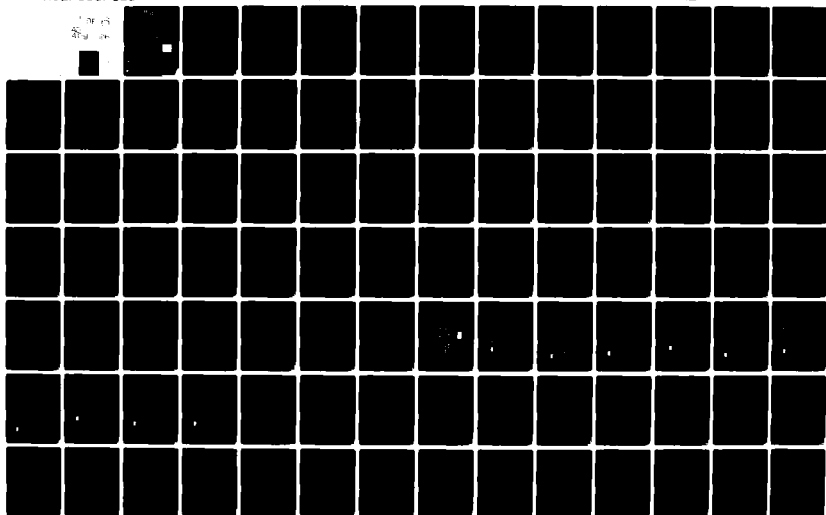


AD-A096 126 NATIONAL RESEARCH COUNCIL WASHINGTON D C MARITIME TRA--ETC F/G 13/2
WORKSHOP ON REDUCING TANKBARGE POLLUTION. APRIL 15-16, 1980. (U)
AUG 80 N00014-75-C-0711

UNCLASSIFIED

NL



3
50

LEVEL

①

AD A 096126

PROCEEDINGS:
**Workshop on
Reducing Tankbarge
Pollution**

APRIL 15-16, 1980

DTIC
MAR 9 1981

The Ruth H. Hooker Technical Library

SEP 30 1980

Naval Research Laboratory



Maritime Transportation Research Board

Commission on Sociotechnical Systems

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DTIC FILE COPY

81 3 04 015

①

⑥

PROCEEDINGS:
Workshop on
Reducing Tankbarge
Pollution,

APRIL 15-16, 1980.

MARITIME TRANSPORTATION RESEARCH BOARD
COMMISSION ON SOCIOTECHNICAL SYSTEMS
NATIONAL RESEARCH COUNCIL

ERIC
MAR 2 1981

⑪ Aug 80

⑬ NO00024-75-2-0711

⑫ 542

NATIONAL ACADEMY PRESS
WASHINGTON, D.C. 1980

406356
MTRB
DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

406356

1/16

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the federal government. The Council operates in accordance with general policies determined by the Academy under the authority of its congressional charter of 1863, which establishes the Academy as a private, nonprofit, self-governing membership corporation. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

This is a report of work supported by the Department of Transportation under the provisions of contract N00014-75-C-0711 between the National Academy of Sciences and the Office of Naval Research.

Inquiries concerning this publication should be sent to:

Maritime Transportation Research Board
National Research Council
2101 Constitution Avenue, N. W.
Washington, D.C. 20418

Printed in the United States of America

APPROVED FOR PUBLIC RELEASE
DISSEMINATION UNRESTRICTED

DISCLAIMER

All opinions, conclusions, and recommendations expressed in the papers and commentary are those of the individual authors. The conclusions and recommendations presented by the moderators in the closing plenary session are those of each working group and are not necessarily those of the moderators. They will not necessarily be the conclusions and recommendations of the Committee on Reducing Tankbarge Pollution or the National Academy of Sciences. The commentary submitted after the workshop is reproduced as received and all material therein is the responsibility of the individual authors or their supporting organization where no authors are given. The material in the section covering the opening plenary session is taken from the speakers prepared texts and may vary from what was actually said; no transcript of the opening session was made. Conclusions and recommendations made by the Committee on Reducing Tankbarge Pollution will be published in a separate report.

Accession For	
DTIC (PAGE)	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	<input type="checkbox"/>
By _____	
Distribution	
Availability Codes	
Dist _____	Special _____
A	

FOREWORD

As a result of the controversy over its proposed regulations requiring double-hull tankbarges for oil transport, the Coast Guard asked the Maritime Transportation Research Board (MTRB) of the National Academy of Sciences to study ways of reducing tankbarge pollution. The workshop held April 15-16, 1980 was the first phase of the project. The second phase will be the Committee's report with conclusions and recommendations which will be published later as a separate report.

The purpose of the workshop was to gather information and ideas for the Committee's consideration and to provide another public forum for views and positions to be presented and discussed. Participants from industry, labor, government, and environmental groups were invited to present papers and join the discussions. As evidenced by these proceedings, much information was presented and discussed. While the effect that this workshop will have on the final solution to the problem is not yet known, it was an educational two days for all participants.

The purpose of the opening plenary session was to provide a common background to the participants via a statement of the Academy's role and procedures, position statements from the Coast Guard and industry, and summaries of the two studies on the effectiveness and costs of double-hull barges that were commissioned by the towing industry. Following the opening session the participants separated into five working groups, meeting simultaneously, to listen to papers and discuss the options and problems. At the end of the workshop, the participants reassembled to hear each moderator present a summary of the discussion, conclusions, and recommendations from his group. To provide for any points of view not covered in the discussion, there was an opportunity for participants to submit written comments during the 30 days following the workshop. These are included in Section VIII.

It should be understood that the Committee's deliberations are not limited to the material, conclusions, or recommendations of the workshop. The workshop provided information for the Committee, but the Committee will also consider other material and will form its own conclusions and recommendations which may differ from those made at the workshop.

The Committee on Reducing Tankbarge Pollution and the MTRB wish to thank all the authors and participants who made the workshop a success. Special thanks are given to Clifton Curtis of the Center for Law and Social Policy for his assistance in planning the workshop and to Mr. George Brazier and his assistant, Wayne Young, from the Corp of Engineers for moderating Working Group IV. Finally, Mr. Kenneth Reese, Consultant, is commended for his timely editorial assistance with these proceedings.

MARITIME TRANSPORTATION RESEARCH BOARD
(as of April 1980)

RUSSELL R. O'NEILL, Chairman, Dean, School of Engineering and Applied Sciences, University of California at Los Angeles

PAUL E. ATKINSON, Consultant, Philadelphia, Pennsylvania

RADM WILLIAM M. BENKERT, USCG (Ret), President American Institute of Merchant Shipping, Washington, D.C.

AUSTIN E. BRANT, JR., Partner, Tippetts-Abbett-McCarthy-Stratton, New York, New York

HAZEL BROWN, President, Harry Lundeberg School of Seamanship, Piney Point, Maryland

JAMES G. COSTELLO, President, Universal Maritime Service Corp., New York, New York

DONALD P. COURTSAL, Vice President, Dravo Corporation, Pittsburgh, Pennsylvania

THOMAS B. CROWLEY, Chairman of the Board and President, Crowley Maritime Corporation, San Francisco, California

E. SCOTT DILLON, Consultant, Silver Spring, Maryland

C. L. (Larry) FRENCH, President, National Steel Shipbuilding Company, Inc., San Diego, California

HOWARD A. GAUTHIER, Professor, Department of Geography, Ohio State University

A. SCHEFFER LANG, Washington, D.C.

HENRY S. MARCUS, Associate Professor, Massachusetts Institute of Technology, Cambridge, Massachusetts

OWEN H. OAKLEY, Consultant, McLean, Virginia

RICHARD L. PRESTON, Vice President and Manager, Tanker Department, Exxon International, Florham Park, New Jersey

TED PRZEDPELSKI, Director of Export and Marine Services, International Paper Company, New York, New York

ERIC SCHENKER, Dean, School of Business Administration, University of Wisconsin at Milwaukee

ALLEN E. SCHUMACHER, Chairman, American Hull Insurance Syndicate, New York, New York

ROBERT TAGGART, President, Robert Taggart, Inc., Fairfax, Virginia

STUART W. THAYER, Vice President, Engineering, Lykes Bros. Steamship Company, New Orleans, Louisiana

SHELDON A. VOGEL, Bigham Englar Jones & Houston, New York, New York

JOHN F. WING, Senior Vice President, Transportation Consulting Division, Booz, Allen & Hamilton, Inc., Bethesda, Maryland

Liaison Representatives

RADM BRUCE KEENER, III, USN, Commander, Military Sealift Command,
Department of the Navy
RADM HENRY BELL, USCG, Chief, Office of Merchant Marine Safety, U.S.
Coast Guard, Department of Transportation
MGEN JOHN BRUEN, USA, Commander, Military Traffic Management Command,
Department of the Army
MARVIN PITKIN, Assistant Administrator for Commercial Development,
Maritime Administration, Department of Commerce

Staff

HARVEY C. PAIGE, Executive Secretary, MTRB
LEONARD E. BASSIL, Project Manager, MTRB
EVERETT P. LUNSFORD, JR., Project Manager, MTRB
RICHARD W. RUMKE, Executive Secretary, Ship Research Committee, MTRB

COMMITTEE ON
REDUCING TANKBARGE POLLUTION

DR. ERIC SCHENKER, Chairman, Dean, School of Business Administration,
University of Wisconsin at Milwaukee

HAZEL BROWN, President, Harry Lundeberg School of Seamanship, Piney
Point, Maryland

DONALD P. COURTSAL, Vice President, Dravo Corporation, Pittsburgh,
Pennsylvania

RALPH W. HOOPER, President, Interstate and Ocean Transport Company,
Philadelphia, Pennsylvania

VIRGIL F. KEITH, Managing Principal, Engineering Computer Opteconomics,
Inc., Annapolis, Maryland

ROBERT LAGATTOLLA, President, Water Quality Insurance Syndicate, New
York, New York

BERDON LAWRENCE, President, Hollywood Marine, Inc., Houston, Texas

DR. RICHARD MICHAELS, Director, Urban Systems Laboratory, University
of Illinois at Chicago Circle

Liaison Representatives

LCDR. ALAN SPACKMAN, U. S. Coast Guard, Department of Transportation,
Washington, D.C.

JOHN J. NACHTSHEIM, Maritime Administration, Department of Commerce,
Washington, D.C.

Alternates

LCDR. KENNETH A. ROCK, U. S. Coast Guard, Department of Transportation,
Washington, D.C.

GORDON R. ANGELL, Maritime Administration, Department of Commerce,
Washington, D.C.

Staff

EVERETT P. LUNSFORD, JR., Project Manager, Maritime Transportation
Research Board

MODERATORS

PLENARY SESSIONS - Dr. Eric Schenker, Dean
School of Business Administration
University of Wisconsin - Milwaukee

- GROUP I - Dr. Richard M. Michaels
Urban Systems Laboratory
University of Illinois - Chicago Circle
- GROUP II - Donald P. Courtsal
Vice President
Dravo Corporation
- GROUP III - Hazel Brown
President
Harry Lundeberg School of Seamanship
- GROUP IV - George Brazier, Chief
Construction - Operations Division
U.S. Army Corps of Engineers
- GROUP V - Robert S. Lagattolla
President
Water Quality Insurance Syndicate

TABLE OF CONTENTS

I.	OPENING PLENARY SESSION	1
	Opening Remarks -	3
	Everett P. Lunsford, Jr. Project Manager	
	Keynote Address -	5
	VADM. Robert H. Scarborough U.S. Coast Guard	
	Coast Guard Position -	7
	RADM Henry H. Bell U.S. Coast Guard	
	American Waterways Operators Position -	12
	Berdon Lawrence Hollywood Marine, Inc.	
	Summary of Tankbarge Structural Analysis and Analysis Of Tankbarge Casualty Pollution Data -	16
	Prof. E. G. Frankel E. G. Frankel, Inc.	
	Economic Impact of Tankbarge Standards -	42
	I. Bernard Jacobson Booz-Allen & Hamilton, Inc.	
II.	GROUP I - CONGRESSIONAL MANDATES	59
	Statement -	61
	Senator Warren G. Magnuson	
	Economic Issues in Tankbarge Pollution Control -	64
	Norman Meade National Oceanic and Atmospheric Administration	
	Environmental and Economic Discussion of the Need and Justification of Converting Existing Single Hull Barge Oil Transportation to Double Hull -	70
	Carl H. Oppenheimer Consultant, Marine Biologist	
	The Congressional Mandate for Tankbarge Construction Standards -	87
	Douglas Svendson, Jr., Esq. Camp, Carmouche, Palmer, Barsh, & Hunter Austin P. Olney, Esq. Le Boeuf, Lamb, Leiby, & MacRae	
III.	GROUP II - TECHNICAL OPTIONS AND PROBLEMS	115
	Cargo/Barge-Type Interaction -	117
	William Creelman National Marine Service, Inc.	

Some Alternatives to Double Hulls -	165
William C. McNeal Consultant	
Observations on Pollution Prevention Performance of Double Skin Tankbarges in River Service -	169
C. Van Mook Dravo Corporation	
Inspection and Repair of Tankbarges in Bulk Oil Service -	178
LCDR Kenneth A. Rock U.S. Coast Guard	
In-Service Double Hull Tankbarge Pollution Prevention Effectiveness Survey -	180
LCDR Alan E. Spackman U.S. Coast Guard	
Ocean/Coastal versus Inland Tankbarge Design, Inspection, and Operating Standards -	189
Kent D. Woodward Interstate and Ocean Transport Company	
 IV. GROUP III - PERSONNEL STANDARDS, TRAINING, AND ENFORCEMENT	 199
Tankerman Qualifications -	201
CDR Richard T. Hess U.S. Coast Guard	
Personnel Standards and Training for Tankermen -	204
Charles F. Nalen Lundeberg School of Seamanship	
Licensing of Operators of Uninspected Towing Vessels -	210
CDR James R. Norman U.S. Coast Guard	
Marine Personnel Training -	213
James H. Sanborn Interstate and Ocean Transport Company	
Training, Licensing, and Enforcement -	249
Frank T. Stegbauer National River Academy	
Considerations Involved in the Crew Development and Training of a "Liquid Carrier" Inland Waterway Transportation Company -	255
Donald L. Sullivan Chotin Transportation, Inc.	
 V. GROUP IV - OPERATING ENVIRONMENT	 289
A Comparison of the Volume of Petroleum Hydrocarbons Introduced into Navigable Waters of the United States by Barge Accidents and by Non-Accident Causes -	291
Dr. Charles C. Bates Consultant	

	Traffic Management Control Systems on Inland Waterways -	301
	CAPT. Daniel B. Charter, Jr. U.S. Coast Guard	
	Coast Guard Aids to Navigation and Marine Information -	304
	CAPT. Leonard W. Garrett U.S. Coast Guard	
	Initial and Maintenance Dredging -	308
	William R. Murden, Jr. U.S. Army Corps of Engineers	
	Navigation Improvements and Pollution Reduction -	320
	Harold D. Muth American Waterways Operators, Inc.	
VI.	GROUP V - INSURANCE, LIABILITY, AND PENALTIES	329
	Insurance, Liability, and Penalties -	331
	Lester C. Bedient Crowley Maritime Corporation	
	Insurance, Liability, and Penalties -	337
	W. Kenneth Elkins National Marine Service, Inc.	
	Comments on Insurance, Liability, and Penalties -	348
	Robert S. Lagattolla Water Quality Insurance Syndicate	
	Impact of Proposed Changes to Tankbarge Regulations on the Federal Ship Financing Program -	352
	Mitchell D. Lax Maritime Administration	
	Tankbarge Pollution Compared to Pollution from Tank Vessels -	358
	Sharron Stewart National Advisory Committee on Oceans and Atmosphere	
	The Effect of Pollution Insurance, Liability, and Penalties on Tankbarge Construction -	362
	Richard M. Willis Engineering Computer Optecnomics, Inc.	
VII.	CLOSING PLENARY SESSION - GROUP SUMMARIES	373
	GROUP I - Prof. Richard M. Michaels	375
	University of Illinois at Chicago Circle	
	GROUP II - Donald P. Courtsal	377
	Dravo Corporation	
	GROUP III - Hazel Brown	380
	Lundeberg School of Seamanship	
	GROUP IV - George Brazier	382
	U.S. Army Corps of Engineers	

	GROUP V - Robert S. Lagattolla	389
	Water Quality Insurance Syndicate	
VIII.	COMMENTARY SUBMITTED BY PARTICIPANTS	391
	Ashland Petroleum Company	393
	CAORF Research Staff	410
	Center for Law and Social Policy	431
	Interstate and Ocean Transport Company	462
	Moran Towing & Transportation Company, Inc.	509
	William C. McNeal	512
	Residuals Management, Inc.	513
	The Seafarers International Union of North America	516
IX.	PROPOSED COAST GUARD RULES - June 14, 1979	519
X.	PARTICIPANTS	529

PROCEEDINGS:
Workshop on
Reducing Tankbarge
Pollution

OPENING PLENARY SESSION
Dr. Eric Schenker, Chairman, Presiding

OPENING REMARKS

Everett Lunsford
Project Manager
Committee on Reducing Tankbarge Pollution
Maritime Transportation Research Board
National Academy of Sciences

Dr. Eric Schenker, chairman of the committee, is the moderator today. Dr. Schenker is the Dean of the School of Business Administration at the University of Wisconsin at Milwaukee; his specialty is transportation economics.

This study by the National Academy of Sciences on reducing tankbarge pollution, while sponsored by the Coast Guard, is an independent look at the tankbarge pollution question. The Academy's primary work is providing scientific and technical advice to the Federal Government. This is accomplished by volunteer committees drawn from industry, the academic community, and other nongovernmental organizations with an interest in the particular issue. The committees have liaison representatives from the interested government agencies, but these liaison representatives do not have a vote in committee decisions. Administrative support for the committees is provided by Academy staff.

In selecting a committee, the objective is to provide a balance, with all major parties represented. We also try to have some neutral members on our committees to provide a different perspective on the problem. These would be people with experience or training applicable to the problem, but with no direct involvement with the affected parties. An example in this case is Dr. Schenker, who is a transportation economist, but has no direct involvement in the maritime industry. The Academy board or commission in charge of each study assembles a list of nominees, with biographical data for each, for that committee. This list is reviewed by the Academy for completeness, balance, and any conflicts of interest. A board will be asked to nominate additional members, or a nomination may be disapproved, if the Academy is not satisfied.

When a committee's report is complete, it is reviewed by the board and commission administering the study and, in some cases, by the Academy's Report Review Committee. The commission review is accomplished by independent reviewers unknown to the committee and administering board. After a report is approved, it is sent to the sponsoring agency and made available to the public through the Academy's publications office or the National Technical Information Service.

The Committee on Reducing Tankbarge Pollution consists of the following persons:

Dr. Eric Schenker, Chairman

Hazel Brown, President
Harry Lundeberg School of Seamanship

Donald Courtsal, Vice President
Dravo Corporation

Ralph Hooper, President
Interstate & Ocean Transport

Virgil Keith, Managing Principal
Engineering Computer Optecnomics

Robert S. Lagattolla, President
Water Quality Insurance Syndicate

Berdon Lawrence, President
Hollywood Marine

Dr. Richard Michaels, Urban Systems Laboratory
University of Illinois at Chicago Circle

This workshop is Part I of the committee's study; proceedings will be published separately this summer. Part II is the committee report itself, which is scheduled for publication in December.

I want to emphasize that the objective is to examine ways of reducing tankbarge pollution; therefore, the scope of this workshop is much broader than the Coast Guard's proposed double-hull barge rules. The committee's report will address the various ways in which tankbarge pollution can be reduced and the advantages, problems, and costs of each. Our purpose these two days is to gather information for the report.

If, at the end of the workshop, anyone feels his particular viewpoint was not fully presented, we will accept written comments until May 16. These comments will be considered by the committee in preparing its report. Do not send any material that you submitted to the Coast Guard in response to its double-hull rules. Each committee member has a complete copy of the docket, including letters, public hearing transcripts, and the Booz-Allen and Frankel studies.

KEYNOTE ADDRESS

Vice Admiral Robert H. Scarborough
Vice Commandant, United States Coast Guard

When Admiral Jack Hayes first took office as Commandant he committed himself to a basic tenet -- to maximize safety with minimum necessary regulation, while still facilitating commerce. That's not only a mouthful, but a tall order. It is also why we are here today.

As we reviewed the comments received on the tankbarge regulatory action, we both had nagging doubts about what was really in the national interest. And when I speak of the national interest, I mean it in its broadest sense -- the whole range of strategic considerations that must go into that kind of a decision in today's world. I suppose the feeling was a gut reaction which said that "If we begin with certainties, we shall end in doubts; but if we begin with doubts, and are patient in them, we shall end in certainties."

What leads us astray sometimes is the certainty of having a mandate in law which requires action. Combine that with the typical Coast Guard "can do" spirit and you have a compelling need to "do something!" There shouldn't be any disagreement that the law requires us to do something. The decision we have to make is what is the best way to meet the intent of Congress.

The proposals that the Coast Guard published were one possible solution. It is not the only solution, and we certainly are not committed to it if a better idea can be identified.

I will not discuss the specific proposals that we published, as this will be done later. Needless to say, they aroused considerable controversy. The "process," believe it or not, is working. Your voices, our doubts, and I hope our mutual commitment to do what is proper, is why you all are here today. The Secretary of Transportation and the Commandant both recognize that the national interest requires that all parties with a legitimate interest be involved in finding a solution. The decision we ultimately make will no doubt have an effect on the growth and economic health of the towboat and barge industry.

We asked the National Academy of Sciences to study the tankbarge oil-pollution problem because the Academy has the unique ability to call upon the entire range of this nation's intellectual resources when it is necessary to address such a problem of national importance. The Academy also has a very well structured process which goes to great lengths to eliminate bias in determining study recommendations. The workshop approach was chosen to provide a fail-safe opportunity for all

interested parties to engage in a unique dialogue within the rulemaking process.

We hope these workshops will provide information that will help the Academy's study committee to formulate meaningful findings. The Academy's final report should round out our total knowledge on the problem. From there I know we can proceed with the assurance that we will be prepared to meet our statutory responsibilities with regulations which not only protect the environment, but also are the least burdensome and costly to the industries involved.

I urge you to participate in the workshops with the view that we do not desire this to be an adversary proceeding, but an objective approach to identify solutions which are suitable for all concerned. By definition, there is something for everyone in compromise. We are here to find more acceptable ways to reach an uncompromised objective.

COAST GUARD GENERAL COMMENTS

Rear Admiral Henry H. Bell
Chief, Office of Merchant Marine Safety
United States Coast Guard

I am sure that most of you are familiar with the background of the Coast Guard's efforts to reduce oil pollution from tankbarges. However, I will review some of the background for the benefit of any who are not aware of the Coast Guard's involvement and to highlight some aspects of this effort that I feel are important.

This workshop will address all aspects of the problem of oil pollution from tankbarges. I would like briefly to present the problem as the Coast Guard sees it.

For the years 1971 through 1978, data in the Coast Guard Pollution Incident Reporting System (PIRS) shows that tankbarges spill an average yearly volume of about 56,000 barrels of oil. The amount spilled in any individual year varies, and the percentage of the total amount of oil entering the waters of the U.S. from this source varies from 5 to 24 percent. I realize that many people have pointed out shortcomings in the PIRS data. This is especially true for individual cases. However, as an overall measure of the volumes of oil being spilled by various sources the PIRS data constitutes a good indicator.

To try better to understand the tankbarge pollution problem, the Coast Guard contracted with Vitro Laboratories Division of Automation Industries to study tankbarge oil pollution. The important conclusion reached by that study was that approximately 85 percent of the total volume of oil spilled by tankbarges came from about 15 percent of the incidents, and these incidents involved hull damage. In preparing the response to a Presidential initiative which required an evaluation of design, construction, and equipment standards for tankbarges, the Coast Guard examined the PIRS data and reached the same conclusion.

Thus the Coast Guard has concluded that tankbarges are a significant source of oil pollution and that the majority of this pollution comes from tankbarge incidents that involve hull damage.

The Coast Guard is charged by various laws with reducing oil pollution from tank vessels. The first regulatory effort at reducing oil pollution due to tankbarge-hull damage was published in December 1971. At that time a proposal to require double walls on new tankbarges was published, and ideas on how to reduce pollution from existing tankbarges were requested. The proposal to require double walls was withdrawn because of industry opposition and a recommendation

that the problem needed further study. No ideas or suggestions on how existing barges should be handled were received.

A joint Maritime Administration/Coast Guard tankbarge study was completed in 1974. The results of that study of various construction alternatives indicated that a double-hull construction standard with a 24-in. separation of hulls would be most effective in preventing pollution if hull damage occurred. The 1978 Vitro study mentioned before was done to establish the sources of oil pollution from tankbarges and help us to determine if regulations were needed. In addition to these studies, various internal studies of tankbarge casualty and pollution data were performed by the Coast Guard. These previous studies and the Coast Guard analysis of the problem are contained in the regulatory analysis for the proposals that were published in the Federal Register on June 14, 1979.

The Coast Guard published a proposed solution to the problem as a Notice of Proposed Rulemaking (NPRM) and an Advance Notice of Proposed Rulemaking (ANPRM). I would like to stress two points. First, this solution to the problem is one of many possible solutions. Second, the proposal to require double hulls on new tankbarges was an NPRM, while the proposal to phase out existing single-hull tankbarges was an ANPRM.

An NPRM is published when the Coast Guard is fairly certain as to the regulatory action necessary to achieve a statutory goal. An advance notice is used to solicit ideas on the approach to be taken to solve a problem when the Coast Guard is less certain as to how to proceed. In this instance, a fairly detailed proposal was laid out, based on the lack of response to the 1971 request for ideas. This was done to stimulate discussion and in the hope that it would result in alternatives being presented to the Coast Guard. I think it is fair to say that the ANPRM has generated discussion of the specific alternative proposed. However, its broader objective of generating alternatives has been completely unsuccessful. The general impression conveyed by the public hearings and the written comments is that the Coast Guard is committed to the alternative published as an ANPRM. I reiterate that the Coast Guard is not committed to the phaseout of existing tankbarges. The Coast Guard is committed to examining all alternatives and pursuing the one that is best suited to solving the problem.

The fact that both an NPRM and an ANPRM were analyzed in the same regulatory analysis was a major factor in determining the format of that analysis. The methodology utilized for evaluating the economic impacts of the proposals was chosen for two reasons. The economic analysis measured the impact of the proposals and the relative magnitude of the costs attributable to the proposal for new barges and those attributable to the phaseout of existing tankbarges. To accomplish this, a present-value calculation was utilized. Leaving aside the absolute value of the cost, I think all will agree that phasing out existing single-hull tankbarges is very expensive.

As I have pointed out before, the ANPRM was one approach suggested by the Coast Guard. Many of the comments received have pointed out effects that were not foreseen in the original analysis. The bankers have offered considerable testimony on the possible dire consequences of an early phaseout and the effect on small operators. In this regard I would say that the ANPRM has been effective as a tool for insuring public participation and gathering additional information.

The tankbarge industry has spent a great deal of time and money on two studies which independently have analyzed the June 14 proposals. The economic-impact study by Booz-Allen & Hamilton (BAH) will be discussed following my presentation. However, I will discuss some factors that relate to both the Coast Guard and BAH analyses. Unfortunately the two analyses cannot be directly compared in their present forms.

