of damage Z = ...

Length of *l* = ... Height of h = ... Penetration b = ...
damage* l_1 = ... damage* h_1 = ... of damage* b_1 = ...

(If damage extends above bulkhead (or freeboard) deck, additional dimensions should be given for the part located below this deck, these being marked with suffix "$_1$")

Second ship involved in collision (to be completed in case of collision between two ships)

Name(o) (or number) .....

Length between perpendiculars L = ... Moulded breadth B = ... Moulded depth D = ...

Draught before damage: amidships d = ... (or fore ..... and aft .....)

NOTES

1. Damage cards should be completed for decked, steel sea-going ships 25 m. in length and over, for all breaches of the hull causing flooding of any compartment above double bottom (collisions, stranding, etc.).
2. The term "damaged ship" refers to the ship for which this card is being completed.
3. A sketch showing location of damage and of main transverse bulkheads would be desirable.
4. Depth D should be measured to the bulkhead deck in passenger ships and to the freeboard deck in non-passenger ships (or to the uppermost completed deck, if bulkhead or freeboard deck are not specified).
5. In the case of collision with another ship, it is desirable to fill in damage cards for both ships.
6. All measurements should be given in metres.
7. Data marked with an asterisk (*) are the most important.
8. The provision of data marked (o) is optional.

Figure 30. (continued)

Additional data to be supplied if available

1. Wind and sea (Beaufort scale) at time of casualty .....

2. Speed at time of impact, in knots $\frac{\text{damaged ship } v_1 = \ldots\ldots}{\text{second ship } v_2 = \ldots\ldots}$

3. Angle of encounter .....

4. Did the ship to which this card refers sink? .....

   If not, give draught after damage .....

   If so, indicate time taken to sink after collision ..... and manner of sinking .....

5. Appropriation of breached compartment(s) (e.g. machinery room, cargo hold, etc.) .....

6. Type and quantity of cargo in damaged compartment, if any .....

7. Total number of persons on board ship before damage .....

8. Total number of persons lost .....

9. Were there any special circumstances which influenced the results of damage (e.g. open watertight doors, manholes, side-scuttles, or pipes, fractures, etc.)? .....

10. Position of watertight bulkheads in vicinity of damage (distance from AP to each of them) .....

11. Number of compartments flooded .....

12. Was there a double bottom in the damaged area? .....

    If so, indicate whether the inner bottom was breached .....

13 Any additional information considered useful (details of construction, year built, etc.) .....

INTER-GOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION

INTACT STABILITY CASUALTY RECORD

Date and place of casualty(0).....

Ship's name(0) or number..... Year of build(0).....

Type of ship* (passenger, cargo, bulk carrier, oil tanker, fishing vessel, etc.).....

Length between perpendiculars* L_{pp}= ..... Breadth moulded* B= .....

Depth moulded* D= (see Note).....

Draught amidships to assigned loadline or subdivision line d ..... (or forward ..... aft .....)

Service conditions (light or loaded, with approximate percentage of cargo, stores, fuel and passengers).....

.....

Type of cargo, if any..... disposition..... stowage factor.....

Deck cargo, if any..... type..... quantity.....

Quantity of ballast water, if any.....

Sea and wind conditions at time of casualty: sea*..... wind* (Beaufort scale).....

Wind velocity u= ..... Wind pressure p_v.....

Wave length λ..... Wave height h_w.....

Direction of wind relative to ships head..... (degrees) Direction of waves relative to ships head..... (degrees)

Speed of ship at time of casualty V= ..... knots

Name, length and height of enclosed superstructures and deck-houses above the deck to which D was measured*.....

.....

.....

Bilge keels – Width(0)..... Longitudinal extent(0)..... Depth of bar keel, if any(0).....

Total number of passengers N_p..... Total number of crew N_c.....

Was water trapped on deck?..... if so, indicate the extent.....

Were all vulnerable openings effectively closed at time of casualty?.....

Was icing a contributory factor to casualty?.....

.....

Was the vessel under action of helm at time of casualty?.....

Were any special instructions relative to this ship in existence, concerning the maintenance of stability, e.g. filling tanks, etc.?.....

.....

.....

Were any voyage limits and/or weather restrictions imposed for the vessel?.....

.....

Were any particular circumstances related to the casualty?.....

Give short description of casualty .....

.....

Figure 31. IMCO Intact Stability Casualty Record.

Figure 31. (continued)

General Particulars		For ship in fully loaded homogenous arrival condition (with 10% stores, fuel etc).	For ship in condition at time of loss
Draught (amidships)	d		
Displacement*	Δ		
Centre of gravity above moulded base line*	KG		
Metacentric height (uncorrected)*	GM		
Distance between the transverse metacentre and centre of buoyancy	BM		
Reduction in GM due to any free surface of liquids*			
Block coefficient of fineness of displacement*	δ		
Coefficient of fineness of midship section	β		
Coefficient of fineness of waterplane	α		
Height of centre of buoyancy above moulded base line	KB		
Lateral area of ships profile (including erections, etc.) exposed to wind	A_v		
Distance between centre of lateral area of ships profile exposed to wind and corresponding waterline			
Estimated rolling period (P – S – P) (in seconds) (0)	T_r		
Rated amplitude of roll (maximum)	θ_r		
Angle of heel for immersion of uppermost continuous deck			
Righting levers (GZ) based upon centre of gravity (G) corrected for any free surfaces, for the following angles of heel:*			
0°			
10°			
20°			
30°			
40°			
50°			
60°			
70°			
80°			
90°			
Maximum righting lever	GZ_m		
Angle of maximum stability	θ_m		
Angle of vanishing stability	θ_v		
Lightship Displacement Δ_o=		Centre of gravity above moulded base line KG_o=	

Notes

1. Casualty records to be completed for all sea-going passenger ships, sea-going cargo ships of 25 m. in length and over, and sea-going fishing vessels of 15 m. in length and over, in respect of both losses of ships and cases in which dangerous heeling occurred due to unsatisfactory intact stability, including those cases where loss or heeling of the ship was due to shifting of cargo.
2. Depth D should be measured to the bulkhead deck in passenger ships and to the freeboard deck in non-passenger ships (or to uppermost completed deck, if bulkhead or freeboard deck is not specified).
3. The metric system should be used for all measurements.
4. Data marked with an asterisk (*) are the most important.
5. The provision of data marked (*) is optional.
6. It is desirable to attach a sketch of statical stability curves, drawn for both the above loading conditions, using the following scales:
   (i) 20 mm. for every 10° angle of inclination.
   (ii) 10 mm. (or 20 mm.) for every 0·1 metre of righting lever.

Ships not propelled by mechanical means,

Wooden ships of primitive build,

Pleasure yachts not engaged in trade,

Fishing vessels, and

Ships solely navigating in the Great Lakes of North America.

IMCO has never computerized the data from these reports. All of the data are available in two forms:

- The original data cards. The Office of Merchant Marine Safety of the U.S. Coast Guard has possession of these forms.
- Summary Reports. In 1965 an IMCO subcommittee published an analysis and summary of the Damage Cards[1] based on the 1962 through 1965 data.

Although the data files for 1962 through 1965 contain the most complete casualty information that IMCO has, the data for that period does not represent all major ship accidents. This incompleteness can be expected because the reporting is voluntary. Many member countries consider information about damage to their own ships as proprietary, and either do not file reports or file them without identifying the ship. Both the Casualty Records and the Damage Cards mark certain types of information "(o)" meaning optional. Listed as optional is the name of vessel and the date and place of the casualty.

Now that attempts are being made to revive these IMCO Damage Cards, Regulation 21 of the International Convention for Safety of Life at Sea was drafted to encourage member countries to report casualties. The regulation states:

a) Each administration undertakes to conduct an investigation of any casualty occurring to any of its ships subject to the provisions of the present convention when it judges that such an investigation may assist in determining what changes in the present Regulations might be desirable.

b) Each contracting Government undertakes to supply the Organization with pertinent information concerning the findings of such investigations. No reports or recommendations of the Organization based on such information

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[1] Working Group on Watertight Subdivision and Damage Stability of Passenger and Cargo Ships, IMCO, "Analysis of Damage Cards," (London: 1965).

shall disclose the identity or nationality of the ship concerned or in any manner fix or imply responsibility upon any ship or person.[1]

While this regulation encourages member countries to report casualties, the regulation does not change the reporting from a voluntary to a mandatory basis. Further, whether or not a report will "assist in determining what changes in the present Regulation might be desirable" is open to question. Therefore, while the Damage Cards may be revived, there is little indication that the reporting will be any more complete than it has been in the past. During 1977, only 28 casualty reports were received by the Maritime Safety Committee.

An additional problem with the IMCO data is that it would be extremely difficult to compare casualties in this file with other data systems. The major problem in attempting such a comparison is identifying a Damage Card or Casualty Record with a specific incident. This is again related to the fact that a casualty report does not require the ship name or the date and location of the casualty.

Because of the difficulties in these data, the IMCO files do not appear to be a primary source of ship incident information.

B. LIBERIAN BUREAU OF MARITIME AFFAIRS

The Republic of Liberia requires the Master of any Liberian vessel involved in certain casualties to file a report on the casualty to the Commissioner of Maritime Affairs. Whenever the Commissioner determines the casualty "to be of a major character"[2] he calls for a formal investigation of the incident. These reports of formal investigations, which may be released for publication, contain the only vessel casualty information available to the public from the Republic of Liberia.

A casualty report is required from the Master of a vessel whenever the casualty results in the following:

(a) Actual physical damage to property in excess of $50,000,

(b) Material damage affecting the seaworthiness or efficiency of a vessel,

(c) Stranding or grounding,

---

[1] IMCO, International Convention for the Safety of Life at Sea, 1974 (London: 1974), Regulation 21, p. 16.

[2] The Republic of Liberia, "Liberian Maritime Regulations" (RLM-108), Chapter IX (effective July 11, 1969), p. 21.

(d) Loss of life, or

(e) Injury causing any persons to remain incapacitated for a period in excess of 72 hours.[1]

Included in each casualty report is the name, official number, and type of vessel; name and address of owner; time, date, location, and nature of casualty; name of other involved vessels; persons dead or injured; and type and amount of property damage.

Once the Commissioner of Maritime Affairs receives the ship master's report, the Commissioner, Deputy Commissioner, or persons appointed by the Commissioner determine whether to conduct a formal investigation. This decision is based on either an evaluation of the master's report or by conducting a preliminary investigation. During a preliminary investigation, the investigating officer "may collect evidence, interview witnesses, examine relevant papers, documents and records, board and examine vessels or equipment, and visit the scene of the casualty or offense."[2]

If a formal investigation is conducted, a Marine Board of Investigation, made up of three or more persons appointed by the Commissioner, convenes a hearing. The Board sends the investigative file, the findings of the hearing, and any recommendations for action against involved parties to the Commissioner or Deputy Commissioner if the Board was appointed by him. In this latter case, the Deputy Commissioner includes his recommendations and forwards the report to the Commissioner, who makes the final decision on any penalty action taken.

The actual percentage of Liberian vessel casualties which are reported is not known. However, Liberian law does not require reports on casualties with damage less than $50,000 unless the vessel cannot continue its voyage. This can be compared to the more stringent United States requirements that all damage greater than $1,500 be reported. In addition, only casualty reports which result in formal investigations are made available to the public. The Liberian Bureau of Maritime Affairs indicates that "very few preliminary investigations result in a formal investigation." Figure 32 shows a list of available reports. While it is not known what percentage of casualties result in formal investigations, the list of 7 casualties for 1969-1972 found in figure 32 can be compared to the 172 polluting casualties reported in

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[1] The Republic of Liberia, "Liberian Maritime Regulations" (RLM-108), Chapter IX (effective July 11, 1969), p. 20.

[2] Ibid., p. 21.

Figure 32. Available Liberian Marine Board Reports.

REPUBLIC OF LIBERIA
MINISTRY OF FINANCE
Bureau of Maritime Affairs

MARINE BOARD OR PRELIMINARY INVESTIGATION REPORTS

YEAR	SHIP	CASUALTY
1968	TORREY CANYON	Stranded/Lost
1968	OCEAN EAGLE	Stranded/Scuttled
1970	PACOCEAN	Structural Failure/Sank
1970	PACIFIC GLORY/ALLEGRO	Collision/Explosion
1972	SAN NICOLAS	Sank
1972	TEXANITA/OSWEGO GUARDIAN	Collision
1972	ORIENTAL WARRIOR	Fire/Stern sank, Bow scuttled
1972	GAYO	Explosion/Sank
1972	TIEN CHEE/ROYSTON GRANGE	Collision/Fire
1973	PACROVER	Sank
1973	ORIENTAL MONARCH	Sank
1974	YAGA	Sank
1974	SEAGULL	Sank
1976	ARGO MERCHANT	Grounded/Lost

The following reports are in the final process of review prior to a Decision by Commissioner of Maritime Affairs:

YEAR	SHIP	CASUALTY
1974	ORIENTAL PIONEER	Grounded/Total Loss
1975	BERGE ISTRA	Explosion/Sank
1976	OLYMPIC BRAVERY	Grounded/Lost
1973	ELWOOD MEAD	Stranding/Salved
1973	GOLAR PATRICIA	Explosion/Sank
1973	DONA MARIKA	Stranding/Salved
1975	GRAND JUSTICE/EUGENE H	Collision/Lost
1975	KINABALU SATU	Sank
1977	JOY	Explosion/Fire/Sank

United States Coast Guard Marine Board reports are available for the following:

YEAR	SHIP	CASUALTY
1975	CORINTHOS/EDGAR M QUEENY	Collision/Fire/Scuttled
1976	SANSIENA	Explosion/Scuttled

the Tanker Casualty File for Liberia during that same period.[1] While all 172 polluting incidents may not satisfy the Liberian reporting criterion of $50,000 damage or more, this figure indicates that the Liberian Bureau of Maritime Affairs does not provide a complete picture of that nation's vessel casualties. However, the formal investigation reports may be valuable in determining the chain of events which led to a vessel casualty. Again, too few reports are available to provide a statistically valid basis for predicting vessel casualties.

C. LIVERPOOL UNDERWRITERS ASSOCIATION

Once a month the Liverpool Underwriters Association publishes "Casualty Returns."[2] The association publishes this list of casualties as a service to its members and also as a collection of information for its own files. A casualty is reported in the "Casualty Returns" if a vessel greater than 500 gross tons is involved in a casualty resulting in total vessel loss or loss of life. Figure 33 shows a page from "Casualty Returns." As can be seen, the information provided includes vessel identification, names of owners or operators, and particulars about the voyage, cargo, and casualty.

It is not known how the Liverpool Underwriters Association collects its data. Consequently, it is unclear if "Casualty Returns" provide a complete listing of vessel total losses. Another problem with this data source on casualties is the fact that little information is provided about the casualties. In some cases, the location of the casualty is not provided or the date of the casualty is not shown. In addition, the cause of the casualty and the surrounding environmental conditions are rarely provided. As a result, only general information about casualties can be obtained. Because the information provided in the Casualty Returns is incomplete, it cannot be considered a primary source of data on vessel casualties.

D. TANKER ADVISORY CENTER

The Tanker Advisory Center in New York compiles information about tanker casualties which occur around the world. The data contain information on tankers greater than 6,000 deadweight tons. As of January, 1978, the file had histories of approximately 5,000 tankers.

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[1] Information and Analysis Branch, U.S. Coast Guard, "Coding Instruction for Commercial Vessel Casualties," (Washington, D.C.: 1976), pp. 33 and 36.

[2] Liverpool Underwriters Association, "Casualty Returns," published monthly (Liverpool, England).

LIVERPOOL UNDERWRITERS ASSOCIATION

CASUALTY RETURNS, JANUARY, 1966

IMPORTANT CASUALTIES

(All vessels are constructed of steel unless otherwise stated)

VESSEL	FLAG Port of Registry	TONS GROSS	YEAR BUILT	OWNERS (Operators)	VOYAGE	CARGO	PARTICULARS OF CASUALTY
*LAMPSIS	Gr Piraeus	7,229	1943	Proteus Shipping Co., S.A.	Casablanca-Philadelphia	Manganese ore	In heavy weather cracks main deck and hull, bulwarks weakened, leaking, engine-room flooded. Sank about lat. 34 18 N., long. 51 22 W.
†NERUTO MARU	Ja Kobe	2,966	1965	Tokushima Kisen K.K.	Kennedy Bay-Osaka	Timber	Sank in heavy weather about lat. 21 5 N., long. 124 15 E.
ANKAA	Ch Valparaiso	611	1921	Cia. Nav. Latinoamericana, Ltda.	——	——	Sank off Chanaral Dec. 26, 1965.
†MONTE PALOMARES	Sp Bilbao	8,335	1961	Naviera Aznar, S.A.	Hampton Roads-Spain	Grain	Abandoned due severe listing, reported cargo shifting in heavy weather. Sank about lat. 37 40 N., long. 46 29 W. Of crew of 38 six were saved
†KUUTSALO	Fi Helsinki	1,251	1955	Anella Shipping, Ltd., O/Y.	Kolobrzeg-Holmsund	Bricks	Sank in rough seas, reported due cargo shifting, NW. of Gotska Sancon Island, Sweden. Seventeen saved, two drowned.
†MONELOS	Sp Coruna	956	1956	Naviera Lucentum, S.A.	Rijeka-Palma (Maj)	Timber	Sank in storm about 150 miles E. of Palma, in about lat. 38 57 N, long. 6 21 E. Two of crew of 16 saved.
MASTROLIAS	Gr Piraeus	762	1917	Matheos Rigas	——	Ballast	Broken and sunk in deep water N.W. of Polykandros Island.
JAG SEVAK	In Bombay	4,843	1940	Great Eastern Shipping Co., Ltd.	Visakhapatnam——	Cement and general	Aground entrance channel Visakhapatnam. Constructive total loss. (See July, 1965, Return.)
*WINNER	Li Monrovia	7,219	1943	Winner Shipping Corp., Ltd.	At Wakayama	Ballast	Grounded Wakanoura, refloated, drydocked Hitachi. Constructive total loss. (See September, 1965, Return.)
†AMARYLLIS	Pa Panama	7,201	1945	Amarylis S.S. Co., Ltd.	Manchester-Baton Rouge	Ballast	Aground Riviera Beach, Florida. Constructive total loss. (See September, 1965, Return.)
*ERETTEO	It Rome	7,195	1943	Fratelli d'Amico	Poronaisk-India	Woodpulp and paper	Grounded Sakhalin Island. Constructive total loss. (See October, 1965, Return.)
*THORSHALL (tank)	No Sandefjord	27,040	1961	A/S Thor Dahl	Botany Bay-Dumai	——	Aground about lat. 6 50 S., long. 105 20 E. Constructive total loss. (See November, 1965, Return.)
PINO AN (ex Bermuda Mariner)	Li Monrovia	9,653	1946	Cia. Nav. Pearl, S.A.	Rotterdam-Sea trials	——	Aground about lat. 52 2 N., long. 4 8 E. Compromised total loss. To be broken up. (See November, 1965, Return.)

* Electrically welded. † Part electrically welded.

Figure 33. Excerpt from Liverpool Underwriters Association Casualty Returns.

The Center, headed by Arthur MacKenzie, was established to provide specific vessel casualty histories for shippers, insurance companies, or anyone involved with tankers.

The Tanker Advisory Center began collecting data in early 1971, and by February, 1974, has compiled historical data back to January 1, 1964. This data system contains two types of information: (1) vessel characteristics, and (2) casualty data. The vessel characteristics, i.e., deadweight tons, year built, flag, owners, etc., were taken from The Tanker Register[1] (see The Tanker Register, section IX.H of this report). All of the casualty data have been taken from Lloyd's List[2] and are updated daily. No other data sources are used to expand or verify Lloyd's information on the casualties. Lloyd's reports generally contain such information as vessel type, location of casualty, effect of casualty, type of casualty, amount of pollution and cost of repairs. This information is recorded at the Center. From The Tanker Register, such information as type of vessel, flag, deadweight tons, owner, builder, year built, size, name, and any name changes are obtained and added to the vessel file.

At the Tanker Advisory Center, each printed report of a casualty from Lloyd's List is put in the files. The accidents are recorded under vessel name and under type of casualty. Mr. MacKenzie, or one of his associates at the Center, makes a decision, based on Lloyd's description of the casualty, what type of casualty took place, and the effect of that casualty. Tables 3 and 4 list the possible types and effects of casualties. If the involved vessel does not have a previous record at the Center, information concerning the ship is found in The Tanker Register and recorded in the files at that time.

Once the information is compiled at the Center, it is sent to Marine Management Systems in Stamford, Connecticut. There the data are computerized. The data can be accessed through interaction with the GE Timesharing Network. To obtain data from this system, the user specifies the parameters by which he/she would like the data searched. Data can be extracted by vessel name, in which the vessel specifications and a description of the casualties in which the vessel is known to be involved are printed (see figure 34). Data may also be extracted by type of casualty, flag, effect of casualty, etc. Figure 35 shows a printout of the U.S. flag vessels involved in casualties resulting in loss of life.

As mentioned in the section on the Tanker Casualty File, the incidents not included in Lloyd's List are those which do not become known to Lloyd's agents either through

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[1] H. Clarkson and Company of London, The Tanker Register, published annually (London, England, 1960-).

[2] Lloyd's of London, "Lloyd's Weekly Casualty Reports," (London, England).

Table 3

Code for Tanker Casualties

Casualty Type

11	Weather damage at sea
12	Weather damage in port underway
13	Weather damage in port moored
21	Stranding in coastal waters
22	Stranding in port
23	Stranding in river
24	Stranding in unreported area
31	Collision at sea
32	Collision in coastal waters
33	Collision in port
34	Collision in river
35	Collision in unreported area
41	Contact damage
42	Hit bottom, grounded
43	Hit dock, buoy, or structure
44	Hit vessel moored to dock
45	Hit vessel at anchor
46	Struck submerged object
47	Hit by vessel while anchored
48	Hit by vessel while moored
49	Hit by assisting tug
51	Fire and/or explosion, cargo tanks
52	Fire and/or explosion, pumproom
53	Fire and/or explosion, engine room
54	Fire and/or explosion, main engine
55	Fire and/or explosion, boilers
56	Fire and/or explosion, other area
61	Damage to machinery, propeller, rudder, etc.
71	Lost anchor and/or chain
72	Alleged crew negligence
73	Ice damage
74	Flooded engine room
75	Blacked out
76	Lube oil system contaminated
77	Engine trouble
78	Pumproom flooded
80	Steering gear trouble
81	Oil spill
82	Damage from war or hostilities
83	Other casualty
84	Broke down at sea
85	Stopped at sea for repair
90	Scrapped
91	Sold for scrap
92	Converted

Table 4

Code for Tanker Casualties

Casualty Effect

A	Diverted for repairs
B	Returned to port for repairs
C	Remained in port for repairs
D	Not assigned yet
E	Towed into port
F	Towed part way then under own power
G	Tow requested but underway before tug arrived
H	Tug accompanied vessel to port
J	Speed reduced because of damage
K	Lightered cargo
L	#### Tons of damaged steel
M	## Person(s) dead or missing
N	## Person(s) severely injured
O	Lost #### tons of oil to the environment
P	Lost an unknown quantity of oil to environment
Q	Total loss
R	Constructive total loss
S	Compromised total loss
T	Vessel abandoned by crew
V	Dock, buoy, or structure reported damaged
W	Dock, buoy, or structure heavily damaged
X	Reserved
Y	Other vessel heavily damaged
Z	Other vessel reported damaged

Figure 34. Printout of Vessel Casualty History, Tanker Advisory Center.