Discounted present value of the future costs and benefits of a program is an accepted technique for rational decisionmaking. It is the only rational basis for choice between alternatives for which the quantities and timing of future costs and benefits differ. The Coast Guard used this technique to represent, on a comparable basis, the estimated costs of the NPRM and the particular example used in the ANPRM. BAH either rejected this technique or assumed that the appropriate discount rate should be zero, which rendered the technique irrelevant. Therefore, it is not valid to compare the BAH estimate of undiscounted total costs to the figure used by the Coast Guard for the present value of estimated future costs.

The relative discounted cost of alternatives can be sensitive to the discount rate chosen. There has been a lot of consideration by economists of the selection of an appropriate discount rate. We do not know of any authoritative statement of the proper rate for evaluating the cost impact of government-imposed regulations. The Coast Guard selected the 10 percent rate specified in OMB Circular A-94 as an authoritative value of general applicability. This may not be the proper rate, but certainly some rate other than zero should be used.

The other major problem in comparing the two analyses is the actual costs used in the estimates. The Coast Guard used constant 1978 dollars, while the BAH study used costs for an unspecified time. The original MARAD/CG barge-construction costs were developed from engineering estimates. BAH used contract prices and shipyard bids provided by the barge operators. They showed that the difference in cost between double-hull and single-hull construction was 37 to 43 percent rather than the 15 to 22 percent derived by the Coast Guard, the implication being that the engineering estimates were unrealistically low.

The Coast Guard has subsequently obtained contract prices for 99 double-hull and single-hull barges from MARAD Title XI mortgage-guarantee applications for 1978 and 1979. One important

result of analyzing this data is the finding that construction costs were inflating at an effective annual rate of about 25 percent during this period. Any analysis of historical construction-cost data must be calibrated in constant dollars to avoid spurious comparisons of trends. At about 2 percent per month, even a few months' difference in the ages of the data can introduce significant errors. If the dates of the data for single-hull construction are older than those for double hulls, then the apparent differences include both the actual cost differences at a given time and the inflation for all construction.

The BAH study does not include the dates for the data points utilized, so the possibility that the time factor may not have been properly considered can not be examined. The Title XI data calibrated to November 1979 are higher than those in BAH Figure I-I (New Construction Costs for Inland Barges). However, they are about 16 percent higher for single hull and only 3 percent higher for double hull. These data indicate a differential cost for double hulls of about 24 percent in constant dollars. What is clear is that all of the data on cost have to be assembled and analyzed using established statistical procedures which account for the relationship among date, size of barge, and cost.

Estimating the difference in total cost of new construction under different regulatory assumptions requires a consistent set of assumptions about the timing and composition of the building program. Differences in the Coast Guard and BAH fleet projections could account for a substantial difference in the projected costs derived in the two analyses. Projecting fleet size requires an explicit assumption of the growth in demand for the transportation of oil by barges. In projecting the construction necessary to achieve the projected fleet size, the mix of barge sizes should reflect current practices and waterway capabilities rather than replacement in kind of barges of obsolete sizes.

The other major study for the American Waterways Operators Tank Barge Conference, performed by E. G. Frankel, Inc., was a structural and statistical assessment of the Coast Guard proposals. I would like to note that the Coast Guard agrees with the methodology of relating incidents and spills. In the regulatory analysis prepared by the Coast Guard, the effectiveness of the double hulls was improperly stated. Double hulls will prevent between 85 and 95 percent of the spills caused by hull damage. However, because of the influence of large spills that probably could not be prevented by any reasonable construction standard, the subsequent reduction in volume of oil spilled will range between 28 and 50 percent. A more detailed presentation will be given by LCDR Spackman in a paper he has prepared for the workshop on technical options and problems.

The other point that I would like to make is with regard to the structural assessment. Methods of collision analysis are somewhat tentative at this time. All the methodologies for collision analysis

contain simplifying assumptions which make the results imprecise. Since this is a highly technical subject that is very complicated, the Coast Guard has not prepared a paper on this subject. The Coast Guard has reviewed the Frankel structural analysis and has some problems with the manner in which the methodology was applied and some of the assumptions made. My staff is available for technical discussions on this subject.

I have not covered all of the information contained in the public docket on the Coast Guard proposals. Copies of the Coast Guard proposals, the regulatory analysis, all written comments, and the transcripts from the five public hearings have been given to the National Academy of Sciences committee that is studying the tankbarge oil-pollution problem. All of this material should clearly present to that committee what the concerns of all parties were with regard to the specific Coast Guard proposals.

In conclusion I would like to join ADM. Scarborough in urging that you participate in this workshop to identify solutions which are suitable for all concerned.

SUMMARY OF INDUSTRY POSITION

Berdon Lawrence
Chairman, American Waterways Operators
Tank Barge Conference

Introduction

At this time of raging inflation, pending recession, shortage of capital, energy shortage, and environmental concern, the government and industry working together surely can find improved solutions to the tankbarge pollution problem.

Tankbarge transportation is the lowest-cost, most energy-efficient, and safest modes of surface transportation. You may recall that the Southern Railroad advertised recently that railroads are the most economic and energy-efficient means of transportation among truck, rail, and barge. We challenged them. We said this was not true and that we would move their cargo, cars, and locomotives and still be more energy-efficient and economical. They agreed to leave barges out of future ads.

We feel that through this workshop and the National Academy of Sciences, which allows a broad participative format, better decisionmaking will occur on tankbarge design standards and alternatives to reducing pollution. This format allows all relevant factors to be presented, discussed, and studied.

The industry is opposed to mandatory imposition of double hulls on tankbarges. There are many problems with double hulls, such as serious safety drawbacks during operations in coastal and open waters, and they are not as effective as is contended.

We will demonstrate that double hulls are not as cost-effective and technically effective as other regulatory measures. This workshop needs to reassess the nature of barge accidents and spills and undertake an examination of more effective alternatives.

Congressional Mandate

The Coast Guard has stated that its promulgation of regulations requiring double hulls responds to a Congressional mandate and refers to "zero discharge" by 1985. Although we feel that the Coast Guard has a mandate to reduce pollution by tank vessels, that mandate is unrelated to a zero-discharge requirement and clearly and absolutely does not mandate double hulls. A key point to remember is that the

cost to eliminate the last few percentage points of a problem can often be astronomical.

The Industry's Environmental Record

On the nation's inland waterways, barges contribute less than 2 percent of the petroleum hydrocarbons that enter the aquatic environment. The other 98 percent comes from urban runoff, municipal wastes, and industries. This fact must be kept in perspective before any regulation that would drastically hinder our nation's ability to transport energy by water is considered.

Our industry is proud of our clean-water record. The domestic barge fleet spills only about 5 barrels of oil for every 240,000 barrels it transports. This is a ratio of less than .00002 (two one-hundred thousandths).

While double-hull barges have advantages in some trades, they are not a cure-all for the problem of oil pollution from tank barges.

Environmental Considerations

Petroleum and petroleum products are transported primarily in single-hull barges.

Chemicals and toxic and extremely hazardous materials are handled in double-hull barges; double hulls are preferred by industry in such service because of frequent cargo changes and the characteristics of toxic cargoes.

A clear distinction must be made between petroleum and toxic chemicals. They have different characteristics and require different vessel configurations.

It's easy to say that any oil spillage is bad. No matter how many hulls we use and how many other measures we institute, we will have some pollution.

Spillage of oil by barges or other sources has not been proved, despite research, to cause imbalances in aquatic systems. Short-term effects may occur in localized systems but such systems are soon restored to balanced, productive environments. Natural degradation and dispersion reduce oil to a nonpolluting state.

Millions of barrels of hydrocarbon material have been introduced into the sea for centuries through natural seepage and bio-organic production processes. For a simple example of living organisms' producing oil, fail to wash your hair for several days and see what happens. As a counterbalance, naturally occurring bacteria degrade oil. This phenomenon is being observed particularly in the Gulf of

Mexico today as the oil released from the Ixtoc well in Mexico is being reworked by natural processes.

We must discuss these aspects and be realistic in our approach.

Alternatives

The industry suggests that this workshop, at a minimum, should consider the following measures as effective alternatives to the imposition of double hulls on tank barges.

Better aids to navigation to help operators avoid accidents

- More channel markers.
- Larger and better-quality markers and lights.
- Improved electronic types of aids for navigation of the tow and location of the channel for more efficiency in all types of weather.
- Studies of the relocation of dangerous existing man-made structures and new ones being planned.

Better design criteria along the lines first suggested by the Towing Industry Advisory Committee in 1975

- Increased plate thickness.
- A 6 in. minimum radius at the critical point where the bottom joins the side.
- More rub bars installed at critical wear points.

Better use of our human resources to prevent pollution

- Continued industry training of crews. Better training of Coast Guard inspectors and elimination of the rapid rotation of inspectors, as this eliminates needed experience and professional ability. The inexperienced inspector cannot spot problems.
- Improvement in oil-spill cleanup ability and rate of cleanup.
- Faster response to spills (vital equipment should be strategically located).
- Development and distribution of improved damage-control techniques and equipment.
- Channel-maintenance dredging to ensure channels are kept at authorized depths. Increasing costs (\$.50/yard to \$7.50/yard in 10 years) and shortages of spoil sites have restricted dredging and impaired navigational safety.
- Improved ice breaking capability to maintain a safe environment when the transportation of petroleum is essential.

Conclusion

- The tank barge industry supports improved measures to curb pollution.

- We are proud of and will continue our efforts for pollution control.
- We are proud that we have accomplished this while being cost-effective and a safe mode of transportation.
- The proposed regulations for double hulls miss the mark -- they attempt to remove the symptoms, not the cause of oil spills.
- The proposed regulations are unnecessarily expensive and burdensome without being effective at a time of unprecedentedly high interest rates.
- By being able to work together in this workshop, however, we can show that there are viable alternatives that should be initiated that are both effective and cost-efficient in further reducing pollution.
- Surely the government and industry, working together, can find a better way.

SUMMARY OF TANKBARGE STRUCTURAL ANALYSIS
AND
ANALYSIS OF TANKBARGE CASUALTY POLLUTION DATA

Prof. E. G. Frankel
E. G. Frankel, Inc.

I. SCOPE AND APPROACH

E. G. Frankel, Inc., authored a study assessing the expected pollution reduction which would result from implementation of the U.S. Coast Guard's proposed tankbarge design standards and regulatory action. The report consists of a structural analysis of single- and double-hull tankbarges with respect to pollution prevention in accidents; an analysis of tankbarge pollution data for the period 1973-1977; and (based on the first two section and Booz-Allen's economic impact study of tankbarge standards) the determination of a cost/benefit ratio for the regulatory programs.

A. STRUCTURAL ANALYSIS

The purpose of the structural analysis was twofold: first, to assess the relative ability of selected single- and double-hull barge designs to withstand cargo-tank penetration; second, to determine the maximum energy-absorption potential for each design. Three idealized damage types were discussed:

- Side collision: Impact is sustained along a vertical line extending the full depth of the barge. The striking object is considered perfectly rigid.
- Side ramming: A rigid, blunt horizontal object strikes the barge at mid-depth, causing a roof-like indentation of the shell.
- Hard grounding: A barge strikes a sharp rock while traveling with forward velocity. A narrow, ripping failure occurs.

Three 300-ft. (30,000-barrel capacity) inland tankbarge designs were compared for collision and ramming damage. The designs were typical single- and double-hull and a single-hull barge with increased side-shell thickness. The shape and extent of damage to the barge structure were determined for an accident causing just enough damage to rupture the cargo tank. (For the double hull this means rupturing both the outer and inner hulls.)

In the grounding analysis, the two typical 300-ft. inland barge designs as well as single- and double-hull oceangoing barges 340 ft.

long (100,000 barrels capacity) were compared. Energy absorbed per foot of damaged length was calculated for idealized "rocks" of various sizes. The length of damage was determined for the barges in the fully laden condition as a function of barge speed.

Throughout the analysis, assumptions were made which lead to overestimation of the energy-absorption potential of the vessels. Hence, an upper limit to the pollution-avoidance ability of the barges was estimated. The major assumptions and difficulties of the analysis are discussed in Part II of this paper.

Finally, the results were summarized and design implications were considered.

B. ANALYSIS OF TANKBARGE POLLUTION DATA

Tankbarge oil-spill statistics exhibit a highly skewed size distribution. That is, a small percentage of spills accounts for a large percentage of the volume of oil pollution. These large-volume spills are most likely to result from high-energy collisions and groundings in which all tankbarges are vulnerable to cargo spillage irrespective of construction standard. Consideration of this fact allows an estimate to be made of the effectiveness of double-hull construction in reducing tankbarge oil pollution by examination of the small subpopulation of polluting incidents comprising the largest spills.

The total relevant spill population consists of 331 transport-related single-hull tankbarge pollution incidents during the period 1973-1977. The data were derived from the Pollution Incident Reporting System for spills which were properly identified by tankbarge official number. Of these 331 incidents, the 36 largest spills (greater than or equal to 1000 barrels) were each examined to determine whether a double-hull construction standard would have prevented the spill. These 36 spills accounted for 91 percent of the total (331-incident) spill volume. Assuming that double-hull construction would be fully effective in preventing pollution from all less-than-1000-barrel incidents, an upper-bound measure of double-hull effectiveness was calculated.

Assessment of whether or not a spill was preventable was based on the structural analysis of this report, review of the U.S. Coast Guard Casualty Report (CG-2692), and, when necessary, the surveyor's report and opinion.

C. COST-EFFECTIVENESS DETERMINATION

Booz-Allen and Hamilton, Inc., has evaluated the economic impact of a double-hull construction standard for tankbarge new construction and

a program of accelerated retirement for the existing single-hull fleet. Using their fleet projections and added construction and operating costs and our double-hull effectiveness allowed the determination of program cost in dollars per barrel of oil spill prevented. This number, by itself, is insufficient to judge the desirability of the programs. Given that reduction of oil pollution of our waters is deemed necessary, policy choices should be based on comparison of this figure with estimates of tankbarge-pollution-abatement benefits and costs for alternative programs (such as increased personnel training or improved aids to navigation), as well as comparison of the costs and benefits of reducing oil pollution from other sources.

II. STRUCTURAL ANALYSIS

A. METHODOLOGY

Hull-damage failures are of two general types: deformation/buckling failure, and ripping/cracking failure. In an accident, the former absorbs (requires) much more energy than the latter. Plastic analysis methods were used to determine the energy required to deform the structural members sustaining damage. "Plastic energy" is the work done in permanently deforming a material. The gross distortions of buckling, stretching, tearing, crushing, bending, and twisting of plates and shapes in steel-vessel collisions and groundings are plastic deformations.

A structural analysis of idealized side-ramming and side-collision damage to river barges of single- and double-hull construction was carried out. Assumptions were made which lead to an overestimation of energy of damage: deformation-type failure was assumed; only strike locations most favorable to large energy absorption before cargo-tank rupture were considered. Grounding incidents were analyzed for inland and offshore barges of single- and double-hull construction types. The failure was a narrow rip in the bottom plating.

The general approach of the analysis was to assume a pattern of structural-member failure for each damage type, strike location, and design type and to determine the plastic energy required to deform the structure to this final assumed shape. The final condition represents rupture of the cargo tank. For a double-hull design, this implies failure of both the inner and outer skins. [The plastic (internal) energy of deformation is equal to the kinetic (external) energy lost in the accident. The external kinetic energy is the energy of rigid-body motion of the participants in the accident. This includes translational and rotational energy of vessels and their entrained water, or "added mass."]

Damage-analysis methods were reviewed and those deemed most appropriate to each damage type were used.

For ramming/collision damage types, most of the plastic energy of deformation is absorbed in "membrane stretching" of the plating and stiffeners of the outer (and inner) skin. This energy is proportional to the volume of steel involved in the "stretching." The volume in turn is determined by the thickness of plating (and size of stiffeners) and the longitudinal and vertical extent of damage. Since the longitudinal extent of damage was assumed to be either one or two frame spacings, the energy-absorption potential is quite sensitive to the particular design chosen for analysis.

1. Barge Designs Analyzed

For this analysis, typical single-skin and double-skin 300 ft. (30,000 barrels capacity) designs were used. Single-skin inland barges are generally built to a better-than-ABS-minimum-scantling rule in selected areas, based on experience. A modified single-skin barge, for which the central strake of steel of the side shell was increased from 3/8 to 7/16 in., was also analyzed. The oceangoing barges analyzed are 340 ft. long and have a capacity of approximately 100,000 barrels. Figure 1 describes the principal scantlings of the vessels.

2. Assumptions

Because of the complexity of tankbarge-accident analysis, several simplifying assumptions were necessary to make the problem analytically tractable. The assumptions were chosen so as to be as realistic as possible and to provide an upper bound on the energy-absorption capacity. In this manner, reliable comparisons of designs could be made, and a rough idea of collision survivability, in absolute terms, could be obtained. Each assumption listed below is followed by an evaluation of whether it led to an overestimate or underestimate of absorbed energy.

- Failure of beamlike members (longitudinal plating and stiffeners for side impacts, and transverse beams and floors for grounding) when the transverse central displacement equals one third of the span of the member.

This represents a significant overestimate of energy. The assumption is that the full ductility of the steel is exhausted while no cracks, tears, or punctures occur.

- The "striker" is perfectly rigid.

While it may seem at first that we neglected the energy absorption of the striking structure and therefore underestimated the crashworthiness of our barge, it must be kept in mind that a striking bow will develop sharp edges which will tend to produce ripping and puncturing of the struck vessel, resulting in cargo spillage before

FIGURE 1 300'x54'x12' RIVER BARGES - TYPICAL SCANTLINGS

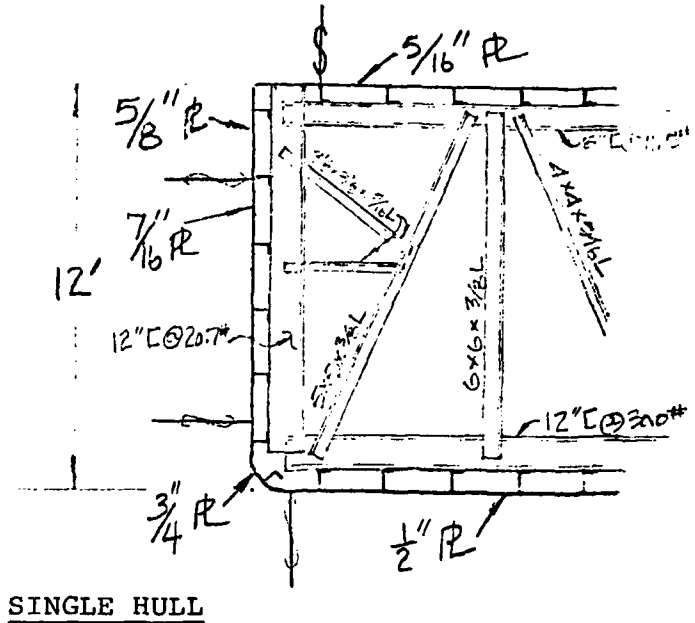
Deck Longitudinals:
 5 1/2 x 2 1/2 SS
 (1/2 of 9" C @ 15.0#)

Side Longitudinals:
 6 x 3 1/2 x 5/16 L

Bottom Longitudinals:
 7 1/2 x 3 SS
 (1/2 of 12" C @ 20.7#)

Transverse Frame
 Spacing = 8'

Stanchions Per
 Transverse = 6



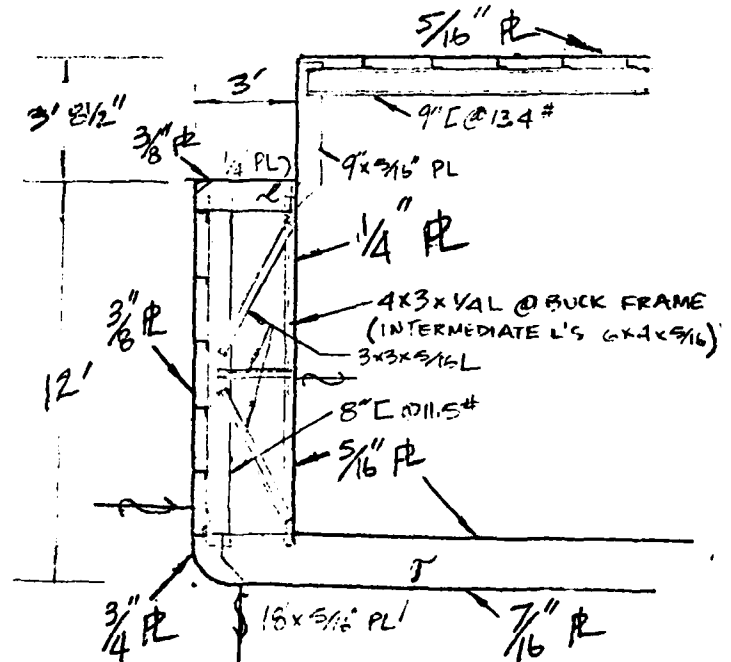
SINGLE HULL

Deck Longitudinals:
 4 x 3 x 5/16 L

Side Longitudinals:
 5 x 3 x 5/16 L

Transverse Frame
 Spacing = 6'9"

Floor Spacing:
 2'3"



DOUBLE HULL

appreciable energy dissipation. Thus, the overall effect of this assumption is indeterminate.

- Damage center located at or midway between frames.

This leads to an overestimate of energy. For impact off-center or near a transverse bulkhead, less steel participates in the damage.

- Bending energy ignored.
Very slightly underestimate: bending energy represents less than 2 percent of the total plastic energy of deformation.
- Damage confined to one or two frame spaces.

Prediction of the onset of transverse-frame buckling is probably one of the most difficult aspects of the failure-mechanism analysis and unfortunately is also one of the most important in determining energy absorption. Based on some photographic evidence, this assumption seems reasonable.

- Elasticity ignored.

Unimportant; accounts for less than 1 percent of the energy absorbed.

- Dynamic effects ignored.

There is evidence that for ship collisions, these effects -- i.e., strain-rate sensitivity, inertia, and heat effects -- are of minimal importance.

- In each accident case, it was necessary to assume a specific sequence and mode of deformation of the structural members taking part in the energy absorption.

Thus, the more complex the structural arrangement, the more uncertainty is introduced into the analysis.

- Yield stress taken as 30,000 psi.

This assumption underestimated the absorbed energy because the loads were underestimated. Strain-hardening effects might have been accounted for by using

$$\sigma_0 = \frac{1}{2} (\sigma_y + \sigma_u)$$

where

σ_y = yield stress = 30,000 psi

σ_u = ultimate strength = 60,000 psi

The net effect of all the above assumption is to overestimate the energy-absorption potential. The critical factor is the failure type: for both single- and double-hull designs, it is extremely unlikely that a high-energy collision would not involve a sharp, penetrating rip or the formation of a crack (which could cause cargo spillage) before exhausting the available steel ductility.

B. DAMAGE ANALYSIS

1. Side Collision

In this scenario, the barge collides with a vertical rigid object. The type of damage sustained might result from a crash on a bridge-pier corner or a strike by a stiff vertical ship bow. Results of the analysis are given in Table 1.

TABLE 1
SIDE COLLISION SCENARIO:
ENERGY ABSORBED AND IMPACT VELOCITY

Strike Location	On Frame		Between Frames	
	E (ton-knots ²)	V* (knots)	E (ton-knots ²)	V (knots)
Single Hull ¹	66450	4.7	29530	3.1
Double Hull	34090	3.4	45810	3.9
Single Hull Increased Side-Shell Thickness ²	74920	5.0	33760	3.4

* Transverse

¹t_{side} = 7/16"

²t_{side} = 5/8"

Single Hull

The side shell was assumed to deform as shown in Figure 2. The damage is confined to two frame spacings; the plating indents, forming

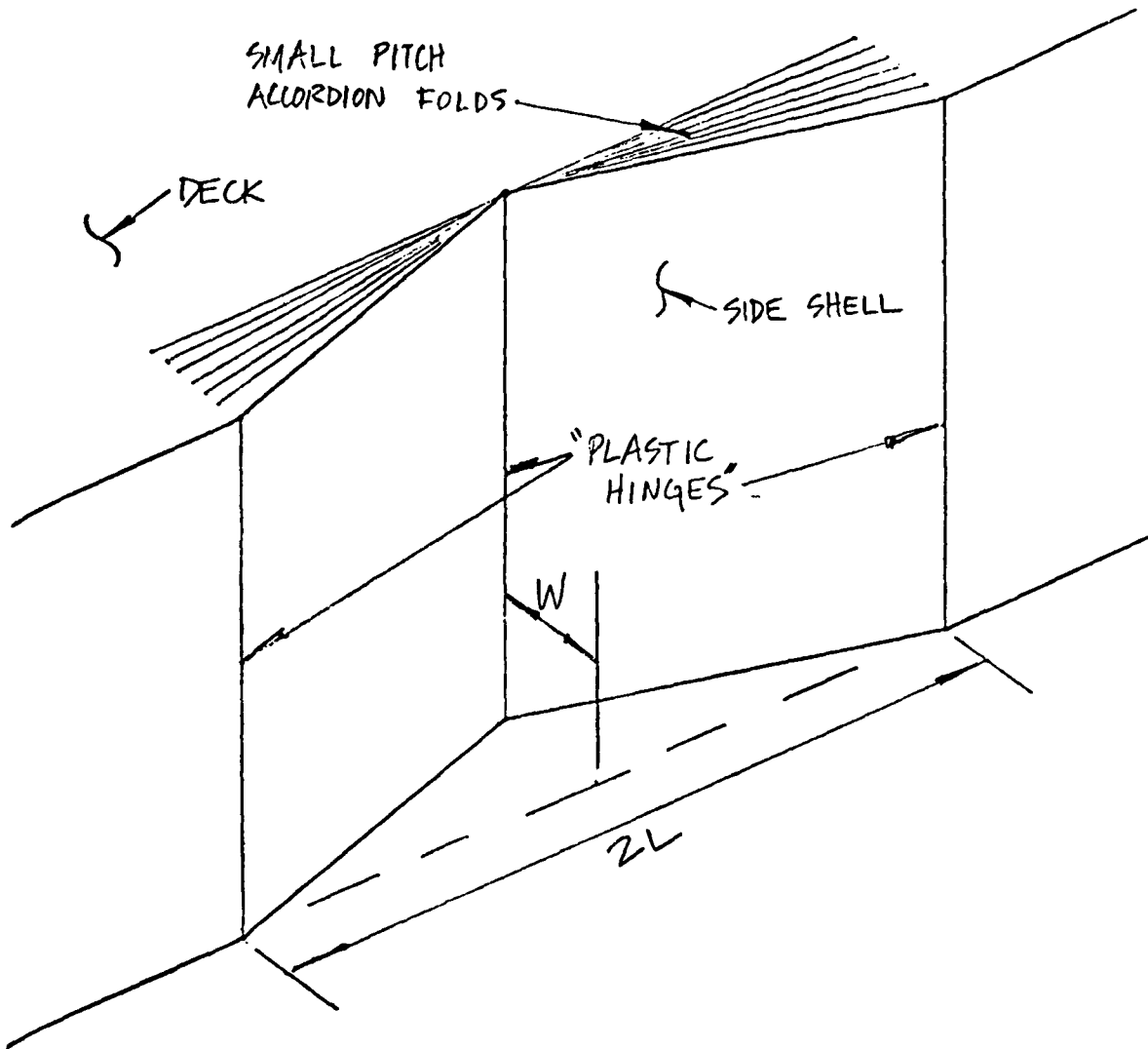


FIGURE 2
SIDE COLLISION DEFORMATION

two flat section with plastic hinges at the line of the strike and at each flanking transverse frame.