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ICHAEL C.LEMOS          DWT:249979   LIQ. BULK TANKER FLAG: GRE CLASS: AB
                        STEAM TURB  OWN: SUNRISE SHIPPING CO.,S. (195413)
                        DEL DATE: 0171  SHIP NO: 27100085  BLDR NO: 25030

0772 HIT BY VESSEL      : HIT AT ST.CROIX 42= BULWARKS,1SHELL AND 1DECK PLA
     WHILE ANCHORED       TE DAMAGED
                          EFFECT:
                          10 TONS OF DAMAGED STEEL

1173 WEATHER DAMAGE     : BREAKWATER BUCKLED,MAIN CONDENSER,MAIN BOILER DAM
     AT SEA               AGED.15 TANK CRACKS

1073 ALLEGED CREW       : MAIN BOILER 6 ECONOMISER ELEMENTS CHOKED IRON OXI
     NEGLIGENCE           DE,CRACKED,LEAKING

0274 ENGINE TROUBLE     : REMAINED JEBEL DHANNA 4 DAYS,ENGINE FAILURE. NO D
                          ETAILS GIVEN
                          EFFECT:
                          REMAINED IN PORT FOR REPAIRS

0374 WEATHER DAMAGE     : #6 C AFT BULKHEAD FRACTURED GUARDRAILS,PIPES,GUAR
     AT SEA               D PLATES DAMAGED

0374 OIL SPILL          : LOST OIL OVERBOARD WHILE DISCHARGING LE HAVRE
                          EFFECT:
                          5 TONS OF OIL LOST TO THE ENVIRONMENT

0175 STRANDING IN       : STRANDED ST.CROIX,LOADED,BOTTOM PLATING WAY #1 TA
     COASTAL WATERS       NK EXTENSIVELY DAMAGED & TWO TANKS RUPTURED,HEAVY
                           OIL LEAKAGE TO SEA,REFLOATED,LIGHTERED 35 MILES
                          OFF ST.CROIX
                          EFFECT:
                          500 TONS OF OIL LOST TO THE ENVIRONMENT
                          370 TONS OF DAMAGED STEEL
                          LIGHTERED CARGO

0775 ALLEGED CREW       : MAIN HP TURBINE & CONDENSER DAMAGED BY CREW  NEGL
     NEGLIGENCE           IGENCE ROTOR REQUIRES REBALANCING AND 7,600 CONDE
                          NSER TUBES TO BE RENEWED

0576 DAMAGE TO MACH.,   : DELAYED C.TOWN 4 DAYS,IN BALLAST;STERN TUBE WHITE
     PROP,RUDDER,ETC.     METAL CRACKED,LEAKING
                          EFFECT:
                          REMAINED IN PORT FOR REPAIRS