For a strike midway between frames, the collision mechanics and applicable methods are identical to the case of impact directly on a frame. The longitudinal extent of damage, however, was assumed to be one frame spacing.

In addition to the typical 300 ft. inland barge, a barge with heavier side plating was analyzed. The increase in collision protection and the added weight of steel (which translates into lost cargo-carrying capacity at a constant draft) were calculated.

Double Hull

For the double-hull barge, the collision mechanics is more complex by virtue of the wing-void structure and the double-bottom floors, which are very stiff in the transverse direction and therefore restrict the longitudinal extent of damage near the bottom. For impact directly on a frame, the side shell deforms as shown in Figure 2.

Results

The analysis shows that for an impact midway between frames, the energy absorbed before rupture of the cargo tank is approximately the same for single and double hulls of typical scantlings. An increase in side-shell thickness on the single-skin barge from 7/16 in. to 5/8 in. adds 19 percent more energy-absorption potential, while increasing the weight of steel by 24 long tons. For a strike directly on a frame, the single-skin barge has about twice the energy absorption of the double-skin barge. The side-shell thickness increase adds another 18 percent to this. Membrane-tension energy in stiffened longitudinal plating (shell and wingwall bulkhead) accounts for 72 to 88 percent of the total energy absorbed. This energy is proportional to the volume of the structural members involved. Hence, the extent of longitudinal "spreading" of the damage is a critical determinant of total energy absorbed. Longitudinal structural members promote this spreading. In the double-hull barge, the transversely framed double bottom limits the extent of damage longitudinally and reduces the penetration depth corresponding to rupture. Moreover, the transversely stiff floors create "hard spots," or sharp edges, which promote ripping or puncture failure before the energy-absorption potential of the members has been fully utilized.

Increasing the thickness of the shell plating was shown to have a significant effect on collisionworthiness without exacting a large penalty in steel weight. The increase in energy is due to the increase in the volume of steel participating in the damage. The increased thickness has a further important effect in that it tends to spread the

longitudinal extent of damage by promoting the collapse of the transverse frames flanking the strike, allowing still more structure to absorb energy.

2. Side Ramming

In this scenario, the barge strikes a rigid, horizontal, blunt-ended object. The results are shown in Table 2. A representation of the damage is shown in Figure 3.

TABLE 2
SIDE RAMMING SCENARIO:
ABSORBED ENERGY AND IMPACT VELOCITY

Strike Location	On Frame		Between Frames	
	E (ton-knots ²)	V* (knots)	E (ton-knots ²)	V (knots)
Single Hull ¹	32000	3.3	14880	2.2
Double Hull	35360	3.4	16300	2.3
Single Hull Increased Side-Shell Thickness ²	44820	3.9	20470	2.6

* Transverse

¹t_{side} = 7/16"

²t_{side} = 5/8"

Single Hull

The side shell was assumed to deform in a pyramidal or rooflike shape, with four plastic hinges radiating diagonally in straight lines to the corners of the damaged area. For the strike directly on a truss frame, the damaged area extends two frame spacings. For the strike midway between frames, the damage is confined to one frame spacing.

Failure occurs when the penetration reaches one third of the shorter dimension of the damaged area. For the strike directly on the frame, this would be the depth of the barge; for the strike midway between frames, it is one frame spacing. The corresponding penetration depths are 4 and 2.67 ft., respectively.

Double Hull

The outer hull collapses as in the single-skin case, with damage confined to the area above the floors -- i.e., the top 10.5 ft. After 3 ft. of penetration, the inner hull is engaged and the sides deform in

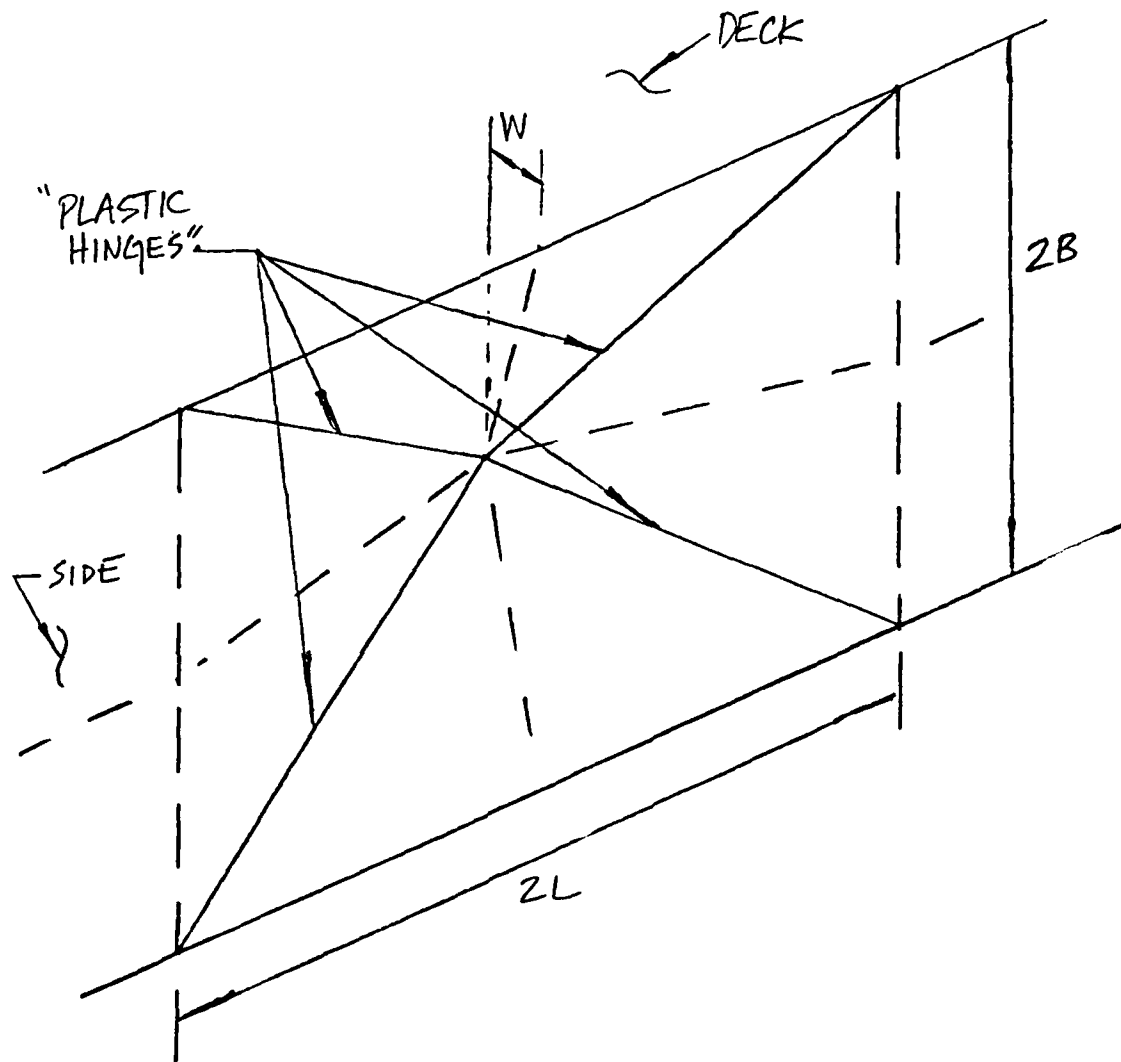


FIGURE 3
SIDE RAMMING DEFORMATION

unison. After rupture of the outer hull, it was assumed to offer no further resistance. Failure of the inner hull occurs when the total penetration has reached 6.5 and 5.25 ft. for strikes directly on and midway between frames, respectively.

Results

The single- and double-hull barges were found to have roughly the same energy absorption. The strike at the frames involves twice as much steel and has about twice the energy of the strike between frames. For both strike locations, the single-skin barge with 5/8 in. side-shell plating has 40 percent more energy-absorption potential than the typical barge with 7/16 in. sides.

It would seem that the double-hull barge should absorb substantially more energy than the single-hull because its two skins undergo basically the same deformation as the single-skin's one. However, this effect is offset by the narrower frame spacing and shorter effective height of plating on the double-hull vessel of the analysis.

3. Hard Grounding

In this accident scenario, a barge strikes an idealized sharp "rock" while traveling with some forward velocity, and the bottom suffers a long, narrow, ripping failure. The analysis calculated the energy absorbed per foot of damaged length. The results are given in Tables 3 and 4.

Two "rocks" were investigated: one of a height equal to half the double-bottom depth, the other penetrating the full double-bottom depth. In addition, two rock widths were analyzed to determine the effect of the transverse extent of the rip on the amount of energy absorbed.

Single Hull

The mechanics of the destruction of the bottom plating is straightforward: the plating is ripped and pushed to the side, along with the attached longitudinals, creating a swath the width of the rock (see Figure 4).

Double Hull

The damage mode is identical to the single-skin mode with the additional consideration of the transverse floors: for the full-depth rock, the floors were simply treated as transverse members; for the

TABLE 3
GROUNDING OF 300' INLAND BARGES:
ENERGY AND LENGTH OF DAMAGE

Rock Height		High (2')		Low (1')	
		Wide (3')	Narrow (1')	Wide (3')	Narrow (1')
Single- Hull	E/l	3270	960	3050	890
	l^*	23'	80'	25'	86'
Double- Hull	E/l	3600	1450	2360	880
	l^*	21'	53'	33'	88'
% Increase in E/l for DH vs SH		+10%	+50%	-23%	-2%

"high" rock height = 2' = double bottom depth

"low" rock height = 1'

"wide" rock width = 3'

"narrow" rock width = 1'

E/l = energy absorbed per foot of damaged length
 (ton_m-knots²/foot)

l^* = length of damage for fully laden barge
 (Δ = 4260 long tons) at V = 6 knots

TABLE 4
GROUNDING OF 340' OCEAN-GOING BARGES:
ENERGY AND LENGTH OF DAMAGE

Rock Height		High (2')		Low (1')	
		Wide (3')	Narrow (1')	Wide (3')	Narrow (1')
Single- Hull	E/l	4130	970	4130	970
	l*	65'	280'	65'	280'
Double- Hull	E/l	7340	1950	3840	1270
	l*	37'	138'	70'	213'
% Increase in E/l for DH vs SH		+78%	+102%	-7%	+32%

"high" rock height = 4' = double bottom depth

"low" rock height = 2'

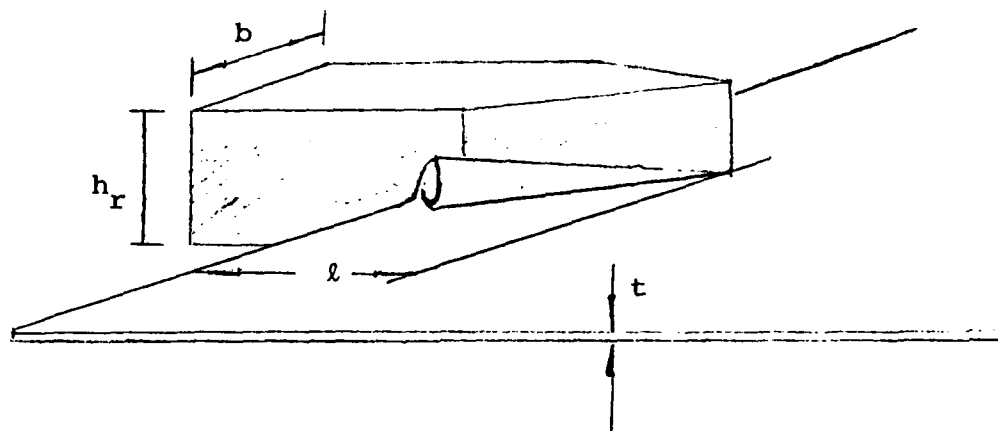
"wide" rock width = 3'

"narrow" rock width = 1'

E/l = energy absorbed per foot of damaged length
 (ton_m-knots²/foot)

l* = length of damage for fully laden barge
 (Δ = 15000 long tons) at V = 6 knots

FIGURE 4 - IDEALIZED GROUNDING DAMAGE



b = width of idealized "rock"
 l = length of damage
 t = thickness of plating
 h_r = height of "rock"

half-depth rock, a rooflike form was assumed, similar to the shapes proposed for the side-ramming scenario.

Results

The ripping of a narrow slit in the bottom plating of a vessel by an idealized sharp rock requires very little energy per foot of damage. As the width of the penetrating object increases, and more plating and longitudinals resist the advance of the tear, the energy absorbed increases substantially.

For the inland barges, the double hull affords up to 50 percent more energy absorption per foot of damage. The offshore double hull shows increases of 80 to 100 percent over the single skin for, the "high" rock by virtue of the inner bottom platings becoming involved in the energy absorption. Thus, in addition to preventing spillage from incursions less than the double-bottom height, the inner bottom and floors serve to reduce the length of damage, and hence the number of cargo tanks ruptured, for rocks penetrating into the cargo tank.

C. SUMMARY

1. General

- There are two general types of collision-protection schemes: resistance type and absorption type. Resistance structures are designed to withstand impact loads without failure. Absorption-type schemes are designed to dissipate energy by plastic deformation. Because of the huge loads and consequent large steel requirements, resistance structures are the less desirable approach to tankbarge-pollution abatement.

- There are two types of failure that structural members can experience: ripping/cracking failure, and deformation/buckling failure. The former requires significantly less energy. Deformation/buckling energy is proportional to the volume of structural steel undergoing damage and utilizes much of the available ductile energy (toughness) of the structure.

2. Comparison of Designs

- The type of framing scheme employed in the side structure of a barge strongly influences its energy-absorption capacity. Longitudinal framing tends to spread the fore-aft extent of structure participating in the energy absorption. In a transversely framed vessel, the damage is localized, the loads become higher, and cargo-tank rupture occurs

with less energy dissipation. Double bottoms are constructed using transverse floors.

- Double-hull barges are superior to single hulls in preventing oil outflows caused by sharp, shallow, low-energy rips and tears by virtue of their spatial separation of the cargo tanks from the outer shell. An example of this situation is grounding on a sharp object, such as ice.

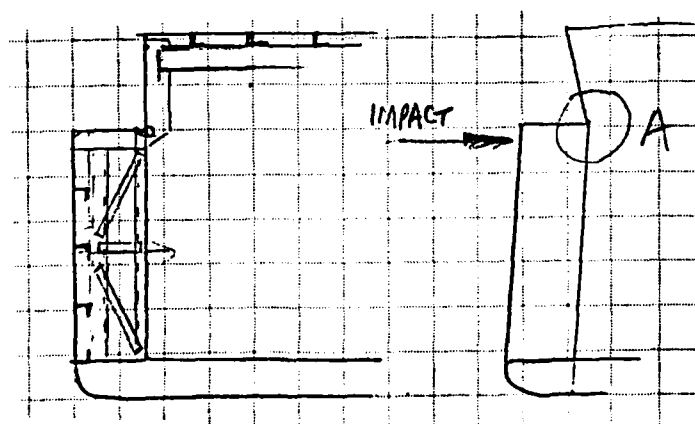
- Double hulls may be superior to single hulls for collisions with very large-radius rigid objects (e.g., 20 ft. radius bridge pier) because the object spreads the damage without the aid of the structure.

- Single-hull designs are better energy absorbers for collisions with blunt objects because of their longitudinal framing and the spreading mechanism described above.

- For deformation/buckling failures, increased shell thickness allows greater absorption of energy (prior to cargo-tank rupture) per ton of light ship weight than a double-hull design.

- The energy of collision for which both single- and double-hull designs suffer significant cargo spillage is not unusually high, in light of the sizes and typical speeds of vessels plying U.S. waterways.

- Because of the complexity of their wingwall structure, double-hull designs have an increased probability of cargo-tank rupture by cracking or tearing. For example, the area marked A in the sketch below is a point of high stress concentration in a side collision.



3. Implications for Tankbarge Design

- Consideration of pollution resistance should be a part of tankbarge-design development.
- Longitudinal framing is preferred to transverse framing because of its spreading of the damage. To further encourage this spreading, transverse beams should be spaced as widely as possible (while continuing, of course, to satisfy all scantling requirements) and should be designed to buckle when subjected to large end loads (corresponding to impact on side of barge).
- For double-hull barges, designs allowing the inner and outer skins to act independently will increase the potential energy absorption. This would require a relatively weak connection between the skins at the bottom and deck. The effect would be to allow the side shell and wingwall in turn to act as single-skin side shells, each absorbing a large amount of energy.
- Investigation of schemes for the use of tubular (and other) structures as energy-absorbing devices should be encouraged.
- Increasing bilge and deck radii and changing flanged knuckles to radii will reduce stress concentrations and crack formation from bumps and dents.
- Double-hull barges may pollute less from cargo-tank penetrations because of the containment effect of wing and/or double-bottom voids. For very large spills, the probably effect is small. The effect may be significant for minor inner-skin ruptures.
- In evaluating the overall desirability of double bottoms, consideration must be given to the added stranding potential of this design. When a single-hull barge grounds, some oil is released and the vessel rises in the water. When a double-bottom barge rips its bottom plating, the barge sinks deeper because buoyancy is lost. As the barge would now rest more heavily on the bottom, lightening efforts would be made more difficult and the probability of a total loss of the vessel would increase. Such a catastrophic casualty might lead to spillage of an entire bargeload of oil, which would dwarf other tankbarge pollution incidents.
- Imposition of uniform design standards for inland and offshore tankbarges implicitly dismisses differences in operating environment, such as exposure of oceangoing tankbarges to heavy slamming, cyclical hogging and sagging stresses, and differing exposure to traffic and operating hazards (restricted maneuvering, swift currents, locking, fleeting, midstreaming, etc.).

III. ANALYSIS OF TANKBARGE POLLUTION DATA

A. METHODOLOGY

Spill data from the Pollution Incident Reporting System (PIRS) were obtained for the five-year period 1973-1977. Table 5 describes the derivation of the relevant spill population. Table 6 lists corrections to the data base.

To illustrate the degree of skewness of the spill data, the spills were listed in order of size. Analysis of this compilation revealed that the 90th percentile and smaller spills account for only 11 percent of the total spill volume; the 50th percentile and smaller spills account for less than 0.5 percent of the volume. Since a small number of the largest spills accounts for most of the volume of tankbarge oil pollution, a determination of double-hull effectiveness for these spills allows a good estimate of overall effectiveness to be made.

The effectiveness of double-hull construction in preventing pollution was evaluated for each of the 36 spills (in the relevant population) which were 1000 barrels in size or larger. These 36 spills accounted for 91 percent of the total volume spilled. By assuming that for all less-than-1000-barrel spills double-hulls would prevent pollution, an upper-bound estimate of effectiveness was determined.

B. EVALUATION OF DOUBLE-HULL EFFECTIVENESS

Assessment of whether or not a spill was preventable was based on the implications of the structural analysis, surveyors' opinions, and Coast Guard vessel-casualty reports.

In cases of rammings and collisions (all of which occurred to inland barges longer than 240 ft), it was judged that double walls would not have prevented or significantly reduced pollution where gross structural deformation caused a large rupture of the side of the barge with penetration exceeding 36 in. (the typical width of wing voids). In grounding incidents, if the penetration was estimated to be less than 24 in., the spill was considered preventable. Where it was not known whether the object was high enough to penetrate the inner bottom, the double hull was considered effective. All cases of capsizing, sinking, and explosion or fire were considered unpreventable.

C. RESULTS

Table 7 lists the 36 spills of 1000 barrels or more in descending order by size, indicating cumulative spill-volume percentage and assessment of double-hull preventability. In the 36-spill sample, seven spills were preventable by double-hull construction. These seven

TABLE 5 - TANKBARGE OIL SPILL DATA

	Number of Incidents	Volume (Barrels)
Tankbarge oil pollution 1973-1977 ¹	4429	253601
<u>less</u> PIRS ² data not identified by name or official number	-156	63379
	4273	190222
<u>less</u> transfer incidents ³	-3918	-10899
	355	179323
<u>less</u> ⁴ 15 incidents involving improperly identified ⁵ barges	-15	-7683
	340	171640
<u>less</u> 1 spill caused by broken line on pier	-1	-1786
<u>less</u> 3 tankship incidents	-3	-148
<u>less</u> 2 spills from an offshore barge > 30000 dwt ⁶	-2	-1954
<u>less</u> 3 double-hull tankbarge incidents	-3	-1750
	331	166002
<u>plus</u> net corrections ⁷	-	+2207
Total identified, transport-related, single-hull tankbarge pollution incidents 1973-1977	331	168209

1 Source: Polluting Incidents In and Around U.S. Waters, 1973-1977

2 Pollution Incident Reporting System.

3 Includes all spills less than 100 gallons in size. In this category, 3409 incidents accounted for 1483 barrels of spillage. Virtually all these spills are transfer incidents.

4 The subsequent adjustments involve the 165 spills larger than 500 gallons. Hence, all 190 incidents in the 100-500 gallon size-range are assumed to involve single-hull tankbarges.

5 Vessel official number from PIRS not found in CG List of Inspected Tankbarges.

6 These two spills, of 25 and 1929 barrels, were from the ocean-going barge "New York", which, being larger than 30000 DWT, would be exempt from the proposed regulations.

7 See Table 6 for a list of the corrections.

TABLE 6
CORRECTIONS TO USCG DATABASE

Barge	Spill Size in Barrels		Confirmation
	USCG Report	Correct Value	
TS-86	1,500	20,000	USCG 2692
ABC-2311	24,000	19,000	Saybolt Report
Nepco 140	7,142	5,645	USCG 2692
Florida	5,357	1,714	Cairo Marine Report
MM-102	4,000	3,068	Patco Report
Texas	2,000	1,209	Ingram measurement
Sully	1,400	1,000	USCG 2692
IOT 162	2,100	2,000	Company records
TM-10	9,000	6,000	USCG 2692, company records
WGH 16	1,930	1,000	Ashland Oil

Net Difference = +2207

TABLE 7 ANALYSIS OF BARGE SPILLS OF 1000 BARRELS OR MORE

Rank	Barge	Appendix Page #	Barrels		Cumulative %	D/H Preventable	Accident Description
			Capacity	Spill			
1	TS-86	D-8-4	35,000	20,000	12	N	Collision-ship
2	ABC-2311	D-19-2	23,000	19,000	23	N	Ram-bridge capsiz
3	B-521	D-9-2	21,000	17,730	34	N	Ram-bridge
4	Ethel H	D-7-4	66,332	10,000	40	N	Grounded-sank
5	Belcher 35	D-14-2	29,180	7,500	44	N	Collision-ship
6	TM-10	D-15-3	19,500	6,000	48	N	Grounded-capsize
7	STC-101	D-6-1	20,000	5,900	51	N	Flooded-sank
8	Nepco 140	D-22-3	148,000	5,645	55	Y	Grounded
9	LTC-65	E-7-5	19,000	5,000	58	N	Collision-ship
10	Butane	D-1-1	23,000	5,000	61	N	Collision-towboat
11	SJT-4	D-4-2	20,900	3,800	63	Y	Grounded
12	ST-120	D-7-3	16,000	3,666	65	Y	Ram-riverbank
13	Hygrade 2	D-5-4	20,000	3,100	67	Y	Grounded
14	MM-102	D-12-1	27,200	3,068	69	N	Collision-tow
15	B-421	D-9-1	21,000	2,666	70	N	Ram-bridge
16	Wassen 2	D-16-1	30,454	2,500	72	N	Ram-bridge
17	B.115	D-23-3	108,362	2,430	73	Y	Grounded
18	B.105	D-21-4	102,662	2,380	75	Y	Grounded
19	IOT-162	E-5-1	20,900	2,000	76	N	Collision
20	Chotin 2181	D-11-3	20,428	2,000	77	N	Ram-old lock
21	Chotin 2185	D-12-4	19,000	2,000	78	N	Ram-old lock
22	Patco 200	D-21-3	31,845	2,000	79	N	Ram-bank
23	Nepco 140	D-22-4	148,000	2,000	80	Y	Grounded
24	STCO 221	D-23-1	23,000	2,000	82	N	Collision-tow
25	B.65	D-14-4	75,340	1,930	83	N	Grounded in ice
26	Florida	D-20-1	31,845	1,714	84	N	Ram-sunken barge
27	B-117	D-6-4	17,500	1,600	85	N	Ram-bridge
28	Delaware	D-3-3	20,900	1,500	86	Y	Ram-pier
29	Missouri	D-15-2	28,500	1,400	87	N	Ram-bridge
30	Hines 370	D-19-4	32,566	1,340	87	N	Ram-submerged wing dam
31	Texas	E-6-1	31,845	1,209	88	N	Ram-dock
32	Ocean 135	D-17-3	132,000	1,167	89	N	Grounded
33	STCO 213	D-20-3	23,000	1,000	89	N	Collision-barge
34	STCO 225	D-23-4	23,000	1,000	90	N	Collision-barge
35	Sully	D-11-4	21,500	1,000	91	N	Fire-explosion
36	WGH 16	E-1-2	23,000	1,000	91	Y	Grounded
TOTAL					153,245	(91.1% of total sample of 168,209)	

spills accounted for 25,521 barrels or 17 percent (25,521/153,245) of the sample volume. Assuming that double hulls would also be fully effective for all spills of less than 1000 barrels, the total effectiveness would be 24 percent (40,536/168,209). Since some of the larger spills of less than 1000 barrels resulted from high-energy accidents, it is fair to say that an entirely double-hulled fleet would eliminate 20 percent of the transport-related oil pollution of a single-hull fleet and that most of the spillage would result from infrequent, large oil spills. Summary statistics for the 36-spill sample and subsamples based on preventability and certificated route are given in Table 8.

Figure 5 shows the percentage of the total spill volume accounted for by all spills smaller than the Nth largest spill and the percentage of the total accounted for by preventable spills smaller than the Nth largest spill. The graph shows that the larger a spill, the less likely it is to be preventable. Thus, while a double-hull tankbarge design standard would eliminate the great majority of oil-spill incidents, the expected volume of pollution from double-hull barges is at least 76 percent of that of single-hull barges and probably 80 percent.

IV. COST-EFFECTIVENESS OF THE PROPOSED REGULATIONS

The measure used to evaluate the effectiveness of the Coast Guard's proposed regulations was cost per barrel of oil spill prevented. This cost was arrived at by applying the derived double-hull pollution-reduction effectiveness to the Booz-Allen & Hamilton forecasts of tankbarge fleet mix (by single-/double-hull standard) for the existing regulatory environment and assuming implementation of the proposed regulations. The expected pollution for each scenario was thus derived. The difference in expected spill volume for the 42-year period considered (1979-2020) is the expected benefit of the program. Using Booz-Allen & Hamilton's total construction and operating costs for the program, the dollar cost per unit-volume reduction of oil pollution was determined.