1177 ALLEGED CREW       : DAMAGE TO AIR HEATER FOR MAIN BOILER DUE CREW NEG
     NEGLIGENCE           LIGENCE

1177 HIT DOCK, BUOY     : HIT SPM AT DAS ISLAND WHILE MOORING,BOTH DAMAGED;
     OR STRUCTURE         REMAINED AT DAS ISLAND FOR 19 DAYS;SOFT NOSE STEM
                           & SIDE SHELL PLATES HEAVILY SET IN AND HOLED IN
                          SEPARATE LOCATIONS
                          EFFECT:
                          DOCK, BUOY OR STRUCTURE REPORTED DAMAGED
```

Figure 35. Printout of U.S. Vessel Casualties, Tanker Advisory Center.

SHIP NAME	FLAG	#CAS	CDAT	CASU
CHEVRON MISSISSIPPI	USA	2	1274	11
COVE COMMUNICATOR	USA	9	1065	49
			0477	55
EXXON SAN FRANCISCO	USA	1	0177	56
HESS BUNKER	USA	5	0968	34
OGDEN CHALLENGER	USA	7	0271	31
PASADENA	USA	5	0364	51
SANTA MARIA	USA	6	1064	33
TEXACO NORTH DAKOTA	USA	2	1073	52
TULLAHOMA	USA	6	0769	32

newspaper articles, the local maritime bureau, or through claims for damaged cargo. Lloyd's has agents in over 1,900 ports around the world. The U.S. Coast Guard has indicated that, other than the Far East, they believe Lloyd's data to be very complete. In an effort to estimate how complete the data are, Mr. MacKenzie has received, from the Information and Analysis Branch of the U.S. Coast Guard, microfilm of the casualties in the Vessel Casualty Reporting System for fiscal year 1976 to compare to the Center's tanker casualty data. Mr. MacKenzie had indicated the work has just begun, but in this initial effort he has found close to 100 percent of the casualties in the VCRS data are also in the Tanker Advisory data. Mr. MacKenzie believes that if his data are incomplete he is probably missing minor casualties. An analysis of the American casualties in both the Tanker Casualty File and the Vessel Casualty Reporting System can be found in section VII-G of this report.

One problem in obtaining data through the timesharing network is that information on ships which are scrapped or are total losses is not computerized. If information about a particular vessel is needed, this may not present problems because users usually want information about vessels in service. However, if statistics about casualties in specific locations or a ship owner's fleet history is desired, the data will be incomplete. This missing information is available in hard copy at the Tanker Advisory Center but is not easily obtained because casualties are filed only by vessel name or primary type of casualty ("total loss" is a result, not a type of casualty).

The other possible problems are common to all data systems: inaccurately or incompletely recorded data. Data may be inaccurately recorded at Lloyd's, incorrectly transferred from Lloyd's to the Center's records, or inaccurately entered into the computer. Also, a tanker casualty may be missed, as the Center does not have a standardized procedure for detecting errors.

A review of the Tanker Advisory Center's data system indicates that two means of upgrading the file would be to (1) include total losses in the Marine Management System, and (2) institute a systematic procedure for detecting and correcting errors in the file. Including total losses in the computer system would make that file more complete. Instituting an editing procedure would improve the accuracy of the data at both the Tanker Advisory Center and at Marine Management Systems.

While the Tanker Advisory Center contains information which other data systems also have, its primary usefulness is that it provides an easily accessible data base through which those associated with the shipping industry and the general public may obtain vessel casualty histories.

E. TANKER CASUALTY FILE

The Tanker Casualty File is a computerized data base containing information about international casualties involving tankships. This system was designed by the Office of Merchant Marine Safety of the U.S. Coast Guard as an aid to the evaluation of the safety of marine transportation of oil. The data include information about casualties to:

- Tankships carrying oil, including petroleum in any form;
- Combination carriers, i.e., ore/oil and bulk/oil, if the vessel was in tanker service; and
- Oil/chemical carriers even if the cargo was not petroleum.

The data do not include information regarding:

- Incidents of hostile action;
- Shipyard accidents;
- Breakdowns not requiring assistance to port;
- Loading and discharge mishaps; and
- Incidents involving tankships carrying grain, wind, molasses, sludge, fish oil or vegetable oil.

  Note: Fires, explosions, sinkings, and capsizings occurring while a ship is at pier are included.

At present, the computerized data file contains casualty information for the years 1969-1973. The data for 1974-1976 have been collected and keypunched by a private consulting firm. The Office of Merchant Marine Safety is presently editing these data.

Figure 36 diagrams the process by which a casualty becomes a part of the Tanker Casualty File. The primary sources of data are Lloyd's Weekly Casualty Report[1] and Lloyd's Register Quarterly.[2] A casualty is reported if it becomes known to one of Lloyd's agents. Lloyd's has agents stationed in over 1,900 ports in over 180 countries. These agents are often members of the shipping or business community or work as insurance agents for Lloyd's. Because Lloyd's insures ship cargo, an agent usually becomes aware of ship casualties when

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[1] Lloyd's of London, "Lloyd's Weekly Casualty Reports," (London, England).

[2] Lloyd's of London, "Lloyd's Register Quarterly," (London, England).

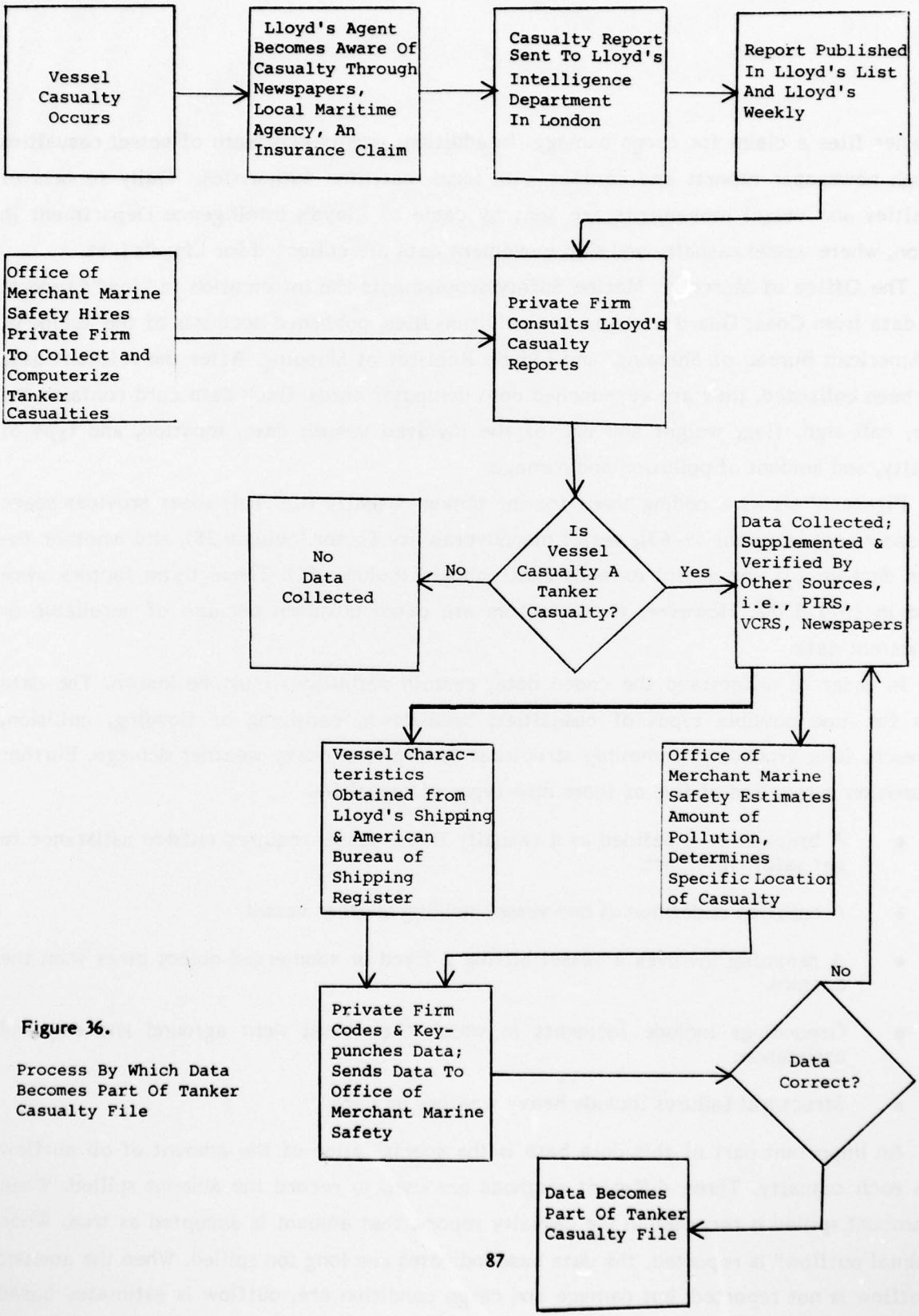


Figure 36.

Process By Which Data Becomes Part Of Tanker Casualty File

an owner files a claim for cargo damage. In addition, agents can learn of vessel casualties through newspaper reports and contact with local maritime authorities. Daily reports of casualties and vessel movements are sent by cable to Lloyd's Intelligence Department in London, where vessel casualty and ship movement data are collected for Lloyd's List.

The Office of Merchant Marine Safety supplements the information in Lloyd's reports with data from Coast Guard accident and pollution files, published accounts of the accident, the American Bureau of Shipping, and Lloyd's Register of Shipping. After the relevant data have been collected, they are keypunched onto computer cards. Each data card contains the name, call sign, flag, weight and age of the involved vessel; date, location, and type of casualty, and amount of pollution and damage.

Figure 37 shows a coding sheet for the tanker casualty file. This sheet provides space for repair cost (columns 59-63), vessel maneuverability factor (column 38), and whether the dollar damage off the vessel exceeds that onboard (column 66). These three factors were added in 1971-1972. However, these factors are often unknown because of unreliable or nonexistent data.

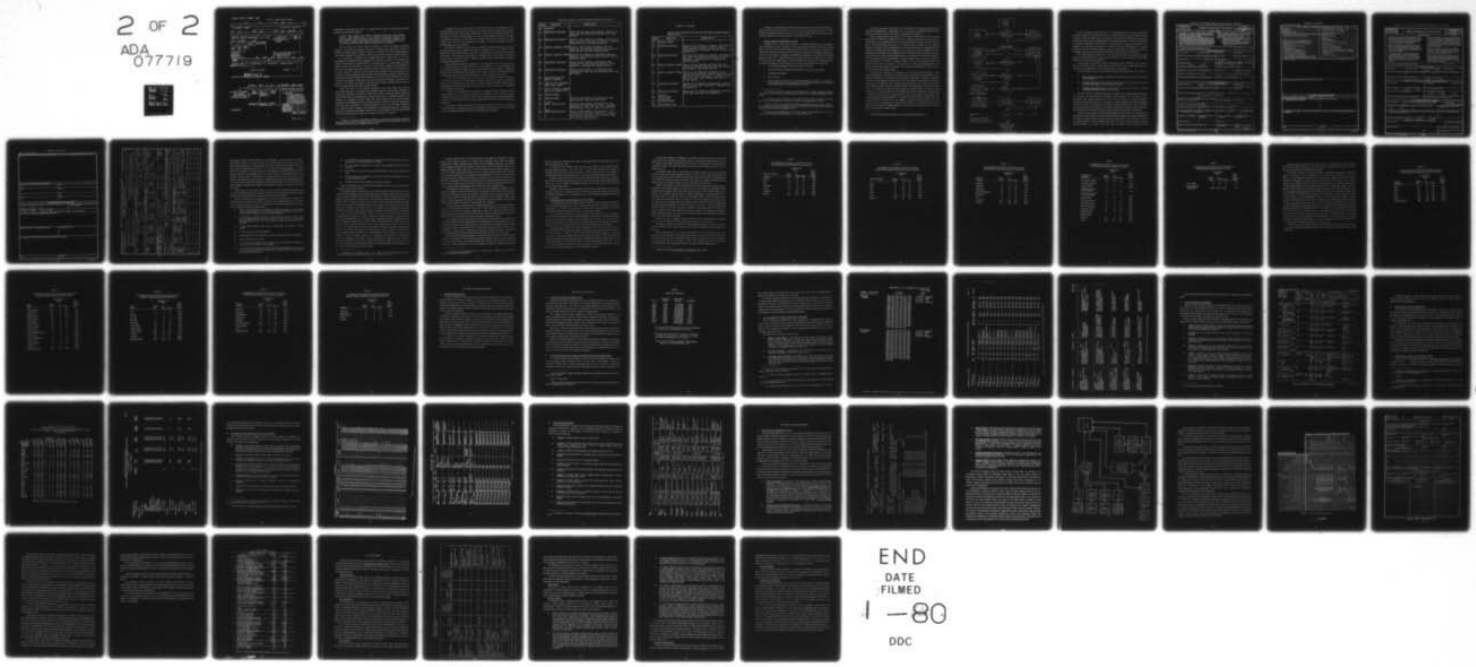
In order to understand the coded data, certain definitions must be known. The data allow for nine possible types of casualties: breakdown, capsizing or flooding, collision, explosion, fire, grounding, ramming, structural failure, and heavy weather damage. Further explanation is required of five of these nine types of casualties.

- A breakdown is defined as a casualty if the vessel required outside assistance to get safely into port.
- A collision is defined as one vessel striking another vessel.
- A ramming involves a vessel hitting a fixed or submerged object other than the bottom.
- Groundings include incidents in which the vessel went aground and required assistance.
- Structural failures include heavy weather damage.

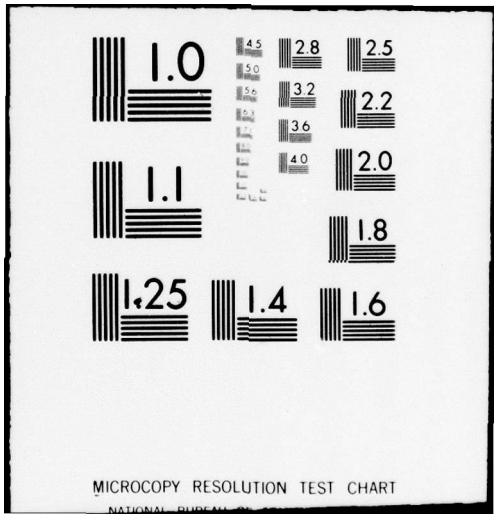
An important part of this data base is the specification of the amount of oil outflow from each casualty. Three different methods are used to record the amount spilled. When the amount spilled is recorded in the casualty report, that amount is accepted as true. When "minimal outflow" is reported, the data base indicates one long ton spilled. When the amount of outflow is not reported, but damage and cargo condition are, outflow is estimated based on the damage and cargo condition. Outflow is estimated to be equal to the vessel's

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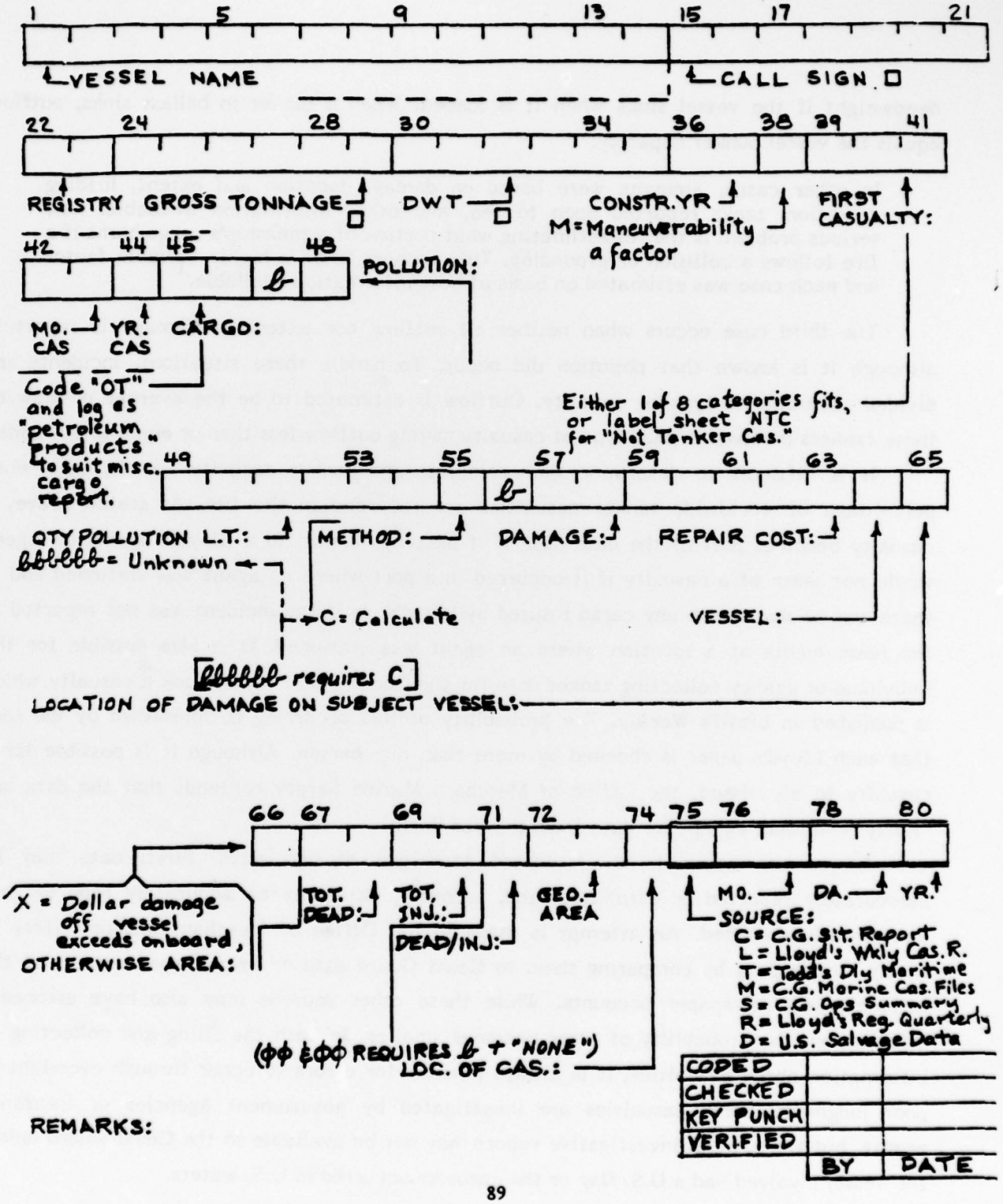


Figure 37. Tanker Casualty Worksheet.

Sht__ of __

deadweight if the vessel sinks when it is loaded. When a tanker in ballast sinks, outflow equals the vessel bunker capacity.

> In other cases, amounts were based on damage location and extent, loading condition, tanks reported open to sea, and other information available. One serious problem is that of estimating what portion of a tankship's cargo burns if a fire follows a collision or grounding. This appears to be a highly variable factor and each case was estimated on basis of best information available.[1]

The third case occurs when neither oil outflow nor extent of damage is reported, although it is known that pollution did occur. To handle these situations, incidents are divided according to type of casualty. Outflow is estimated to be the average outflow of those tankers involved in that type of casualty having outflow less than or equal to 500 tons.

It is difficult to determine how complete the tanker casualty file is, i.e., what percentage of worldwide tanker casualties are recorded in the file. As stated above, a casualty becomes part of the data base if it becomes known to a Lloyd's agent. An agent would not learn of a casualty if it occurred in a port where no agent was stationed and if there was no damage to any cargo insured by Lloyd's, or if the incident was not reported in the news media at a location where an agent was stationed. It is also possible for the individual or agency collecting tanker data for the Coast Guard to overlook a casualty which is published in Lloyd's Weekly. The probability of this occurring is diminished by the fact that each Lloyd's paper is checked by more than one person. Although it is possible for a casualty to be missed, the Office of Merchant Marine Safety contends that the data are "fairly" complete except for data from the Far East.

Errors can occur in the reported casualties in two ways. First, data may be inaccurately reported or estimated, and, secondly, data may be accurately reported but inaccurately recorded. An attempt is made in the Office of Merchant Marine Safety to verify Lloyd's data by comparing them to Coast Guard data or to published reports of the incident, i.e., newspaper accounts. While these other sources may also have erroneous information, the probability of error becomes smaller. In both the filing and collecting of information about casualties, it is always possible for errors to occur through oversight or poor judgment. Some casualties are investigated by government agencies or insurance agents, but the official investigative report may not be available to the Coast Guard unless the vessel involved had a U.S. flag or the casualty occurred in U.S. waters.

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[1] James C. Card, et al., "Tankship Accidents and Resulting Oil Outflows, 1969-73," Report presented at the Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution (San Francisco, California: 1975), p. 207.

If Lloyd's is the only data source for a specific casualty, the possibility of error becomes greater; first, because the data are not verified, and, secondly, because all the information required for the Tanker Casualty File is not reported in Lloyd's Weekly. This often forces the data collecting agency to make certain judgments about the incident. Consequently, particular caution should be exercised when using the vessel and cargo damage data. No matter who estimates this damage, it must be remembered that the resulting figures are only estimates.

The Office of Merchant Marine Safety has adopted a policy for dealing with missing information about cost of repairs and amount of pollution. If costs of repairs are not reported, the Coast Guard makes no attempt to estimate them. In cases where the amount of pollution is not reported, the estimates are always made at the Office of Merchant Marine Safety in order to maintain a degree of consistency above and beyond the general estimating rules discussed earlier.

Data pertaining to either the casualties or the particulars of the vessels involved in the casualties may be accurately recorded in Lloyd's Weekly or in Lloyd's Register but inaccurately recorded for coding into the Tanker Casualty File. The Office of Merchant Marine Safety has indicated that a number of the original reports are reread and data are verified, particularly for more serious casualties, in order to eliminate these errors.

An error of interpretation may also occur in the category of specific location of casualty (pier, harbor, etc.). In some cases it is difficult and, in other cases, it is impossible to glean this information from the report. If a good estimate of specific location can be made, Merchant Marine Safety does this interpretation. For cases in which it is impossible to tell, "Unknown" is entered.

In addition to the uncertainties regarding the completeness and accuracy of the file, another problem with the data which makes analysis difficult is the method of coding geographic location. As can be seen in figure 38, the world is divided into only 22 geographic locations. The large areas covered by these codes makes analysis by smaller areas nearly impossible.

No attempt is made to determine the cause of casualties. This leaves a large gap in the data. However, it should be noted that the method of collecting data for this file often makes it impossible to garner that amount of detail about the accident.

Figure 38. Coding for Location of Ship at the Time of the Casualty.

CODE	LOCATION	BOUNDARIES
00	ATLANTIC	
01	NORTHWEST ATLANTIC	North of the Tropic of Cancer, between 30° West and the East Coast of the U.S. and Canada.
02	NORTHEAST ATLANTIC	North of the Tropic of Cancer, between 30° West and the West Coast of Europe - Includes Denmark Strait and Greenland Sea.
03	MIDDLE ATLANTIC OCEAN	Between the Tropic of Cancer and the Equator, and between South America and the West Indies and the African Coast.
04	MIDDLE ATLANTIC OCEAN	Between the Tropic of Capricorn and the Equator, and between South America and the African Coast.
05	SOUTHWEST ATLANTIC	South of the Tropic of Capricorn and between 30° West and the coast of South America - Includes the Drake Strait.
06	SOUTHEAST ATLANTIC	South of the Tropic of Capricorn and between 30° West and the African Coast and 20° East.
07	CARRIBEAN SEA AND GULF OF MEXICO	
08	GULF OF ST. LAWRENCE AND GREAT LAKES	
09	DAVIS STRAITS, HUDSON BAY, AND BULFIN BAY	
10	INDIAN OCEAN	
11	INDIAN OCEAN	South of the Tropic of Capricorn, and between 20° East and 140° East.
12	WEST ~~EAST~~ INDIAN OCEAN	North of the Tropic of Capricorn, and between 20° East and 70° East - Includes Arabian Sea, Gulf of Aden, and Red Sea.
13	EAST ~~WEST~~ INDIAN OCEAN	North of the Tropic of Capricorn, and between 70° East and 140° East - Includes Bengal Bay and other small bodies among the Malaya Archipelago.

Figure 38. (continued)

CODING FOR LOCATION OF SHIP AT THE TIME OF THE CASUALTY
(Continued)

CODE	LOCATION	BOUNDARIES
20	PACIFIC OCEAN	
21	NORTHWEST PACIFIC	North of the Tropic of Cancer, and between 180° Meridian and the coast of Asia - Includes Sea of Okhotsk, Sea of Japan, and Yellow Sea.
22	NORTHEAST PACIFIC	North of the Tropic of Cancer, and between the 180° Meridian and the coast of North America - Includes Gulf of Alaska and Bering Strait.
23	MIDDLE PACIFIC OCEAN	North of the Equator and South of the Tropic of Cancer, between the East Indies and Central and South America.
24	MIDDLE PACIFIC OCEAN	South of the Equator and North of the Tropic of Capricorn, between Australia and the South American Coast - Includes Coral Sea and other small bodies of water in these limits.
25	SOUTHEAST PACIFIC	South of the Tropic of Capricorn, between 70° West and 180° Meridian - Includes the Tasman Sea.
26	SOUTHWEST PACIFIC	South of the Tropic of Capricorn, between 140° East and the 180° Meridian.
30	ARCTIC ~~ARTIC~~ OCEAN	
40	ANTARCTIC ~~ANTARTIC~~ OCEAN	
50	MEDITERREAN SEA	

A number of studies have been published analyzing these data. Three basic studies are those done by Porricelli and Keith,[1] J. J. Henry, Inc.,[2] and Card, Ponce, and Snider.[3] These studies provide frequency tables of types of casualties, deaths, injuries, polluting incidents, amounts of pollution, and specific location for the 1969-1973 data.

F. VESSEL CASUALTY REPORTING SYSTEM

Annually the U.S. Coast Guard compiles a computerized summary of commercial vessel casualties that were reported by Coast Guard marine inspectors during the previous fiscal year. The Vessel Casualty Reporting System (VCRS) is the process through which these United States marine casualties were reported. This system was designed to provide an aid to the Coast Guard in establishing standards and regulations for the safety of life and property at sea. All U.S. registered vessels and vessels involved in casualties in U.S. waters are required to file casualty reports. The law requires that the master of a vessel report to the Officer in Charge of Marine Inspection any casualty which results in the following:

a. Actual physical damage to property in excess of $1,500;

b. Material damage affecting the seaworthiness or efficiency of a vessel;

c. Stranding or grounding;

d. Loss of life; or

e. Injury causing any persons to remain incapacitated for a period in excess of 72 hours; except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.[4]

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[1] V.F. Keith, et al., "An Analysis of Oil Outflows Due to Tanker Accidents," Report presented at the Conference on Prevention and Control of Oil Spills (Washington, D.C., 1973).

[2] J.J. Henry Co., Inc., "Analysis of Oil Outflows Due to Tanker Accidents, 1971-72," Report for the United States Coast Guard, CG-D-81-74 (Washington, D.C., 1973).

[3] James C. Card, et al., "Tankership Accidents and Resulting Oil Outflows, 1969-73," Report presented at the Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution (San Francisco, California, 1975).

[4] Information and Analysis Branch, U.S. Coast Guard, "Coding Instruction for Commercial Vessel Casualties" (Washington, D.C., 1976), pp.33 and 36.

The facts contained in filed reports are collected into a computerized data base at Coast Guard Headquarters in Washington, D.C.[1] The process by which this information gets from the master of a vessel to the computer is diagrammed in figure 39.

When a casualty occurs, the master of the vessel is required by law to file a report (either Form CG-924-E or CG-2692). This report is signed by the master of the vessel, the vessel owner, or a representative from the company owning the vessel. Next the report is sent to the Marine Safety field office. At the field office, a decision is made regarding whether the casualty will be investigated. In cases where the report is straightforward and there is no question about what happened, the casualty will not be investigated. When an investigation is necessary, the investigating officer attempts to meet the vessel as it comes into port so that he can question witnesses or those involved before they leave the ship. It is the investigating officer's responsibility to collect evidence and to resolve any contradictions occurring in the report or reports received. After the investigating officer has completed the report, he attaches a cover letter to it giving his interpretation of the primary cause of the casualty. The report is then reviewed and approved by both the head of the field office and the district office.

From the district office, the report goes to the Casualty Review Branch at Coast Guard Headquarters. At this office, the report is read and reviewed for completeness. If the report is incomplete, it is returned to the field office. Otherwise, it is logged in, assigned a case number, and is added to the index card file in the Casualty Review Branch. The report is then sent to the Marine Safety Evaluation Branch where the case is again reviewed. This office looks for trends in the data. The Information and Analysis Branch receives the report next. In this office the report data are coded for computerization. To keep the coding consistent, one individual codes the vessel specifications and environmental conditions, and a Yeoman First Class codes the nature, primary cause, and location of the casualty. Once this information has been keypunched, it is sent back to Information and Analysis; there the punched cards are checked for errors through a computer editing program. The cards containing errors are repunched by staff in the Information and Analysis Branch and once again checked through the editing program. At the end of the fiscal year, all the data on punch cards are put on magnetic tape.

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[1] Information and Analysis Branch, U.S. Coast Guard, Washington, D.C.

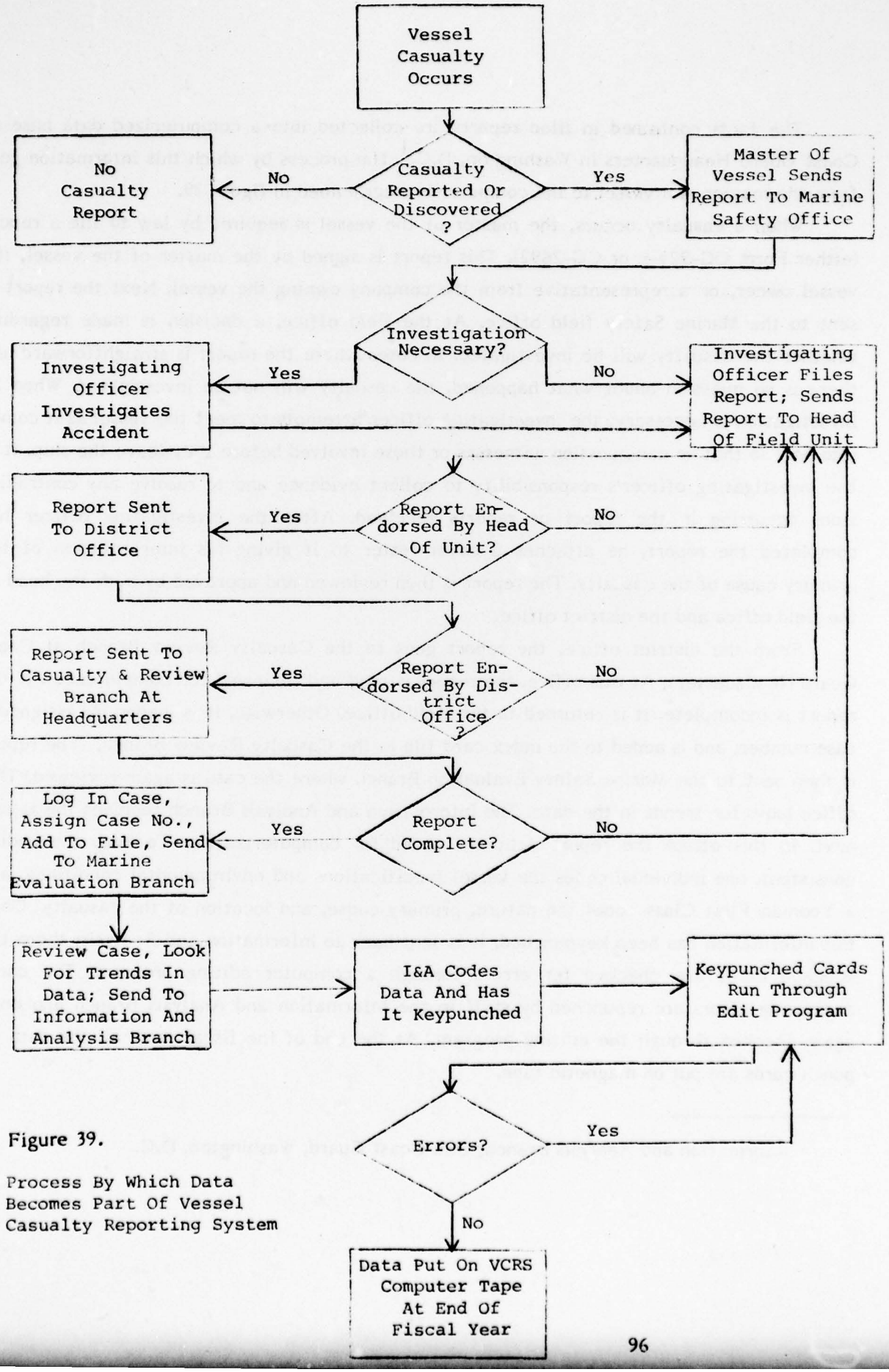


Figure 39.

Process By Which Data Becomes Part Of Vessel Casualty Reporting System

It is not unusual, at any given time, for an investigating officer to have a number of incomplete reports on his desk. The officer is usually waiting for involved vessels to come into port so that the report may be completed. At the end of the fiscal year, a copy of all incomplete reports is sent to Headquarters. The investigating officer sends with each report a statement indicating what he believes to be the primary cause of the casualty. The purpose of the end-of-year procedure is to enable Coast Guard Headquarters to keep an accurate record of the year's casualties. After the final report is completed and filed at Headquarters, all necessary adjustments are made to the previously recorded data.

The VCRS data are divided into 3 major accident categories involving: (a) a vessel casualty, (b) death and/or injury occurring at the time of the vessel casualty, and (c) death and/or injury without a vessel casualty.

Coast Guard form CG-2692 is used in reporting (a). Form CG-924E is used in case of (b) or (c). Figures 40 and 41 show copies of these forms. Form CGHQ-4095, figure 42, illustrates the coding sheet from which casualty data is keypunched.

As can be seen in figure 42, the computerized data are subdivided into three sections:

- Data required on all cases, including vessel number and type, as well as time and date of casualty.
- Vessel casualty data containing vessel specifications, nature, cause, result, and environmental conditions surrounding the casualty.
- Personal injury/death data including name, activity, and status of person involved; also type, cause, and result of injury.

Of major concern in using any data base for analysis is the completeness and accuracy of that data. The Information and Analysis Staff considers that the VCRS data is incomplete. They believe, however, that the file contains reports on almost all accidents involving oceangoing vessels and on all casualties of large magnitude. For small fishing boat and tug casualties, the Information and Analysis staff believes that the data may reflect only 50-60 percent of all accidents. A comparison between the American tanker accidents in the VCRS file and the tanker casualty file can be found in section VII-G of this report.

There are three areas in the VCRS reporting process where errors or inaccuracies are most likely to occur. The first and most obvious place is onboard the involved vessel, where the report is initially filled out. The master of the vessel may not take the time to fill out the report properly or may purposely hide some of the facts of the casualty in order to protect himself or his crew. In the first case, the report may be corrected by the

Figure 40. Form CG-2692; Report of Vessel Casualty or Accident.

DEPARTMENT OF TRANSPORTATION
U. S. COAST GUARD
CG-2692 (Rev. 12-70)

REPORT OF VESSEL CASUALTY OR ACCIDENT

Form Approved
OMB No. 04-R3003
REPORTS CONTROL SYMBOL MVI-4017

INSTRUCTIONS

1. An original and two copies of this form shall be submitted, without delay, to the Officer in Charge, Marine Inspection, in whose district the casualty occurred, or in whose district the vessel first arrived after such casualty.
2. If the person making the report is a licensed officer on a vessel required to be manned by such officer, he must make the report in writing and in person to the proper Marine Inspector. If because of distance it may be inconvenient for such an officer to submit the report in person, he may submit the required number of copies by mail. However, to avoid delay in investigations, it is desired that reports be submitted in person.
3. This form should be completed in full; blocks which do not apply to a particular case should be indicated as "NA". Where answers are unknown or none, they should be indicated as such. All copies should be signed.

NOTE: (1) Report all deaths and injuries, which incapacitate in excess of 72 hours, on CG-924E whether or not there was a vessel casualty.
(2) Attach separate Form CG-924E to this report for each person killed or injured and incapacitated in excess of 72 hours as a result of the vessel casualty reported herein.

To: Officer in Charge, Marine Inspection, Port of

DATE SUBMITTED

I PARTICULARS OF VESSEL

1. NAME OF VESSEL	2. OFFICIAL NUMBER	3. HOME PORT	4. NATIONALITY
5. TYPE OF VESSEL (Frt., pass., tkr., etc)	6. PROPULSION (Steam, diesel, etc)	7. GROSS TONNAGE	8. REGISTERED LENGTH OR L.O.A.
9. HULL MATERIALS	10. YEAR BUILT	11. RADIO EQUIPMENT ☐ TRANSMIT ☐ RECEIVE ☐ VOICE ☐ CW (Key)	
12. (a) RADAR EQUIPPED ☐ YES ☐ NO		(b) IF YES, RADAR OPERATING AT TIME OF CASUALTY ☐ YES ☐ NO	
13. (a) CERTIFICATE OF INSPECTION ISSUED AT PORT OF		(b) DATE CERTIFICATE OF INSPECTION ISSUED	
14. (a) NAME OF MASTER OR PERSON IN CHARGE (Indicate which)		(b) DATE OF BIRTH	(c) LICENSED BY COAST GUARD ☐ YES ☐ NO
15. (a) NAME OF PILOT (If on board at time of accident)		(b) PILOT SERVING UNDER AUTHORITY OF LICENSE ISSUED BY ☐ USCG ☐ STATE ☐ FOREIGN	
16. (a) NAME OF OWNER(S), OPERATOR(S) OR AGENT (Indicate which)		(b) ADDRESS OF OWNER(S), OPERATOR(S), OR AGENT	

II PARTICULARS OF CASUALTY

17. (a) DATE OF CASUALTY	(b) TIME OF CASUALTY (Local or zone)	(c) ZONE DESCRIPTION	(d) TIME OF DAY ☐ DAY ☐ NIGHT ☐ TWILIGHT

18. LOCATION OF CASUALTY (Latitude and longitude; distance and TRUE bearing from charted object; dock; anchorage; etc.)

19. BODY OF WATER (Geographical name)	20. RULES OF THE ROAD APPLICABLE ☐ INLAND ☐ GREAT LAKES ☐ WESTERN RIVERS ☐ INTERNATIONAL ☐ OTHER (Specify)

21. (a) DID CASUALTY OCCUR WHILE UNDERWAY: ☐ YES ☐ NO

(b) IF YES, LAST PORT OF DEPARTURE	(c) IF YES, WHERE BOUND WHEN CASUALTY OCCURRED

22. (a) WEATHER CONDITIONS WHEN CASUALTY OCCURRED:
☐ CLEAR ☐ PARTLY CLOUDY ☐ OVERCAST ☐ FOG ☐ RAIN ☐ SNOW ☐ OTHER (Specify)

(b) VISIBILITY (Miles, yds., ft., etc.)	(c) WIND DIRECTION	(d) FORCE IN KNOTS	(e) GUST ☐ YES ☐ NO	(f) AIR TEMPERATURE

23. (a) SEA CONDITIONS WHEN CASUALTY OCCURRED	(b) SEA WATER TEMP (If available)	(c) HEIGHT OF SEA	(d) DIRECTION OF SEA	(e) HEIGHT OF SWELL	(f) DIRECTION OF SWELL

24. (a) NATURE OF CARGO (Specify)	(b) AMOUNT OF DRY CARGO (Long tons)	(c) AMOUNT OF BULK LIQUID (Long tons)	(d) AMOUNT OF DECK LOAD (Long tons)

25. (a) DRAFT FORWARD	(b) DRAFT AFT

26. (a) TYPES OF LIFESAVING EQUIPMENT USED, IF ANY	(b) NO. LIVES SAVED WITH LIFE-SAVING EQUIPMENT	(c) LIFESAVING EQUIPMENT SATISFACTORY ☐ YES ☐ NO (If no, explain in Item 34)

PREVIOUS EDITION MAY BE USED

(Over)

Figure 40. (continued)

Reverse of CG-2692 (Rev. 12-70)

27	CREW	PASSENGERS	OTHER (Specify)
NUMBER ON BOARD			
DEAD/MISSING			
INCAPACITATED (over 3 days)			

28 ESTIMATED LOSS/DAMAGE TO YOUR VESSEL $

ESTIMATED LOSS/DAMAGE TO YOUR CARGO $

ESTIMATED LOSS/DAMAGE TO OTHER PROPERTY $

(Specify whether vessel, dock, bridge, etc.)

29 NATURE OF THE CASUALTY (Check one or more of the following. Give pertinent details in item 30.)

	COLLISION WITH OTHER VESSEL(S) (Specify)		EXPLOSION/FIRE (Other)
			GROUNDING
			FOUNDER (Sinking)
	COLLISION WITH FLOATING OR SUBMERGED OBJECTS		CAPSIZING WITHOUT SINKING
	COLLISION WITH FIXED OBJECTS (Piers, bridges, etc.)		FLOODING, SWAMPING, ETC., WITHOUT SINKING
	COLLISION WITH ICE		HEAVY WEATHER DAMAGE
	COLLISION WITH AIDS TO NAVIGATION		CARGO DAMAGE (No vessel damage)
	COLLISION (Other)		MATERIAL FAILURE (Vessel structure)
	EXPLOSION/FIRE (Involving cargo)		MATERIAL FAILURE (Engineering machinery, including main propulsion, auxiliaries, boilers, evaporators, deck machinery, electrical, etc.)
	EXPLOSION/FIRE (Involving vessel's fuel)		
	FIRE (Vessel's structure or equipment)		EQUIPMENT FAILURE
	EXPLOSION (Boiler and associated parts)		CASUALTY NOT NAMED ABOVE
	EXPLOSION (Pressure vessels and compressed gas cylinders)		

30 DESCRIPTION OF CASUALTY (Events and circumstances leading to casualty and present when it occurred. Attach diagram and additional sheets, if necessary)

31 DAMAGE (Give brief general description and state if vessel is a total loss.)

III ASSISTANCE AND RECOMMENDATIONS

32 AUTO ALARM TRANSMITTED BY YOUR VESSEL: ☐ YES ☐ NO

33(a) ASSISTANCE RENDERED BY STATIONS AND VESSELS (Include Coast Guard and other stations and vessels)

(b) OTHER ASSISTANCE RENDERED

34 RECOMMENDATIONS FOR CORRECTIVE SAFETY MEASURES PERTINENT TO THIS CASUALTY (Include explanation of unsatisfactory lifesaving equipment)

TITLE	SIGNATURE

GPO 951-342

Figure 41. Form CG-924 E; Report of Personnel Inquiry or Loss of Life.

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-924E (Rev. 9-68)	**REPORT OF PERSONAL INJURY OR LOSS OF LIFE**	Form Approved Budget Bureau No. 004R-3004 REPORTS CONTROL SYMBOL MVI-4016

INSTRUCTIONS

1. This form shall be completed for every loss of life and for every injury which incapacitates the injured for a period in excess of seventy-two hours *(3 days)*, if the accident involves any vessel except those numbered under the Federal Boating Act.
2. Injuries to longshoremen or harbor workers are not required to be reported unless the injury arises out of failure of ship's equipment, a vessel casualty, misconduct or negligence of ship's personnel or the injury results in death.
3. A signed original and two signed copies shall be submitted as soon as possible to the Officer in Charge, Marine Inspection, U. S. Coast Guard, in whose district the accident occurred, or in whose district the vessel first arrive(s)(d) after such casualty.
4. The master or person in charge is required to report in person to the Officer in Charge, Marine Inspection as soon as possible after the casualty occurs unless it can be shown that it was inconvenient to do so because of the distance involved. However, nothing shall relieve the person in charge of the vessel from submitting this report.
5. This report should be completed in full. Blocks which do not apply to a particular case should be indicated as "NA." Where answers are unknown or none, they should be indicated as such.
6. Report all vessel casualties or accidents on Form CG-2692, Report of Vessel Casualty or Accident. Attach a Form CG-924E to the CG-2692 for each person killed, missing or injured as a result of the marine casualty or accident.

TO: Officer in Charge, Marine Inspection, Port of	DATE SUBMITTED

I. PARTICULARS OF VESSEL

1. NAME OF VESSEL	2. OFFICIAL NUMBER	3. VESSEL INSPECTED BY USCG ☐ YES ☐ NO	4. NATIONALITY
5. TYPE OF VESSEL *(Frt., pass., tkr., etc.)*	6. PROPULSION *(Steam, diesel, etc.)*	7. NAME OF OWNER(S), OPERATOR(S), OR AGENT *(Indicate which)*	
8(a) NAME OF MASTER OR PERSON IN CHARGE *(Indicate which)*		(b) LICENSED BY COAST GUARD ☐ YES ☐ NO	

II. PARTICULARS OF PERSON INJURED, DECEASED OR MISSING *(Believed dead)*

9(a) NAME OF PERSON		(b) HOME ADDRESS	(c) DATE OF BIRTH
10. BOOK OR "Z" NUMBER	11. LICENSED BY COAST GUARD ☐ YES ☐ NO	12. STATUS OR CAPACITY ON VESSEL	
13. ACTIVITY ENGAGED IN AT TIME OF CASUALTY		14. IF CREW MEMBER OR SHORE WORKER ☐ ON WATCH ☐ WORKING ☐ OTHER	
15(a) NAME OF IMMEDIATE SUPERVISOR AT TIME OF CASUALTY		(b) SUPERVISOR'S CAPACITY OR STATUS ON VESSEL	

III. PARTICULARS OF ACCIDENT OR CASUALTY

16. DATE OF CASUALTY	17. TIME OF CASUALTY *(Local or zone)*	18. ZONE DESCRIPTION	19. TIME OF DAY ☐ DAY ☐ NIGHT ☐ TWILIGHT
20(a) DID CASUALTY OCCUR WHILE UNDERWAY ☐ YES ☐ NO	(b) IF YES, LAST PORT OF DEPARTURE	(c) IF YES, WHERE BOUND WHEN CASUALTY OCCURRED	
21(a) VESSEL LOCATION AT CASUALTY *(Latitude and longitude; distance and TRUE bearing from charted object; dock; anchored; etc.)*		(b) BODY OF WATER *(Geographical name)*	
22(a) RESULT OF CASUALTY: ☐ INJURY ☐ DEATH ☐ MISSING *(Complete INJURY or DEATH entries below, as appropriate)*			
(b) NATURE OF INJURY			(c) TOTAL DAYS INCAPACITATED
(d) REASON FOR DEATH		(e) LOCATION OF INDIVIDUAL AT DEATH	
		(f) DATE OF DEATH	

EDITIONS 4-61 AND 3-67 MAY BE USED

(Over)

Figure 41. (continued)

Reverse of CG-924E (Rev. 9-68)

23. DESCRIPTION OF CASUALTY *(Give events leading up to casualty and how it occurred. Attach diagram & additional sheets, if necessary.)*

24. WITNESSES TO ACCIDENT *(At least two, if possible)*

NAME	NAME
ADDRESS	ADDRESS
NAME	NAME
ADDRESS	ADDRESS

IV. ASSISTANCE AND RECOMMENDATIONS

25(a) MEDICO *(Medical)* MESSAGE SENT ☐ YES ☐ NO	(b) IF YES, GIVE DATE OF FIRST MESSAGE	(c) IF YES, GIVE TIME OF FIRST MESSAGE *(Local or zone and description)*
26(a) TREATMENT ADMINISTERED ☐ YES ☐ NO	(b) IF YES, BY WHOM ☐ SHIP'S DOCTOR ☒ OTHER SHIP'S PERSONNEL ☐ OTHER *(Specify)*	

27. BRIEFLY DESCRIBE TREATMENT *(If administered by other than M. D.)*

28(a) NAME OF HOSPITAL, IF PERSON WAS HOSPITALIZED	(b) ADDRESS OF HOSPITAL

29. RECOMMENDATIONS FOR CORRECTIVE SAFETY MEASURES PERTINENT TO THIS CASUALTY

TITLE	SIGNATURE

GPO 948-671

Figure 42. Form CGHO-4095, Code Sheet-Marine Casualty Statistics.

DEPARTMENT OF TRANSPORTATION
U. S. COAST GUARD
CGHQ-4095 (Rev. 12-75)

CODE SHEET – MARINE CASUALTY STATISTICS

1 VESSEL NAME

INSTRUCTIONS

1. Vessel casualty with no personal injuries or death.
Obtain data from CG-2692 and related papers, code all items in Sections 1 and 2 of code sheet.

2. Personal injury or death not involving a vessel casualty.
Obtain data from CG-924E and related papers, code all items in Sections 1 and 3 of code sheet.

3. Vessel casualty and personal injury or death.
Obtain data from CG-2692 and related papers and enter codes in Sections 1 and 2. For each related CG-924E, enter codes in Section 3 of same code sheet, if there are 2 or more persons involved, enter data from first CG-924E in Col. A of Section 3, data from second in Col. B, etc. If more than 4 persons involved, use a second code sheet, entering data in Sections 1 and 3.

SECTION 1 - DATA REQUIRED ON ALL CASES

2. CASE NO (1-5)	3. VESSEL NO (6-11)	4. CG INSPECTED (12)	5. TYPE OF VESSEL (13-14)	6. PROPULSION (15)	7. PERSON IN CHARGE (16)	8. DATE OF CASUALTY: MO. OF CAS. (17-18) / MO CODE (19-20) / MO. INVEST COMP. (21) / YEAR OF CAS. (22)	9. TIME OF DAY (23)	10. TYPE OF IO REPORT (24)
		1- YES 2- NO		1-STEAM 2- MOTOR (Diesel) 3-GASOLINE 4- SAIL 5- NON-SELF PROPELLED 6- OTHER 7- NUCLEAR (-) UNKNOWN			1- DAY 2- NIGHT 3- TWILIGHT (-) UNKNOWN	1-MAR. Bd. 2-NARR. 3-LTR. TRANS.

SECTION 2 - VESSEL CASUALTY DATA

11. SEQUENCE NUMBER (25)	12. GROSS TONNAGE (26)	13. LENGTH (IN FEET) (27)	14. HULL MATERIAL (28)	15. AGE OF VESSEL (29)	16. BODY OF WATER (30-31)
	1- 0-15 2- 16-100 3- 101-300 4- 301-500 5- 501-1000 6- 1001-5000 7- 5001-10000 8- 10001-15000 9- 15001 AND UP (-) UNKNOWN	1- 0-65 2- 66-100 3- 101-200 4- 201-300 5- 301-400 6- 401-500 7- 501-600 8- 601-700 9- 701 AND UP (-) UNKNOWN	1- STEEL 2- WOOD 3- CEMENT 4- PLASTIC 5- ALUMINUM 6- OTHER INCLUDES FERRO-CEMENT (-) UNKNOWN	1- 0-5 2- 6-10 3- 11-15 4- 16-20 5- 21-30 6- 31-40 7- 41-50 8- 51 AND UP (-) UNKNOWN	

17. CASUALTY PARTICULARS A. NATURE (32-33)	B. PRIME CAUSE (34-35)	C. AREA CAUSAL CONN. (36-38)	D. ADD CONT. FACT. (39-41)	18. WEATHER (42)	19. VISIBILITY (IN MILES) (43)	20. WIND (IN KNOTS) (44)	21. SPECIFIC LOCATION OF CASUALTY (45-47)
				1- CLEAR 2- PARTLY CLDY 3- OVERCAST 4- FOG 5- RAIN 6- SNOW 7- OTHER (-) UNK.	1- HAZARDOUS (1/0-1/4) 2- VERY POOR (1/4-1/2) 3- POOR (1/2-1) 4- FAIR (1-2) 5- GOOD (2 AND UP) (-) UNKNOWN	1- CALM 2- 1-3 KT 3- 4-10 4- 11-16 5- 17-27 6- 28-40 7- 41-55) 8- 56-65) 9-65 AND OVER (-) UNKNOWN	

22. SEA CONDITIONS (48) (SEE SWELL IN FEET)	23. SERVICE OF VESSEL (49-50)	24. KILLED OR MISSING: A. CREW (51-52) / B. PASS (53-54) / C. LONG SHR. (55-56) / D. OTHER (57-58)	25. INJURED AND INCAPACITATED: A. CREW (59-60) / B. PASS (61-62) / C LONG SHR. (63-64) / D. OTHER (65-66)	26. ESTIMATED LOSSES: A. VESSEL (67-70) / B. CARGO (71-74) / C. PROP. (75-78)	27. VESSEL TOTAL LOSS? A. AMOUNT (79) / B. SPEC. CODE (80)
1- CALM 2- 5-15 (SLIGHT) 3- 16-20 (MODERATE) 4- 21-40 (ROUGH) 5- 41 AND UP 6- ICE (-) UNKNOWN					1- TOTAL LOSS 2- NOT TOTAL LOSS

SECTION 3 - PERSONAL INJURY/DEATH

28. TYPE OF INJURY	29. NAME OF VICTIM	30. PAPERS OF INJURED PERS.	31. STATUS	32. ACTIVITY	33. STATUS OF SUPVR.	34. RESULT OF ACCIDENT	35. VESS. LOC.	36. PERSONAL CASUALTY PARTICULARS: A. Nature Of Casualty / B. Prime Cause / C. Area of Causal Conn. / D. Add Area Causal Conn. / E. Part Of Body Injured / F. Nature Of Vessel Cas.
1- Death/Miss. 2692/924E 2- Injury (924E/2692) 3- Death/Miss. 924E Only 4- Injury 924E Only	1st Initial 2nd Initial or X 1st Three Letters of Last Name	1- Licensed 2- Documented 3- None 4- Other (Include Foreign Seamen)	1- Passenger 2- Longsh/HW 3- Tankerman 4- Other 5- Artificial or fix. struct. worker 6- Deck crew 7- Engine crew 8- Steward Dept.	1- Off Duty 2- Deck Dep. Dty 3- Eng. Dep. Dty 4- Stew. Dep. Dty 5- Handle Cargo 6- Fishing 7- Drills 8- Passenger 9- Other 0- Unknown	1- License 2- Document 3- Unlic./Undoc. 4- Longsh. Har. Wkr. 5- Other 6- None	1- Death 2- Injury (Perm) 3- Injury (Temp) 4- Injury (Disability unknown) 5- Missing	1- GL (Dock) 2- GL (Underway) 3- W. Riv. (dock) 4- W. " (Underway) 5- Inld(dock,anch.) 6- Inld (Underway) 7- Ocean (") 8- For.(dock,anch.) 9- Other	
(25)	(26) (27) (28-30)	(31)	(32)	(33)	(34)	(35)	(36)	(37-38) / (39-40) / (41-43) / (44-46) / (47-48) / (49-50)
A.								
B.								
C.								
D.								

investigating officer through questioning of the witnesses. If the casualty is not investigated, there is little or no chance that the error will be caught. In the second case, unless the investigating officer can find contradictions either in the report or through witnesses, he has no way of discovering this error. It is in the reporting of primary cause, i.e., human error, heavy weather, etc., where this error is most likely to occur. This type of error can be expected because the reporting system very often calls for self-incrimination; the law requires that the master of the ship file a casualty report, yet this may result in a suit against and punishment of persons guilty of inappropriate actions. The investigating officer in his cover letter states what he believes to be the primary cause of the accident; however, unless evidence contradicts the master's written report, the officer is forced to agree with that report.

The second major area where errors can occur is at Coast Guard Headquarters where the data are coded. In an effort to reduce this error, coding is now done by only two people in hope that if interpretive errors occur they will at least be consistent.

Finally, errors can occur in keypunching the data. This is especially true because the keypunching is not verified. In an effort to find and correct keypunching errors, a computer editing program has been written. In reviewing the VCRS editing program, we have found that it includes procedures for verifying that:

- There is common coding of conditions surrounding a casualty in cases involving more than one vessel, i.e., if a collision occurred, the weather at the time of collision was the same for vessel 1 as it was for vessel 2;
- Characteristics in specific fields are written within the range of possible codes, e.g., the possible codes for the time of day are "1", "2", "3", or "-"; if any other character appears in the time of day column all data on that punch card are reprinted;
- A Coast Guard inspected vessel is not a fishing vessel, tug, towboat, or foreign vessel;
- Certain vessels are not self-propelled;
- Foreign vessels have a foreign pilot or master in charge and are self-propelled;
- Certain vessels are not manned;
- If a vessel is the primary vessel (vessel causing a multi-vessel casualty), its primary cause is not "fault of other vessel";
- If the area of causal connection and/or additional contributing factor are rules of the road violations, then the primary cause is "personnel fault" and the primary factor is "rules of the road";

- If the number of crew, passengers, longshoremen, or other deaths or injuries is greater than 10, then these data are accurate;
- If vessel, cargo, or property loss is greater than $500,000, then these data are accurate;
- If the vessel is a total loss then the dollar damage to the vessel is greater than zero;
- If the type of injury is a death or injury then the nature of the casualty is a death or injury respectively; and
- The body of water code is feasible for the coded location.

If any card contains one of the checks listed above, all data on the card are printed. Inaccurate cards are then repunched.

This editing program has been used on the VCRS data back through fiscal year 1974. In using the vessel casualty data for 1969 through 1976, it becomes obvious that this editing program has been valuable. Data prior to 1974 contains a number of keypunch errors. The program cannot, however, catch all errors. One area which causes particular difficulty is the location code. In editing, the body of water code is checked against the specific location. However, because the computerized location code contains only three of the five actual digits used to identify the location, there is an overlap in the computerized codes; and, therefore, the body of water code is necessary to identify certain locations. For instance, from fiscal year 1976 to the present, "030" is coded to mean either Castine, Maine, or Laupahoehoe Point, Hawaii.[1] In order to identify the specific location, the body of water must be coded Inland Atlantic for Castine, Maine, or Inland Pacific for Laupahoehoe Point, Hawaii. Another example of this is for fiscal years 1970 through 1975. The specific location code for both the Inland Gulf and the Arctic Ocean began with the letter M, which was followed by a 2 digit mile post number in the Gulf and a 2 digit Coast Guard assigned block number in the Arctic. Here again it is necessary to use both the body of water and the specific location codes to determine the exact location of the casualty. As a result, it is possible for certain keypunch errors to run through the editing program without being caught. For example, if the Inland Atlantic which should be coded "01" were mistakenly punched "03" which is the code for the Inland Pacific and the specific location was "040" which was meant to be Cape Elizabeth, Maine, it would be accepted by the editing program but would be interpreted as Cape Kaea, Hawaii.

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[1] Information and Analysis Branch, U.S. Coast Guard, "Coding Instruction for Commercial Vessel Casualties" (Washington, D.C., 1976), pp. 33 and 36.

Another problem exists in the editing program with regard to checking for location errors. Seven specific locations in Alabama and Mississippi--Sand Island and Mobile, Alabama, Horn Island, Pascagoula, Biloxi, Ship Island and Gulfport, Mississippi--are allowed to go through the program with a body of water code of either the Inland Atlantic or the Inland Gulf (body of water codes "01" or "02"). This appears to be a programming error. One of the edit checks listed above indicates that the editing program verifies that when the area of causal connection or the additional contributing factor is "rules of the road," then the primary cause is "personnel fault" and the primary factor is "rules of the road." Since this edit is performed, it would be a simple matter to reverse the process and verify that all primary factors coded "rules of the road" would also have an area of causal connection as a rules of the road guide. This additional check would catch other possible errors.