For the years 1973-1977, the annual average volume of transport-related tankbarge pollution was 47,400 barrels. The average size of the fleet carrying oil during this period was approximately 2850 barges, of which 2160 were single-hull barges. When we adjust for partial double-hull vessels by assigning half of these barges to each category, the proportion of single-skin barges in the oil-trading fleet was about 80 percent. Using the value of double-hull effectiveness of 24 percent (as determined from the statistical analysis), annual pollution for tankbarges was:

TABLE 8
SUMMARY STATISTICS 1973-1977
LARGE SPILL SAMPLE - ALL SPILLS OF ONE THOUSAND
BARRELS OR MORE
(Volumes in Barrels)

ENTIRE SAMPLE

N = 36	V = 153,245	
Mean = 4257	Median = 2190	S.D. = 4859

CATEGORIZED BY DOUBLE-HULL EFFECTIVENESS

Preventable

N = 9	V = 25,521	
Mean = 2836	Median = 2430	S.D. = 1325

Unpreventable

N = 27	V = 127,724	
Mean = 4731	Median = 2000	S.D. = 5477

CATEGORIZED BY ROUTE

Offshore

N = 7	V = 25,552	
Mean = 3650	Median = 2380	S.D. = 2909

Inshore

N = 29	V = 127,693	
Mean = 4403	Median = 2000	S.D. = 5211

SPILLAGE FROM ALL SPILLS SMALLER THAN THE Nth LARGEST SPILL

TOTAL SPILLAGE

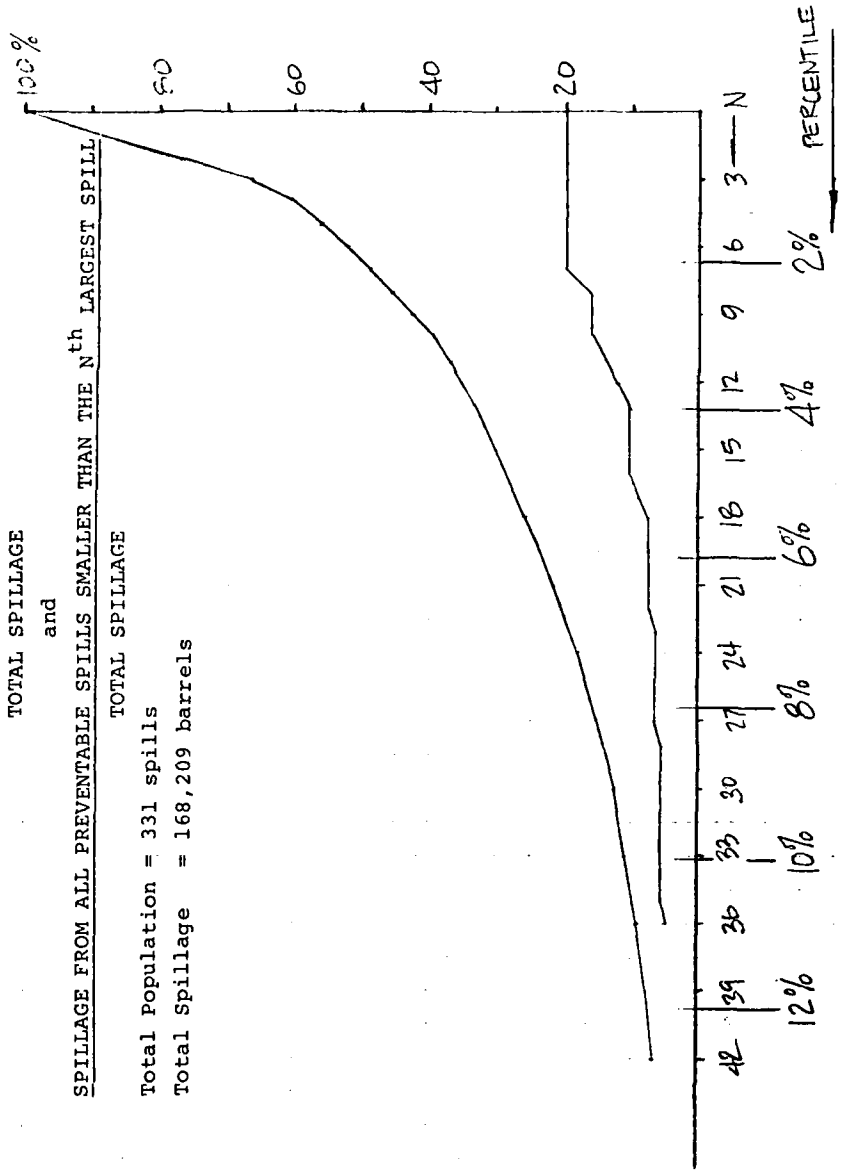
and

SPILLAGE FROM ALL PREVENTABLE SPILLS SMALLER THAN THE Nth LARGEST SPILL

TOTAL SPILLAGE

Total Population = 331 spills

Total Spillage = 168,209 barrels



EXPECTED ANNUAL TANKBARGE POLLUTION

Single Hulls	17.5 barrels/barge/year
Double Hulls	13.3 barrels/barge/year

Booz-Allen & Hamilton's fleet forecasts of tankbarges devoted to carriage of oil for the study horizon (1979-2020) were as follows:

AVERAGE FLEET COMPOSITION 1979-2020

	<u>Proposed Regulations</u>	<u>Existing Regulations</u>
Single Hulls	337	1615
Double Hulls	<u>2361</u>	<u>909</u>
Total	2698	2524

The expected annual pollution for the 42-year period was then calculated for the two scenarios.

AVERAGE ANNUAL POLLUTION
(Barrels)

<u>Proposed Regulations</u>	<u>Existing Regulations</u>
37,200	40,400

Savings from Regulations = 3,200 BBL/Year

Booz-Allen & Hamilton calculated that the expected additional construction and operating costs resulting from the Coast Guard's proposed regulations would be \$2,874 billion for the 42-year period 1979-2020, or about \$68 million annually. Therefore,

$$\frac{\text{Annual Costs}}{\text{Expected Pollution Reduction}} = \frac{\$68,000,000}{3,200} = \$21,300/\text{barrel of spill prevented}$$

This figure represents a low estimate because:

- The upper-bound double-hull effectiveness of 24 percent was used.
- A high estimate was made of 1973-1977 annual pollution.
- The future benefits (pollution avoided) were not discounted.

Using a double-hull effectiveness of 20 percent yielded a cost of \$34,000 per barrel of oil pollution avoided.

ECONOMIC IMPACT OF TANKBARGE STANDARDS

I. Bernard Jacobson
Senior Associate
Booz, Allen & Hamilton
Transportation Consulting Division

Booz, Allen & Hamilton was engaged in July 1979 by The American Waterways Operators, Inc., to analyze the increased costs that will be suffered by the domestic inland- and coastal-barge industry if the U.S. Coast Guard implements double-hull design standards for new and existing tankbarges. This report documents our findings and conclusions.

In this Executive Summary:

- The purpose of the study is defined.
- A summary of the findings and conclusions is presented.
- A summary of differences in the costs and methods of calculation as computed by Booz, Allen & Hamilton and by the Coast Guard is presented.
- The sources of information are described.

1. PURPOSE OF STUDY

The Coast Guard has proposed to amend its regulations for the design and construction of tankbarges carrying oil in U.S waters. The Proposed Rule in 44 FR 34440 of June 14, 1979 (CG Docket 75-083a) would require double hulls for barges built after December 31, 1979. The Advance Notice of Proposed Rulemaking in 44 FR 34443, June 14, 1979, (CG Docket 75-083a) would prohibit certification of any oil tankbarge that is 20 years old after December 31, 1985, if it was not constructed with or converted to double hull or double side with end voids, double bottom with end voids, or independent cargo tanks. Limited exemptions to the proposed regulations are offered for existing barges for nonpolluting cargoes, permanently moored barges, and barges operating with minimal potential exposure to collisions, rammings, and groundings. In accordance with the Department of Transportation's "Regulatory Policies and Procedures" (44 FR 11034, February 26, 1979), a Draft Regulatory Analysis was prepared by the Coast Guard and released in July 1979. Chapter 4 of that analysis deals with the economic impacts of the proposed regulations.

The purpose of this study is to:

- Assess the increased costs that will be suffered by the barge industry and the consumers of its services as a result of the proposed Coast Guard construction standards.
- Compare the results of this analysis to the economic assessment offered by the Coast Guard.

2. SUMMARY OF RESULTS

Booz, Allen & Hamilton has calculated that the expected impact of the Coast Guard's proposed regulation will be \$2.658 billion over the period 1979-2020. This is 722 percent of the Coast Guard's total of \$368.3 million and indicates an understatement of \$2.290 billion in the Draft Regulatory Analysis. The findings and conclusions that led to these figures are shown below in:

- Construction costs.
- Operating costs.
- Other economic impacts.

(1) Additional Construction Costs Will be \$2.062 Billion During the Period 1979-2020

Because of the proposed regulations, the barge industry will spend \$8.226 billion for construction costs instead of \$6.164 billion during the years 1979-2020. This is 134 percent of the capital needs if there were no change in the regulations. The cost of construction of an average double-hull inland barge is \$611,000, which is 41 percent more than the \$433,300 needed for a single-hull barge. An average offshore barge would increase 38 percent in cost, from \$4.2 million to \$5.8 million, for a double hull. Retrofit costs would vary from \$11 to \$44 per barrel capacity, but retrofit would generally be uneconomical compared to building a new barge.

(2) Additional Operating Costs Will be \$596 Million Over the Period 1979-2020

The proposed regulations will cost the barge industry an average of \$14.2 million per year to operate the additional barges needed to maintain operating capacity. Other potential sources of increased operating costs are more difficult to estimate. Double-hull construction will cause the loss of 4.6 percent of fleet capacity for weight-limited cargoes because of the additional weight of steel for double-hull construction. This requires 87 make-up barges and 15 towboats to push the barges. The annual

operating cost of the barges is \$2 million, and the annual operating costs, including amortized construction costs, of the towboats is \$12.2 million. The Coast Guard did not compute any cost, although it did identify the need for 90 additional barges.

(3) Other Economic Impacts That Will Result From These Regulations Are:

- The additional cost of the proposed regulation will be shared between the barge operators and their customers. Most of the additional cost of one half mill per ton-mile will be passed through to the purchaser of the transportation.
- The impact of the need for large capital borrowing will fall harder on the smaller barge operators. The costs of capital are larger for these small companies and may force some of them out of the petroleum trades and also out of the barge business.
- If smaller firms go out of business, the level of concentration of a smaller number of larger companies will increase in the oil transportation industry. Specialized services and local regions will suffer the most.

3. DIFFERENCES BETWEEN COAST GUARD AND BOOZ, ALLEN & HAMILTON COST ANALYSES

A number of differences exist between the methodologies and the results of the Booz, Allen & Hamilton analysis and the Coast Guard's Draft Regulatory Analysis. These are based on the following factors used in the Booz, Allen & Hamilton analysis:

- Expected continued construction of single-hull barges under the existing regulations.
- Higher cost differences between double- and single-hull construction.
- Nonzero construction-cost inflation.
- Higher cost of capital.
- Higher barge lifespan.
- Calculation of increased operating costs.

Figure 1 identifies the quantitative differences between the two analyses.

FIGURE 1
Table of Differences Between
Booz, Allen & Hamilton and Coast Guard Analyses

Factor	Booz, Allen & Hamilton	U.S.Coast Guard	Booz, Allen & Hamilton Percent Greater
Total Cost of			
Proposed Regulations	\$2,658 million	\$368.3 million	722
-Construction Cost	\$2,062 million	\$368.3 million	560
-Operating Cost	\$ 596 million	\$ 0	-
Increased Cost for			
Average Inland-Barge			
New Construction	\$ 178 thousand	\$ 66 thousand	270
Increased Cost for			
Average Offshore-			
Barge New			
Construction	\$1,574 thousand	\$1,020 thousand	154
Construction Cost			
Inflation	11-13 percent	0 percent	-
Cost of Capital	9-18 percent	10 percent	-
Average Barge			
Lifespan	28.3 years	20 years	142
Single-Hull Inland-			
Barge Construction			
Under Existing			
Regulations	848 barges	0 barges	-

SOURCE: Booz, Allen & Hamilton analyses

4. INFORMATION SOURCES

The information used in this analysis came from a variety of sources. They are described below according to the type of data supplied. Information was gathered concerning:

- New and retrofit construction cost and design parameters.
- Fleet life expectancy.
- Traffic statistics, costs, and rates.
- Costs and sources of capital.
- Industry concentration.

(1) Construction Costs and Designs

New construction cost information was collected from seventeen inland and four offshore barge operators who had recently built or

had received firm shipyard bids for single- and double-hull tankbarge construction. Retrofit data were collected from nine inland and two offshore operators who had recently received bids for or completed conversions. Older costs were obtained from seven inland and two offshore operators to develop an historical index of barge-construction cost inflation. Nine barge operators and four shipyards provided design data and capacity measurements of standard-size inland and off-shore barges.

(2) Fleet Life Expectancy

Two Coast Guard computer tapes of the List of Inspected Tank Barges and Tankships (CG-499) from 1974 and 1979 provided barge life expectancy information.

(3) Traffic Statistics, Costs, and Rates

Statistics of liquid bulk carriage of oil and chemicals by barge were available in the Corps of Engineers' Waterborne Commerce of the United States publications. Additionally, 33 operators from all regions of the country who serve all petroleum transportation markets by water provided proprietary traffic information to permit further statistical breakdowns of traffic into market segments that reflect equipment utilization and operator procedures. They also provided other proprietary data for their market segments describing cost elements of operations and maintenance expenses, as well as barge rates actually charged to shippers and receivers. Carrier data described petroleum transportation on the following waterways:

• Inland

- Mississippi River System.
- Gulf Intercoastal Waterway and connecting navigable channels.
- Atlantic Coast Rivers and Bays.
- Pacific Coast Rivers and Bays.
- Local port traffic.

Offshore

- Atlantic Coast.
- Pacific Coast.
- Gulf Coast.

(4) Costs and Sources of Capital

Information concerning the availability and cost of capital to various size barge operators was collected from ten barge operators, two banks, and two other financial institutions involved in providing capital and equipment to the barge industry.

(5) Industry Concentration

The January 1979 List of Inspected Tank Barges and Tankships (CG-499) provided information on the distribution of various size barge lines in the industry. One barge operator performed a major edit on the file and consolidated multiple listings for identical companies.

**ECONOMIC IMPACTS
OF
PROPOSED DOUBLE HULL
TANK BARGE REGULATIONS**

(COAST GUARD DOCKETS 75-083 AND 75-083a)





PURPOSE OF THE STUDY

**ASSESS INCREASED COSTS TO BARGE INDUSTRY FROM
DOUBLE HULL REQUIREMENT FOR TANK BARGES CARRYING
CRUDE OIL AND PETROLEUM PRODUCTS**

- **NEW BARGES BUILT AFTER DEC 31, 1979**
- **EXISTING BARGES OVER 20 YEARS BY DEC 31, 1985
(UNLESS CONVERTED)**



ECONOMIC IMPACTS (1979 TO 2020)

- **CONSTRUCTION COSTS — \$2,168 MILLION**
- **OPERATING COSTS — \$596 MILLION**
- **OTHER IMPACTS**
 - **MOST COSTS WILL PASS TO SHIPPER**
 - **SOME SMALL BARGE OPERATORS WILL QUIT**
 - **INDUSTRY WILL BE MORE CONCENTRATED**

INCREASED OPERATING COSTS

COUNTED

- MAKE-UP BARGE CONSTRUCTION
- BARGE OPERATIONS
- TOWBOAT CONSTRUCTION
- TOWBOAT OPERATIONS

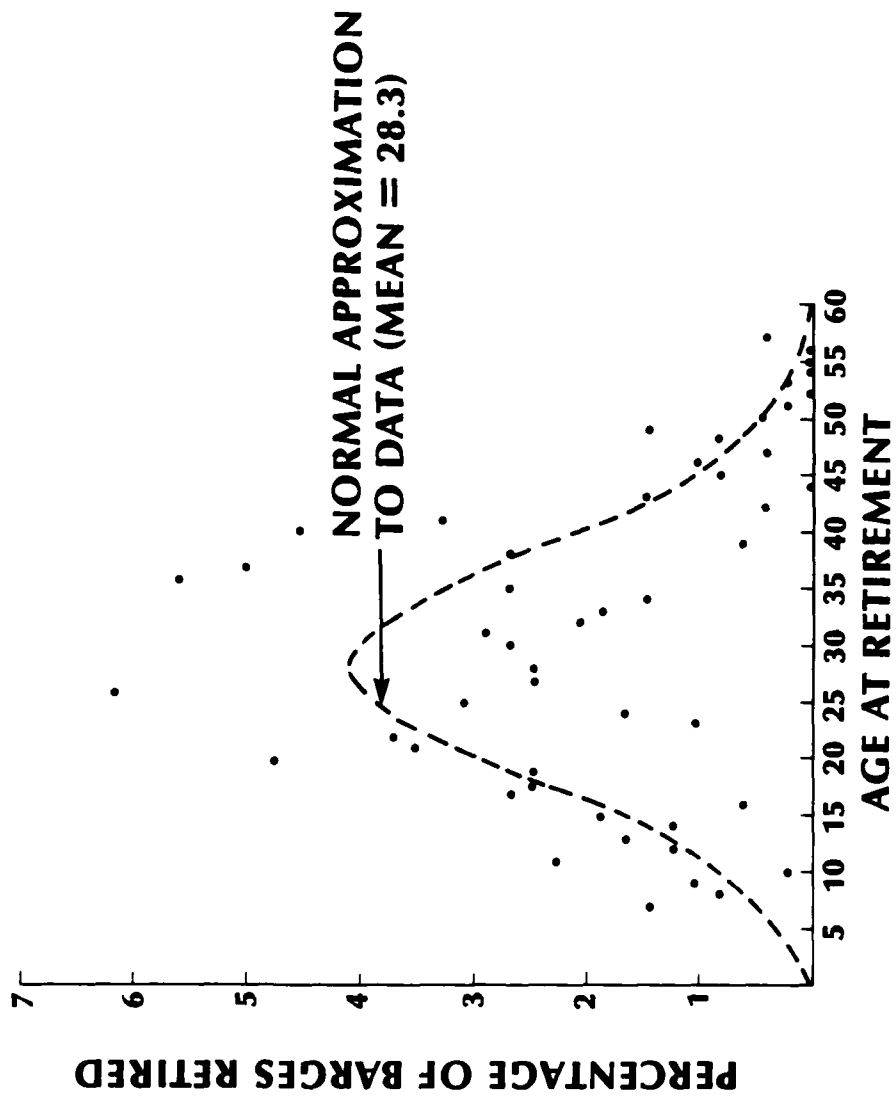
UNCOUNTED

- MANEUVERING POWER REQUIREMENTS
- INSPECTION AND MAINTENANCE
- INSURANCE

INFORMATION SOURCES

- NEW AND RETROFIT CONSTRUCTION COST AND DESIGN PARAMETERS
- FLEET LIFE EXPECTANCY
- TRAFFIC STATISTICS, COSTS AND RATES
- COSTS AND SOURCES OF CAPITAL
- INDUSTRY CONCENTRATION

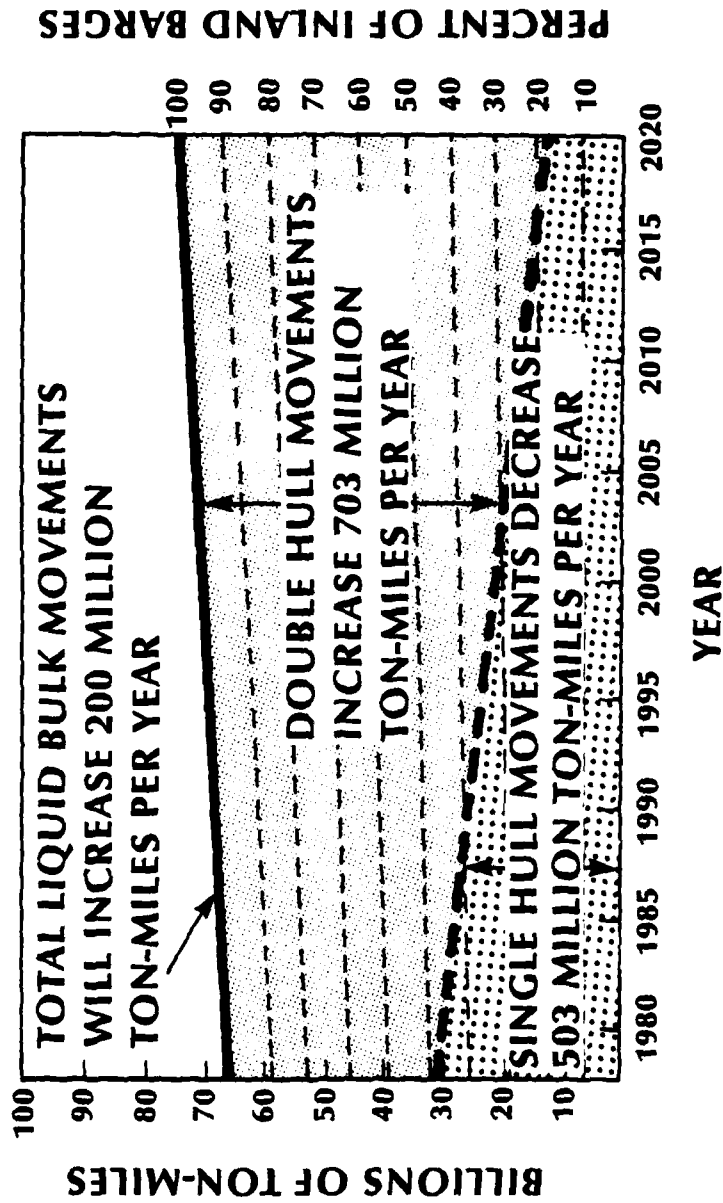
**FREQUENCY DISTRIBUTION OF PERCENTAGE
OF BARGES RETIRED FROM 1975 TO 1979
VERSUS AGE AT RETIREMENT**



INDUSTRY PREFERRED EQUIPMENT TYPE

	SINGLE HULL	DOUBLE HULL
PETROLEUM	CRUDE OIL GASOLINE JET FUEL KEROSENE DISTILLATE RESIDUAL FUEL(SOUTH)	LUBRICATING OILS NAPHTHA ASPHALT RESIDUAL FUEL (NORTH) PETROLEUM PRODUCTS, NEC
CHEMICALS		LIQUID SULFUR SODIUM HYDROXIDE CRUDE TAR PRODUCTS ALCOHOLS BENZENE AND TOLUENE SULFURIC ACID INSECTICIDES BASIC CHEMICALS, NEC

PROJECTIONS OF TON-MILES AND PERCENTAGE OF BARGES NEEDED UNDER EXISTING REGULATIONS





DATA SUMMARY

TOTAL COST OF PROPOSED REGULATIONS <ul style="list-style-type: none">● CONSTRUCTION COST● OPERATING COST	\$2,764 MILLION \$2,168 MILLION \$ 596 MILLION
INCREASED COST FOR AVERAGE INLAND BARGE NEW CONSTRUCTION	\$ 178 THOUSAND
INCREASED COST FOR AVERAGE OFFSHORE BARGE NEW CONSTRUCTION	\$1,574 THOUSAND
CONSTRUCTION COST INFLATION	11-13 PERCENT
COST OF CAPITAL	9-18 PERCENT
AVERAGE BARGE LIFESPAN	28.3 YEARS

REQUIRED FREIGHT RATES FOR CAPITAL RECOVERY



	LARGE FIRM	SMALL FIRM
CAPITAL NEEDS	(2) 240' x 50' BARGES @ \$880,000 = \$1,760,000	(2) 240' x 50' BARGES @ \$880,000 = \$1,760,000
COST OF CAPITAL	25% EQUITY @ 20% 75% DEBT @ 12% = 14%	50% EQUITY @ 20% 50% DEBT @ 16% = 18%
TERM OF LOAN	10 YEARS	15 YEARS
CAPITAL RECOVERY	1,760,000 ÷ 5.2161 = \$337,417 PER YEAR = \$ 937 PER DAY	1,760,000 ÷ 3.1272 = \$488,888 PER YEAR = \$ 1,358 PER DAY
TRANSPORTATION PROVIDED	360 DAYS ÷ 5 DAY TRIP = 72 TRIPS/YEAR @ 44,000 BBL/TRIP = 3,168,000 BBL/YEAR	360 DAYS ÷ 5 DAY TRIP = 72 TRIPS/YEAR @ 44,000 BBL/TRIP = 3,168,000 BBL/YEAR
REQUIRED RATE FOR CAPITAL RECOVERY ONLY	\$337,417 ÷ 3,168,000 = 10.65¢/BBL	\$488,888 ÷ 3,168,000 = 15.43¢/BBL

TABLE OF DIFFERENCES

	BOOZ-ALLEN	COAST GUARD
TOTAL COST OF PROPOSED REGULATIONS		
● CONSTRUCTION COST	\$2,764 MILLION	\$ 368.3 MILLION
● OPERATING COST	\$2,168 MILLION \$ 596 MILLION	\$ 368.3 MILLION 0
INCREASED COST FOR AVERAGE INLAND BARGE NEW CONSTRUCTION	\$ 178 THOUSAND	\$ 66 THOUSAND
INCREASED COST FOR AVERAGE OFFSHORE BARGE NEW CONSTRUCTION	\$1,574 THOUSAND	\$1,020 THOUSAND
CONSTRUCTION COST INFLATION	11-13 PERCENT	0 PERCENT
COST OF CAPITAL	9-18 PERCENT	10 PERCENT
AVERAGE BARGE LIFESPAN	28.3 YEARS	20 YEARS
SINGLE HULL INLAND BARGE CONSTRUCTION UNDER EXISTING REGULATIONS	848 BARGES	0 BARGES

GROUP I
CONGRESSIONAL MANDATES

STATEMENT OF SENATOR WARREN G. MAGNUSON
PRESENTED AT THE NATIONAL ACADEMY OF SCIENCES
TANKBARGE POLLUTION WORKSHOP

I have been asked to give a brief description of the Congressional mandate behind a bill I authored in 1977-78, Senate Bill 682, which became the Port and Tanker Safety Act of 1978 (PTSA), as it may relate to the proposed regulations for reducing tankbarge pollution.

In amending the Tank Vessel Act, the PTSA set forth a number of policy statements that are particularly relevant to the discussion of this workshop's subject. The Congress noted in section 5 of the Act:

"That existing standards for the design, construction, alteration, repair, maintenance, operation, equipping, personnel qualification, and manning of all such vessels which use any port or place subject to the jurisdiction of the United States or which operate in the navigable waters of the United States must be more stringent and comprehensive for the mitigation of the hazards to life, property, and the marine environment."

Barges carrying petroleum and petroleum products are clearly within the range of vessels covered; they clearly operate within the waters of concern; and they clearly fall within the ambit of the Act's policies. The Senate report specifically stated that these provisions apply "to any vessel regardless of tonnage, size or manner of propulsion; whether self-propelled or not. . . which carries, or is designed to carry, oil or any hazardous material in bulk as cargo."

A second statement of policy in the PTSA is:

"that standards developed through regulations shall incorporate the best available technology and shall be required unless clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation and vessel safety or protection to the marine environment" (which by definition specifically includes all navigable waters).

This statement of policy was regarded as very significant by Congress. The Ports and Waterways Safety Act had lacked this concept, and its absence was considered a major deficiency in the PWSA. The Congress also emphasized that in implementing the best-available-technology requirement, more than increased costs resulting from more stringent safety and pollution prevention was to be considered in the above quoted policy statement's balancing test. The Senate Report states:

"Standards developed through regulations under the Ports and Waterways Safety Act (and the Tank Vessel Act) shall incorporate the best available technology. This guiding concept is lacking in the Ports and Waterways Safety Act. In addition, any standards considered effective and necessary from the technical standpoint shall be required unless clearly shown to create undue economic hardship (not simply increased expense) which is not outweighed by environmental benefits."