In analyzing the VCRS casualty file, one of the major problems is dealing with the number of changes in codes from fiscal year to fiscal year. In some cases, the meaning of the particular keypunch column has changed. For instance, from fiscal year 1963 to 1968, card columns 21 and 22 indicated the year of casualty; from fiscal year 1969 to 1973, column 21 was a special indicator and column 22 represented the year of casualty; in fiscal year 1974, column 21 became the month the investigation was completed.

In other cases, the coding in specific columns has changed. This is a particular problem in the coding of specific locations. From 1963 to 1968, columns 45-47 specified the air temperature at the time of casualty. Beginning in fiscal year 1969, these three columns indicated the specific location of the casualty. Since 1969 the meaning of these columns has stayed the same, but the specific location codes have changed three times.

In the analysis that has been performed using the VCRS file, data from 1969 to the present were used. Since the editing program described above has only been used since 1974, a number of keypunch errors were detected in the earlier data. If extensive analysis of these data is done, it may be worthwhile for the Coast Guard to go back and correct these errors. In addition, it may be useful in cases where codes have changed, but column meaning has not, to go through historic data and make the codes agree with the most recent code.

The Coast Guard annually publishes a summary of the previous year's VCRS data called "Statistics of Casualties."[1] This publication presents frequency tables of nature of casualty by primary cause, type of vessel, gross tonnage, age, location, time of day, and estimated losses from vessel casualties. In the case of deaths and injuries, frequency tables show

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[1] Information and Analysis Branch, U.S. Coast Guard, "Statistics of Casualties," published annually (Washington, D.C.).

nature of casualty by primary cause, type of vessel, particulars of the person, part of the body injured, and time of day.

In addition to the "Statistics of Casualties," the Information and Analysis Branch annually publishes trends in the VCRS data. A great deal of statistical analysis or interpretation of this data has not been done. This may in part be due to the number of coding changes which have taken place over the years since the data have been collected.

Another problem arises when trying to determine the specific location of a casualty. While location is coded in these data, the code can be specific only within approximately 10 miles. This is not a problem in analyzing accidents on the high seas but can be when analyzing specific port areas.

Although there are particular problems involved with the VCRS file, it has the most complete record of U.S. casualties and also is one of the few data bases containing the cause of accident. Therefore, it is at present one of the best data bases available for analyzing vessel casualties.

G. COMPARISON OF THE VCRS AND TCF DATA BASES

A comparative analysis was made on the two primary vessel casualty data bases, the Vessel Casualty Reporting System and the Tanker Casualty File, to determine the relative completeness of the data. This comparison includes those vessel casualties that should theoretically be included in both files; that is, U.S. registered tankers.

The criteria for inclusion of a vessel casualty in the VCRS are property damage in excess of $1,500, damage affecting the seaworthiness or efficiency of a vessel, stranding or grounding, loss of life, or injury causing incapacitation for more than 72 hours. Some casualties recorded in the TCF may not meet these criteria. It is not possible, however, to determine which of the data in the TCF and not in the VCRS falls into this category.

During the years 1969 to 1973, the VCRS reported 1,064 American tanker casualties; four of these did not have official numbers and therefore could not be identified, reducing the VCRS number to 1,059. Of these 1,059, 98 were secondary vessels in multivessel casualties. In theory, the Tanker Casualty File records only primary vessels. (The data file did show 29 vessels listed as secondary vessels recorded in the Tanker Casualty File. It is not known whether this is an error in the VCRS or in the TCF, but these 29 were left in for the comparative analysis.) This left 961 American vessels in the VCRS. The Tanker Casualty File for that same period showed 317 American tanker casualties.

Using Lloyd's Register of Shipping,[1] the official numbers for vessels in the Tanker Casualty File were matched to the official numbers in VCRS. One hundred eighty-one of the 317 vessels in the Tanker Casualty File were found in VCRS, leaving 136 or 42.9 percent not recorded in VCRS. This also means that 81.2 percent of the tankers in VCRS were not reported in TCF.

Comparisons were made to determine if the types, places, and time of casualties missed in either of the files followed a pattern. In order to make these comparisons, two sets of tables were compiled. The first set compared the Tanker Casualty File vessels found in the VCRS with those not found in the VCRS. The second set of tables compared the VCRS vessels found in the Tanker Casualty File with those not found in the TCF.

Tables 5-9 show the first set of these tables. These five tables show the percentage of casualties in the Tanker Casualty File which are not in VCRS and the percentage in VCRS for each specific category. This first set of tables is concerned with where the VCRS data is lacking. In the specific location table, the highest percentage of missed casualties is for those that occur in the open sea. This is to be expected because the Coast Guard patrols U.S. waters only and not the open sea. While the VCRS does contain some casualties from the open sea, it is more likely that more of these would be missed. It does seem unusual that the second highest percentage of missed casualties is at the piers. It must be remembered, however, that the VCRS does not report casualties with damage less than $1,500. The impact casualties which take place at the pier are usually at low speeds and, therefore, damage tends to be much less, so that some of these casualties may be missed because they result in less than $1,500 of damage.

Table 6--by year of casualty--indicates that the VCRS is detecting more casualties with time. Only in 1969 did VCRS miss more than half of the casualties in TCF.

The type of casualty which the VCRS most frequently missed was structural failures. This is consistent with the results of table 46 since most structural failures take place in the open sea.

Table 8 indicates that it is the water bodies closest to the U.S. shores where the VCRS missed the fewest casualties. Those locations where half or more of the TCF casualties are detected by VCRS are in the Northwest Atlantic--which includes the eastern U.S. shores, the Caribbean Sea and the Gulf of Mexico, Gulf of St. Lawrence and the Great Lakes; the Northeast Pacific, which includes the western U.S. shores; and the Middle Pacific.

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[1] Lloyd's of London, Lloyd's Register of Shipping, (London, 1974).

Table 5

A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Location Type

Specific Location	Casualties in TCF			% of Total
	Not in VCRS	In VCRS	Total	Not in VCRS
Harbors	42	76	118	35.6
Piers	23	21	44	52.3
Sea	32	19	51	62.7
Entrance	16	25	41	39.0
Coast	16	26	42	38.1
Unknown	7	14	21	33.3
TOTAL	136	181	317	42.9

Table 6

A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Year of Casualty

Year of Casualty	Casualties in TCF: Not in VCRS	In VCRS	Total	% of Total Not in VCRS
1969	40	36	76	52.6
1970	21	42	63	33.3
1971	31	36	67	46.3
1972	31	38	69	44.9
1973	13	29	42	31.0
TOTAL	136	181	317	42.9

Table 7

A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Casualty Type

Type of Casualty	Casualties in TCF: Not in VCRS	In VCRS	Total	% of Total Not in VCRS
Explosion	4	6	10	40.0
Collision	33	47	80	41.3
Ramming	36	33	69	52.2
Structural Failure	30	11	41	73.2
Breakdown	9	18	27	33.3
Fire	6	6	12	50.0
Grounding	18	60	78	23.1
TOTAL	136	181	317	42.9

Table 8

A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System by Location

Location of Casualty	Casualties in TCF Not in VCRS	In VCRS	Total	% of Total Not in VCRS
Northwest Atlantic	20	66	86	23.3
Northeast Atlantic	4	1	5	80.0
Middle Atlantic	2	0	2	100.0
Caribbean Sea and Gulf of Mexico	22	47	69	31.9
Gulf of St. Lawrence and Great Lakes	6	6	12	50.0
Indian Ocean	1	0	1	100.0
West Indian Ocean	9	6	15	60.0
East Indian Ocean	20	12	32	62.5
Northwest Pacific	5	3	8	62.5
Northeast Pacific	26	28	54	48.1
Middle Pacific	6	7	13	46.2
Mediterranean	1	0	1	100.0
Unknown	14	5	19	73.7
TOTAL	136	181	317	42.9

Table 9

A Comparison of the Tanker Casualty File with the Vessel Casualty Reporting System for Spills

	Casualties in TCF			% of Total
	Not in VCRS	In VCRS	Total	Not in VCRS
No. of Spills	11	29	40	27.5
Amount Spilled (Long Tons)	2,004	45,013	47,017	4.3

Finally, as seen in table 9 the VCRS missed only 27.5 percent of the spills recorded in the TCF. The spills missed were the smaller spills, as indicated by the fact that VCRS missed only 4.3 percent of the total amount spilled.

The Tanker Casualty File does not compare as favorably as the VCRS, as shown in tables 10 through 14, nor are explanations of the reasons why casualties are missed as apparent. In all categories, except one, the percentage of casualties not in the TCF hovers around its percentage of missed casualties--81.2 percent. This holds for the year of casualty, water bodies, gross tons, and type of casualty. In fact, in these four tables shown, the percentage missed never drops below 50 percent. The lowest percentage in the four tables is 62.2 percent, which is the percentage of collisions missed. Also in these four tables the percentage missed drops below 70 percent only four times--in the Indian Ocean, in the Carribean and for collisions, and explosions or fires. However, the most significant tables for the purposes of oil spill analyses is table 14, which indicates the number of spills recorded in the VCRS. This table shows the number of casualties that had light, moderate, and heavy oil pollution (This is the only indicator of spillage in the VCRS file.). In all three of these categories, the percentage missed by TCF drops below 60 percent and for heavy oil pollution drops down to 40 percent. What is more significant is that the total number missed by TCF is only 19, and 11 of these 19 are only light pollution. While the VCRS does not give the amount of oil spilled, it does include a dollar figure for cargo damage. Of the spills missed by TCF, only two showed any dollar damage in the VCRS. These two indicated damages of $9,000 and $1,000. However, it must be pointed out that the Coast Guard does not consider the VCRS damage figures to be highly accurate.

Therefore, while the Tanker Casualty File does seem to miss a large number of tanker casualties, it misses very few tanker spills. Further, the spills missed by the TCF are usually small spills.

Table 10

A Comparison of the Vessel Casualty Reporting System, with the Tanker Casualty File by Year of Casualty

Year of Casualty	Casualties in VCRS: Not in TCF	In TCF	Total	% of Total Not in TCF
1969	162	36	198	81.8
1970	138	42	180	76.7
1971	143	36	179	79.9
1972	167	38	205	81.5
1973	170	29	199	85.4
GRAND TOTAL	780	181	961	81.2

Table 11

A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Water Body

Water Body	Casualties in VCRS: Not in TCF	In TCF	Total	% of Total Not in TCF
Inland Atlantic	219	51	270	81.1
Inland Gulf	147	32	179	82.1
Inland Pacific	121	27	148	81.8
Western Rivers	29	2	31	93.5
Great Lakes	46	7	53	86.8
Ocean, Atlantic	55	16	71	77.5
Ocean, Pacific	60	15	75	80.0
Ocean, Indian	15	7	22	68.2
Ocean, Mediterranean	1	0	1	100.0
Ocean, Artic	2	0	2	100.0
Ocean, Caribbean	8	4	12	66.7
Ocean, Gulf	41	7	48	85.4
Foreign Waters	35	13	48	72.9
Unknown	1	0	1	100.0
GRAND TOTAL	780	181	961	81.2

Table 12

A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Vessel Size

Gross Tons	Casualties in VCRS: Not in TCF	In TCF	Total	% of Total Not in TCF
0-15	1	0	1	100.0
16-100	4	1	5	80.0
101-300	4	0	4	100.0
301-500	7	2	9	77.8
501-1,000	30	3	33	90.9
1,001-5,000	82	17	99	82.8
5,001-10,000	34	11	45	75.6
10,001-15,000	258	64	322	80.1
<15,000	358	83	441	81.2
Unknown	2	0	2	100.0
GRAND TOTAL	780	181	961	81.2

Table 13

A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Type of Casualty

Type of Casualty	Casualties in VCRS: Not in TCF	In TCF	Total	% of Total Not in TCF
Collision	46	28	74	62.2
Ramming	226	54	280	80.7
Explosion/Fire	21	12	33	63.6
Grounding	243	57	300	81.0
Flooding	7	0	7	100.0
Structural Failure	209	29	238	87.8
Heavy Weather	18	1	19	94.7
Other	10	0	10	100.0
GRAND TOTAL	780	181	961	81.2

Table 14

A Comparison of the Vessel Casualty Reporting System with the Tanker Casualty File by Pollution Indication

Pollution	Casualties in VCRS: Not in TCF	In TCF	Total	% of Total Not in TCF
Light Oil	11	8	19	57.9
Moderate Oil	6	5	11	54.5
Heavy Oil	2	3	5	40.0
TOTAL	19	16	35	

VII. VESSEL PERSONNEL INJURIES

A. MARINE INDEX BUREAU

In 1936, a number of ship owners formed the Marine Index Bureau to maintain one central location for records of injuries or illnesses to U.S. merchant marines. It is not unusual for a seaman to work on a number of different ships or for more than one owner during his working career. If a seaman is injured or becomes ill on any vessel, the ship owner may be held liable for support and care. The Marine Index Bureau was formed to aid the ship owners in cases of liable suits.

Reports of personnel injury or illness are sent voluntarily to the Marine Index Bureau by ship owners. Included in the report are the name and social security number of the injured or ill person, nature and date of injury or illness, and vessel name, owner, and destination. Information is stored on index cards, and data through 1976 have been computerized. The index card file is catalogued in three ways; by name of person, social security number, and official vessel number. The computerized data are suitable for research, but do not contain name or social security number of the person involved. Summaries of the computerized data are periodically sent to ship owners contributing to the Marine Index Bureau's data base.

The files do not contain complete records of personnel injuries and illnesses because the information is voluntarily provided and because some ship owners keep their own records. Nevertheless, the Marine Index Bureau has indicated that they have over seven million records of individual injuries and illnesses. Therefore, this data base is the most complete record of marine personnel casualties available.

VIII. VESSEL POPULATION

A. ANALYSIS OF WORLD TANKER FLEET

Since 1941, the Sun Oil Company has annually compiled statistics on the population of the World Tank Ship Fleet. This analysis was developed originally to aid national security planning during World War II. In 1958, Sun Oil began publishing its yearly analysis.[1] The information used for this publication is compiled from the individual vessel files of the Office of Subsidy Administration of the Maritime Administration.

The analysis contains tables showing the number and deadweight tonnage of all tankers, 2,000 gross tons or greater. The tank fleet is then broken down by flag of registry, carrying capacity, average speed, age, draft, and special type of tanker. Also included is the number and deadweight tonnage of tankers under construction or on order. As an example, table 15 shows the World Tank Ship Fleet from 1963 to 1973.

Each year, a section is also included which presents the results of research efforts into tankship economics. For example, two recent years contained analyses of the economic choice between buying or renting tankships and the need for deepwater port facilities in the U.S. in light of energy supply and demand conditions.[2]

Both the statistical tabulations and the economic analysis are expected to be valuable in analyzing marine safety. The first section will be useful because it presents the past and present tankship world population about which projections of growth, casualties, and spills must be made. The second discusses basic tankship economic considerations which may be useful for cost-benefit analysis of alternative regulations.

B. LIST OF FOREIGN FLAG VESSELS CARRYING LETTERS OF COMPLIANCE

Any "foreign vessel of novel design or carrying certain bulk dangerous cargoes which create potential unusual operating risks"[3] into U.S. ports must possess a Letter of Compliance (LOC), issued by the United States Coast Guard. As of April 12, 1978, only foreign flag vessels with a valid IMCO Chemical Code Certificate of Fitness qualify for an

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[1] Sun Oil Company, "Analysis of World Tanker Fleet," published annually (St. Dairds, Pennsylvania, 1958).

[2] Ibid., 1973 and 1972.

[3] Office of Marine Environment and Systems, U.S. Coast Guard, "Commandant Notice 16616," (Washington, D.C., 1978), p. i.

Table 15

World Tank Ship Fleet

Dec. 31	Number of Vessels	Deadweight Tonnage	T-2[1] Equivalents
1963	3,279	76,179,000	4,841
1964	3,359	85,126,000	5,455
1965	3,436	93,172,000	5,984
1966	3,524	102,909,000	6,641
1967	3,613	112,366,000	7,275
1968	3,775	128,128,000	8,312
1969	3,893	146,029,000	9,461
1970	4,002	167,940,000	10,925
1971	4,207	193,891,000	12,577
1972[2]	4,342	221,204,000	14,341
1973	4,563	256,716,000	16,650

[1] A T-2 tank ship is defined herein as a 16,765 deadweight ton vessel with a service speed of 14.5 knots.

[2] 1972 data have been restated to include six additional combined carriers delivered in 1972 but not previously recorded in the December 31, 1972 totals.

Source: Sun Oil Company, Analysis of World Tanker Fleet, St. Daivds Pennsylvania, 1973.

LOC. These letters, which are valid for two years, are issued after the vessel has been inspected by an officer from the U.S. Coast Guard.

The Office of Marine Environment and Systems periodically publishes an updated List of Foreign Flag Vessels Carrying Letters of Compliance.[1] Included in this list are the name and flag of the vessel; the chemicals the vessel is authorized to carry; the examination, issuance and expiration dates of the LOC; and the date the vessel owner was first contacted regarding the LOC (see figure 43). The list contains the only information found to date on the population of foreign vessels carrying dangerous cargo.

C. LIST OF INSPECTED TANK BARGES AND TANKSHIPS

All U.S. registered tankships which carry combustible or flammable liquid cargo in bulk and all tank barges carrying certain flammable and combustible liquids and liquefied gases in bulk are required to be inspected by the United States Coast Guard.[2] The List of Inspected Tank Barges and Tankships[3], which is published semi-annually, lists such vessels certified by the Coast Guard.

This document is presented in three sections:

- Inspected Tank Barges - containing vessel name, Coast Guard number, gross tonnage, whether the barge is manned, year built, hull construction, length, owner, operator, certified route, hull type, highest grade authorized cargo, capacity, expiration date of certificate of inspection, where the certificate of inspection is maintained, and the status of the vessel, i.e., active, revoked certificate, etc. Figure 44 shows part of this list.

- Inspected Tankships - containing the same information as tank barges except that type of propulsion instead of hull type is shown.

- Hazardous Materials Barges - containing a list of all tank barges certified to carry dangerous cargo as specified in the Code of Federal Regulations.[4] Included in this section are the barge, name, official number, temperature and pressure at which the cargo is carried, and those cargoes the barge is authorized to carry (see figure 45).

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[1] Office of Marine Environment and Systems, U.S. Coast Guard, "Commandant Notice 16616," (Washington, D.C., 1978), p. i.

[2] U.S. Code of Federal Regulations, Title 46, Section 30.01-5, (Washington, D.C., 1976).

[3] U.S. Coast Guard, "List of Inspected Tank Barges and Tankships, CG-499" published semiannually (Washington, D.C.).

[4] U.S. Code of Federal Regulations, Title 46, Section 151, (Washington, D.C., 1976).

ENCLOSURE(1) TO COMOTINST 16616.2A CH-2
6 FEB 1978

VESSEL + REGISTRY	CARGOES	DATE	
BOW SKY NORWAY	AAC ACA ACN ACR ACY ADN AEE ALA ALC AMH ANL ATN BAE BAR BCL BMH BNZ BTE CBO CBT CCH CCW CHA CHD CHT CLP CNO CPO CPS CRB CRF CRS CSS CTA DAT DBA DBO DCM DCN DDM DEA DEE DEN DET DIA DIE DIP DMB DMF DMG DOX DPK DPM DPP DPU DVH EAC EAI EDA EDB EDC EPA EPC ETC ETM FFA FMA FMT HMC HMI MAM MEA MEP MMM MPA MPL MSO MSR NCT NIT NPP NPS NTD NTM OLM PAC PAH PAM PAN PAR PCE PHN PNA PPI PRD SAC SFA SHP SHR STY TCN TCO TDH TEA TEC TEN TET THF TTP UAS VAK VAM VNT	5-31-77 6-13-77 11-01-77 6-13-79	CONTACT EXAM LOC EXPIRES
BOW SPRING NORWAY	AAC ACN ACR ACY ADN AEE ALA ALC AMH ANL ATN BAE BAR BCL BMH BNZ BTE CBO CBT CCH CCW CFR CHA CHD CPO CPS CRB CRP CRS CSS CTA DAT DBA DBO DCM DEA DEE DEN DET DIA DIE DIP DMB DMF DMG DOX DPP DPQ DPU DVH EAC EAI ECH EDA EDB EDC EPA EPC ETC ETM FFA FMA FMS MAM MEA MEP MMM MPA MPL MSO MSR NAC NCT NIT NPP NTD NTM OLM PAC PAH PAM PAN PAR PCE PHN PNA POX PRD SAC SFA SHP SHR STY TCO TDI TEA TEA TEC TET THF UAS VAK VAM VNT	4-07-76 4-23-76 5-26-76 4-23-78	CONTACT EXAM LOC EXPIRES

Figure 43. Sample Printout of List of Foreign Flag Vessels Carrying Letters of Compliance.

VESSEL NAME / VESSEL NUMBER	GT / CREW	BUILT / MAT	LENGTH / BREADTH	OPERATOR / OWNER	RTE. / SBCH	HULL TYPE	GRU CARGO CAPACITY	CERT. EXP. LAST DRYDOCK	OCMI	STATUS
AO 354	797	1973	148.0	ASHLAND PETROLEUM CO	LL	2	AX	05/13/78	HOU	
CG 618424	U	S		ASHQUIP INC	2		13206 B	05 76	HOU	
AO 355	797	1973	148.0	ASHLAND PETROLEUM CO	LL	2	AX	10/30/78	NEW	
CG 619281	U	S		ASHQUIP INCORPARATED	2		13206 B	10 76	NEW	
AO 355	737	1973	148.0	ASHLAND PETROLEUM COMPANY	LL	2	AX	10/30/78	NEW	
CG 626834	U	S		ASHQUIP INCORATED	2		13206 B	10 73	PIT	
AO 361	1614	1973	298.0	ASHLAND PETROLEUM CO	LL	2	AX	10/26/78	NEW	
CG 617561	U	S		ASHQUIP INC	2		24623 B	10 76	NEW	
AO 362	1673	1973	298.0	ASHLAND PETROLEUM CO	LL	2	AX	09/17/78	HUN	
CG 617643	U	S		ASHQUIP INC	2		26331 B	09 76	HUN	
AO 364	797	1973	147.0	ASHLAND PETROLEUM CO	LL	2	AX	08/10/78	NEW	
CG 619851	U	S		ASHQUIP INCORPORATED	2		13206 B	08 76	NEW	
AO 365	797	1973	148.0	ASHLAND PETROLEUM CO	LL	2	AX	09/23/77	HUN	
CG 619372	U	S		ASHQUIP INCORPORATED	2		13206 B	12 75	HUN	
AO 371	1614	1973	298.0	ASHLAND PETROLEUM CO	LL	2	AX	10/09/78	NEW	
CG 619729	U	S		ASHQUIP INCORPORATED	2		24623 B	10 76	NEW	
AO 372	1673	1973	298.0	ASHLAND PETROLEUM CO	LL	2	AX	10/24/78	HOU	
CG 619778	U	S		ASHQUIP INC	2		26331 B	10 76	HOU	
AO 374 X	797	1973	148.0	ASHLAND PETROLEUM CO	LL	2	AX	08/07/78	PAT	
CG 617836	U	S		ASHQUIP INC	2		13206 B	08 76	PAT	
AO 375	797	1973	148.0	ASHLAND PETROLEUM CO	LL	2	AX	10/08/78	NEW	
CG 619273	U	S		ASHQUIP INCORPORATED	2		13206 B	10 76	NEW	
AO 381	1614	1973	298.0	ASHLAND PETROLEUM CO	LL	2	AX	12/17/78	HUN	
CG 619331	U	S		ASHQUIP INCORPORATED	2		24623 B	10 73	PIT	
AO 382	1673	1973	298.0	ASHLAND PETROLEUM CO	LL	2	AX	04/13/78	HUN	
CG 620180	U	S		ASHQUIP INCORPORATED	2		26331 B	04 76	HUN	
AO 385	797	1973	148.0	ASHLAND PETROLEUM CO	LL	2	AX	10/20/78	NEW	
CG 619471	U	S		ASHQUIP INCORPORATED	2		13206 B	10 76	NEW	
AO 394	797	1973	147.6	ASHLAND PETROLEUM COMPANY	LL	2	AX	07/29/78	NEW	
CG 621451	U	S		ASHQUIP INCORPORATED	2		13206 B	07 76	NEW	
AO C-217	945	1952	150.0	ASHLAND OIL INC	LL	3	BB	02/25/79	HUN	
CG 000489	U	S	52.5	ASHLAND OIL & REFINING CO	1		15263 B	02 77	HUN	
AO B 56	615	1948	195.0	ASHLAND OIL INC	RR	3	BX	11/01/78	HUN	
CG 000141	U	S	35.0	ASHLAND OIL INC	2		10130 B	11 76	HUN	

Figure 44. Excerpt From United States Coast Guard Inspected Tank Barges and Tankships

CG0008763 CC-418		000	
ACETIC ACID	AMMONIA ANHYDROUS	BENZENE	BENZENE,XYLENE,TOLUENE CRUDE
BUTYL ACRYLATE (N,INHIBITED)	BUTYRALDEHYDE (ISO-,N-)	1,2-DICHLOROPROPANE	DIETHANOLAMINE
DIETHYLENETRIAMINE	ETHYLENEDIAMINE	ETHYLENE DICHLORIDE	2-ETHYLHEXYL ACRYLATE (INHIB)
FORMIC ACID	BUTYL ACRYLATE (ISO) (INHIB)	MONOETHANOLAMINE	MORPHOLINE
PROPIONIC ACID	STYRENE (INHIBITED)	TRIETHANOLAMINE	TRIETHYLENE TETRAMINE
CG0008813 CC-419			
BENZENE	BUTYRALDEHYDE (ISO-,N-)	BUTYL ACRYLATE (ISO-,N-,INHIB)	ETHYL ACRYLATE (INHIBITED)
ETHYLENE DICHLORIDE	2-ETHYLHEXYL ACRYLATE (INHIB)	ISODECYL ACRYLATE (INHIBITED)	METHYL ACRYLATE (INHIBITED)
PROPYLENE	STYRENE (INHIBITED)	VINYL ACETATE (INHIBITED)	BUTYL ACRYLATE (ISO) (INHIB)
BUTYRALDEHYDE (ISO-,N-)	1,2-DICHLOROPROPANE	BENZENE,XYLENE,TOLUENE CRUDE	AMINOETHYL ETHANOLAMINE
TRIETHANOLAMINE	TRIETHYLENE TETRAMINE	ACETIC ACID	AMMONIA ANHYDROUS
FORMIC ACID	PROPIONIC ACID		
CG0008862 CC-420		000	
ACRYLONITRILE (INHIBITED)	BENZENE	BUTYRALDEHYDE (N)	ETHYL ACRYLATE (INHIBITED)
ETHYLENEDIAMINE	ETHYLENE DICHLORIDE	VINYL CHLORIDE (INHIBITED)	STYRENE (INHIBITED)
BUTYL ACRYLATE (ISO) (INHIB)	MORPHOLINE	VINYL ACETATE (INHIBITED)	PROPANOLAMINE (ISO-)
BENZENE,XYLENE,TOLUENE CRUDE	EPICHLOROHYDRIN		
CG0008912 CC-421		000	
BUTYL ACRYLATE (N,INHIBITED)	BUTYL ACRYLATE (ISO) (INHIB)	BUTYRALDEHYDE (ISO-,N-)	DIETHYLENETRIAMINE
MONOETHANOLAMINE	MORPHOLINE	TRIETHANOLAMINE	TRIETHYLENE TETRAMINE
BENZENE,XYLENE,TOLUENE CRUDE	2-ETHYLHEXYL ACRYLATE (INHIB)	2-METHYL-5-ETHYL PYRIDINE	AMINOETHYL ETHANOLAMINE
DIETHANOLAMINE	STYRENE (INHIBITED)	VINYL ACETATE (INHIBITED)	
CG0008961 CC-422		000	
AMINOETHYL ETHANOLAMINE	BENZENE	BUTYL ACRYLATE (N,INHIBITED)	BUTYL ACRYLATE (ISO) (INHIB)
ISOPROPYLAMINE	BUTYL ACRYLATE (ISO-,N-,INHIB)	1,2-DICHLOROPROPANE	DIETHANOLAMINE
DIETHYLENETRIAMINE	BENZENE,XYLENE,TOLUENE CRUDE	2-METHYL-5-ETHYL PYRIDINE	TRIETHYLAMINE

Figure 45. Excerpt From List of Hazardous Materials Barges.

This list contains the only information found to date on U.S. vessels carrying dangerous cargo.

D. LLOYD'S REGISTER OF SHIPPING

Lloyd's of London publishes a Register of Shipping annually.[1] This register contains the list of vessels and their specifications which were built in accordance with Lloyd's rules of construction and classification. Also contained in this publication are particulars of oceangoing merchant ships of 100 gross tons and greater known to Lloyd's. This information is obtained by Lloyd's agents from shipyards around the world.

Figure 46 shows a page from Lloyd's Register of Shipping. Information contained in the register on each vessel is listed in seven columns, with the following data in each column:

- Column 1 contains Lloyd's register number which does not change during the life of the vessel; the call sign; official number and navigational aids, i.e., direction finder, echo sounding device, radar, etc.
- Column 2 contains the vessel's former names, owners, managers, port of registry and flag.
- Column 3 includes gross, net, and deadweight tonnage; whether the ship is a shelter-decker; whether the vessel has a tonnage mark; and whether the vessel is an ore/oil carrier.
- Column 4 includes hull, ice class, machinery, refrigeration, inert gas systems, and equipment classifications; also lists any special surveys, requests for class withdrawal, and classifications with other societies.
- Column 5 contains the date the vessel was built, shipbuilder, shipyard and number, overall length, registered length between perpendiculars, extreme breadth, moulded breadth, maximum draught, moulded depth, superstructures, (i.e., bridge, forecastle, etc.), type of deck, cargo battens, bulkheads, alterations, keel and water ballast; whether the hull is riveted or welded, and the rise of the floor.
- Column 6 includes description of ship—diesel-electric, gas-turbine, paddle; passenger capacity, holds at their lengths; the carrying capacity for container ships; type of tanks; number, size, and type of hatchways; number of winches, cranes, and derricks.
- Column 7 contains type of engines, maximum designed power, engine design, capacity of fuel bunkers, any special types of propellers, speed in normal weather, and type of boilers.

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[1] Lloyd's of London, "Lloyd's Register of Shipping."

1 LR NUMBER / Call Sign / Official No. / Navigational aids	2 SHIP'S NAME / Former names / Owners / Managers / Port of Registry / Flag	3 TONS	4 CLASSIFICATION	5 HULL	6 SHIP TYPE/CARGO FACILITIES	7 MACHINERY
6908979	**A YAR MIN THA MEE**	200		**1969** Yokohama Yacht Co. Ltd.—Yka (597-2)	**TM Patrol Vessel**	2 Oil 4SA each 12Cy. 160 × 220
	Government of the Union of Burma	102		36.58 9.61 1.220	Mchy aft	418kW (560bhp)
	Rangoon Burma			9.15 2.44		Kubota Tekkosho Osa
				1 dk		
7111121	**A YAR MAI**	230		**1970** Yokohama Yacht Co. Ltd.—Yka (632-1)	**TM Patrol Vessel** —P	2 Oil 4SA each 12Cy. 160 × 220
	Government of the Union of Burma (Defence Industries - Home Utilities Division)	102		36.58 9.61 1.385	Mchy aft	418kW (560bhp)
	Rangoon Burma			9.15 2.44		Kubota Tekkosho Osa
				1 dk		
7111133	**A YAR MAUNG**	230		**1970** Yokohama Yacht Co. Ltd.—Yka (632-2)	**TM Patrol Vessel** —P	2 Oil 4SA each 12Cy. 160 × 220
	Government of the Union of Burma (Defence Industries - Home Utilities Division)	102		36.58 9.61 1.385	Mchy aft	418kW (560bhp)
	Rangoon Burma			9.15 2.44		Kubota Tekkosho Osa
				1 dk		
7628398	**A 15**	170		**1976** Schoeps Damen B.V.—Gorinchem (776)	**TM Tug**	2 Vee Oil 4SA each 12Cy. 159 × 203
		125			Mchy aft	
	Republica de Cuba	—	BV	22.18 6.05		Caterpillar Tractor Co Peoria
	Havana Cuba			6.01 2.72		Gen 1 × 48kW
				1 dk		Fuel 30.5t (d.o.) 10.75kn
6051281	**A 24**	219		**1950** Smith & Rhuland Ltd.—Lunenburg	**Wood M Fishing**	Oil 6Cy. 330 × 405
VOSD	ex Cape Fourchu 74	106		*32.62* 7.32	Side fishing	
192650	**Parsons Brothers Industrial Sales & Service**	—		7.27		Cooper Bessemer Corp. Grove City
Esd Pfd Rdr RT	Halifax Canada					
7046762	**A. A. FERRANTE**	116		**1945** Martinolich SB. Corp.—S.Fo	**Wood M Fishing**	Oil
WA2003		71		*22.47* 6.51		187kW (250bhp)
248426	**A. A. Ferrante Fishing Corp.**	—		3.38		Enterprise Eng. & Fdry. Co S.Fo
	New Bedford, Ma United States of America					Fuel (d.o.)
6701761	**A. B. WOOD II**	124		**1966** Bishop SB. Inc.—Aransas Pass, Tx	**TM Supply Ship**	2 Oil each 12Cy. 159 × 203
WB6461	ex Lord Reyingh ex Leo Jude	132		42.98 11.03 3.388	Deck Cargo	1 141kW (1 530bhp)
501922	**Cavanagh Leasing Corp.**	—		42.68 10.98 3.97		Caterpillar Tractor Co Peoria
Df Rdr RT	Miami, Fl United States of America			1 dk		12kn
7040764	**A. BROOKE TAYLOR**	298		**1913** American Car & Fdry. Corp.—Wmg	**Wood M Fishing**	Oil
WA2010		130		*44.51* 7.12		448kW (600bhp)
211345	**A. Brooke Taylor Inc.**	—		3.36		
	Boston, Ma United States of America					Fuel (d.o.)
7206238	**A. C. CROSBIE**	7 100	✠100A1 SS 7/76	**1972**-11 Robb Caledon S.Bs. Ltd.—Dun (568)	**M General Cargo/Container Ship**	Vee Oil 4SA 14Cy. 400 × 400 sr geared
VYBL	ex Ida Lundgren 76	3 783	Ice Class 1		Fixed guides	5 222kW (7 000bhp) Pielstick
327335	**Common Brothers Ltd.**	9 792	✠LMC UMS	122.81 19.05 8.103	4 Ho 18.9 27.2 23.7 9.0 ER	Crossley Premier Eng. Ltd Mch
Df Esd	Chimo Shipping Ltd		EL Z 2½°U2	114.92 19.00 11.00	B 11 900	Aux8 (Comp) 0.69MPa (7kg/cm²)
Gp Rdr RTv	St. John's, Nfl Canada			RAD 19.6 F 13.8 1 dk	C Ho 202/20 (40) C.Dk 90/20' (40')	Gen 1 × 400kW 3 × 344kW 440V 60Hz a.c
				rf 152	4 Ha (sl) (18.9 27.2 23.7 × 16.3) (4.8 × 6.5) ER	Controllable pitch propeller
				NS 88H WB3441t incl. DTmf 278t DTma 278t	Cr 4(12.25)	Fuel 938.0t (fo) 15kn
6851886	**A. CHEKOV**	122		**1956** ..... German Dem. Republic	**M Fishing**	Oil 4SA 8Cy. 240 × 360
UZZU		36		26.73 6.30 2.601		
M 4611	U.S.S.R.	35		3.00	1 Ho	Schwermesch. Karl Liebknecht Kmgt
	Astrakhan U.S.S.R.			1 dk	B 102	Fuel (d.o.) Rvn
					1 Ha (1.9 × 2.9)	
7216878	**A. D. GEOPOTES I**	4 122		**1972** N.S.W. Govt. Eng. & SB. Undertaking —Newcastle, N.S.W. (89)	**TM Hopper/Dredger**	2 Oil 4SA each 16Cy. 222 × 292
GRAS		2 060			Trailing Suction Bottom doors	2 984kW (4 000bhp)
352115	**Volker Dredging (U.K.) Ltd. & Nash Dredging & Reclamation Co. Ltd.**	6 228	BV	96.07 16.62 7.392	Single side arm Dredging depth 29.0	Lister Blackstone Mirrlees Mar. Dursley
Df Esd				85.96 16.54 9.06	Hopper 6550T	Thw. thrust propeller fwd
Gp Rdr RT	King's Lynn United Kingdom			1 dk	Mchy aft	12kn
					Hopper 3 000	
					Der 2(5)	
6908840	**A. D. VICTORIA**	636	✠100A1 SS 11/73	**1969**-8 N.S.W. Govt. Eng. & SB. Undertaking—Newcastle, N.S.W. (81)	**Dredger**	
		484	dredger		Bucket	
332297	**Australian Dredging & General Works Pty. Ltd.**	—	EL (T) 1°U2	46.64 10.60 2.789		
Esd RT	Melbourne Australia			45.73 10.52 4.04	Cr 1(3) Der 2(3)	
				1 dk		Gen 1 × 300kW 1 × 20kW
				rf nil		240/415V 50Hz a.c
				4BH WB148t		

A. D. VICTORIA

Figure 46. Excerpt from Lloyd's Register of Shipping.

The annual Register is updated with monthly supplements which include changes of name, ownership, flag, etc., for all ships and a separate listing of all new vessels not recorded in the annual Register.

E. MERCHANTS FLEETS OF THE WORLD

The U.S. Maritime Administration annually publishes a summary of merchant ships of the world.[1] These data, obtained from public sources and U.S. Government records, include information on "oceangoing vessels of 1,000 gross tons or more, and exclude ships operating on the Great Lakes and inland waterways and special types such as channel ships, ice breakers, cable ships, etc."[2]

The merchant fleets have been subdivided into passenger carrying vessels, bulk carriers, tankers, and freighters. Freighters have been further broken down by general cargo carriers, full containerships, partial containerships, roll-on/roll-off vessels, and barge carriers. Frequency tables in this volume show number of vessels, gross tons, and deadweight tons by type of vessel and by countries with merchant fleets (see figure 47). In addition, comparative tables are presented for the current year, previous year, and 10 years earlier.

In addition, the Maritime Administration annually publishes "Bulk Carriers in the World Fleet"[3] which lists and presents statistics on the bulk carriers of the world. Distributions and summaries of bulk carriers by type of ship, age, speed, size, and draft are shown. Vessels by country of registry and type of carrier are listed with the year built, gross tons, deadweight tons, speed and draft (see figure 48).

F. MERCHANT VESSELS OF THE UNITED STATES

The U.S. Coast Guard annually publishes the, Merchant Vessels of the United States,[4] contains a list of U.S. merchant vessels and yachts having valid marine documents, i.e., registers, enrollments and licenses, or licenses on January 1. This annual volume is updated

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[1] Maritime Administration, U.S. Department of Commerce, "Merchant Fleets of the World," published annually (Washington, D.C.).

[2] Ibid., p. i.

[3] Maritime Administration, U.S. Department of Commerce, "Bulk Carriers in the World Fleet" (Washington, D.C.).

[4] U.S. Coast Guard, Merchant Vessels of the United States, published annually (Washington, D.C.).

MERCHANT FLEETS OF THE WORLD

OCEANGOING STEAM AND MOTOR SHIPS OF 1,000 GROSS TONS AND OVER AS OF DECEMBER 31, 1976

(Excludes Ships Operating Exclusively on the Great Lakes and Inland Waterways and Special Types such as Channel Ships, Icebreakers, Cable Ships, etc., and Merchant Ships Owned by any Military Force.)

(Tonnage in Thousands)

Country of Registry	Total			Passenger Carrying Vessels			Freighters			Bulk Carriers			Tankers		
	Number	Gross	Dead-weight	Number	Gross	Dead-weight	Number	Gross	Dead-weight	Number	Gross	Dead-weight	Number	Gross	Dead-weight
Total - All Countries	23,586	358,203	606,499	710	5,697	2,962	12,923	77,939	104,639	4,570	95,451	163,298	5,383	179,116	335,600
United States 1/	842	12,655	18,566	61	610	393	494	5,877	6,930	18	293	529	269	5,875	10,714
Privately-Owned	577	10,531	16,020	6	74	50	299	4,420	4,931	18	293	529	254	5,744	10,510
Government-Owned	265	2,124	2,546	55	536	343	195	1,457	1,999	-	-	-	15	131	204
Reserve Fleet	247	1,961	2,366	51	486	313	184	1,370	1,890	-	-	-	12	105	163
Other 2/	18	163	180	4	50	30	11	87	109	-	-	-	3	26	41
*Albania	10	50	68	-	-	-	7	41	56	3	9	12	-	-	-
Algeria	40	512	773	-	-	-	23	89	130	3	25	36	14	398	607
Argentina	159	1,354	1,899	7	36	28	87	582	753	15	187	298	50	549	820
Australia	85	1,177	1,776	-	-	-	37	301	353	33	601	975	15	275	448
Austria	16	62	94	-	-	-	14	39	59	2	23	35	-	-	-
Bangladesh	17	92	132	-	-	-	15	90	128	-	-	-	2	2	4
Belgium	81	1,411	2,275	1	13	15	37	337	433	25	688	1,179	18	373	648
Brazil	268	3,203	5,205	6	31	12	166	984	1,335	37	880	1,578	59	1,308	2,280
British Colonies	90	1,983	3,354	2	7	7	26	128	154	32	714	1,179	30	1,134	2,014
Bulgaria	111	857	1,229	4	22	12	59	284	377	29	261	384	19	290	456
Burma	9	50	64	2	4	3	7	46	61	-	-	-	-	-	-
Cameroon	2	15	16	-	-	-	2	15	16	-	-	-	-	-	-
Canada	70	385	530	10	29	12	21	71	84	14	135	208	25	150	226
Chile	44	400	611	1	3	2	31	216	310	6	82	139	6	99	160
China (Taiwan)	151	1,442	2,222	10	54	61	95	529	724	32	506	820	14	353	617
*China (People's Rep.)	432	3,573	5,310	25	126	78	289	1,908	3,686	53	604	967	65	935	1,579
Colombia	35	218	285	-	-	-	33	197	254	1	2	2	1	19	29
*Cuba	68	470	643	2	15	10	53	367	502	5	33	49	8	55	82
Cyprus	535	2,839	4,142	6	46	35	451	2,083	3,009	41	310	463	37	400	635
Czechoslovakia	13	144	214	-	-	-	8	41	54	5	103	160	-	-	-
Denmark	353	5,026	8,205	3	54	18	234	1,460	1,870	44	737	1,213	70	2,795	5,285
Dominican Republic	1	1	2	-	-	-	1	1	2	-	-	-	-	-	-
Ecuador	19	164	247	-	-	-	8	55	66	-	-	-	11	109	181
El Salvador	1	2	3	-	-	-	1	2	3	-	-	-	-	-	-
Ethiopia	4	19	25	-	-	-	3	17	22	-	-	-	1	2	3
Finland	192	1,994	3,185	7	41	10	106	447	574	29	367	615	50	1,139	1,986
France	458	11,616	20,394	6	113	26	238	1,786	2,298	60	1,600	2,735	154	8,117	15,335
Gabon	5	106	183	-	-	-	3	21	27	1	11	16	1	74	140
Germany (West)	633	9,053	14,871	6	63	17	461	3,038	3,912	77	2,323	4,012	89	3,629	6,930
*Germany (East)	155	1,250	1,791	4	43	26	122	684	893	18	239	369	11	284	503
Ghana	19	127	166	-	-	-	19	127	166	-	-	-	-	-	-
Greece	1,916	24,365	40,936	57	452	231	984	6,255	9,289	546	8,712	15,013	329	8,946	16,403
Guatemala	4	8	12	-	-	-	4	8	12	-	-	-	-	-	-
Guinea	2	14	19	-	-	-	1	3	4	1	11	15	-	-	-
Honduras	11	52	53	-	-	-	11	52	53	-	-	-	-	-	-
*Hungary	15	54	76	-	-	-	15	54	76	-	-	-	-	-	-
Iceland	30	56	84	-	-	-	28	53	80	2	3	4	-	-	-
India	337	5,110	8,252	12	91	78	204	1,647	2,354	88	2,199	3,782	33	1,173	2,038
Indonesia	186	729	945	30	126	96	128	465	652	7	49	68	21	89	126
Iran	50	611	1,037	-	-	-	42	340	485	-	-	-	8	291	552
Iraq	26	657	1,195	-	-	-	12	78	112	-	-	-	14	579	1,083
Ireland	17	171	259	-	-	-	5	11	11	9	155	241	3	5	7
Israel	52	466	604	-	-	-	43	280	327	9	186	277	-	-	-
Italy	628	10,671	17,432	50	616	209	193	1,062	1,381	155	4,089	6,962	230	4,904	8,880
Ivory Coast	14	106	139	-	-	-	14	106	139	-	-	-	-	-	-
Jamaica	1	6	5	-	-	-	1	6	5	-	-	-	-	-	-
Japan	2,071	39,149	66,648	29	115	64	920	5,485	7,348	572	13,928	23,185	550	19,621	36,051
Kenya	6	15	23	-	-	-	4	12	19	1	2	2	1	1	2
Korea (South)	191	1,563	2,627	-	-	-	124	509	751	32	273	440	35	781	1,436
*Korea (North)	14	68	95	1	4	2	9	37	52	1	5	8	3	22	33

Figure 47. Excerpt From Merchant Fleets of the World.

BULK CARRIERS IN THE WORLD FLEET
OCEANGOING MERCHANT TYPE SHIPS OF 1,000 GROSS TONS AND OVER
AS OF DECEMBER 31, 1976

(TONNAGE IN THOUSANDS)

E7-01

COUNTRY OF REGISTRY / VESSEL TYPE / NAME OF SHIP	NUMBER OF SHIPS	YEAR BUILT	GROSS	DEAD-WEIGHT	SPEED (KNOTS)	DRAFT (FEET)
UNITED STATES						
GENERAL BULK						
COLUMBIA		1945	14.5	23.3	14	34
COLUMBIA		1944	06.8	16.6	14	30
FLOR		1948	10.9	23.5	16	34
KOPAA		1944	14.2	24.2	16	34
MARINE ELECTRIC		1944	13.8	25.6	14	33
MERRIMAC		1944	16.0	25.0	14	35
OVERSEAS TRAVELER		1945	15.1	25.1	15	33
POTOMAC		1945	13.9	22.8	14	32
RICE QUEEN		1944	10.4	14.4	14	31
SUGAR ISLANDER		1973	15.5	29.6	15	34
TAMARA GUILDEN		1961	15.0	23.8	15	36
TEX		1948	10.9	23.5	16	34
YELLOWSTONE		1945	11.0	16.2	17	33
CLASS TOTALS	13		168.0	293.6		
COLLIERS						
AMERICAN BEAR		1945	16.3	24.3	13	34
CLASS TOTALS	1		16.3	24.3		
ORE CARRIERS						
INGER		1945	14.2	23.5	14	32
WALTER RICE		1945	14.1	23.5	14	32
CLASS TOTALS	2		28.3	47.0		
ORE/BULK/OIL						
ULTRAMAR		1973	40.4	82.2	16	46
ULTRASEA		1974	39.8	82.2	16	46
CLASS TOTALS	2		80.2	164.4		
TOTAL ALL TYPES	18		292.8	529.3		

Figure 48. Excerpt From Bulk Carriers in the World Fleet.

with "The Monthly Supplement to Merchant Vessels of the United States."[1] Figure 49 shows a page from the annual record which includes identification, specifications, service, owner, and place built of all vessels listed.

G. RECORD OF THE AMERICAN BUREAU OF SHIPPING

The American Bureau of Shipping publishes an annual Register of Shipping.[2] An example from this record is shown in Figure 50. For each vessel, information is in eight columns and includes the following data:

- Column 1 contains the identity number which is used with the computerized system by which these records are produced; however, this number may not be the same for each vessel from year to year. Also included in this column is the official vessel number, signal letters, former names, and port of registry.
- Column 2 contains the length, breadth, depth, and draft of the vessel.
- Column 3 includes gross and net tons; and the Underwriters Cubic Factor, which is length times breadth times depth to the upper depth divided by 100.
- Column 4 contains the fuel capacity for oil burning vessels; the tanks available for fresh and salt water ballast and their capacity in long tons; total number of containers for container carriers; the type and capacity in long tons of deck equipment for handling cargo; capacity of refrigerated spaces; and the maximum pressure (psi) for carriage of liquefied gases.
- Column 5 includes type of vessel, machinery location, riveting and material used in the hull, number of decks, and number of hatches.
- Column 6 contains type of engine, horsepower, and type of refrigerating machinery.
- Column 7 lists the shipbuilder, shipyard location, and date the ship was built.
- Column 8 contains the hull and equipment, machinery, and refrigeration classifications.

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[1] U.S. Coast Guard, "The Monthly Supplement to Merchant Vessels of the United States," published monthly (Washington, D.C.).

[2] American Bureau of Shipping, Record, published annually (New York, New York).

Official No.	Signal and radio-call letters	Rig	Name of vessel		Tonnage: Gross	Tonnage: Net	Dimensions in feet: Length	Dimensions in feet: Breadth	Dimensions in feet: Depth	Hull	When built	Where built	Service	Horse power	Name of owner	Home port
283057		Brg	1		226	226	120 0	30 0	7 9	S	1960	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
505903		Brg	1		909	909	195 1	35 1	10 8	S	1966	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
537267		Drg	1		16	16	40 0	12 0	3 7	S	1968	Port Lavaca Tx	Drg	—	SHORELINE DREDGING & CONSTR TX	CORPUS CHRISTI TX
547995		Brg	1		1,391	1,391	242 0	42 0	15 9	S	1973	Portland Or	Tnk	—	TIDEWATER BARGE LINES INC OR	PORTLAND OR
283058		Brg	2		226	226	120 0	30 0	7 9	S	1960	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
505904		Brg	2		909	909	195 1	35 1	10 8	S	1966	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
285348		Brg	3		226	226	120 0	30 0	7 9	S	1961	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
505905		Brg	3		909	909	195 1	35 1	10 8	S	1966	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
526689	WY72125	Oil Cl	3	•	14	13	35 0	20 0	5 5	W	1969	Ise shi Japan	Yct	15	HARTHORN W. ANDREW	BOSTON MA
285349		Brg	4		226	226	120 0	30 0	7 9	S	1961	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
505906		Brg	4		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
292781		Brg	5		226	226	120 0	30 0	7 9	S	1963	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