Congress recognized it was directing the establishment of "stringent standards for the design, construction, equipment, maintenance, alteration, repair, operation and manning of all vessels" (S. Rept.) and that such standards were going to increase costs as part of the price for increased environmental and safety standards.

The Congress was frustrated with the Coast Guard's unwillingness to establish more stringent and effective pollution prevention and safety regulations, and this frustration was one of the major reasons for the enactment of S. 682. There can be no question that the mandate from Congress in this legislation was for more effective and stringent environmental and safety standards. Nor can there be any doubt that the standards in controversy in these proposed regulations and in this workshop are within the range of standards that Congress foresaw as resulting from the legislative mandate.

The opponents of the proposed double-hulled tankbarge requirements generally raise two principal objections: first, that the regulations impose undue costs on the tankbarge industry; and, second, that the regulations would not be nearly as effective as the Coast Guard has predicted in reducing oil pollution from tankbarges. Both of these objections are completely legitimate and proper arguments for the industry to raise in the regulatory proceedings. S. 682, as mentioned earlier, provided that as a matter of policy, such standards shall not be required if "clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation and vessel safety or protection of the marine environment."

What this provision calls for, then, is that the objections of the industry concerning both costs and effectiveness be presented in a linked, coordinated fashion. Coordination of the arguments is necessary because both arguments are key to the balancing test -- effectiveness versus undue economic impact.

Because the industry is in the best position to know the economic impact of the standards, it is incumbent that it clearly demonstrate to the Coast Guard why the Coast Guard has erred. As pointed out earlier, this showing must be more than one of simply demonstrating increased costs. Similarly, it is incumbent that the industry clearly demonstrate why the benefits to navigation, vessel safety, or protection of the marine environment that the Coast Guard states will

accrue as a result of the standards will in fact not accrue, or why these benefits are clearly outweighed by an undue economic impact. If, in the Coast Guard's judgment, these showings can be made, Congress's mandate provides that the Coast Guard will alter or withdraw the proposed standards. Similarly, environmental and other interests have the opportunity to analyze and comment on the proposed standards, their predicted impact, and the supporting data.

The mandate of the PTSA I have been asked to comment upon is thus simple. It is the implementation and the Coast Guard's decisionmaking within this broad mandate that are really at issue. The proposed double-hull requirement for tankbarges does not exceed the grant of authority S. 682 made to the Coast Guard. The controversy, which this workshop is focusing on, merely highlights the differing interests and data that come to light when an agency begins implementation of its broad mandate, particularly when that implementation will produce increased costs in a less-than-ideal economic environment.

It is true that when Congress was developing and considering the PTSA, it was focused principally on tankers and the rash of tanker accidents off our shores. Nevertheless, the Act's authority and mandate do intentionally extend to all tank vessels, including barges, whose operations take place in waters that are environmentally more sensitive than the ocean.

Anyone who tells you that the Congress did not intend that the Coast Guard impose these specific standards is simply dealing with an inadequate or incorrect knowledge of this bill's legislative history. It was not Congress's intent to impose any specific set of standards for barges -- it was, however, Congress's intent to give a broad mandate to the Coast Guard to accomplish a certain set of environmental and safety objectives. The rejoinder to the Coast Guard should not be that Congress did not intend you to do this or that; the rejoinder is to provide the Coast Guard with the data and analysis it needs to make an intelligent decision within the broad mandate it was given. And this is the issue to which this workshop could most effectively address itself.

ECONOMIC ISSUES IN TANKBARGE POLLUTION CONTROL

Norman Meade
Office of Coastal Zone Management
National Oceanic and Atmospheric Administration

I. INTRODUCTION

A strong round of protest has been heard from representatives of the tankbarge industry concerning recent proposals by the United States Coast Guard to amend existing tank vessel regulations.¹ These new proposals would require double-hull construction for all new tankbarges designed to carry oil in bulk in U.S. waters and would accelerate the normal attrition of certain single-hull tankbarges in this trade. An examination of the Regulatory Docket (CG-Docket 75-983a) reveals that an overwhelming majority of those submitting comments on behalf of industry are of the opinion that the newly proposed rules will impose an unfair financial burden on that sector. Indeed, some go so far as to allege that if the proposed tankbarge regulations are put in force, the entire U.S. inland and coastal transportation system will be adversely affected, creating the potential for disruptions of the normal flow of goods between key demand centers across the country.

The Coast Guard is proposing these regulations in compliance with legislative mandates to reduce oil pollution of our nation's waterways. In its Draft Environmental Impact Statement Regulatory Analysis (DEISRA), the Coast Guard presents detailed arguments supporting the need for these regulations.² After several years of extensive technical evaluation, the Coast Guard believes that by the year 2000 its proposals will lead to a reduction of close to 80 percent of the total volume of oil released to the environment by tankbarges as a result of hull damage.

While the Coast Guard has made some attempt to forecast the likely economic effects of the proposed regulations, it admits that its analyses probably do not reflect the full social costs of the proposed action.³ The barge industry feels strongly that a recent Booz, Allen & Hamilton study, undertaken to evaluate the impact of the proposed rules on the industry, has proven that the Coast Guard is greatly underestimating the true costs of implementing the proposed regulations.⁴ For these and other technical reasons, the Coast Guard, the domestic tankbarge industry, and others affected by these proposed rules, find themselves in heated debate over the efficacy of the proposals.

The objective of this paper is to examine the issues that have been

raised by the regulatory proposals using economic analysis as a point of departure. In particular, the following questions will be addressed:

1. What, if any, legislative requirements exist for conducting a complete accounting of the full social costs and benefits of the proposed regulations?
2. Has such a full accounting been properly undertaken?
3. If not, what additional information would be required to fulfill this need and how useful would it be?
4. What are some of the regulatory alternatives which should be investigated before final rules are promulgated?

In addressing the first question, an examination of existing law was required to determine what criteria Congress has set for evaluating impacts of proposed tankbarge pollution regulations. An analysis of these criteria clearly shows that it was Congress's intent that a full accounting of the social benefits and costs be provided before such regulations are implemented.

The second and third questions require consideration of whether the Coast Guard employed existing methods of analysis in such a way as to account for all of the social benefits and costs of its proposed actions. Given the results of the Coast Guard's several studies, and the explanations of its methods, it is not possible to weigh the technical merits of the arguments for or against the new tankbarge rules.

In order to do so, it would be necessary to implement more rigorous economic, environmental, and engineering studies than have been conducted so far. But, given the broad criteria that are available at the federal level for justifying regulatory actions such as the Coast Guard has proposed, it may not be necessary (legally) to proceed with further study prior to their implementation. However, in order to address the serious concerns of those most affected by such a decision, and to thoroughly and accurately evaluate alternative measures for achieving the stated goals of recent antipollution legislation, such studies can only be seen as highly desirable.

Alternative regulatory actions identified in addressing question four can provide important, positive incentives for compliance by those most adversely affected by the present proposed regulations. Several, perhaps less costly, alternatives exist for reaching the stated goals of the Federal Government without continued sacrifice of water quality. These alternatives include: an expansion of the 20-year cutoff period for existing single-skin barges; and incorporation of insurance actuarial schedules in the setting of insurance rates according to the actual expected accidental oil-spill risk for present

and future tankbarge structural configurations; and the use of interim rules that would require existing, single-skin barges to contain dedicated air or ballast spaces in particularly vulnerable areas of the vessel, such as in the rake and end voids.

Given the vagaries of the marketplace, the difficulty of obtaining accurate technical information, and the conflicting needs of the affected parties, it likely will not be possible to completely satisfy the requirements of all concerned. However, if all are fully apprised of the implicit economic and environmental trade-offs, it should be possible for them to reach less contentious, political resolutions of the problem.

II. LEGAL MANDATES FOR ECONOMIC ANALYSIS

Under authority of the National Environmental Policy Act (NEPA) of 1969 (P.L. 91-611) and the Port Tanker and Safety Act of 1978 (P.L. 95-474), the Coast Guard is required to undertake economic analyses of the beneficial and adverse impacts of the proposed tankbarge regulations.⁵ While not explicitly stating how the analyses should be conducted, or what their precise objectives should be, Congressional intent clearly includes requirements for examination of all of the relevant economic consequences of these types of regulatory actions and identification of who the affected parties are and to what extent they will be impacted. Further, "Principles and Standards" developed by the Water Resources Council (1973) requires not only that all water- and land-resources programs and projects be fully evaluated as to their possible economic consequences, but also that the implications for enhancing "the quality of the environment by management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems" be fully explored.⁶ These criteria have been partly addressed by the Coast Guard in the DEISRA. However, as stated in many of the letters appearing in the Docket (CG-Docket 75-9-083a), the information produced so far is not sufficient for those purposes. Despite this fact, there may be other criteria on which the Federal Government may wish to base its decisions on the matter, and for which existing information can be deemed adequate. For example, the Congress and/or the President could decide that, regardless of some of the adverse consequences of the decision, it may be preferable to proceed with implementation of the current proposals for such reasons as: redistribution of wealth; environmental preservation; securing votes; or for some other political or economic purposes. Regardless of the social and private goals of the affected parties, one must proceed under the assumption that implicit ideals embedded in the U.S. political system require an open and full evaluation of all pollution-control proposals prior to their implementation.

III. REVIEW OF EXISTING STUDIES AND METHODS

Since 1971, the Coast Guard and other federal agencies have prepared several studies of the problems involved in reducing accidental tankbarge oil pollution.⁷ Congress and the Executive Branch have concluded that tankbarge pollution can be controlled through a combination of methods, including the proposed new equipment standards. However, the Coast Guard has indicated in the DEISRA that various alternatives are still under consideration with respect to existing barges and the most efficient way to impose new requirements on them.

In the recent report submitted by Booz, Allen & Hamilton, and as brought out by recent industry comments, there is a great deal of misunderstanding and disagreement over such basic questions as: (1) what are the true social costs to be borne by the U.S. public and what will the effects be on individual sectors of the economy, including final consumers; (2) are there ways in which the economic burden can be more desirably shared among those beneficially and adversely affected; (3) what are the most economically efficient ways of attaining the intended goals of the regulations; and (4) what are the full societal benefits, and to which groups and individuals will they flow and in what amounts? It is not within the scope of this paper to assess thoroughly the quality and quantity of the data and conclusions submitted by the various parties debating these issues. Rather, the responsibility for undertaking such a formidable and important task can best be given to a carefully selected, objective group of experts with a good deal of resources and time to devote to the problem. I can only conclude, and I believe this would hold for most of my professional colleagues, that the evidence I have seen does not convince me of the correctness of the positions of any of the parties to this debate. One cannot begin to derive scientifically based results using poorly documented conclusions, incomplete data, and ill-stated assumptions.

From an analytical point of view, there is less than an adequate basis for reasonably evaluating the risk of pollution under various mixes of equipment, watchkeeping, piloting, enforcement, and penalty standards. This inadequacy has more to do with the lack of technical data than with any significant problems with methodological procedures available to perform the analyses. For substantially the same reasons, one is not able to perform adequate forecasts of the likely economic impacts. In both cases, however, further development of more practical modeling techniques may eventually lead to a greater ability to use incomplete data sets more effectively.

IV. CONCLUSIONS

Strong political forces are at work in an attempt to influence the decisions to be made during the coming months concerning tankbarge-pollution control. It is incumbent upon all parties to the

decisionmaking process to produce the best available, factual information possible, which will help in turn to insure that a truly rational decision, contributing positively to overall societal welfare, is taken.

It is my hope that under the auspices of the present regulatory project evaluation being conducted by the National Academy of Sciences, a proper definition of the problem and a range of possible solutions will be developed to allow for a timely set of decisions on this matter. At the same time, serious consideration should be given to improving the system of regulatory analysis which governs the conduct and quality of the research undertaken by the Coast Guard. The current fragmentation and lack of consistent criteria for evaluating these and other, similar regulatory actions not only waste scarce public resources, but add unnecessary costs in the private sector as well. If we are to meet reasonable and not necessarily mutually exclusive goals of insuring economic prosperity and environmental quality for this and future generations, a way must be found soon to reduce further, divisive controversy between the regulators and the regulated.

NOTES

- 1 Federal Register, Vol. 44, No. 116, (pp. 34440-34446), Washington, D.C., June 14, 1979.
- 2 U.S. Department of Transportation, U.S. Coast Guard, Draft Environmental Impact Statement Regulatory Analysis, Washington, D.C., September, 1979.
- 3 Ibid, pp. 42-65.
- 4 Booz, Allen & Hamilton, Economic Impact of Tank Barge Standards, Bethesda, Maryland, September 14, 1978.
- 5 U.S. House of Representatives, Committee on Merchant Marine and Fisheries, Port Tanker and Safety Act of 1978 -- Minority Report, Washington, D.C., July 21, 1978.
- 6 Water Resources Council, "Water and Related Land Resources, Establishment of Principles and Standards for Planning," Federal Register, Vol. 38, No. 174 (pp. 24778-24869), Washington, D.C., September 1973.
- 7 For example, see the following studies: U.S. Coast Guard and Maritime Administration, Tank Barge Study, Washington, D.C., October 1974; Bender, Avi, Gerald G. Brown, Jr. and Joseph M. Rosenbusch, Tank Barge Pollution Study, Automation Industries, Inc., Bethesda, Maryland, February 1978; and Johnson E.K. (LCDR), U.S. Guard Implementation of Presidential Initiative For An Evaluation of Design, and Equipment Standards for Tank Barges Which Carry Oil, U.S. Coast Guard, Washington, D.C., August 1978.

ENVIRONMENTAL AND ECONOMIC DISCUSSION OF THE NEED
AND JUSTIFICATION OF CONVERTING EXISTING SINGLE-HULL-BARGE
OIL TRANSPORTATION TO DOUBLE HULL

Carl H. Oppenheimer
Marine Biologist, Consultant

The conversion from single- to double-hull barge transportation in the navigable waters of the United States will impose a burden on our present energy and financial resources and balance. Therefore, before any action is taken to require all oil to be transported in double-hull barges, it is pertinent to examine the large data base on the environmental aspects of past oil accidents arising from single-hull barges and compare these data with the estimated savings for cleanup and the cost of conversion.

In 1976 there were 15 large oil spills reported that were caused by barge-hull damage in the 25,500 miles of waterways of the United States. Of these, eight were between 1 and 10 thousand gallons, three were between 10 and 100 thousand gallons, and four were more than 100 thousand gallons. The spills could not be predicted and did not occur twice in the same area. The public is the ultimate user of U.S. oil at a rate of approximately 16 million barrels a day. Oil spills are due to human error or mechanical failure. Therefore, members of the public must assume some responsibility for the fact that oil spills may occur in their backyards. The present status of the environmental effects of oil pollution relative to the need for change in pollution-abatement intensity is discussed later in this paper.

It is obvious that all oil pollution cannot be eliminated. The cost per a reduction unit (i.e., a barrel not spilled) will increase exponentially with an increase in oil-pollution-reduction effort (i.e., the percent reduction in total oil spilled). Therefore, an environmental evaluation must contain some estimate of total funding available relative to the percentage of oil-spill reduction required for environmental protection. As the barge-hull accidents provide between 2 and 8 percent of all oil estimated to be released to the aquatic environment of the United States, the barge-spill reduction potential will be a minor part of the total. This factor must be evaluated along with the present cost of spill prevention, including schools, regulation, equipment, runoff, fines, cleanup, etc.

At a time when our economy is changing, energy resources are in competition throughout the world, and predictions and projections of energy and economy changes are numerous and varying, we must assess any projected change that may impact our balance of energy in the future. In plain terms, we must relate our future activities to energy to avoid

any unnecessary burdens on our society. It is in this context that I would like to address the question at hand.

Various sources of data describing our energy balance are available from Exxon, Chase Manhattan Bank, the Council on Environmental Quality Report-1979, the Harvard Business School book, "Energy Future," etc. An analysis of these data adjusted to oil-import limitations (President Carter's 1979 Energy Address), indicate a projected lessening dependence on oil in the future.

Other presentations will cover engineering and cost analysis required for the conversion. Some of the points covered are pertinent to the following comparison of costs and environmental impact.

The United States Gross National Product (GNP) can be directly related to the consumption of Btu's as shown in Figure 1. While we have become more efficient in dollar/energy aspects, the table shows a leveling off in the past few years at about 60,000 Btu's for a 1972 dollar. Table 1 shows how the energy is used. Transportation energy is projected to remain stable at 1978 levels. Some 47 percent of the total Btu's used in 1978 originated from oil.

The President's 1979 energy address recommending import levels makes it obvious that unless some alternate form of energy is immediately available, oil will continue to be transported at past levels within the United States. Contrary to the intent of Congress to stop all oil pollution in our inland waters by 1985, oil pollution cannot be eliminated without stopping oil transportation and use. While this latter is the only alternative to absolute oil-pollution control, it obviously cannot be achieved because of current dependence on oil and because the development of alternate energy resources can only be accomplished using existing energy resources.

Figure 1 says essentially that each 1972 dollar of GNP is equivalent to 55,000 to 65,000 Btu's. As the GNP includes all forms of currency exchange, from welfare to income and profit, Figure 1 shows a valid measure of the relationship between dollars circulated and Btu's used. Thus, any future dollar expenditure, such as discussed for barge transportation or, more seriously, for alternate energy sources, can be related to energy directly. The major source of our energy is fossil deposits, and 60,000 Btu's per dollar is equivalent to half a gallon of gasoline per dollar of GNP.

These GNP/Btu data can be used to calculate the energy required for the conversion to double-hull barges. Industry estimates for this purpose a total cost of \$2.8 billion, which is equivalent to 29 million barrels of oil. The Draft Environmental Impact Statement (DEIS) values for the conversion were \$368 million or the equivalent of 3.8 million barrels of oil. One might ask where such energy is going to come from in our projected energy future.

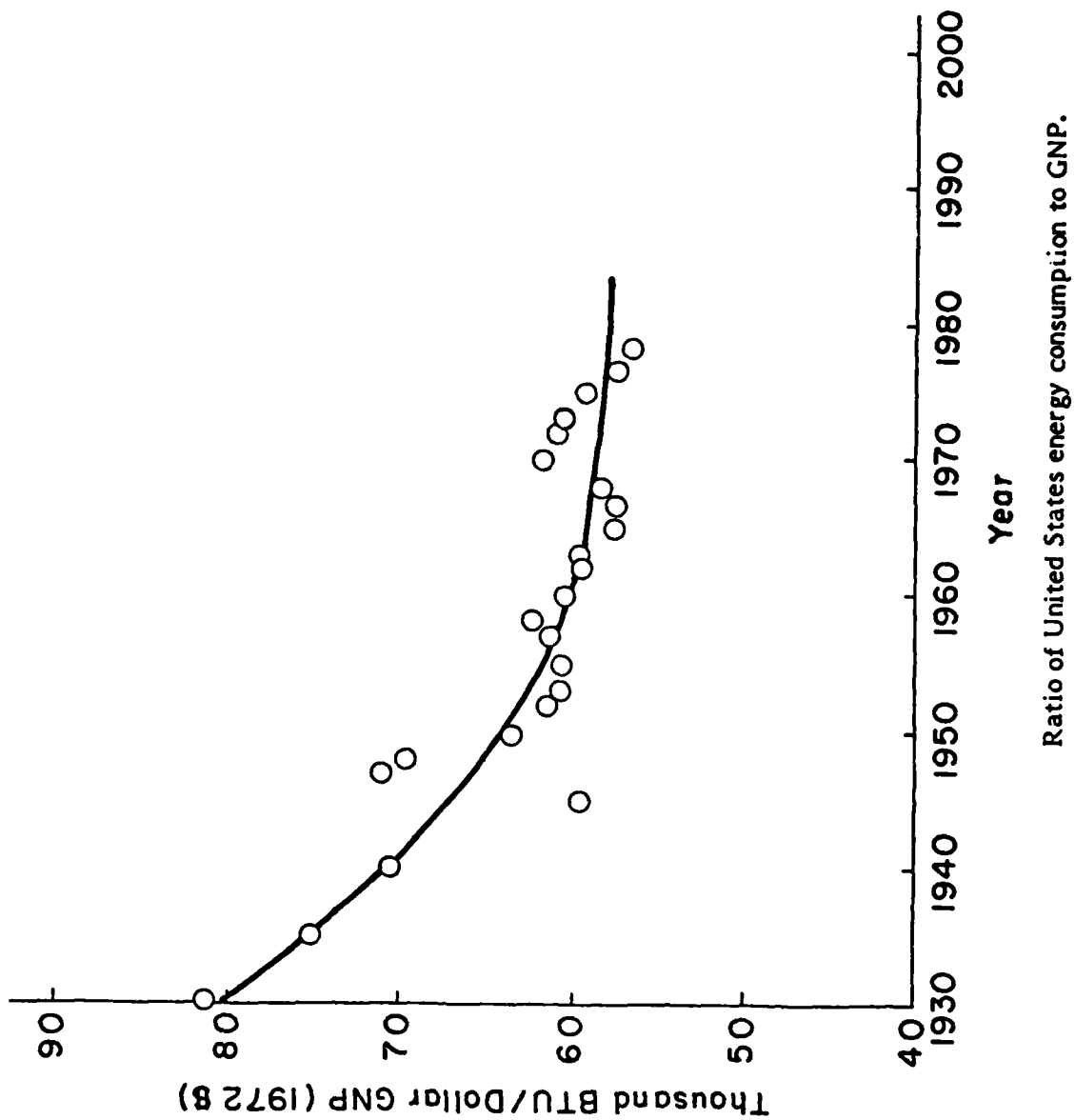


Figure 1. Ratio of GNP to BTUs for the United States, 1930 to 1980 at 1972 dollars.

From Council on Energy Resources, Univ. Texas Austin. National Energy Policy Issues, June 1979

Table 1.

United States Energy Consumption.
quadrillion Btu

<u>Year</u>	<u>Total</u>	<u>Non-fuel</u>	<u>Residential</u>	<u>Commercial</u>	<u>Industrial</u>	<u>Transportation</u>
1960	44.6	2.2	9.7	4.5	17.3	10.8
1965	53.3	2.6	11.6	6.0	20.4	12.7
1970	66.9	3.9	14.5	7.9	24.3	16.3
1973	74.6	4.5	16.1	9.2	26.1	18.7
1975	70.6	3.8	16.2	9.3	23.2	18.1
1978	78.0	4.4	18.0	10.6	24.7	20.6
1980	80.1	4.6	17.5	10.2	26.8	21.0
1985	81.9	5.0	16.1	10.1	30.2	20.5
1990	85.5	5.6	16.7	10.3	32.9	20.0
2000	101.2	7.3	17.9	10.7	44.3	21.0

From Council on Energy Resources, Univ. Texas, Austin.
National Energy Policy Issues, June 1979

Economic constraints on oil transportation, as already presented in other testimony, in terms of construction and transportation costs should be related directly to energy consumption, energy resources, and need.

There is a difference of opinion as to whether double hulls will significantly decrease hull-damage oil spills. The Coast Guard estimated the reduction to be 85 percent (MARAD/USCG Tank Barge Study, October 1974), while industry suggests it may be approximately 20 percent (report of E. G. Frankel, 1979). In 1977, approximately 1,242,000 gallons (29,571 barrels) of oil or oil products were spilled in U.S. waters by single-hull accidents. This figure represents 28 accidents (DEIS App. D).

A comparison of 1972 and 1977 hull-spill data indicates that along with the larger amount of oil consumed in this country in 1977, the spill rate decreased from 1,769,000 gallons in 1972 to 1,242,000 in 1977 (DEIS data). The 1972 spill data are probably conservative because more effective spill reporting was developed in the interim.

An 85 percent reduction applied to the DEIS value would result in 186,353 gallons of oil released to the environment. If the Frankel-report reduction of 20 percent is used, the spill volume would be 993,600 gallons. It is significant that the reduction of either 85 percent or 20 percent is minor as related to the 16.9 million gallons of oil and related material reported spilled in the United States from all causes in 1974 (Table 2) and the 1.66 billion gallons spilled in the world (Table 3).

The critical point to discuss, regardless of economic and engineering arguments relating to single- vs. double-hull barges, is whether past operations and accidental spills due to hull damage have caused significant damage to the environment.

A review of the large volume of general literature on the biological effects of oil, which was stimulated in this country by the Santa Barbara incident, shows that a great difference of reported results exists between laboratory and field experiments. Laboratory experiments indicate toxic effects of oil at varying concentrations generally exceeding the physical dissociation phenomenon of oil. Oil, being hydrophobic, goes into the water with difficulty, and the physical-chemical aspects may be easily fractionated. The following example illustrates a problem area.

Table 4 shows the composition of several types of crude oil, and Table 5 shows the solubility in water of various compounds in the oil. The aromatic compounds on the right sides of the two tables are much more soluble than the other compounds. As these more soluble compounds are more toxic, the data are significant to interpretation. If one takes, as is normally done in crude-oil-toxicity experiments, even volumes of oil and water, mixes them, and then utilizes the soluble

Table 2

TYPE OF MATERIAL DISCHARGE, 1974

	<u>Number of incidents</u>	<u>% of total</u>	<u>Volume in gallons</u>	<u>% of total</u>
Crude oil	3,639	26.0	9,028,262	53.0
Gasoline	545	4.0	1,045,603	6.0
Other distillate fuel oil	322	2.0	1,824,130	11.0
Solvent	44	0.0	13,114	0.0
Diesel Oil	1,833	13.0	1,120,862	7.0
Asphalt or residual fuel oil	1,127	8.0	1,908,752	11.0
Animal or vegetable oil	57	0.0	27,316	0.0
Waste oil	1,094	8.0	111,900	1.0
Other oil	2,774	21.0	728,497	4.0
Liquid chemical	222	2.0	913,027	5.0
Other pollutant (Sewage, dredge, spoil, chemical wastes, etc.)	162	1.0	31,792	0.0
Natural Substance	105	1.0	1,528	0.0
Other Material	199	1.0	104,709	1.0
Unknown material	<u>1,843</u>	<u>13.0</u>	<u>56,816</u>	<u>0.0</u>
TOTAL	13,966	100.0	16,916,308	100.0

Data for Waters of the United States. Source. Boyd, B.D. et.al. 1976. The statistical picture regarding discharges in and around the United States Waters. In Sources, Effects and Sinks of Hydrocarbons in the Aquatic Environment, AIBS Symposium, August 1976, pp 37-53

Table 3

BUDGET OF PETROLEUM HYDROCARBONS ENTERING THE OCEAN*

SOURCE: INPUT RATE (mta)

	<u>Best Estimate</u>	<u>Probable Range</u>
Man-Made:		
Marine Transportation		
LOT Tankers	0.31	0.15 - 0.4
Non-LOT Tankers	0.77	0.65 - 1.0
Dry Docking	0.25	0.2 - 0.3
Terminal Operations	0.003	0.0015 - 0.005
Bilges/Bunkering	0.5	0.4 - 0.7
Tanker Accidents	0.2	0.12 - 0.25
Non-Tanker Accidents	<u>0.1</u>	0.002 - 0.15
TOTAL	2.1	
River Runoff		
Atmospheric Rainout	1.6	-----
Urban Runoff	0.6	0.4 - 0.8
Coastal Municipal Wastes	0.3	0.1 - 0.5
Coastal (Non-Refining)	0.3	-----
Industrial Wastes	0.3	-----
Coastal Refineries	0.2	0.2 - 0.3
Offshore Production	0.008	0.08 - 0.15
Natural:		
Offshore Seeps	<u>0.6</u>	-----
GRAND TOTAL	6.113	

Source: Sources, Effects and Sinks of Hydrocarbons in the Aquatic Environment. 1976.

Table 4

Physical characteristics and chemical properties of several crude oils

Characteristic or component	Crude oil		
	Prudhoe Bay ^d	South Louisiana ^b	Kuwait ^b
Aromatics (wt)	25.0	16.5	21.9
Benzene	7.0	3.9	4.8
Indane and tetralins	-	2.4	2.2
Dinaphtho benzene	-	2.9	2.0
Naphthalenes	9.9	1.3	0.7
Acenaphthenes	-	1.4	0.9
Phenanthrenes	3.1	0.9	0.3
Acenaphthalenes	-	2.8	1.5
Pyrenes	1.5	-	-
Chrysenes	-	-	0.2
Benzochlaphenes	1.7	0.5	5.4
Dibenzochlaphenes	1.3	0.4	3.3
Indanochlaphenes	-	-	-
Polar material ^g (wt)	2.9	8.4	17.9
Insoluble ^g (wt)	1.2	0.2	3.5

These analyses represent values for one typical crude oil from each of the geographical regions; variations in composition can be expected for oils produced from different formations or fields within each region.

^a Adapted from Thompson et al. [21] and Coleman et al. [26].

^b From Pancirov [25].

^c Fraction boiling from 20° to 205°C.

^d Reported for fraction boiling from 20° to 150°C.

^e Fraction boiling above 205°C.

^f Reported for fraction boiling above 220°C.

^g Prudhoe Bay crude oil weathered two weeks to duplicate fractional distillation equivalent to approximately 205°C n-

percent from gas chromatography over the range C₁₁ to C₃₂ plus for the Prudhoe Bay crude oil sample only. Unpublished data (R.C. Clark, Jr.)

^h Polar material: Clay-gel separation according to ASTM method D-2007

ⁱ Insolubles: Pentane-insoluble materials according to ASTM method D-893

[10; part 23].

Characteristic or component	Crude oil		
	Prudhoe Bay ^d	South Louisiana ^b	Kuwait ^b
API gravity (20°C) (°API)	27.8	34.5	31.4
Sulfur (wt)	0.94	0.25	2.44
Nitrogen (wt)	0.23	0.69	0.14
Nickel (ppm)	10	2.2	7.7
Vanadium (ppm)	20	1.9	28
Naphtha fraction ^c (wt)	23.2	18.6	22.7
Paraffins	12.5	8.8	16.2
Naphthenes	7.4	7.7	4.1
Aromatics	3.2	2.1	2.4
Benzene	0.3 ^d	0.2	0.1
Toluene	0.6	0.4	0.4
C ₈ aromatics	0.5	0.7	0.8
C ₉ aromatics	0.06	0.5	0.6
C ₁₀ aromatics	-	0.2	0.3
C ₁₁ aromatics	-	0.1	0.1
Indane	-	-	0.1
High-boiling fraction ^e (wt)	76.8	81.4	77.3
Saturates	14.4 ^f	56.3	34.0
n-paraffins	5.8 ^g	5.2	4.7
C ₁₁	0.12	0.06	0.12
C ₁₂	0.25	0.24	0.28
C ₁₃	0.42	0.41	0.38
C ₁₄	0.50	0.56	0.44
C ₁₅	0.44	0.54	0.43
C ₁₆	0.50	0.58	0.45
C ₁₇	0.51	0.59	0.41
C ₁₈	0.47	0.40	0.35
C ₁₉	0.43	0.38	0.33
C ₂₀	0.37	0.28	0.25
C ₂₁	0.32	0.20	0.20
C ₂₂	0.24	0.15	0.17
C ₂₃	0.21	0.16	0.15
C ₂₄	0.20	0.13	0.12
C ₂₅	0.17	0.12	0.10
C ₂₆	0.15	0.09	0.09
C ₂₇	0.10	0.06	0.06
C ₂₈	0.09	0.05	0.06
C ₂₉	0.08	0.05	0.05
C ₃₀	0.08	0.04	0.07
C ₃₁	0.08	0.04	0.06
C ₃₁ plus	0.07	0	0.06
Isoparaffins	-	14.0	13.2
1-ring cycloparaffins	9.9	12.4	6.2
2-ring cycloparaffins	7.7	9.4	4.5
3-ring cycloparaffins	5.5	6.8	3.3
4-ring cycloparaffins	5.4	4.8	1.8
5-ring cycloparaffins	-	3.2	0.4
6-ring cycloparaffins	-	1.1	-

Table 5

Solubility of petroleum hydrocarbons in water

Compound	Carbon number	Solubility ^a (ppm)	Reference
PARAFFINS			
Methane	1	24	47
Ethane	2	60	47
Propane	3	62	47
<i>n</i> -Butane	4	61	47
<i>n</i> -Pentane	5	39	47
<i>n</i> -Hexane	6	9.5	47
2-Methylpentane	6	13.8	47
3-Methylpentane	6	12.8	47
2,2-Dimethylbutane	6	18.4	47
<i>n</i> -Heptane	7	2.9	47
<i>n</i> -Octane	8	0.66	47
<i>n</i> -Nonane	9	0.220	48
<i>n</i> -Decane	10	0.052	48
<i>n</i> -Undecane	11	0.0041	48
<i>n</i> -Dodecane	12	0.0037	49
		0.0029 (SW)	
<i>n</i> -Tetradecane	14	0.0022	49
		0.0017 (SW)	
<i>n</i> -Hexadecane	16	0.0009	49
		0.0004 (SW)	
<i>n</i> -Octadecane	18	0.0021	49
		0.0008 (SW)	
<i>n</i> -Eicosane	20	0.0019	49
		0.0008 (SW)	
<i>n</i> -Hexacosane	26	0.0017	49
		0.0001 (SW)	
<i>n</i> -Triacontane	30	0.002	2
<i>n</i> -Heptacontane	37	10 ^{-6b}	50

Compound	Carbon number	Solubility ^a (ppm)	Reference
CYCLOPARAFFINS			
Cyclopentane	5	156	47
Cyclohexane	6	55	47
Cycloheptane	7	30	47
Cyclooctane	8	7.9	47
AROMATICS			
Benzene	6	1,780	47
Toluene	7	515	47
<i>o</i> -Xylene	8	175	47
Ethylbenzene	8	152	47
1,2,4-Trimethylbenzene	9	57	47
<i>iso</i> -Propylbenzene	9	50	47
Naphthalene	10	31.3	51
		22.0 (SW)	
1-Methylnaphthalene	11	25.8	51
2-Methylnaphthalene	11	24.6	51
2-Ethyl-naphthalene	12	8.00	51
1,5-Dimethylnaphthalene	12	2.74	51
2,3-Dimethylnaphthalene	12	1.99	51
2,6-Dimethylnaphthalene	12	1.30	51
Biphenyl	12	7.45	51
		4.76 (SW)	
Acenaphthene	13	3.47	51
Phenanthrene	14	1.07	51
		0.71 (SW)	
Anthracene	14	0.075	2
Chrysene	18	0.002	2

^a In distilled water, except where noted by (SW), indicating filtered seawater, usually corrected to a salinity of 35‰ (parts per thousand); ppm = parts per million - micrograms per gram.

^b Extrapolated.

portion for toxicity tests, one can interpret from the solubility data obvious concentration factors. It should be noted, however, that oil spilled in the environment is immediately subject to dilution, flushing, evaporation, etc., which make it difficult to relate laboratory experiments to environmental conditions. This and other factors may account for the difference in toxicities reported from laboratory experiments and from recovery of environmental spills.

In contrast to the laboratory experiments, are reports on effects of various spills in nature. The fate and effects of oil in the environment for specific spills are reviewed in four recent reports: Effects of Petroleum on Arctic and Subarctic Marine Environments, Vols I and II, edited by Malins, 1977; Conference on Oil Spills sponsored by EPA, API, and USCG, 1977; Conference on Ecological Impacts of Oil Spills, AIBS, 1978; and an API release, Oil and the Sea, 1979. These reports provide an overview of the ecological impacts of the major oil spills since 1969. In general, they cover spills such as the San Francisco spill of 1971, the Argo Merchant of 1976, NEPCO Barge 140 of 1976, Bouchard Barge 165 of 1977, Sansinena of 1976, and Ekofisk of 1977, etc. All these reports indicated that little or no long-lasting ecological effect from the oil spills could be detected. No data for immediate change in the regional fisheries were included.

Interpretation of the data base on laboratory and natural environmental effects of oil and oil products must be carefully developed. In some instances, such as Santa Barbara (1969), Falmouth Bay (1969), Tampico Maru (1957), San Francisco (1971), and Arrow (1970), 10 years of investigations -- at first concentrated and later sporadic -- were conducted. As of the present time, no one has summarized the data on the short- and long-term effects, nor has much effort been made to evaluate the present status of the areas relative to the spills. The numerous reports on the spills that have appeared clearly indicate that the communities of organisms were actively restoring or had already restored themselves. The restored community was not always identical to the original, if the latter was on record. However, there may have been other environmental changes influencing community structure during the interim. In general, productivity and distribution of organisms indicated environmental balance. Kerr (1977) briefly discusses the return of biological communities to normal after major oil spills.

In almost all publications, however, the scientists, while indicating return to environmental balance with time, state that because they could not find acute, long-lasting effects, further study was needed.

Because of the uncertainty and contrasting opinions of the scientific community, one must turn to the environment for the answers. There is sufficient data from all sources to use the natural laboratory to determine cause-and-effect relationships. If one assumes that our navigable waters are continually influenced by weather

changes, land modification, water modification, and nutrient balance, etc., then the only criterion that may demonstrate an overall balance of the system is fish yield. These data would normalize variations of species and the food web by natural and man-made perturbations and the accommodation of species to the changes. An examination of commercial fish yields at various trophic levels will thus indicate an end result of all food-chain alteration in the system.

For example, an evaluation of the species composition and yield of the Corpus Christi Bay system commercial fishes, shows fluctuations in pounds per species, while the total number of species and the yield remain relatively stable, indicating that no major man-induced impacts have occurred. Thus, the total yield can be a significant indicator of continual environmental balance as related to man's impacts on the environment. In some areas in this country, such as the Hudson River estuary or Lake Erie, the destruction of the aquatic system by man's careless use of water is obvious.

The above logic can be applied to the understanding of environmental perturbations caused by oil spills and oil activities. There is no question as to the immediate impact of some oils. This is well documented. However, one must relate such information to natural fluctuations of populations and seasonal changes as affecting the yield of a system. Unfortunately, the effect of environmental change on total annual sustained fish yield has been either not significant or not studied. Well documented records of the commercial catch by region are available from the National Oceanic and Atmospheric Administration (NOAA). These records can be used to indicate the regional impact of oil spills.

Rather than enter into a lengthy discussion of the pros and cons of available data, how the data were obtained, and the ecological significance of laboratory experiments with hydrocarbons, which is a study in itself, we may ask the environment of an oil-exposed system for answers. The estuaries of Texas and Louisiana are some of the most productive areas in the world, on a per-acre basis, according to fisheries statistics from NOAA and the Food and Agriculture Organization (FAO). In addition, they are the sites of crude-oil production, petrochemical plants, and ports. There are good NOAA data on fish yield since 1962.

Galveston and Corpus Christi ports and waterways produce and transport a large percentage of the oil used in the United States. Both bays have had active oil fields for the past 30 or more years, and adjacent upland areas have been in production since 1917 with associated runoff to the bay systems. This area, then, would constitute a good area to evaluate for potential long-term oil-pollution effects. By analogy, one can estimate the short- and long-term effects of oil activities, including barge transportation, and extrapolate the findings to areas of lesser oil exposure. There is a question of temperature effects on the fate and effects of oil in

northern areas as related to Texas and Louisiana which are in a temperate zone. An analysis of the literature on long-term effects of oil on northern environments is not conclusive relative to fish yield in the system or to whether the effects can be environmentally significant to specific species after cleanup and after up to 10 years of time. Thus, it would seem that the environmental comparison using Corpus Christi and Galveston Bays could be significant.

In 1977, the Port of Corpus Christi reported that approximately 330 million barrels of oil and oil products were imported or exported through the bay system. During 1977, 209 thousand barrels of crude oil were produced from wells in the bay system. During the same year, the Corps of Engineers reported in Waterborne Commerce of the U.S. that 731 million barrels were moved in the Galveston Bay area. In 1977, 3.8 million barrels of crude oil were produced. This represents 1 billion barrels or approximately 5 percent of the crude oil produced in and imported to the United States in 1977. "Energy Future" reported that 18.4 billion barrels of oil were used in this country in 1977, or approximately 39 percent of total world consumption.

The total fish yields for Corpus Christi and Galveston Bays for 1974 were estimated by Bowman, et al., to be 154 and 241 pounds per acre per year, which, when related to nutrient input, is near the capacity of the natural system. NOAA data for commercial fish catch for the Corpus Christi-Aransas Bay system are shown in Table 6. There is no indication of decline that could be related to oil operations. The total yield is high, and the leveling off of catch, as related to seasonal variations, indicates that the bays are near optimum yield. Similar data are available for Galveston Bay commercial fish catch.

The Louisiana coast is known for its fish and shellfish yield, but at the same time has maintained substantial coastal oil production. Fish-catch statistics (Table 7) indicate a high, stable yield, while oil production continues to increase. Offshore oil production increased from 25 million barrels per year in 1954 to 500 million barrels in 1972.

Coast Guard records for 1973-1976 in Corpus Christi Bay provide a histogram (Figure 2) of the number of spills versus the sizes of spills reported during that period. These data indicate that Corpus Christi Bay spills are of the same order of magnitude as those reported in the DEIS for other areas of the U.S.

Thus, the environmental evaluation of Corpus Christi Bay may be related to the short- and long-term environmental effects of spills for other areas of the country. This substantiates the information in the report by Malins (1977) on arctic and subarctic environments, which indicates that no long-term effects of oil on such environments could be demonstrated. As the data in Malins (1976) are based on studies of oil impacts on natural environments, these data are significant to any comparison between Corpus Christi and more northern, colder environments. Such data may also be supported by the findings after the Bravo 1977 spill in the North Sea, where short-term environmental effects were reported only near the platform.

Table 6

TOTAL LANDINGS OF FISH AND SHRIMP
AND OTHER SHELLFISH
IN
CORPUS CHRISTI - NUECES and ARANSAS - COPANO BAYS
1962 - 1976
(In thousands of pounds)

Year	Corpus Christi - Nueces Bays					Aransas - Copano Bays					C.C. - Nueces & Aransas-Copano Bays Total
	Fish	Shrimp		Other Shellfish	Total	Fish	Shrimp		Other Shellfish	Total	
		White	Brown				White	Brown			
1962	77	197	116	83	473	1,094	250	196	1,608	3,148	3,621
1963	78	96	95	46	315	866	279	77	126	1,348	1,663
1964	56	243	52	1	352	552	592	182	113	1,439	1,791
1965	59	227	227	113	626	551	723	223	40	1,537	2,163
1966	81	470	107	1	739	469	321	483	20	1,293	2,032
1967*	251	343	172	0	766	328	252	236	159	975	1,741
1968	114	634	0.6	0	748	510	1,737	13	205	2,465	3,213
1969	92	239	89	152	572	728	573	163	767	2,231	2,803
1970*	113	207	139	0	459	430	1,068	259	999	2,756	3,215
1971	217	84	19	100	420	626	344	79	622	1,671	2,091
1972	317	397	54	70	838	684	1,073	136	1,401	3,294	4,132
1973	627	850	372	41	1,890	719	994	877	1,282	3,872	5,762
1974	746	320	155	327	1,548	690	706	211	1,089	2,696	4,244
1975	664	531	400	127	1,722	720	625	559	905	2,809	4,531
1976	554	396	341	124	1,415	1,148	609	475	1,325	3,568	4,983
1977	<u>535</u>	<u>568</u>	<u>739</u>	<u>103</u>	<u>1,945</u>	<u>662</u>	<u>1,781</u>	<u>474</u>	<u>2,310</u>	<u>5,227</u>	<u>7,172</u>
Total	4,581	5,802	3,157	1,288	14,828	10,777	11,927	4,643	12,982	40,329	55,157
16 Year Average	286	363	197	81	927	674	745	290	811	2,520	3,447

*Hurricanes

From NOAA - Texas Landings

SIZE OF SPILL

Total of all Substances
291,794 gal. — 37 months
(USGS)

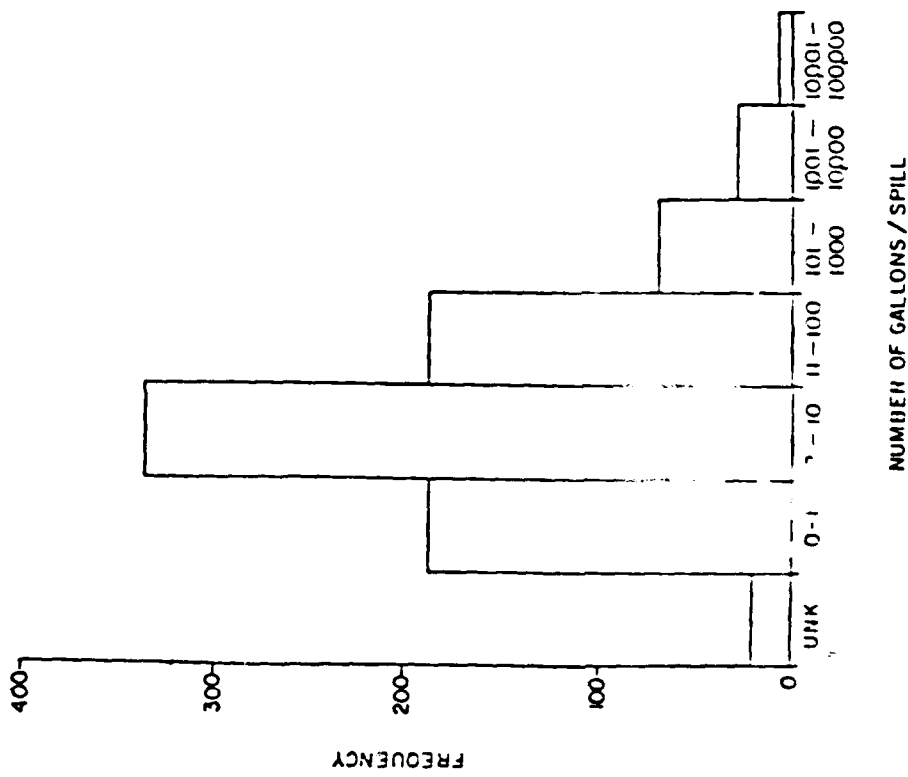


Figure 2. Corpus Christi Oil Spill Events 1974-76.

Source: Oppenheimer, C.H. et.al. 208 Waste Loading, Corpus Christi Bay; Task 2.2.3, Water Quality Baseline, 1978.

AD-A096 126

NATIONAL RESEARCH COUNCIL WASHINGTON D C MARITIME TRA--ETC F/6 13/2
WORKSHOP ON REDUCING TANKBARGE POLLUTION. APRIL 15-16, 1980.(U)
AUG 80 N00014-75-C-0711

UNCLASSIFIED

NL

Copy
to
be
made

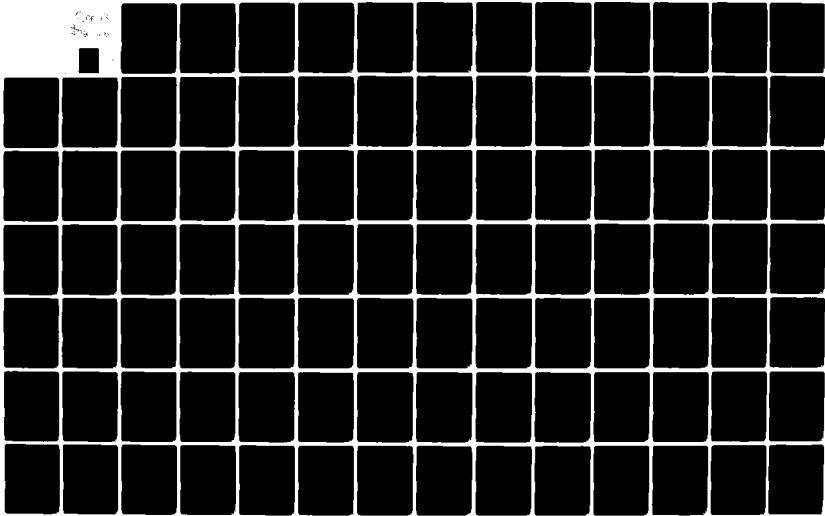


TABLE 7

Louisiana Annual Total Commercial Fish and Shellfish
Catch in Million Pounds. NOAA Data

<u>Year</u>	<u>Catch</u>
1961	731
1962	748
1963	741
1964	648
1965	787
1966	638
1967	602
1968	755
1969	1,003
1970	1,104
1971	1,367
1972	1,051
1973	1,031
1974	1,223
1975	1,116
1976	1,195
1977	897 (Menhaden not included)
1978	1,655

One of the items used in the DEIS to justify double-hull barges is potential reduction of cleanup costs. Data from the DEIS and the Frankel report indicate that the cleanup saving due to double-hull conversion is considerably less than the conversion-cost equivalent. The savings of \$94 per barrel stated in the DEIS must be contrasted to a conversion cost of \$30,000 per barrel in the Frankel report. Cost data for one large spill can also be analyzed. The ABC spill of 1974 (DEIS, D-19) of 24,000 barrels of oil had a cleanup cost of approximately \$39 per barrel. This can be used to compare with the conversion-cost analysis.

In summary, while no absolute data on long-term loss of fishery habitat have been attributed to oil spills from single-hull barges, certain logical evaluations using existing oil-pollution data can be made. Results of in situ research on major spills indicate no long-lasting effects on the environment in terms of productivity. All habitats studied regained their capacity to produce, but at times the habitat composition varied. The amount of reduction of oil spills by double-hulled vessels is in debate because of differences in the data base. However, the estimated range of oil spilled by barges in the nation's 25,500 miles of waterways is small compared to the total oil introduced into the environment from all causes. Finally, extensive oil activities in Texas and Louisiana, representing 5 percent of the total oil produced and imported, have not caused noticeable effects on

the capacity of the environment to produce. This natural-laboratory information may be extrapolated to other U.S. waterways.

BIBLIOGRAPHY

- Alexander, M. M., P. Longabucco, and D. Phillips. 1978. The ecological impact of bunker C oil on fish and wildlife in St. Lawrence River marshes. Proc. Conf. Assessment of Ecological Impacts of Oil Spills. AIBS, 14-17 June 1978. pp. 252-267.
- American Institute of Biological Sciences. 1976. Sources, effects and sinks of hydrocarbons in the aquatic environment. Symposium Proc. AIBS.
- Assessment of Ecological Impacts of Oil Spills. 1978. Proc. Conf., AIBS, Washington, D.C.
- Ayers, R. W. 1978. The effects of the barge STC-101 oil spill on shallow water invertebrates of lower Chesapeake Bay. Proc. Conf. Assessment of Ecological Impacts of Oil Spills. AIBS, 14-17 June 1978. pp. 252-294.
- Booz, Allen and Hamilton. 1979. Economic impact on tank barge standards. Report to the American Waterways Operators, Inc., Arlington, Va.
- Bowman, D., W. B. Brogden and C. H. Oppenheimer. 1976. Development of the methodology and analysis: Creel census of Corpus Christi Bay area, 1974 Summer. Rept. Lower Nueces River Water Supply Distr.
- Clark, R. C., and J. S. Finley. 1977. Effect of oil spills in the arctic and subarctic environments. In: Malins, D. C., Ed. Effects of petroleum on arctic and subarctic marine environments and organisms. Vol. II Biological effects. Academic Press. pp. 411-476.
- Chan, G. 1972. The effects of the San Francisco oil spill on marine life. College of Marin, Kentfield, Ca.
- Council on Energy Resources, The University of Texas at Austin. 1979. National Energy Policy Issues. University of Texas.
- Draft Regulatory Analysis and Environmental Impact Statement, Design Standards for New Tank Barges and Regulator Action for Existing Tank Barges to Reduce Oil Pollution Due to Accidental Hull Damage. 1979. U.S. Coast Guard.

- E. G. Frankel Report. 1979. Evaluation of the United States Coast Guard Draft Regulatory Analysis Design Standards for Tank Barges-Structural and Statistical Assessment. Report to the American Waterways Operators Tank Barge Conference.
- Electric Power Research Institute (EPRI). 1979. Proceeding: Advisory workshop to identify research needs on the formation of acid precipitation. Sigma Research Inc. Rept. to EPRI, Palo Alto, Ca.
- Kerr, R. A. 1977. Oil in the Ocean: Circumstances Control its Impact. Science, 198: 1134-1136.
- Kuhnhold, W. W. 1978. Impact of the Argo Merchant oil spill on macrobenthic and pelagic organisms. Proc. Conf. Assessment of Ecological Impacts of Oil Spills. AIBS, 14-17 June 1978. pp. 153-179.
- Malins, D. C. 1977. Ed., Effects of petroleum of arctic and subarctic marine environments and organisms. Vol. I and II. Academic Press.
- Mertins, E. W. 1976. The impact of oil on marine life: A summary of field studies. Symp. Sources, effects and sinks of hydrocarbons in the aquatic environment. AIBS, pp. 508-515.
- Oil Spill Conference Proceedings. 1977. Prevention, behavior, control, cleanup. Am. Pet. Inst. Env. Prot. Agency, U.S. Coast Guard.
- Stobaugh, R., and D. Yergin. 1979. Energy future. Report of the energy project at the Harvard Business School. Random House, N.Y.

THE CONGRESSIONAL MANDATE
FOR
TANKBARGE CONSTRUCTION STANDARDS

Douglass Svendson, Jr., Esq.
Camp, Carmouche, Palmer, Barsh & Hunter

Austin P. Olney, Esq.
LeBoeuf, Lamb, Leiby & MacRae

INTRODUCTION

The purpose of this paper is to assist the National Academy of Sciences and the United States Coast Guard in discerning the Congressional mandate for reducing oil pollution from tankbarges. As a starting point, this paper will describe those Congressional mandates relied upon by the Coast Guard as a basis for issuing regulations to reduce oil pollution from tankbarges.

The major conclusion of this paper is that it would be a severe misconstruction of the Coast Guard's statutory mandate to focus the agency's regulatory objectives on the imposition of double-hull technology on barges in order to achieve 100 percent reduction of preventable discharges by the year 2000.

This paper will demonstrate that the Congress did not intend the Coast Guard to use the zero-discharge "objectives" of the Clean Water Act¹ as a regulatory basis. Rather, the Congress required the service to regulate on a technology basis to be determined after weighing a range of regulatory measures and by balancing of a number of competing interests. The concluding section will relate the Coast Guard's regulatory process to a series of overriding mandates imposed by the Congress and by the Administration.