505907		Brg	5		909	909	195 1	35 1	10 8	S	1966	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
292782		Brg	6		226	226	120 0	30 0	7 9	S	1963	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
505908		Brg	6		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
538933		Brg	6		317	317	150 0	32 0	7 5	S	1965	Toll City In	Frt	—	GREENVILLE DREDGING CO MS	GREENVILLE MS
292783		Brg	7		226	226	120 0	30 0	7 9	S	1963	Toll City, Ind	Frt	—	HARBERT CONSTRUCTION CORP AL	MEMPHIS TN
507188		Brg	7		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
537768		Oil S	7		18	13	38 0	16 0	2 8	S	1964	Port Lavaca Tx	Exp	165	FISHER, E H	CORPUS CHRISTI TX
507189		Brg	8		909	909	195 1	35 1	10 8	S	1967	Pittsburgh Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
278121		Brg	9		252	252	130 2	29 9	7 1	S	1946	St Louis, Mo	Frt	—	LIMITED LEASING CO MO	ST LOUIS MO
507190		Brg	9		909	909	195 1	35 1	10 8	S	1967	Pittsburgh Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
260317	WH4560	Go S	02		16	13	32 6	12 5	5 7	W	1950	Cambridge, Md	Fsh	110	OLSEN, OSCAR	NEW YORK N Y
278122		Brg	10		252	252	130 2	29 9	7 1	S	1946	St Louis, Mo	Frt	—	LIMITED LEASING CO MO	ST LOUIS MO
507191		Brg	10		909	909	195 1	35 1	10 8	S	1967	Pittsburgh, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
278123		Brg	11		252	252	130 2	29 9	7 1	S	1945	St Louis, Mo	Frt	—	LIMITED LEASING CO MO	ST LOUIS MO
507192		Brg	11		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
278124		Brg	12		252	252	130 2	29 9	7 1	S	1956	Paducah, Ky	Frt	—	LIMITED LEASING CO MO	ST LOUIS MO
507193		Brg	12		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
278125		Brg	13		252	252	130 2	29 9	7 1	S	1956	Paducah, Ky	Frt	—	LIMITED LEASING CO MO	ST LOUIS MO
507194		Brg	13		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507195		Brg	14		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507196		Brg	15		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507197		Brg	16		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507198		Brg	17		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507199		Brg	18		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
270645		Brg	• 19		2,589	2,589	290 3	50 1	20 7	S	1955	Alameda, Calif	Tnk	—	AMERICAN TUG BOAT CO WA	SEATTLE WA
507200		Brg	19		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
277024		Brg	• 20		429	429	160 1	35 1	9 3	S	1955	Port Arthur, Tex	Misc	—	FLORES, HUNTER MARINE INC TX	GALVESTON TX
507201		Brg	20		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507202		Brg	21		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
535681	WY26402	Go S	• 21		22	18	38 1	12 9	6 8	F	1971	Miami Fl	Yct	650	LORIE, FELIPE	MIAMI FL
507203		Brg	22		909	909	195 1	35 1	10 8	S	1967	Neville Island, Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507204		Brg	23		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
262803		Brg	24		757	757	259 0	39 4	8 1	S	1951	Manners Harbor, N Y	Frt	—	READING CO PA	PHILADELPHIA PA
275450	WL3897	Brg	• 24		407	407	120 0	40 0	8 5	S	1958	Manners Harbor, N Y	Frt	—	GATES CONSTRUCTION CORP N J	NEW YORK N Y
507205		Brg	24		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
262804		Brg	25		757	757	259 0	39 4	8 1	S	1951	Manners Harbor, N Y	Frt	—	READING CO PA	PHILADELPHIA PA
269876		Brg	25		78	78	70 0	23 9	5 4	S	1950	Miami, Fla	Frt	—	POWELL BROS INC FL	MIAMI FL
275851		Brg	• 25		534	534	138 0	40 0	11 5	S	1958	Manners Harbor, N Y	Frt	—	GATES CONSTRUCTION CORP N J	NEW YORK N Y
507206		Brg	25		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
269938		Brg	26		78	78	70 0	23 9	5 4	S	1950	Miami, Fla	Frt	—	POWELL BROS INC FL	MIAMI FL
275852		Brg	• 26		534	534	138 0	40 0	11 5	S	1958	Manners Harbor, N Y	Frt	—	GATES CONSTRUCTION CORP N J	NEW YORK N Y
507207		Brg	26		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
507208		Brg	27		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
282785		Brg	28		292	292	150 1	30 1	7 1	S	1960	Toll City, Ind	Frt	—	MCDONOUGH CO DE	PITTSBURGH PA
507209		Brg	28		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
282786		Brg	29		292	292	150 1	30 1	7 1	S	1960	Toll City, Ind	Frt	—	MCDONOUGH CO DE	PITTSBURGH PA
507210		Brg	29		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267375		Brg	• 30		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
282787		Brg	30		292	292	150 1	30 1	7 1	S	1960	Toll City, Ind	Frt	—	MCDONOUGH CO DE	PITTSBURGH PA
507211		Brg	30		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267376		Brg	• 31		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
507212		Brg	31		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267377		Brg	• 32		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
507213		Brg	32		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267378		Brg	• 33		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
507214		Brg	33		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267379		Brg	• 34		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
507215		Brg	34		909	909	195 1	35 1	10 8	S	1967	Neville Island Pa	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267380		Brg	• 35		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
540880		Brg	35		836	836	195 0	35 0	10 7	S	1972	St Louis Mo	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE
267381		Brg	• 36		161	161	110 0	26 0	6 2	S	1924	Ambridge, Pa	Frt	—	CRAIN BROS INC PA	PITTSBURGH PA
540881		Brg	36		836	836	195 0	35 0	10 7	S	1972	St Louis Mo	Frt	—	DUNDEE CEMENT CO DE	WILMINGTON DE

Figure 49. Excerpt From Merchant Vessels of the United States.

1 Vessel	2 Dimensions	3 Tonnage	4 Capacities	5 Hull	6 Machinery	7 Builders	8 Classification
A-1 UNITED STATES STEEL CORP. U.S.A. PITTSBURGH,PA	300' 52' 14' DR 0'	—		BARGE INDEPENDENT TANK CARRIER STEEL, 1 DK FRMG LONG 2 WT 2 WT LONG BH 2 IT CYLINDRICAL 18.3'X 238' SEE COMMENT 8 (P XXIX)		AMERICAN BRIDGE DIVISION, 274 UNITED STATES STEEL CORP. ORANGE,TX 9-66	✠ A1 INDEPENDENT TANK BARGE, RIVER SERVICE SSH NO 3 3-81 AHS 3-77, DD 3-81
A-2 UNITED STATES STEEL CORP. U.S.A. PITTSBURGH,PA	300' 52' 14' DR 0'	—		BARGE INDEPENDENT TANK CARRIER STEEL, 1 DK FRMG LONG 2 WT 2 WT LONG BH 2 IT CYLINDRICAL 18.3'X 238' SEE COMMENT 8 (P XXIX)		AMERICAN BRIDGE DIVISION, 275 UNITED STATES STEEL CORP. ORANGE,TX 9-66	✠ A1 INDEPENDENT TANK BARGE, RIVER SERVICE SSH NO 3 3-81 AHS 3-77, DD 3-81
A-572 GREAT LAKES DREDGE & DOCK CO. U.S.A. ST LOUIS,MO	100' 30' 7' DFT 5.927' FBD 1.125'	101 101 — —		BARGE STEEL		LESTER F. ALEXANDER CO. NEW ORLEANS,LA 45	
A 904 INGALLS 26-52 GEORGETOWN CONSTRUCTION CO. U.S.A. WILMINGTON,DE	270.33' 48' 9.67' 84.5385 14.6346 DR 4'	1161 1161 — —		BARGE TANK STEEL, 1 DK FRMG LONG 6 OT 1 OT LONG BH 10 CTW 48'		INGALLS SHIPBUILDING CORP. 630 DECATUR,ALA 11-45	✠ —— (M)
A 906 INGALLS 26-54 GEORGETOWN CONSTRUCTION CO. U.S.A. WILMINGTON,DE	270.33' 48' 9.67' 84.5385 14.6346 DR 4"	1161 1161 — —		BARGE TANK STEEL, 1 DK FRMG LONG 6 OT 1 OT LONG BH 10 CTW 48'		INGALLS SHIPBUILDING CORP. 631 DECATUR,ALA 1-46	✠ —— (M)
AALLOTAR OGVZ OY WÄRTSILÄ AB HELSINKI ROF DS GC RAD PFI	416.42' LOA 136.92m 377.87' 94' 28.67m 115.11m 16.51m 12.34m 8313' DR 15'	7601 3766 1250 —	OIL	TW FERRY PASS 4 STEEL, 3 DKS 12 BH TO 2ND DK UPPER INT DK AT SIDES NS BOW & STERN DOORS		DUBIGEON-NORMANDIE S.A. 135 NANTES,FRANCE 2-72 EN CHANTIERS DE L'ATLANTIQUE LR	
AALSUM C16144 PCAM FERNLEAF STOOMVAART-MAATS. DOSTZEE" AMSTERDAM ROF DS GC RAD PFI	541' LOA 164.98m 521.67' 78.66' 44' 159.01m 21.36m P 13.41m DR 2'	12982 6081 20998 —	OIL 16167 GC 801M 12 DR 12-16T	BLK CAR MCHY AFT SELF UNLOADER STEEL, 1 DK FRMG LONG 8 WT 6 HA 42.8, 38.7X 34.9' 6 HO	7 CYL OIL ENG, 29.53"X 61.97" SA, 2 CYC, HP9800 1 AXB 1 AXWHB 15K	KALDNES MEK. VERKSTED, A/S 161 TONSBERG,NOR 2-65 EN SOC ANON FIAT S.G.M 65	NV
AB 61 540291 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4081 UNITED STATES STEEL CORP. AMBRIDGE,PA 6-72	
AB 62 540292 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4082 UNITED STATES STEEL CORP. AMBRIDGE,PA 6-72	
AB 63 540293 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4083 UNITED STATES STEEL CORP. AMBRIDGE,PA 6-72	
AB 64 540294 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4084 UNITED STATES STEEL CORP. AMBRIDGE,PA 6-72	
AB 65 540295 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4085 UNITED STATES STEEL CORP. AMBRIDGE,PA 6-72	
AB 66 540296 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4086 UNITED STATES STEEL CORP. AMBRIDGE,PA 72	
AB 67 540297 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4087 UNITED STATES STEEL CORP. AMBRIDGE,PA 72	
AB 68 540298 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4088 UNITED STATES STEEL CORP. AMBRIDGE,PA 72	
AB 69 540299 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4089 UNITED STATES STEEL CORP. AMBRIDGE,PA 72	
AB 70 540300 BARRERS TRUST CO., AS TRUSTEE U.S.A. NEW YORK,NY	195' 35' 12' GREAT LAKES (RESTRICTED) DFT 9.167' FBD 2.896'	685 685 — —		BARGE HOPPER STEEL		AMERICAN BRIDGE DIVISION, 4090 UNITED STATES STEEL CORP. AMBRIDGE,PA 72	

Figure 50. Excerpt From Register of Shipping.

H. THE TANKER REGISTER

The Tanker Register[1] is published by H. Clarkson and Company Limited and contains a listing for all tankers and combined carriers, 6,000 deadweight tons and greater. Figure 51 illustrates an example of this register. Information for each vessel is in columns and contains the following data.

- Column 1 includes present and former vessel names.
- Column 2 contains vessel description which may be motor tanker (M.T.), steam tanker (S.T.), turbo-electric tanker (T.E.T.), or turbine tanker (T.T.); also included is vessel flag and call sign.
- Column 3 includes vessel deadweight tons, draught, and tons per inch.
- Column 4 shows deadweight tons, draught, length overall, and extreme breadth in meters.
- Column 5 presents the owners' and managers' names.
- Column 6 contains average service speed, average daily fuel consumption, and bunker capacity.
- Column 7 shows the year the vessel was built, the shipbuilder, and where the ship was built.
- Column 8 includes length overall, length between perpendiculars, extreme breadth, and moulded depth in feet.
- Column 9 contains number of center and wing cargo tanks, cargo carrying capacity, and permanent ballast.
- Column 10 presents gross registered, net registered, Suez Canal net, and Panama Canal net tonnage.
- Column 11 includes number of pumprooms, number of main cargo pumps and total capacity of main cargo pumps.
- Column 12 shows type of engines, bore and stroke, horsepower, and engine builder.
- Column 13 contains special remarks which may vary from other registers to type of tank cleaning system.

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[1] H. Clarkson & Company Limited, The Tanker Register, published annually (London, 1960-).

1 Name of Vessel	2 Description Flag Call Sign	3 Deadweight Draught TPI (Summer)	4 Metric D.W. Draught L.O.A. Ext. Bdth	5 Owners Managers	6 Speed Consumption Bunker Capacity	7 Year Built Builders Where Built	8 L.O.A. L.B.P. Ext. B'dth Mld. Depth	9 Tanks Centre Wing Capacity '000cu ft '000bbls Ballast '000cu ft.	10 G.R.T. N.R.T. Suez Tonnage (Net)	11 Pump rooms Pumps Capacity t.w/hr	12 Engines H.P. at r.p.m. Builders	13 Remarks
DORIOS Ex-Pappas Thessaloniki	M.T. Li. ELGN	**90,800** 44·30 218·8	***92,257*** *13.50* *258.00* *39.01*	Eleni Corp.	**16·3** 65H (3,500) 3,086	1967 A/B Götaverken Gothenburg	846·46 800·00 128·00 58·04	4 8 3,544 631 17	43,231 32,344 42,272	1 3 2,500	2 S.A. 9-cyl. 850x1700 19,800 at 119 As hull	AB, B, LRT, Str., Bdg.Aft B/CM 423'-14"Am.
DOSINA	M.T. N.A. PJKK	**69,390** 43·49 175·8	***70,504*** *13.26* *243.84* *33.59*	Curacaosche Scheepvaart Mij *Shell Tankers B.V.*	**15·6** 65H (3,500) 3,246	1966 Rotterdamsche D.D. Mij. N.V. Rotterdam	800·00 760·00 110·20 56·63	7 12 2,914 516 451	38,818 25,066 33,661	1 4 6,400	2 S.A. 9-cyl. 840x1800 18,900 at 112 N.V. Mach. & Schpsw. van P. Smit Jr.	LR, VP, LRT, Str., GF, Bdg.Aft B/CM 401'
DOVER MARU	M.T. Ja. JMGV	**58,918** 39·89 167·1	***59,863*** *12.16* *232.00* *31.75*	Mitsui O.S.K. Lines Ltd.	**15·7** 58·2H (1,500) 4,267	1967 Ishikawajima-Harima Hvy. Ind. K.K. Tokyo	761·16 728·33 104·16 63·66	7 2,548 454 940	38,915 22,459 33,208	1 2 3,937	2 S.A. 8-cyl. Sulzer 900x1550 18,400B at 122 As hull	Bulk/oil Carrier, NK
DR. D.K. SAMY Ex-Kaiko Maru	M.T. Li. 6ZRP	**94,400** 47·40	***95,915*** *14.45* *250.01* *38.56*	Puerto Barrios Cia. Nav. S.A.	**15·6** 67·2 6,020	1968 Mitsubishi Hvy. Ind. Ltd. Nagasaki	820·25 777·75 126·50 67·58	4 8 4,041 719 88	54,513 36,410 47,330	1 3 8,100	2 S.A. 9-cyl. 850x1600 18,360 at 119 As hull	Ore/oil Carrier, GF
DRAGON PARK Ex-Failaika	T.T. Ko. 6LBV	**53,288** 38·67	***54,143*** *11.79* *233.53* *31.19*	Pan Ocean Bulk Carriers Ltd.	**15·75** ... 2,207	1952 Bethlehem Steel Corp. Quincy REBUILT 1965	766·17 725·00 102·33 52·08	5 12	30,073 22,848	1 4 3,750	Steam turbine 12,500 at ..... As hull	LR, B, LRT, Str., GF, Bdg.Amids.
DRESDEN	T.T. USSR UKSV	**49,370** 38·04	***50,162*** *11.59* *230.50* *31.01*	Union of Soviet Socialist Republics	**17**	1965 Admiralteiski Shipyard Leningrad	756·25 702·08 101·75 50·50		32,692 16,213 ...		Steam turbine H. Cegielski	RS
DRUPA	T.T. Br. GRVH	**70,871** 43·45 176·5	***72,008*** *13.24* *243.84* *33.58*	Shell Tankers (U.K.) Ltd.	**15·5** 80F 4,535	1966 Deutsche Werft A.G. Hamburg	800·00 764·00 110·17 56·75	... ... 2,910 518 461	39,796 26,648 34,324	1 4 6,400	Steam turbine 16,000S at 107 Stal-Laval Turbine Co.	LR, B, LRT, Str., Bdg.Aft B/CM 375'-16"Br.
DRUZHBA Ex-Golden Arrow	T.T. USSR USQF	**40,715** 35·80	***41,368*** *10.91* *214.88* *29.39*	Union of Soviet Socialist Republics	**15·5** 90F 3,865	1960 Hitachi Zosen K.K. Maizuru	705·00 674·50 96·42 48·58	... ... 1,945 346 ...	25,719 16,568 ...		Steam turbine Hitachi Zosen K.K.	RS
DRUZHBA **NARODOV**	M.T. USSR	**19,684** 30·75	***20,000*** *9.37* *177.27* *22.40*	Union of Soviet Socialist Republics	**16·2**	1969 Stocznia im Komuny Paryskiej Gdynia	581·58 544·58 73·50 40·42		14,203 8,481 ...		2 S.A. 6-cyl. Sulzer 760x1550 H. Cegielski	RS
DUBNA	M.T. USSR	**6,500**	***6,604***	Union of Soviet Socialist Republics	**14**	1974 Rauma-Repola O/Y Rauma			4,500		Diesel Masch. Halberstadt	RS
DUNAV Ex-Montana	M.T. Bu. LZFD	**20,462** 31·10 78·0	***20,790*** *9.48* *170.46* *21.95*	Bulgarian Tanker Fleet *State Shipping Corp.*	**15** 30H (1,500) 1,679	1961 Sir James Laing & Sons Ltd. Sunderland	559·25 536·00 72·00 40·67	8 18 937 170 –	13,628 8,084 10,203	1 4 2,040	2 S.A. 6-cyl. 670x2100 8,700B at 116 Wm. Doxford & Sons Ltd.	LR, B, SD, LRT, GF, Bdg Aft B/CM 270'-12", 10", 8"Br
DURANGO	M.T. Sp. EBVY	**19,514** 30·31 72·0	***19,827*** *9.24* *172.49* *21.79*	Vizcaina, Naviera, S.A.	**15** 21D 1,500	1958 Empresa Nacional Bazán El Ferrol	565·92 531·33 71·50 39·08	9 20 889 235 70	12,835 7,274 8,616	2 3 1,776	2 S.A. 8-cyl. 760x1300 7,250 at 125 A/B Götaverken	LR, B, SD, LRT, Bdg Amids B/CM 264' 12"

Figure 51. Excerpt From the Tanker Register.

IX. VESSEL VIOLATION HISTORY

A. PORT SAFETY REPORTING SYSTEM

The Port Safety Branch of the U.S. Coast Guard has developed an information system which combines vessel data collected by various branches of the Coast Guard. These data include histories of vessel violations, boardings, inspections, casualties and pollution. There has been some confusion as to what this system is actually called. For the purposes of this report, the system will be referred to as the PSRS, although this file contains a great deal more information than was contained in the original Port Safety Reporting System.

The purpose of this system is to (1) provide a method for Coast Guard personnel at the field level to retrieve and update vessel histories, (2) provide advance notice to the field units that a vessel coming into port exposes that port to a higher than average danger because of past violations, casualties, or polluting incidents, and (3) act as an aid to management in determining which vessels to board and inspect.

This system, which has been operational since September 8, 1977, contains data stored in a computer data bank in Cupertino, California, and can be accessed through terminals located in 52 Coast Guard field offices and 12 district offices. When a vessel identification is entered at the terminal, the computer responds with a printout of up to six types of data about that vessel. Figure 52 shows a typical vessel history which is printed out at the terminal. Each history may contain:

- Vessel identification consisting of vessel name, flag, call sign, official number, propulsion, length, gross tons, net tons, horsepower, and Lloyd's number. This information is entered by the Port Safety Branch, which has a data file of vessel identification. The information in this file is from Lloyd's Shipping Register, the American Bureau of Shipping Record, the Coast Guard's file on ships carrying certificates of inspection, or Letters of Compliance. If no information is available on the vessel coming into port, the field office enters the vessel name, call sign, flag, and official number. Enough information is then available in the file to identify the ship at the next port it visits. Headquarters then enters the rest of the information from one of the sources mentioned above. Headquarters is presently entering this information on all ships listed in Lloyd's Shipping Register.

- Safety of Life at Sea (SOLAS) Information - A SOLAS Certificate is issued when a vessel meets the minimum requirements of the SOLAS Convention. The date this certificate was issued, its expiration date and type of service for which the vessel is certified is listed in this category. The information is entered into the data file by the Port Safety Branch.

10/31/77 ♦♦♦♦♦ COMPLETE VESSEL HISTORY ♦♦♦♦♦

VESSEL IDENTIFICATION:
NAME: DAGNY UNIT REFERENCE NO: L5259711
FLAG: FI CALL SIGN: OGUF OFFICIAL NO: PROPULSION: DD
LENGTH: 701.0 GROSS TONS: 026359 NET TONS: 015752 HORSEPOWER: 019000

SOLAS INFORMATION:
EXP DATE: 09/19/77 CITY: HEL COUNTRY: FI ROUTE: 00 SERVICE TYPE: TV

BOARDING HISTORY:

DATE	COTP	MSO ACTION/DISCOVERIES	CATEGORY OF BOARDING/INSPECTION
10/06/77	NYC	ADV NOTICE RECEIVED-NO BOARDING	(NO CATEGORY REQUIRED)
09/10/77	NYC	VIO/DEF NOTED-CG2638 TO FOLLOW	BREAK BULK CARGO
		VIO/DEF NOTED-CG2638 TO FOLLOW	BULK LIQUID CARGO

VIOLATION HISTORY: (OWNER: R/A SALLY MHN , FI)

CFR VIOLATED	DATE	COTP	MASTER	
33CFR155.310	03/25/77	NYC	KARLSSON	N.
33CFR155.720	03/25/77	NYC	KARLSSON	N.
33CFR155.820(A)	03/25/77	NYC	KARLSSON	N.
33CFR155.820(B)	03/25/77	NYC	KARLSSON	N.
33CFR156.170(A)(C)(2)	03/25/77	NYC	KARLSSON	N.
33CFR156.170(A)(C)(3)	03/25/77	NYC	KARLSSON	N.
33CFR156.170(A)(C)(4)	03/25/77	NYC	KARLSSON	N.
33CFR156.170(A)(C)(5)	03/25/77	NYC	KARLSSON	N.
33CFR35.20-40(A)	03/25/77	NYC	KARLSSON	N.
46CFR35.30-10	03/25/77	NYC	KARLSSON	N.
46CFR35.30-10	01/26/77	BAL	KARLSSON	N.

♦♦♦♦♦ END OF COMPLETE HISTORY ♦♦♦ FOR OFFICIAL USCG USE ONLY ♦♦♦♦♦

Figure 52. Sample Port Safety Reporting System Printout.

- Casualty Data includes the location, date, nature of casualty and official number of the casualty. This information is entered by Headquarters from the Vessel Casualty Reporting System information (see the VCRS section of this report). The information is updated annually and contains casualty information on U.S. vessels or foreign vessels which were involved in a casualty in U.S. waters.

- Polluting Incidents contains location, date, polluting material, quantity of spill and operation in progress at time of spill. This information is entered at Headquarters from the Pollution Incident Report System information (see PIRS section of this report). The information is updated quarterly and contains incidents involving U.S. vessels or foreign vessels involved in spills in U.S. waters.

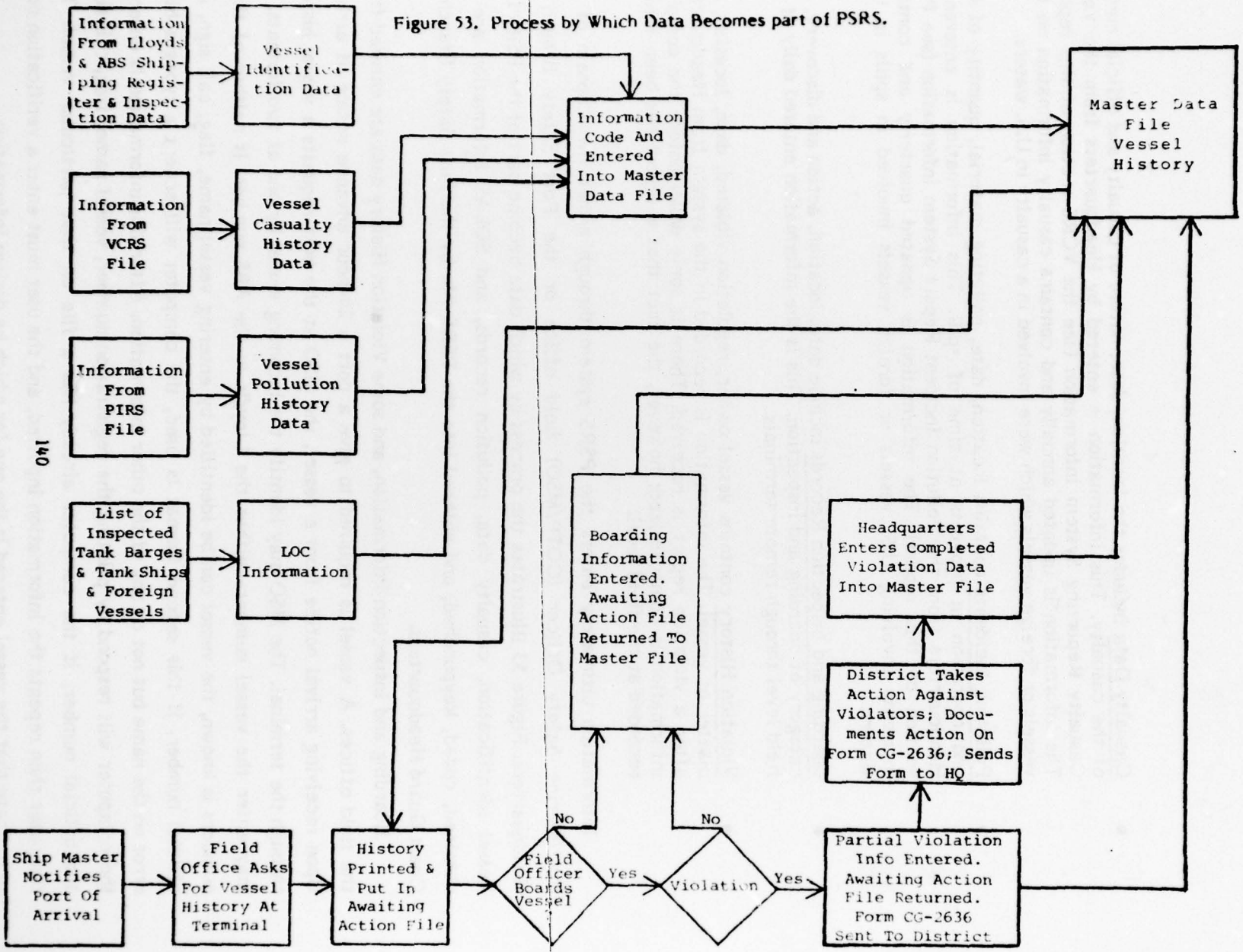
- Boarding and Inspection Records include date, location, action and discovery, and category of boarding and inspection. This is the information entered daily at the field level through remote terminals.

- Violation History contains vessel owner, regulation violated, date, location, and master of vessel. The information is recorded in the system from Headquarters after a violation report is received. There is some delay before the complete information is computerized; however, the fact that a report has been sent is recorded at the field level.

Information ultimately enters the PSRS system through either the Captain of the Port/Marine Safety Officer (COTP/MSO) field office or the Port Safety Branch of Headquarters. Figure 53 illustrates the process by which data become part of the PSRS file. Vessel identification, casualty data, pollution records, and SOLAS information are all obtained, coded, keypunched, and entered into the PSRS file by the Port Safety Branch at Coast Guard Headquarters.

Boarding and Inspection information, and some Violation History data are entered from the field offices. A vessel is required to give a port a 24-hour advance notice of arrival. Upon receiving arrival notice from a vessel, the MSO at the port requests a vessel history through the terminal. The MSO may identify the incoming vessel by one of two formats. He may enter the vessel number--either the Lloyd's or the ABS number. If neither of these numbers is known, the vessel can be identified by entering vessel name, flag, call sign, and official number. If this second format is used, the computer will accept a typographical error on the name but not on any of the other information. After this information is entered, the computer will respond by printing the registration number, vessel name, flag, call sign, and official number, if the computer already has a file on that particular vessel. The computer then repeats the information inputted, and the user must enter a verification code to indicate that the vessel entered is the one for which he desires information.

Figure 53. Process by Which Data Becomes part of PSRS.



If the user enters the Lloyd's or ABS number and there is no data on the file about that vessel, the computer prompts the user to enter the vessel name, flag, call sign, and official number. A new vessel is entered into the file in this manner.