I. THE MANDATE OF THE CLEAN WATER ACT

A. The Congressional Mandate as Perceived by the Coast Guard

The most recent articulation of Coast Guard reliance on legislative authority for promulgating design standards for new and existing tankbarges appears in the Draft Regulatory Analysis and Environmental Impact Statement, dated May 1979.² This document accompanied the Coast Guard's Notice of Proposed Rulemaking on Design Standards For All New Tank Barges to Reduce Oil Pollution Due to Accidental Hull Damage.³ It also accompanied an Advance Notice of Proposed Rulemaking on design standards for existing tankbarges.⁴

This document purports to fulfill the requirements of §102(2)(C) of the National Environmental Policy Act and the CEQ Regulations regarding the preparation of environmental impact statements.⁵ It also purports to satisfy the requirements placed on executive agencies by the President under Executive Order No. 12044.⁶ Although the industry has disputed the adequacy of this document in commenting on the most recent rulemaking, the Draft Regulatory Statement at least indicates what the Coast Guard believes to be the applicable Congressional mandate for imposition of double hulls on barges.

The Coast Guard is seeking, as its ultimate regulatory objective, the elimination of pollution from our navigable waters by 1985.⁷ That goal was stated in §101(a)(1) of the Clean Water Act.⁸ The Coast Guard also cites §311(b)(1) of the Clean Water Act as additional authority for the proposition that all discharges into the navigable waters should be eliminated. That provision states that "the Congress hereby declares that it is the policy of the United States that there should be no discharge of oil . . . into or upon the navigable waters of the United States. . . ."⁹ The Coast Guard has interpreted this to require the use of double hulls on new and existing barges in order to achieve a volume reduction of oil pollution for tankbarges of 80 percent. It contemplates achieving a 100-percent goal by the year 2000.¹⁰

The Coast Guard also draws authority from the so-called "Presidential Initiatives" announced by President Carter in his March 17, 1977, message to Congress, which recommended measures to control the problem of oil pollution of the oceans. Appendix C of the Draft Regulatory Statement cites, as support for the imposition of double-hull requirements on barges, a passage from a White House Fact Sheet distributed by the Office of the White House Press Secretary on March 18, 1977, which directs the study of pollution from tank barges.¹¹

The Coast Guard also cites §5 of the Port and Tanker Safety Act of 1978 as authority for requiring barges to be double hulled.¹² That section gives the Coast Guard discretionary regulatory authority to promulgate regulations for the design, construction, and operation of barges after due consideration of economic impact, benefits to navigation, vessel safety, and protection of the marine environment.

The Coast Guard would argue that the combination of these "authorities" compels the imposition of double-hull requirements on barges carrying oil and hazardous substances. The Coast Guard, however, has not only misconstrued its "mandate," but also has consistently sought to impose double-hull requirements on barges while ignoring the express directives of Congress to consider alternative technologies and to balance competing and conflicting factors.

B. The U.S. Coast Guard Misconstrued the Meaning of the Clean Water Act 1985 No-Discharge Goal and Misapplied it to Vessel-Construction Standards

Section 101(a) of the Clean Water Act states, as an "objective," the national goal of eliminating by 1985 the discharge of pollutants into the navigable waters.¹³ On the face of the statute, it is clear that this is only a goal, and one which is directly qualified in subsequent sections. For example, §402 expressly recognizes that where permits have been obtained, discharges of pollutants into the navigable waters are permissible.¹⁴ More directly on point, §311(b), which relates to discharges from vessels, directs the President to prohibit by regulation only those discharges deemed by him to be harmful.¹⁵ Given this apparent conflict, it is instructive to look to the legislative history for elucidation on the Congressional intent.¹⁶ The House Report accompanying the 1972 Amendments to the Federal Water Pollution Control Act¹⁷ reveals that Congress was concerned about the feasibility of the 1985 deadline. As a result, it was decided that final resolution of the no-discharge requirement should be held in abeyance, pending the completion of studies determining the feasibility of such a goal.¹⁸ The Committee on Public Works stated:

The Committee recognizes the problems associated with implementing a no-discharge policy. Although considerable views were heard on this subject by the Committee during hearings, it was apparent that very little hard evidence was available on which to make final irrefutable judgment on this matter. It was for this reason that the legislation includes Section 315 providing for a study by the National Academy of Sciences and the National Academy of Engineering, acting through the National Research Council, of the effects of achieving or not achieving the 1981 and 1985 goals. At the conclusion of the study, with the appropriate information available, the Congress will be in a position to fully evaluate the implications of a no-discharge policy.¹⁹

When Congress reviewed the 1972 amendments in 1977, it left the wording of §101(a)(1) unchanged and retained the 1985 standard as a mere objective.

Judicial interpretation of §101(a)(1) confirms that the substantive portion of the Act relating to discharges is §304(b)(1)(B). That section required the Administrator of EPA to establish effluent-limitation guidelines for 1977 which constitute the "best practicable control technology currently available."²⁰ The other milestone contained in §304(b)(2)(B) requires EPA to establish 1983 effluent-limitation guidelines which reflect the application of "best available control technology economically achievable."²¹ It is impossible to fully understand the implication of the 1985 no-discharge requirement without relating it to the applicable technology-based

standards. It is these standards which give substance to the regulatory authority exercised under the Clean Water Act.

The Clean Water Act, however, contains no such technology-based requirements for designing and constructing vessels. The Coast Guard has taken the directive of §101(a) and inflated it into a basis for regulating the design and construction of tankbarges. There is, however, no relationship between the discharge standards of the Clean Water Act and the design and construction of vessels. While §101 may state an overall national goal, as a legal matter it is unrelated to the Coast Guard's responsibilities for regulating the construction of vessels.

C. The Coast Guard Misconstrued §311(b) of the Clean Water Act and Its Application to Vessel Construction

Although §311(b) directly affects the authority of the Coast Guard to enforce laws relating to the discharge of harmful quantities of oil or hazardous substances, it is unrelated to the Coast Guard's regulation of design and construction standards for tankbarges. The Act suggests that §311 authority exists apart from laws affecting maritime safety and marine and navigation laws.²²

The Presidential delegation of authority to the Coast Guard under the Clean Water Act includes a broad authority for the implementation of §311, including the promulgation of regulations. The delegation does not include the authority to promulgate design and construction standards pursuant to §311.²³

Further elaboration on the construction of §311 is provided by the legislative history of the Ports and Waterways Safety Act of 1972.²⁴ The Senate Report stated that one of the needs for that law was authorization of new regulations for design and construction standards for vessels. Section 311 was considered too limited since it primarily related to "liability and responsibility for cleanup"; it was an "after the fact" effort to deal with oil pollution.²⁵ Because the Clean Water Act did not address the issue of prevention of oil spills, the Coast Guard was authorized to promulgate new regulations for design and construction of vessels in order to stop spills before they occurred.²⁶ The strongest evidence that §311(b) is inapplicable to the design and construction of vessels is the fact that Congress was compelled to pass the Ports and Waterways Safety Act to fill the legislative void in §311.

Congress considered explicitly the authority contained in the Clean Water Act. The Senate initially incorporated the provisions of §101 of the Clean Water Act into the Ports and Waterways Safety bill. This was ultimately rejected, and the final version of the measure did not contain discharge-related provisions.²⁷ Instead, Congress chose to authorize the promulgation of construction and design standards by the Coast Guard without reference to any discharge criteria. The Coast

Guard adopted ultimately a technology-based standard which was to be determined in accordance with factors relating to economic burden, navigation, and marine safety.²⁸

That the Congress (or at least the Senate) intended actual implementation to be unrelated to either discharge criteria or a predisposition to a particular construction design is clear from the Senate Report, as follows:

The Secretary is empowered to prescribe standards to substitute for any standard listed above (i.e., a double bottom) if the substitute standard provides as appropriate, equivalent, or improved navigation accuracy, vessel safety, or environmental protection. The purpose is to avoid 'locking-in' technological development.²⁹

D. Even if §311(b) Were Applicable to Tankbarge Construction, the Coast Guard Has Misread its Intent

The statutory construction of the Clean Water Act and the Ports and Waterways Safety Act, as amended, and the legislative history reveal no nexus between the no-discharge standard and the exercise of maritime design and construction authority. Moreover, §311 could not be read to compel no discharge as an operating principal of regulation, even if it were applicable. As stated earlier, §311(b) states an objective of no discharge which is directly qualified in the statute. Section 311(b)(3) directs the President to determine those harmful quantities of oil which are subject to the prohibitions of §311. The objective is further conditioned by an exemption which permits the discharge of oil under the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended.³⁰ The section constrains administrative discretion in implementing §311 by directing the President to issue regulations which are consistent with maritime safety and with marine navigation laws and regulations.³¹

The direct statutory qualification of the no-discharge criteria is amplified in the legislative history. Because the definition of discharge used within §311 is so broad, Congress clarified, in committee-report language, the reach of §311. The House Report states that Congress did not intend to interfere with those discharges from legally permitted sources. Total elimination of discharges into U.S. waters was not contemplated by the Congress.³²

These qualifications are significant, because at one time Congress considered prohibiting totally all oil spills. When Congress first considered §11b³³ of the Water Quality Improvement Act of 1970, the Senate version would have prohibited all spills. The House, on the other hand, passed a version which prohibited only "substantial" discharges. The conference committee, closely reflecting the House view, adopted the concept of "harmful" quantities.

Not only have the courts reaffirmed that the Congress did not intend every discharge to be deemed harmful, but the Coast Guard's own implementation of its regulations under §311 reveals a tolerance of spills which are deemed not to be harmful.³⁴ The regulations implementing §311(b) define harmful discharges as those which either violate applicable water-quality standards or which cause a film or sheen on or discoloration of the surface of the water or adjoining shorelines.³⁵ When these regulations were being proposed, Congressional oversight hearings were held, and Senator Muskie (Chairman of the Senate Public Works Subcommittee on Air and Water Pollution) urged that the final regulations be liberalized to include an exemption for those amounts of oil discharged "from a properly functioning vessel engine."³⁶ This reinforces the Congressional intent not to prohibit all discharges and to allow certain amounts of oil discharges from vessels.

The courts have frequently been called upon to determine which spills fall within the range of what Congress would consider de minimis. A leading case in the Fifth Circuit, United States v. Chevron,³⁷ followed a long series of cases which upheld the "visible sheen test." The court concluded that the sheen test was a useful general criterion and provided administrative simplicity, but that it was not dispositive of the issue of harmfulness. Instead, the court held that discharger may overcome the presumption of harmfulness by offering evidence in rebuttal.³⁸ The court reversed the District Court and directed entry of summary judgment for Chevron, holding that the company had presented sufficient evidence (1) to prove that a spill of between 21 and 42 gallons of oil was not harmful and (2) to rebut the sheen-test presumption.³⁹

An analysis of the statute, the legislative history, the regulations, and the court cases demonstrates that §311 does not constitute an unqualified Congressional mandate to eliminate all discharges of oil. To the contrary, the no-discharge standard is a protreptic that is substantially qualified in implementation. Even if it were applicable to the Coast Guard's regulation of vessel construction and design, §311 cannot stand for the proposition that a no-discharge standard would be the basis for exercising such authority.

The Coast Guard's reliance on the two no-discharge mandates of the Clean Water Act is unconvincing. The provisions of the Clean Water Act were not intended to govern marine design and construction standards. Wholesale transfer of these provisions to the design and construction regulatory context is without explicit or implicit legislative authority. The two no-discharge criteria are part of the complex regulatory scheme developed by Congress. To take isolated provisions out of context and apply them to an independently authorized regulatory area is an unwarranted extrapolation of regulatory authority.

The next section of this paper examines the extent to which the Coast Guard actions are consistent with the Port and Tanker Safety

Act^o which is the alternative justification for the imposition of double hulls on existing and new tankbarges.

II. THE MANDATE OF THE PORT AND TANKER SAFETY ACT OF 1978

A. Introduction

The principal conclusion of this section is that the Coast Guard correctly relies on §5 of the Port and Tanker Safety Act as general authority for the promulgation of regulations affecting design and construction standards for tankbarges. The legislative history confirms that this legislation, not the Clean Water Act, forms the basis for regulating the design and construction of tankbarges. Congress did not, however, intend the Coast Guard to narrowly focus on double-hull construction for achieving its regulatory objectives. Tracing the legislative history from the Tank Vessel Act of 1936 through the 1978 Act reveals only fleeting support for mandating double hulls on vessels carrying oil and other hazardous commodities. Over the past eight years, Congressional support for double hulls has seriously eroded. Instead of mandating a specific result, Congress has recently delegated to the Coast Guard responsibility for establishing design and construction standards for barges, based on a thorough evaluation of navigational, safety, economic, and environmental needs.

In relying on outdated mandates, the Coast Guard has failed to fulfill its duty to critically examine alternatives for achieving enhanced prevention of oil spills. This section, and the next, trace the evolution of the Congressional mandate and relate the most recent Congressional enactments to broader Coast Guard Responsibilities for conducting an unbiased, open inquiry into the optimal methods for preventing oil spills from barges.

B. The Early Congressional Attempts to Deal with Vessel-Safety Requirements

Federal authority to carry out a tank vessel safety program began with the Tank Vessel Act of 1936.⁴¹ As in so many other instances of landmark legislation, the genesis of Congressional action was a major disaster. There had been growing concern in the international maritime community about the safety of ships. In 1929 the Convention for Promoting Life at Sea was adopted and became effective for the United States on November 7, 1936. It was the SS Morro Castle disaster, however, which triggered initial Congressional interest. The Morro Castle was lost off Asbury Park, New Jersey, on September 5, 1934, when the vessel caught fire, claiming more than 125 lives. Closely following that disaster was a collision between the Mohawk and the Talisman in which 45 persons lost their lives. Congress enacted provisions for establishing requirements for structural fire-protection and safety equipment and improved manning standards, and extended existing inspection and licensing laws to include oceangoing vessels of

300 gross tons or more. For the first time, legislation was enacted to provide for the regulation of tank vessels having on board flammable or combustible liquid cargoes in bulk. This measure, the Tank Vessel Act of 1936, remained on the books, essentially unchanged, until 1972, when the Senate initiated major amendments through the Ports and Waterways Safety Act of 1972.²

Another series of accidents in 1970 spurred Congressional review of the authority for preventing maritime accidents. Specifically, major accidents in San Francisco Bay, Long Island Sound, and Chesapeake Bay brought into focus the need to promote safety and protect the environmental quality of ports and waterways.³ During the 92d Congress, the House of Representatives passed H.R. 8140 which authorized the Coast Guard to improve vessel-traffic services, systems, and controls. The bill was designed primarily to expand the authority for a port-safety program contained in the Magnuson Act.⁴ The House bill would have provided a broad and permanent statutory basis for the exercise of authority for the nondefense aspects of port safety. The Senate considered S. 2074 which not only sought improvement of programs for improved port safety, but which added a title authorizing the Secretary of Transportation to promulgate comprehensive standards for the design, construction, maintenance, and operation of tankers in order to protect the marine environment.⁵

The impetus to pursue this twofold approach rested with the Senate's view that existing authority was inadequate to deal with the total tanker oil-pollution problem. The Tank Vessel Act was considered inadequate to deal with oil pollution because environmental protection had not been identified as an objective of that Act.⁶ The Senate report reflected the view that the Water Quality Improvement Act⁷ was also inadequate because its regulatory thrust was liability and responsibility for cleanup.⁸ It went on to state:

What is urgently needed is legislation that will put emphasis on prevention, and that is the thrust of H.R. 8140 as amended.

The 91st Congress adopted far-reaching legislation (P.L.91-224) dealing with oil spills. This was excellent and much needed. However, although some regulatory authority for pollution prevention is included, the thrust of that legislation relates to liability and responsibility for cleanup. Unfortunately, no amount of after-the-fact reporting, liability and efforts at cleanup will effectively prevent the growing incidence of oil spill tragedies or restore environmental and ecological resources once destroyed. Thus, the emphasis of H.R. 8140 is on new standards and regulations to prevent damage to the environment. (Emphasis in the original text).⁹

In adding the title on vessel-construction standards, the Senate-report included language stating a preference for the adoption

of double-bottom construction standards. While stopping short of mandating the imposition of double-bottom construction standards on all tank vessels, the Senate Committee did state that "(p)erhaps the clearest instance of a standard presented at the committee's hearings that must be seriously considered, is that of double bottoms."⁵⁰ The conference-report explanation of the resolution of differences between the House- and Senate-passed versions of H.R. 8140 does not clarify the intent of the Congress as a whole on the issue of double bottoms.⁵¹

Subsequent Congressional hearings, however, reveal substantial dissatisfaction on the part of House Conferees over the Senate title relating to construction standards.⁵² The Chairman of the Committee, Representative Sullivan, noted that many members of the conference were opposed to the new title which "transformed the Ports and Waterways Safety Act from essentially a marine safety piece of legislation to [sic] an environmental piece of legislation. . ."⁵³ She further stated that the conferees were faced with the choice of possibly losing the entire piece of legislation or accepting the Senate's title. She related that it seemed reasonable to adopt a policy of compromise to assure passage of the legislation and noted that the house did insist that the construction standards for tank vessels should not apply to dry bulk cargoes.⁵⁴ She stated that she was "deeply concerned over its implication with respect to the construction and operation of deep-ocean and inland tank vessels."⁵⁵ Against this backdrop of uncertainty, Representative John M. Murphy, Chairman of the Coast Guard and Navigation Subcommittee, began oversight hearings of the Coast Guard's implementation of the design and construction provisions of the new Ports and Waterways Safety Act.

Chairman Murphy was focusing on the Coast Guard's proposed regulation⁵⁶ which would have required tank vessels trading within U.S. waters to be equipped with segregated ballast tanks and double bottoms.⁵⁷ In an effort to avoid a negative impact on the U.S. flag fleet, the Coast Guard agreed that no action would be taken on the proposed rulemaking pending the outcome of the Intergovernmental Maritime Consultative Organization (IMCO) Conference on Marine Pollution scheduled for October 1973.⁵⁸

The subcommittee held hearings for four days and received extensive testimony, only the highlights of which can be described in this paper. One of the most graphic illustrations of the House position on the double-hull issue came in an exchange between the principal Coast Guard witness, Rear Admiral William F. Rea, III, Chief, Office of Merchant Marine Safety, U.S. Coast Guard, and Chairman Murphy. The questioning was begun by Representative Downing, who was a member of the conference committee on H.R. 8140.

MR. DOWNING: Welcome Admiral, you say you are operating under the Ports & Waterways Act. Is there any specific reference to double bottoms or segregated ballasts in the Act?

COMMANDER PORRICELLI:⁵⁹ No sir, it came on the Senate side.

MR. DOWNING: Then that is the only reference. Are you getting your authority from the Senate report or from the Act itself?

ADMIRAL REA: No, the Act itself, sir, and also we use both reports as indicators for policy guidance, but the authority is right from the statute.

MR. MURPHY: If the gentlemen will yield, is the Admiral implying that the Senate side intended in the Act that there was a requirement of language for double bottoms?

ADMIRAL REA: No. If I did say that I would withdraw that comment. Let me check real quick here, Mr. Chairman, but it was in the Senate Report, not in the final Act.

MR. MURPHY: Was it in the Senate Report?

ADMIRAL REA: Yes, sir.

MR. MURPHY: Was it not in the House Report?

ADMIRAL REA: No, sir.⁶⁰

Chairman Murphy pressed the Coast Guard further about its decision to impose a double-bottom standard. The following colloquy indicates the degree to which Chairman Murphy believed that the Coast Guard had exceeded its mandate by proposing to impose double-bottom and segregated ballast-tank requirements on tank vessels.

MR. MURPHY: Admiral, it was stated in the Federal Register of January 26, 1973, "The study has not been completed, and no final conclusions have been reached." Why did the Coast Guard act independently in proposing the regulation outlined therein?

ADMIRAL REA: Mr. Chairman, we felt somewhat compelled under the provisions of the Act itself, which says that we shall begin publication as soon as practical of proposed rules and regulations setting forth minimum standards for design, construction and alteration. This is under Title II, section (7).

It was in that area where we felt compelled to table this and others in mind, as a proposed rulemaking in consonance with that part of the Act. [sic]

MR. MURPHY: You felt there was a rush to get it out?

ADMIRAL REA: We felt it was an obligation or responsibility on our part to publish as soon as possible the proposed rule.

Now, the final rule, no. It says they shall begin publication as soon as practical, and it was under this section that we felt we should act, and give as much notice to the public and industry.

MR. MURPHY: You say the Maritime Administration, the Environmental Protection Agency, the Council on Environmental Quality, the Office of Management and Budget, and the Department of State were briefed on the note containing these segregated-ballast, double-bottom concepts before presenting it to IMCO. Did any of those agencies respond?

ADMIRAL REA: None of them objected, sir, to my knowledge. We did not ask them to endorse it. We made them aware of it. There were very free discussions. I sat in on some of these myself. None, to my knowledge have any objection.

MR. MURPHY: Did they respond in writing?

ADMIRAL REA: There were oral presentations. Let me consult with my staff.

No sir, they were not in writing, sir.

MR. MURPHY: They were briefed, and they made no statement in writing to you?

ADMIRAL REA: No, sir.

MR. MURPHY: On page 3 you state:

Section 201(7) of the Ports and Waterways Safety Act of 1972 directs publication as soon as practicable of proposed rules and regulations setting forth minimum standards of design, construction, alteration, and repair of the vessels to which this section applies for the purpose of protecting the marine environment. Is there anything in that language that calls for the kind of rules you proposed on January 26, 1973?

ADMIRAL REA: That language there is the part which we felt compelled us to put out the proposed regulations. No, there is nothing in that particular section which speaks to the particular arrangement we have suggested, sir, but in the context of the whole title there is, further down in the same section, language which says to get these out as soon as possible, and also speaks to some of the topics which we should use which has to do with reducing cargo loss following collision, grounding, or accident, and to reduce damage to

marine environment by normal vessel operation, et cetera; in that same section of the act, sir.

MR. MURPHY: You say "standards specifically mentioned among others are reducing cargo loss following groundings and reducing damage to the marine environment by normal vessel operations such as ballasting and deballasting."

Is there anything in that language that calls for the kinds of rules you proposed on January 26, 1973?

ADMIRAL REA: We feel, sir, in both, for the operation and the other, that one alternative is this we have proposed.

There is nothing that says specifically the proposal we put out, but I certainly think it is within the context of that, the spirit of it, the intent to have this as a possible alternative.

MR. MURPHY: Well, Admiral, in a conference in my office when I asked you who had come up to you with this idea, you suggested that the Congress had come up with this idea of double bottom and segregated ballast.

ADMIRAL REA: Mr. Chairman, I think we pointed out, or indicated, that in the Senate report this feature is spoken to.

MR. MURPHY: But it is not in the law.

ADMIRAL REA: No.

MR. MURPHY: It is not included in the House documents?

ADMIRAL REA: That is correct.

MR. MURPHY: The language of the Senate report, on page 17, says that among the matters brought up at the committee hearings were the following, and they refer to the matter of double bottoms, improved navigability of tankers, including a broad range of things. In other words they were just the matters that were brought up.

I do not think we should imply that the Senate or the Congress, as you suggest, is responsible for the rules that you are proposing to be made here.

ADMIRAL REA: Mr. Chairman, if that was understood by you, I certainly withdraw that. It was one of the features that showed up in the report, and I would perhaps clarify the record to this extent, that the act itself specifically does

not require double bottoms, and we are still trying to be openminded on this. We are not locked in that double bottoms are the only way to go. These are proposed rules, and the final results to reduce marine pollution may be by some other alternative. It is not in the Act itself that we have to have double bottoms.⁶¹ The Department of Transportation was sued by the Natural Resources Defense Council (NRDC) over the delay in promulgating these regulations. They were seeking to compel the imposition of double-bottom requirements on tank vessels, claiming regulations providing for distribution of cargo space failed to fulfill the Congressional mandate. The District Court upheld the Coast Guard's decision not to impose more specific requirements, e.g., double bottom. Natural Resources Defense Council, Inc. v. Coleman, 411 F. Supp. 449 (D.D.C. 1979).]

The U.S. Coast Guard position on double bottoms and segregated ballast tanks was defeated at the 1973 IMCO convention and substantially less stringent standards were adopted. As a result of the action taken by IMCO and the manifest displeasure within the House of Representatives over double bottoms, the Coast Guard conducted several studies to better understand the causes of oil spills, the alternative measures of prevention, and the competitive and direct economic costs associated with fitting the U.S. tank-vessel fleet with double bottoms or segregated ballast tanks, or both.⁶²

Despite an earlier suggestions of Congressional (Senate) preference for double bottoms, the Coast Guard found itself being criticized not only by the industry, but by the international community and by the House of Representatives which strongly disputed the "mandate" for double bottoms contained in the Senate Report. While the Coast Guard was in a deliberative posture examining alternative techniques for preventing oil spills, a number of major oil-pollution disasters caused by oceangoing tankers struck almost concurrently and gave dramatic impetus to new Congressional initiatives in the field of preventing oil spills from tank vessels.

The most infamous spill involved the Liberian tank vessel Argo Merchant which grounded in international waters about 28 miles southeast of Nantucket early on the morning of December 15, 1976. Although there were no casualties, the resulting oil pollution involved an estimated 204,000 barrels of heavy heating oil. Another casualty occurred in December 1976 which involved the Liberian tank vessel Sansinena which exploded and burst into flame while taking on ballast and fuel at an oil terminal in Los Angeles Harbor. This accident resulted in the deaths of 8 persons and injury to 50 others, with considerable damage to shoreside installations and pollution of the harbor. As a result of these two accidents and others, the Secretary of Transportation established a special departmental task force in December 1976 to review marine safety regulations and to assess the effectiveness of regulations for the prevention and containment of oil

spills. After the task force made its findings in January 1977, President Carter convened an interagency task force to review all interrelated issues of tank-vessel safety and the protection of the marine environment. The task-force review culminated in a number of proposals announced by the President to the Congress in a message dated March 17, 1977.⁶³

The President announced a set of measures designed to reduce the risks associated with marine transportation of oil. He directed the Department of Transportation to prepare, within 60 days, proposed new regulations on tanker construction and equipment. He also instructed the Department of State, in conjunction with the Coast Guard, to begin diplomatic efforts to improve the international system of inspection and certification of tankers. He announced a stepped-up boarding program for the entry of tankers into our ports, together with more stringent sanctions for vessels with records of poor maintenance, accidents, or pollution violations. He called on the Senate to ratify the International Convention for the Prevention of Pollution from Ships, 1973, and directed that licensing and qualification standards for U.S. vessels be improved. In response to the President's initiatives, the Coast Guard issued a Notice of Proposed Rulemaking on May 16, 1977, specifically aimed at improving measures relating to large tank-vessel construction.⁶⁴

C. The Origins of the 1978 Efforts By Congress to Revise Design and Construction Authority

The 1978 legislative effort to amend the authority contained in the Ports and Waterways Safety Act was born of major maritime disasters caused by large oceangoing tankers, not by barges. The President in his March 17, 1977, environmental message focused his attention on tankers. The only mention of barges is contained in a White House Fact Sheet which calls for "an evaluation of design, construction and equipment standards for tank barges which carry oil."⁶⁵ In his message, the President does not mention the word barge, and it is clear that because of the circumstances and because of the language used in the text of the statement, the specific standards which he recommended, including double bottoms, were intended only for tankers, not for barges. The adequacy of pollution-prevention measures on oceangoing tankers was the focus of the Congressional debate on the Port and Tanker Safety Act of 1978.