For vessels already on file, the computer prints out the vessel histories requested. Once a history is requested, that history is put in an "awaiting action" file by the computer and will only be removed from this file when an action (or non-action) code is input for that vessel.

The MSO must determine which vessels he is going to board. One of the purposes of the vessel history is to help the officer make this decision. It is hoped that he will board those vessels which have a history of violations or which have not been boarded for some time.

After the MSO has visited a vessel, or at the end of the work day, he recalls the list of requested vessels and enters a two-letter code which defines any action taken relative to these vessels, and he may enter a two-digit code which clarifies any actions taken. Up to ten codes may be entered for each vessel. Figure 54 presents the matrix of possible actions and clarifying categories. Darkened squares represent combinations of actions and categories which the system will not accept.

If, upon boarding a vessel, the MSO discovers a violation, Form CG-2636 is filled out (see figure 55). This form is completed in duplicate with one copy going to Headquarters and one going to the district office. The MSO codes "CB" in the terminal for action taken--"Violation/Deficiency Noted--CG-2636 to follow." Upon receipt, Coast Guard Headquarters enters the information into the PSRS. The district office takes action against the responsible party. Any correspondence relative to the case is copied and forwarded to Headquarters and processed into the data file.

One of the problems in any data system is input errors. The PSRS data file is no exception. In some ways the probability of input errors is compounded in the PSRS because of the quantity of information contained in the system and because much of the data comes from other sources which may also have input errors. These errors could occur at either the field office level or at Headquarters. The only input errors that are detected in this system by an editing program are those which occur in entering the action/category codes after boarding (or not boarding). The edit program will not accept codes which are not specifically listed in the users' manual. Also, the edit program cross checks the action code against the category code to ensure that they are not contradictory.

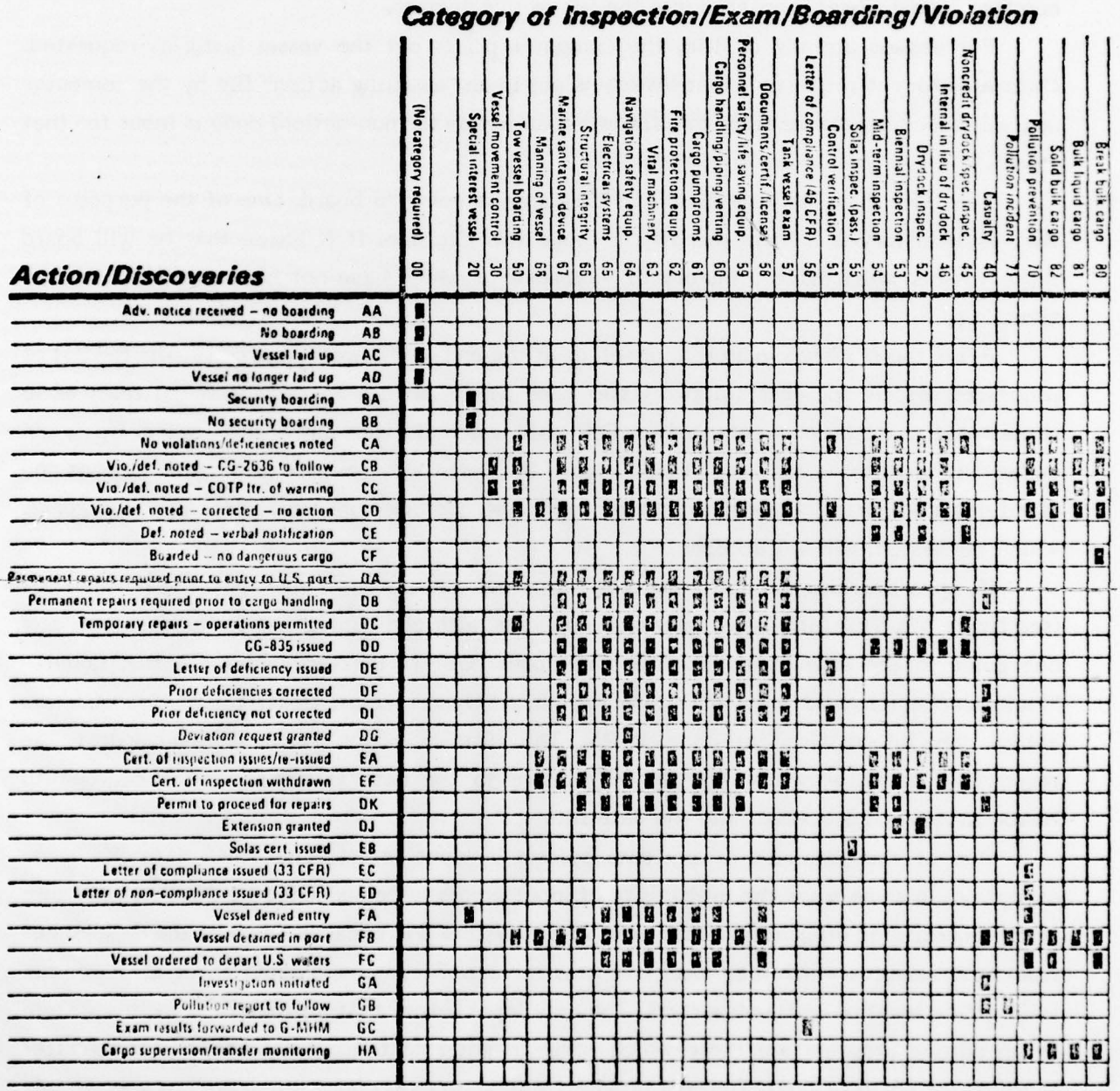


Figure 54. Matrix of PSRS Input Data.

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DEPARTMENT OF TRANSPORTATION
U. S. COAST GUARD
CG-2636 (Rev. 3-72)

REPORT OF VIOLATION

REPORT CONTROL SYMBOL
WLE-14011

INSTRUCTIONS

1. Submit original and one copy to District Commander and retain one copy. (See applicable manual, CG-299, CG-203)
2. Complete all items applicable or insert "NA".
3. Complete the narrative summary on the reverse hereof and list enclosures.
4. Complete shaded areas only for facilities.

REPORTING UNIT	DATE

1. VESSEL/FACILITY

NAME/ADDRESS	OFFICIAL NUMBER	PROPULSION

NATIONALITY	HOME PORT	PORT DEPARTED/ENROUTE
		X

DOCUMENT DESCRIPTION	LENGTH	GROSS TONNAGE	NET TONNAGE	HORSEPOWER
X				

2. CERTIFICATE OF INSPECTION

DATE	PORT	ROUTE	SERVICE
- FROM OTHER SOURCE -			

3. NAME AND ADDRESS

MASTER/OPERATOR/PERSON IN CHARGE	CG LICENSE
	YES ☐ NO ☐

OWNER

AGENT

4. INSPECTED/BOARDED UNDERWAY ☐ MOORED ☐ ANCHORED ☐ FACILITY ☐

TIME/DATE AND LOCATION (body of water, city, state, etc.)

PORT NAME ONLY; NOT TIME

CHART NUMBER	BEARING	DISTANCE	FROM (prominent point)
X	X °T	X YDS./MI.	X

5. VIOLATION(s) (Use additional sheet, if necessary)

A. STATUTE (Cite section of USC and, if necessary, CFR eg 46 USC 404, 33 CFR 80.26)	B. NATURE OF VIOLATION (Describe briefly)	C. PENALTY (Insert penalty statute, amount allowed and against whom for each violation.)
	ITEMIZED	

PREVIOUS EDITION MAY BE USED

Figure 55. Vessel Violation Report Form.

The most severe error is one made in entering the vessel number. If this error occurs at Headquarters when entering the VCRS, SOLAS information, or PIRS data, it is unlikely the mistake will be caught. The result of this error is that either the information will be identified with the wrong vessel, or it will be identified with a nonexistent vessel. When the vessel identification is entered at the field office, the computer repeats the vessel identification for the officer to verify. This check will detect some errors. However, if the user is in a hurry or simply does not check the data, the error will not be caught. Errors may also go uncorrected if the originial information was erroneously coded before it was entered into the computer. Whatever the cause, this type of error is especially severe because it can result in incomplete vessel histories.

Error can also occur in the number of port calls recorded. As previously noted, often when a vessel comes into port (boarded or not boarded), action/category codes are entered into the terminal, and the vessel file is taken out of the awaiting action file and sent back to the main file. If for some reason the ship is reboarded before it leaves port, to enter the second boarding the MSO has to either recall the vessel history or call Headquarters and ask them to enter the additional action. When Headquarters enters the information there is no problem; however, when the vessel history is recalled from the files by the MSO, the number of port calls for that one ship becomes two rather than one.

The Port Safety Branch contends that incomplete information presents a greater problem than inaccurate information. The MSO is allowed space to enter one to ten action/category codes. If the MSO enters only one when more than one apply, the result is an incomplete record.

A field office will receive incomplete information if the MSO at the previous port has not entered an action code for a vessel. In this case, the vessel history can be obtained from the main file, but the file contains no record of the previous port call. To alleviate this possible problem, when an MSO requests the list of vessels awaiting action codes, the vessels are listed in chronological order by the day they were requested. As time passes, the MSO would have to skip over that vessel to get to the other vessels on the list, so that eventually the error should be caught. However, the field office in the next port could be made aware that it has an incomplete record if whenever a vessel history is listed in the "awaiting action" file, the master file has some indication of this fact.

The VCRS data is entered into the PSRS file annually--when the Information and Analysis Branch makes their annual computer tape. This results in a lag in casualty information. The Information and Analysis Branch produces keypunch cards of the casualties

as they become known to their office. The lag in PSRS data could be shortened if the Port Safety Branch asked the Information and Analysis Branch for a printout of the casualties on a quarterly or monthly basis.

The Coast Guard has compiled the results of the boarding/inspection codes from this system for the period January 1, 1978 to June 30, 1978. This information has been compiled for port, district, and national levels. A copy of the national statistics can be seen in figure 56.

These tabulations contain the number of vessel arrivals, number of vessels boarded or inspected, the number of vessels having violations, and the actual number of violations issued.

This tabulation serves to confirm the Coast Guard's suspicion that incomplete information presents a greater problem than inaccurate information. In looking through the vessel counts in each of the ports it is quite obvious that a number of ports do not utilize this system. The data are very incomplete.

This system could be an extremely reliable management tool if the Coast Guard could convince its own personnel to use it. As it is now the data are of little value because they depend on cooperation in each of the ports in order to be used both as a management tool and as a vessel history.

NATIONAL REPORT

— TOTAL B/INSP COUNT = 18,280

— TOTAL VESSEL COUNT = 35,584

ADV NOTICE RECEIVED-NO BOARDING	17,340	17,587
NO BOARDING	60	62
VESSEL LAID UP	7	7
VESSEL NO LONGER LAID UP	7	7
SECURITY BOARDING	489	498
NO SECURITY BOARDING	386	390
NO VIOLATION/DEFICIENCY NOTED	13,556	22,139
— VIO/DEF NOTED-CG2036 TO FOLLOW	1,130	1,355
— VIO/DEF NOTED-COTP LTR OF WARN.	157	170
—VIO/DEF NOTED-CORRECTED-NO ACT.	474	577
— DEF NOTED - VERBAL NOTIF.	42	47
BOARDED: NO DANGEROUS CARGO	1,247	1,275
PERM RQRS REQ PR TO ENTRY US PT.	202	300
PERM RQRS REQ PR TO CARGO HAND.	93	105
TEMP RQRS-OPERATIONS PERMITTED	99	120
CG-835 ISSUED	657	1,061
LETTER OF DEFICIENCY ISSUED	903	1,068
PRIOR DEFICIENCIES CORRECTED	588	721
PRIOR DEFICIENCY NOT CORRECTED	225	273
EXTENSION GRANTED	6	6
DEVIATION REQUEST GRANTED	176	184
PERMIT TO PROCEED FOR REPAIRS	90	104
CERTIF OF INSPECT WITHDRAWN	57	61
CERT OF INSPECT ISSUED/RE-ISSUED	404	447
SOLAS CERTIFICATE ISSUED	3	3
LTR OF COMPLIANCE ISSUED (33CFR)	815	840
LTR OF NON-COMPL ISSUED (33CFR)	636	651
VESSEL DENIED ENTRY	2	4
VESSEL DETAINED IN PORT	20	28
VESSEL ORD TO DEPART US WATERS	1	2
INVESTIGATION INITIATED	82	82
POLLUTION REPORT TO FOLLOW	232	242
EXAM RESULTS FORWARDED TO G-MHM	46	49
CARGO SUPERV/TRANSFER MONITORING	3,044	3,199
(NO CATEGORY REQUIRED)	17,413	17,414
MISC.	6	6
SPECIAL INTEREST VESSEL	875	888
VESSEL MOVEMENT CONTROL	23	24
CASUALTY	100	114
TOW VESSEL BOARDING	146	148
BIENNIAL INSPECTION	364	423
MID TERM INSPECTION	351	378
SOLAS INSPECTION (PASSENGER)	3	3
LETTER OF COMPLIANCE (46 CFR)	48	49
TANK VESSEL EXAM	889	931
DOCUMENT/CERTIFICATE/LICENSE	3,557	3,610
PERSONNEL SAFETY/LIFE SAVING	215	223
CARGO HANDLING/PIPING/VENTING	890	1,030
CARGO PUMPROOMS	189	218
FIRE PROTECTION EQUIPMENT	261	270
VITAL MACHINERY	154	162
NAVIGATION SAFETY EQUIPMENT	4,462	4,625
ELECTRICAL SYSTEMS	100	109
STRUCTURAL INTEGRITY	634	709
MARINE SANITATION DEVICE	7	8
POLLUTION PREVENTION	6,425	6,821
POLLUTION INCIDENT	231	242
BREAK BULK CARGO	5,034	5,924
BULK LIQUID CARGO	6,642	8,129
DRYDOCK EXAM	256	264
NONCREDIT DRY-DOCK/SPEC. INSPEC	183	185
CONTROL VERIF.	50	51
MANNING OF VESSELS	7	7
SOLID BULK CARGO	425	440

Figure 56. Sample Prinout of PSRS Boarding and Inspection Statistics.

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X. CONCLUSIONS

This survey was undertaken to determine the availability, reliability and completeness of data systems which may aid in Analyzing Marine Safety Systems. This survey has pointed out what types of information are available and has shown where data are lacking. The data systems have been grouped by the type of information they contain. A discussion of each of these groups follows.

Marine Activities

Marine activities data which contain the PSS/MEP Quarterly Activities Report are essential in the evaluation of the resource management of the Port Safety and Security Program. This data system provides the only information available regarding the amount of time spent on Coast Guard activities and the percentage of standards performed. The primary problem with the data is that there is little structure to the method by which it is collected. As a result, some ports provide accurate activity data while others do not. This inconsistency in the data collection makes some of the data suspect and analysis difficult. However, this is the only Coast Guard activities information available.

Marine Pollution

An intricate part of analyzing marine safety is evaluating those incidents which pollute the marine environment. Three data systems--PIRS, TOVALOP, and the Directory of Spills--were designed primarily to report polluting incidents (see figure 57). Both TOVALOP and the Directory of Spills contain worldwide incidents; however, both are incomplete systems. The TOVALOP data is obtained on a voluntary basis from tanker owners and the governments of some countries; hence, all available information about this system indicates gaps in the data base. The Directory of Spills contains only "major" polluting incidents and, therefore, was not intended to be a complete data base for worldwide polluting incidents.

The PIRS data are more complete than when the system first began. At this time it is relatively complete in its collection of spills affecting the U.S. shores. However, PIRS data contain a number of input errors. This shortcoming is expected to be corrected through the use of an editing program to be in operation by Summer, 1979. Even with a relatively complete PIRS, the incompleteness of TOVALOP and Directory of Spills leaves us with an incomplete worldwide data base on marine polluting incidents.

Marine Traffic

The two sources of data surveyed here--"Vessel Traffic Data" and "Waterborne Commerce of the United States"--have traffic data only for U.S. waters. The Vessel Traffic

Figure 57. Criteria by Which a Casualty Becomes a Part of a Marine Pollution or Vessel Accident Data System.

Data System	Type of Vessel	Dollar Damage	Material Damage Affecting Seaworthiness of Vessel	Stranding or Grounding	Loss of Life	Injury Causing Incapacitation for More Than 72 Hours	Other Criteria
PIRS	U.S. vessels or vessels in U.S. waters*						Must be a polluting incident.
TOVALOP	Tankers						Must be a polluting incident.
Directory of Spills	All vessels**						Must be a serious polluting incident.
IMCO	All vessels			X	X		Must be a serious casualty or involving loss of life.
Liberian Bureau of Maritime Affairs	All vessels	$50,000+	X	X	X		Must include a formal investigation
Liverpool Underwriters Assoc.	All vessels $\geq$ 500 G.T.				X		or total loss.
Tanker Advisory Center	Tankers $\geq$ 6000 dwt			X			Accident or polluting incident.
Tanker Casualty File	Tankers			X			Accident or polluting incident.
VCRS	U.S. vessels or vessels in U.S. waters	$1500+	X	X	X	X	Accident

* Also includes transportation related facilities and nontransportation related facilities.

** Also includes other type of pollution, i.e., from broken pipeline, etc.

Data studies were performed once and included only seven U.S. port systems. Therefore, it does not appear that this data system will be of great value in the analysis of marine safety, with the possible exception of route identification data.

The Waterborne Commerce data provide essentially complete traffic data for U.S. port systems. The system does have some potential sources of error because of the manner in which the data are collected; however, these traffic data are valuable in the estimation of vessel exposure for casualty probability calculations.

No information has been found on marine traffic outside the United States. Foreign data would be especially valuable to this study if it were available for those areas in which deepwater ports are operational.

Repair Costs

The survey of repair costs was not intended to be a complete survey of such information. It should, however, be noted that the U.S. Salvage Association's data are expected to provide a valuable sample of average repair costs and repair times for specific types of repairs and for specific types of casualties.

Vessel Accidents

An important phase of analyzing marine safety is the evaluation of the number and causes of vessel accidents and use of this evaluation to predict future accidents. Six accident data systems have been surveyed. The result of this survey shows large gaps in available data. A summary of the six systems and their contents follow:

- IMCO collected and evaluated Damage Cards and Intact Stability Casualty Records on serious casualties from member countries between 1962 and 1965. After 1965, only a smattering of information was collected because IMCO did not emphasize these reports. In 1976, this organization again began emphasizing casualty records and has encouraged members to report serious accidents. In 1977, IMCO published a list of serious casualties. This list was taken from the Casualty Returns published by the Liverpool Underwriters Association (see below). These data, because of the voluntary basis on which they have been collected and the lack of emphasis on reporting casualties, contain a sparse collection of information.

- The Liberian Bureau of Maritime Affairs requires ships of Liberian registry to report casualties which resulted in $50,000 or more damage, loss of life, or the vessel being unable to continue its voyage. However, only reports which result in formal investigations are made public and then only at the discretion of the Commissioner of Maritime Affairs. Because of these restrictions for the period 1968 to the present, only 25 reports have been released to the public. The written reports may be valuable in determining the chain of events which led to the accident, but they do not provide a complete picture of Liberian vessel casualties.

- Liverpool Underwriters Association publishes a monthly list of casualties involving vessels 500 gross tons or greater which resulted in total vessel loss or loss of life. Because of the restrictions on the type of data collected, this sytem is too limited to be of value to general marine risk assessments.

- The Tanker Advisory Center in New York collects, from Lloyd's List, information on vessel casualties involving tankers greater than 6,000 deadweight tons. This system contains a relatively complete list of worldwide tanker accidents, with the exception of those occurring in the Far East. This file is often lacking in specific details surrounding the accident because only the information in Lloyd's List is reported at the Tanker Advisory Center. For the years 1969-1973, the Tanker Casualty File, which is also based on Lloyd's data, is much more complete. However the Tanker Advisory Center has data from 1964 to the present which is updated daily.

- The Tanker Casualty File has been generated by the Office of Merchant Marine Safety of the United States Coast Guard. This system contains worldwide tanker accident information for the years 1969-1973. For the years this system covers, the data are more complete than that of the Tanker Advisory Center because sources other than Lloyd's are consulted to obtain further information about the circumstances surrounding the accident. As with the Tanker Advisory Center, the data are believed to be essentially complete with the exception of accidents in the Far East. In addition to recording casualties, the system contains information on oil spills resulting from these casualties.

- The Vessel Casualty Reporting System contains information on accidents involving U.S. vessels or vessels in U.S. waters, resulting in damage greater than $1,500, loss of life, personnel incapacitation longer than 72 hours, or stranding or grounding. This system is believed to be very complete for oceangoing vessels but only 50 to 60 percent complete for small vessels, such as fishing vessels or recreational boats. The data include casual and contributing factors for the accidents, which are useful for a certain type of safety analyses. On the other hand, information on oil or chemical spills is quite sparse.

The vessel accident survey shows fairly complete lists of worldwide tanker accidents for the years 1964 to the present; essentially complete lists with further specific data on worldwide tanker accidents for the years 1969 to 1973; good accident data on oceangoing U.S. vessels and foreign vessels having accidents in U.S. waters, and not as complete data on casualties involving smaller vessels in U.S. waters. The obvious gap in data is a lack of information on worldwide casualties involving vessels other than tankers (see figure 57). The primary vessel casualty data sources are the Vessel Casualty Reporting System and The Tanker Casualty File.

Vessel Personnel Injuries

The only data system discussed in this section is that of the Marine Index Bureau. This system contains records of injuries and illnesses of vessel personnel. Data are provided

voluntarily by ship owners. The data are not complete because some owners prefer to keep their own injury records and consider the information proprietary. At this time it is not known what percentage of owners submit information to the Bureau, nor is it known whether data are strictly from U.S. vessel owners or also include foreign owners.

Vessel Population

In order to determine the probability of a casualty, it is helpful to know the population from which that casualty will occur. To identify that population, three shipping registers, two lists of inspected vessels, and three statistical analyses of world fleets were surveyed. To the best of our knowledge, these figures are accurate.

Vessel Violation Histories

The Port Safety Reporting System included in this section has only been operational since September 1977. This system was designed as an aid to management in the Port Safety and Security Program. This system has tremendous potential for generating valuable statistics, e.g., port calls, number of different vessels actually involved in both accidents and in polluting incidents, the correlation between number of violations and number of casualties for individual vessels, etc. However, the initial tabulations indicate that the data are incomplete. If this system is to be of value, the Coast Guard must have more cooperation from their own personnel at the port level.

Some of the data discussed above could be extremely valuable in analyzing marine safety systems. However, before it can be useful, Coast Guard personnel must begin to utilize this system more consistently at the port level. The PSS/MEP Quarterly Activities Report and the PSRS can be used in analyzing Coast Guard resource management. For instance, the relationship between the performance of standards and the number of facility and vessel casualties can be examined using the Activities Report. Also the data in PSRS can be manipulated to produce summary statistics. Using these data, relationships between boardings or violations and casualties can be explored. The accident and pollution data will be used in conjunction with population and traffic data to explore methods of predicting number of accidents and spills, number of spills per vessel accident, and size of spills.