The dichotomy permeates the deliberations on tanker safety which followed the President's message and the numerous oil-spill casualties. For example, the primary Senate bill, S. 682, proposed in 4 to establish minimum standards for "self-propelled" vessels in excess of 200,000 deadweight tons. Among other requirements, the Senate bill contemplated that any self-propelled tank vessel which was contracted for or constructed after January 1, 1980, would be fitted with a double bottom throughout the cargo length. In contrast, the regulatory

authority for all other types of vessels was left to the discretion of the Secretary.⁶⁶

The House bill followed the same distinction by requiring certain minimum standards for self-propelled vessels and by leaving the regulatory authority for other vessels within the discretion of the Secretary.⁶⁷ Even read in the most unfavorable light, neither the Senate nor the House bills contemplated the imposition of double-hull requirements on tankbarges. Moreover, when the legislation was finally adopted by both Houses of Congress, the provisions contained in the Senate bill relating to the imposition of double bottoms on self-propelled vessels over 20,000 deadweight tons were deleted. The House provisions which prevailed recognized a number of minimum requirements, including segregated ballast systems, but excluding double bottoms.⁶⁸

Once before, following the Ports and Waterways Act, the Coast Guard attempted to rationalize a double-bottom proposal, based solely on language contained in a Senate report, p. 25, *infra*. Had the Coast Guard followed the same reasoning here, and relied solely on Senate-report language to the 1978 amendments to the PWSA, in light of the application of correct facts to that language, double bottoms probably would have been ruled out as an option. For example, the Findings, Purpose, and Policy section of the 1978 report indicate that

"standards developed through regulation under the Ports and Waterways Safety Act (and the Tank Vessel Act) shall incorporate the best available technology. This guiding concept is lacking in the Ports and Waterways Safety Act. In addition, any standards considered effective and necessary from the technical standpoint shall be required unless clearly shown to create undue economic hardship (not simply increased expense) which is not outweighed by environmental benefits."⁶⁹

The key question is the extent of economic hardship in conjunction with increased expenses. The Committee obviously did not intend that "undue economic hardship" could be established solely on the basis of increased expense because all government regulation, however minimal, can be said to increase expenses to some extent. Such an interpretation would literally undo the law. On the other hand, where an industry can demonstrate both "undue economic hardship" as well as a level of increased expense which is not minimal, and both can be shown to outweigh environmental benefits, the proposed standards certainly fall short of the Committee report's directive.

During the 1979 field hearings on the proposed standards, testimony from bankers whose business is barge financing disclosed very serious financing problems likely to confront the industry under the Coast Guard's proposals. No one, including the Coast Guard, questioned the validity of these banking/financing issues. In fact, the Coast Guard

specifically referred to the financing issue in its supplementary notice of deferral.⁷⁰

Bear in mind that added industry costs (i.e., impaired equity, loss of earning power) associated with financing difficulties would not be costs directly attributable to double-hull construction standard compliance (i.e., steel, labor, interest indebtedness, etc.). These direct costs would constitute yet another category, which, it can be shown, is far above what the Committee report called "simply increased expense." In its EIS, the Coast Guard estimated construction costs of \$368 million. Industry studies placed the figure at \$2.6 billion. The Coast Guard, while not agreeing with the industry's cost estimates, nevertheless significantly revised upward its original figures. It should also be noted that these cost revisions were not made within the context of 1980's unprecedented inflation rate of 18 percent.

The question of when an undue economic hardship is or is not outweighed by environmental benefits is obviously more subjective than straightforward. This is particularly true when conventional wisdom demands greater visceral reaction to oil spills than scientific evidence warrants. Dr. Carl Oppenheimer's paper should be instructive in that regard. Nevertheless, we can make some reasonably accurate estimates of the cost per barrel required to achieve the Coast Guard's goal. The E. G. Frankel study concluded that the per-barrel cost to comply with the Coast Guard's proposed standards would approximate \$45,000. Even if the Coast Guard is willing to accept roughly one third of industry's cost-of-compliance estimates, the number is still unreasonably high at \$15,000 per barrel. This appears to be a crystal-clear example of "undue economic hardship which is not outweighed by environmental benefits."

Congress rejected the double-bottom requirement and chose to treat self-propelled tank vessels differently from nonself-propelled tank vessels. The Coast Guard cannot cite the Port and Tanker Safety Act of 1978 as the justification for imposing double-hull requirements on the U.S. tankbarge fleet. That would suggest Congress had selected a regulatory result. It did not. It established a method for achieving that result, wholly apart from those provisions which mandated minimum requirements for self-propelled vessels. The next section of this paper will examine those directives to the Coast Guard which relate to the exercise of design and construction regulatory authority over nonself-propelled vessels.

C. The Congressional Mandate for Nonself-Propelled Vessels

Although the legislative history is not extensive on the Port and Tanker Safety Act of 1978, its provisions are explicit enough to direct the Coast Guard in its regulation of tankbarge design and construction. Section 5 states that:

Standards developed through regulations shall incorporate the best available technology and shall be required unless clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation in vessel safety or protection of marine environment. . .⁷¹

That statement establishes at the outset that the Coast Guard is to develop technology-based regulations which must be weighed against economic factors, navigational safety, and protection of the marine environment. Section 391(a)(6) confers broad authority on the Coast Guard to adopt regulations relating to design, construction, repair, maintenance, operation, equipment, personnel qualifications, or manning which may be necessary for increased protection against hazards to life and property for navigation and vessel safety, and for enhanced protection of the marine environment.⁷²

The statute further authorizes the Secretary to promulgate regulations across a broad spectrum. He can establish requirements relating to hulls, cargo holds or tanks, storage, equipment and appliances for lifesaving, manning, improvements of vessel maneuvering and stopping ability, and reduction or elimination of discharges and regulations relating to the ballasting and tank-cleaning.

These provisions indicate a broad range of measures to be considered by the Secretary in exercising authority under the Act. Exercising this authority presumes that the Coast Guard will establish the necessary factual predicate before issuing regulations.⁷³

An important qualification on the Secretary's regulatory authority is in subsection (6)(c) which requires the Secretary to establish procedures for consulting with and considering the views of interested federal departments and agencies, offices from state and local governments, representatives from the maritime community, representatives of port and harbor authorities or associations, representatives of environmental groups, and any other interested parties who are knowledgeable or experienced in dealing with problems involving vessel safety, port and waterway safety, and protection of the marine environment.⁷⁴ This is not a pro forma provision. It was an added precaution to insure that the regulatory process not only considers, but actively seeks the views of all interested parties. These requirements supplement those of the Administrative Procedure Act. The House Report states that "in addition to any requirements of the Administrative Procedure Act, the Secretary must establish specific consultation and evaluation procedures for the views of various specified interested officials, groups, and individuals. The procedures are intended to provide for such consultation as early in the regulatory process as it is possible."⁷⁵

No regulatory result is suggested, as it was in other areas, for barges. The Congress intended the Coast Guard to consider a wide range of regulatory approaches and all competing points of view.

The approach in the statute is in sharp contrast with the Coast Guard's wooden reliance on §5 of the Port and Tanker Safety Act of 1978 as justification for imposing double hulls on tankbarges. The proposal revived by the Coast Guard on June 14, 1979, is simply an echo of earlier attempts by the Coast Guard to impose double bottoms on the U.S. barge fleet.⁷⁶ These recent attempts are less appropriate now, given Congress's decision not to mandate minimum standards for barges and its insistence on a process that assures full consideration of all interests.⁷⁷

Not only must the Coast Guard adhere to the deliberative process contemplated in the 1978 Port and Tanker Safety Act, but it must adhere to other mandates governing the regulatory process. Requirements such as the National Environmental Policy Act and Executive Order No. 12044 directly affect the way government agencies exercise their regulatory authority. An assessment of the Congressional mandate necessarily involves a consideration of the Coast Guard's fulfillment of these overriding requirements. These are discussed in the following section.

III. OVERRIDING REQUIREMENTS FOR THE RULEMAKING PROCESS

A. The National Environmental Policy Act

The Coast Guard has properly concluded that the construction standard rulemaking for tankbarges is subject to §102 of the National Environmental Policy Act (NEPA) and that it is required to prepare a full environmental impact statement (EIS). The primary purpose of the EIS is to improve the federal decisionmaking process: to insure that environmental impacts are assessed properly and that there is a full disclosure of reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment.⁷⁸ The Department of Transportation has solicited public comment on its implementation of the CEQ regulations. 44 Fed. Reg. 31,341 (1979).] The EIS regulations are designed to expand and sharpen the decisionmaking process so that it is not narrowly focused on a predetermined objective. "An environmental impact statement is more than a disclosure document. It shall be used by federal officials in conjunction with other relevant materials to plan actions and make decisions."⁷⁹ This principle is reaffirmed in another section of the NEPA regulations: "The statement shall be prepared early enough so that it can serve practically as an important contribution to the decisionmaking process and will not be used to rationalize or justify decisions already made [citations omitted]."⁸⁰ Both the timing and the content of the current draft environmental impact statement suggest that the Coast Guard has not complied with these regulations. The double-hull proposal for barges has been pending since 1971, and the agency position has remained largely unchanged. It is self-evident that the environmental impact statement has been prepared as an afterthought in an attempt to justify a predetermined course of

action.⁸¹ This is a violation of one of the fundamental precepts of the NEPA regulations.⁸²

The cursory examination of alternatives to the proposed action, however, constitutes the fundamental failure to fulfill the mandate of NEPA.⁸³ The CEQ regulations underscore the keystone quality of the examination of alternatives. "This section [requiring an examination of alternatives] is the heart of the environmental impact statement. . . it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public."⁸⁴

In addition, the regulations set out the manner in which an agency must present alternatives:

(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.

(c) Include reasonable alternatives not within the jurisdiction of the lead agency.⁸⁵

A brief examination of the impact statement demonstrates that no serious effort was made to analyze alternatives. The section discussing alternatives consists of less than two pages of rationalization for the choice of the double-bottom standard. The analysis fails to meet the rigorous examination required by the regulations and by the courts.

The decision in Natural Resources Defence Council, In. v. Morton, involving a challenge to the Department of the Interior's plan to lease offshore oil tracts, makes it clear that the detailed statement required by NEPA must provide information and analysis "sufficient to permit a reasoned choice of alternatives so far as environmental aspects are concerned."⁸⁶ In interpreting the requirement to consider alternatives, the Second Circuit, in Monroe County Conservation Council v. Volpe, held that an agency cannot briefly describe alternatives "in such a conclusory and uninformative manner that [the EIS] affords no basis for a comparison of the problems involved with the proposed [action] and the difficulties involved in the alternatives."⁸⁷

The Coast Guard fails to consider several alternatives to the proposed double-hull standards which would involve more cost-effective and less energy-consuming methods of meeting the Coast Guard's policy

requirement. The alternatives include better aids to navigation and improved traffic control, as well as the methods suggested in 5 of the Port and Tanker Safety Act of 1978.

If this is the heart of the Coast Guard's EIS statement, it testified eloquently to the inadequacy of the service's efforts to satisfy the requirements of NEPA. The omission of this important section only underscores the Coast Guard's disregard for realistic alternatives to its long-chosen proposed action.

B. Executive Department Requirements for Improving Government Regulations

President Carter issued Executive Order 12044, which directs each executive agency to adopt procedures for improving existing and future regulations.⁸⁸ The primary purpose was to insure that agencies achieved legislative goals effectively and efficiently without imposing unnecessary burdens on the economy, on individuals, on the public or private organizations, and on other levels of government. To achieve these objectives, the President required the agencies to develop regulations to insure that, among other things, meaningful alternatives are considered and analyzed before the regulations are issued.⁸⁹

Section 3 of the Executive Order directs government agencies to prepare regulatory analyses for those regulations identified as having major economic consequences for the general economy, individual industries, geographical regions, or levels of government. The need to fully analyze alternatives is again emphasized. The agencies must adopt procedures to insure that each regulatory analysis contains "a description of the major alternative ways of dealing with the problem that were considered by the agency; an analysis of the economic consequences of each of these alternatives and a detailed explanation of the reasons for choosing one alternative over the others."⁹⁰

The Department of Transportation issued implementing regulations on February 26, 1979.⁹¹ Among the objectives set out in the implementing regulations is a requirements that "[a] regulation should provide a feasible and effective means for producing the desired results; it should be developed giving adequate consideration to the alternatives, to the anticipated safety, environmental, social, energy, economic and legal consequences, and to indirect effect; it should not impose an unnecessary burden on the economy, on individuals, on public or private organization, or on state and local governments."⁹² This language is similar to and reinforces the requirements for exercising regulatory authority under §5 of the Port and Tanker Safety Act of 1978.⁹³

The combination of the mandates found under Executive Order 12044 and under NEPA require federal agencies to develop new regulations in a deliberative, unprejudiced manner. The Draft Regulatory Report reveals a paucity of information on regulatory alternatives other than those

already chosen by the Coast Guard. One can only conclude that the Coast Guard's process has fallen far short of the criteria for an objective, rigorous, deliberative process.

IV. CONCLUSION

The Coast Guard has sought to impose double-hull requirements on barges since 1971. During the past nine years, it has relied on different mandates as justification for pursuing that course of action. Those mandates have changed, but the Coast Guard attitude has not. Tracing the legislative history of the Federal Water Pollution Control Act demonstrates that the Coast Guard has placed unwarranted reliance on the provisions of that Act for purposes of requiring double hulls on barges. It has misread the mandate from Congress in relationship to the Tank Vessel Act. After the passage of the Ports and Waterways Safety Act of 1972 it was arguable that one House of Congress, the Senate, favored double hulls for barges. This is not a substitute for legislation; in any event, subsequent hearings and subsequent Congressional enactments have undermined even that basis for imposing double bottoms. Double bottoms have been rejected by the international community, and the only forum in which double bottoms enjoy support is in the Coast Guard. The latest Congressional enactment, the Port and Tanker Safety Act of 1978, contains no references to double hulls. The only consideration given to double hulls was for seagoing tankers.

This leaves the Coast Guard with a clean slate. It has no specific mandate. It has been granted authority to promulgate regulations in this area, but within the deliberative framework established by the Port and Tanker Safety Act of 1978, the National Environmental Policy Act, and Executive Order 12044 and the implementing regulations. Since the prior Coast Guard regulatory efforts have been characterized by a single-minded determination to impose double hulls on the barge industry, those efforts should be abandoned and the regulatory process should begin anew with a full analysis of all the regulatory tools that are available to the Coast Guard in a manner consistent with those authorities just cited. To do anything less would subvert the requirement that federal agencies conduct their business in an unbiased and objective manner.

NOTES

- 1 33 U.S.C.A. §1251 et seq. (1978).
- 2 Hereinafter cited as Draft Regulatory Statement.
- 3 44 Fed. Reg. 3440 (1979).
- 4 44 Fed. Reg. 3443 (1979).
- 5 42 U.S.C. §4332(2)(C) (1976) and 40 C.F.R. §1501.1 et seq. (1979).
- 6 44 Fed. Reg. 12661 (1978).
- 7 Draft Regulatory Statement at 2.
- 8 33 U.S.C.A. §1251(a)(1) (1978).
- 9 See pp. 2, 7 of the Draft Regulatory Statement, supra, citing 33 U.S.C. §1321(b)(1). The Coast Guard apparently no longer relies on 311(j)(1) as the basis for double-hull requirements, as it did in December 1971 in issuing proposed double-bottom rules. Hearings on Coast Guard Miscellaneous: House Committee on Merchant Marine & Fisheries, 92d Cong., 2d Sess. 193, 194 (1972).
- 10 Draft Regulatory Statement at iii.
- 11 Draft Regulatory Statement, Appendix C, p. 1. The references to barges do not appear in the President's message. They only appear in the "Fact Sheet" issued by the White House Press Office.
- 12 Pub. L. No. 95-474, codified at 46 U.S.C.A. §391(a) (West Supp. 1979).
- 13 33 U.S.C.A. §1251(a)(1) (1978).
- 14 33 U.S.C. §1342 (1976).
- 15 33 U.S.C. §1321(b) (1976).
- 16 See U.S. v. Tex-Ton, Inc., 589 F.2d 1310, 1313 (7th Cir. 1978); International Telephone & Telegraph Corp. v. General Telephone & Electronics Corp., 518 F.2d 913, 917-918 (9th Cir. 1975).
- 17 Pub. L. No. 92-500, codified at 33 U.S.C.A §1251 et seq. (1978).
- 18 H. Rep. No. 92-911, 92d Cong., 2d Sess., at 77 (1972).
- 19 Id.

- 20 33 U.S.C.A. §1311(b)(1)(A) (1978).
- 21 33 U.S.C.A. §1311(b)(2)(A) (1978). For discussion of these goals, see American Frozen Food Institute v. Train, 539 F.2d 107 (D.C. Cir. 1976) and American Paper Institute v. Train, 543 F.2d 328 (D.C. Cir. 1976).
- 22 Any regulations promulgated under the authority of §311 must be consistent with such laws. 33 U.S.C. §1321(b)(3).
- 23 Executive Order No. 11735, 38 Fed. Reg. 21243, 21244 (1973).
- 24 Pub. L. No. 92-340, codified at 33 U.S.C.A §1221 et seq. (1978).
- 25 S. Rep. No. 92-724, 92d Cong. 2d Sess. reprinted in (1972) U.S. Code Cong. & Ad. News, 2766.
- 26 Id. at 2767.
- 27 Hearings on Coast Guard Misc., supra, at p. 3, fn. ***, 189.
- 28 46 U.S.C.A §491(a)(1)(D) (West Supp. 1979).
- 29 S. Rep. No. 95-176, 95th Cong., 2d Sess., at 27 (1978).
- 30 33 U.S.C.A. §1321(b)(3) (1978).
- 31 33 U.S.C.A. §1321(b)(3) (1978).
- 32 H.R. Rep. No. 92-1465, 92d Cong., 2d Sess. (1972).
- 33 Section 11b of the Water Quality Improvement Act of 1970 (Pub. L. No. 91-224) was the predecessor to §311(b), and the language here in question has remained substantially unchanged. (1970) U.S. Code Cong. & Ad. News, 2691, 2719.
- 34 For judicial review of the Congressional intent, see, United States v. Boyd, 491 F.2d 1163, 1169 (9th Cir. 1973).
- 35 40 C.F.R. §110.6 (1979).
- 36 40 C.F. §110.6 (1979). This legislative history is cited in United States v. Boyd, supra, at 1169 and in Ward v. Coleman, 432 F. Supp. 1352, 1358 (W.D. Okla. 1976).
- 37 583 F.2d 1357, 1363 (5th Cir. 1978).
- 38 Id. at 1364.

- 39 Id. at 1360, fn. 7, 1364. There was also expert testimony that a spill of 10 times that amount would not be harmful. Id. at 1361 n. 7.
- 40 33 U.S.C.A. §491a (1978).
- 41 R.S. §4417a, 49 Stat. 1889, codified in amended form at 46 U.S.C.A. §391a (1978).
- 42 Pub. L. No. 92-340, as codified in 33 U.S.C. §1221 et seq. and 46 U.S.C. §391a. The legislative background is taken from the report accompanying H.R. 13311, The Port Safety and Tank Vessel Safety Act of 1978, H.R. Rep. No. 95-1384, 95th Cong., 2d Sess., pt.1 4-5 (1978).
- 43 Sen. Rep. No. 92-724, 92d Cong., 2d Sess., reprinted in (1972) U.S. Code Cong. & Ad. News, 2766, 2769 and 2773.
- 44 50 U.S.C. 191.
- 45 S. Rep. No. 92-724, supra, 2768.
- 46 Id., at 2781.
- 47 Pub. L. No. 91-224.
- 48 Op. Cit. at 1768.
- 49 Id. at 1768, 1769. This point is reemphasized by Representative Pelly, the ranking member of the House Merchant Marine and Fisheries Committee at the time this legislation was considered. During hearings on the Senate Amendments to H.R. 8140, Representative Pelly, citing Senator Hollings, emphasized the lack of authority that the Coast Guard had in the area of tanker-construction standards and echoed a statement made by Committee counsel indicating that §11(J)(1)(c) of the Water Quality Improvement Act, which had been relied upon the Coast Guard in promulgating double-hull regulations for barges in 1971, was a "tenuous" source of authority.
- 50 Id. at 2777.
- 51 The only substantive enlightenment on the design and construction standards pertains to an agreement by the conferees to defer for an additional year, to January 1, 1976, the date by which initial standards for the design and construction of all vessels will be applied to vessels in the foreign trade in the absence of internationally adopted standards. Conf. Rep. No. 92-1178, 92d Cong., 2d Sess., reprinted in (1972) U.S. Code Cong. & Ad. News, 2811, 2812.

- 52 Hearings on Proposed Regulations Promulgated by the Coast Guard as required by Title II of the "Ports and Waterways Safety Act of 1972," To Require That All Large Tankers Contracted for after January 1, 1976, Entering U.S. Territorial Waters Be Equipped with Segregated Ballast Tanks: Hearings Before the Subcommittee on Coast Guard and Navigation of the Committee on Merchant Marine and Fisheries, 93rd Cong., 1st Sess., 1-4 (1976). (Hereinafter "Title II Hearings").
- 53 Id. at 1.
- 54 Id. at 2.
- 55 36 Fed. Reg. 24,960 (1971).
- 56 Title II Hearings, at 2.
- 57 Id. at 3.
- 58 Id. at 4.
- 59 Lt. Commander Joseph D. Porricelli, Assistant Chief, Marine Systems Evaluation Branch, Merchant Marine Technical Division, U.S. Coast Guard.
- 60 Id. at 21-22.
- 61 Id. 35-37.
- 62 Two major studies were the joint Maritime Administration/Coast Guard, "Tank Barge Study," October, 1974; NTIS COM-75-10284/AS and Bender A, et al., "Tank Barge Oil Pollution Study," prepared for Coast Guard by Automation Industries, Inc., final report February, 1978, CG-M-2-78.
- 63 H.R. Rep. No. 95-1384, supra, at 6 (1978).
- 64 Id. at 6-7.
- 65 Hearings on Recent Tanker Accidents: Legislation for Improved Tanker Safety, Hearings before the Committee on Commerce, Science, and Transportation, 95th Cong., 1st Sess., 893 (1977).
- 66 See §§4, 5 regarding Standard Setting Authority under S. 682, text reprinted in Coast Guard Miscellaneous, Hearings before the Committee on Merchant Marine and Fisheries, 95th Cong., 1st Sess., 261, 266 (1977).

- 67 The House considered identical bills, H.R. 3796, H.R. 4860, H.R. 4861, and H.R. 5118, 95th Cong., 1st Sess. A clean bill was eventually reported by the House Merchant Marine and Fisheries Committee, H.R. 13311, 95th Cong., 2d Sess.
- 68 This is consistent with the results of the International Conference on Tanker Safety and Pollution Prevention, London, February, 1978. Although the U.S. delegation sought the imposition of double bottoms on new ships, no such requirement was included; the 78 Protocol adopts the protective location of segregated ballast for new tank vessels. The House Report notes that the minimum standards eventually adopted by the Congress are consistent with the internationally accepted standards agreed to by an overwhelming majority of the delegations participating in the International Conference on Tanker Safety and Pollution Prevention. H.R. Rep. No. 95-1384, supra, at 21.
- 69 S. Rep. No. 95-176, 95th Cong., 2d Sess., 18 (1978).
- 70 45 Fed. Reg. 16,438 (1980).
- 71 46 U.S.C.A. §391(a) (1978).
- 72 46 U.S.C.A. §391(a)(6)(A) (1978).
- 73 Exercise of regulatory authority is also dependent upon Secretarial consideration of the kinds and grades of cargo permitted to be kept on board such vessels.
- 74 46 U.S.C.A. §391(a)(6)(C) (1978).
- 75 H.R. Rep. No. 95-1384, supra, at 21.
- 76 44 Fed. Reg. 34,440 (1979).
- 77 The failure of the Coast Guard to substantively observe the requirements of §5 is best illustrated by its refusal to adequately fulfill the requirements of subparagraph C, the section calling for expanded consultation procedures. See letter from Admiral Hayes to Representative Biaggi, dated February 5, 1980.
- 78 40 C.F.R. §1501.2 (1979).
- 79 Id.
- 80 Emphasis added. 40 C.F.R. §1502.5 (1979).
- 81 The history of this rulemaking and a statement in the Draft Regulatory Report to the effect that the Coast Guard is committed to achieving "a totally double hulled tank barge fleet" confirm this conclusion. Draft Regulatory Statement at 34.

- 82 40 C.F.R. 1502.5 (1979); see also Sierra Club v. Morton, 510 F.2d 813 (5th Cir. 1975); Calvert Cliffs Coordinating Committee, Inc. v. AEC, 449 F.2d 1109 (D.C. Cir. 1971).
- 83 42 U.S.C. §4332(2)(C)(iii) (1976).
- 84 40 C.F.R. §1502.14 (1979).
- 85 40 C.F.R. §1502.14(a)-(c) (1979).
- 86 458 F.2d 827, 836 (D.C. Cir. 1972).
- 87 472 F.2d 693, 696 (2d Cir. 1972).
- 88 Executive Order No. 12044, March 23, 1978, 43 Fed. Reg. 12,661 (1978).
- 89 Id. Section 1(d).
- 90 Id. Section 3(b)(1).
- 91 44 Fed. Reg. 11,034, et seq. (1979).
- 92 44 Fed. Reg. 11,041 (1979).
- 93 The theme of considering alternatives is repeated in 10(b) of the regulations. 44 Fed. Reg. 11,043 (1979).

GROUP II
TECHNICAL OPTIONS AND PROBLEMS

CARGO/BARGE-TYPE INTERACTION
INCLUDING CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

W. A. Creelman
President, Transport Division
National Marine Service, Inc.

National Marine Service Incorporated has extensive experience in the operation of both single-skin and double-skin tankbarges. The National Marine barge fleet profile at the start of 1980 can be summarized as follows:

Barge Service	Hull/Barge Type			Total Barges	Avg. Age	Average Short-Tons Capacity
	Single	Double	Independent			
Ammonia	-	-	6	6	14.7	2,517
Chemical	-	86	-	86	6.5	1,431
Petroleum	29	-	-	29	24.3	2,650
Petroleum	-	16	-	16	10.2	2,420
TOTAL	29	102	6	137	11.3	1,852

All of this equipment operates on the Western Rivers System, including the Gulf Intracoastal Waterway and the Mississippi, Ohio, Illinois, Missouri, Tennessee, Arkansas, Ouachita, Cumberland, Kanawha, Monongahela, and Allegheny Rivers. We have been in business since 1927 and in the past have also operated tank ships, tankbarges, and tugboats on the Atlantic Coast and on the Great Lakes.

In addition to our tankbarging activities we operate a major inland-waterway repair shipyard and have extensive experience in the cleaning, gas-freeing, and repair of all types of barges, including single- and double-skin tankbarges.

Further, we maintain a staff of professional tankermen in Chicago, St. Louis, New Orleans, and Houston and operate river and canal towboats all of which have tankermen in the crew. Their duties include tankbarge loading and unloading as well as towboat operation. Our entire corporate experience since 1927 has been in tankbarge and tank ship activities.

Our experience tells us that while double-skin barges have important advantages in some trades, they are clearly not a cure-all for preventing pollution from tank vessels. In fact, we have found that double skins in certain casualty situations actually create a risk of greater pollution than would be the case with single skins.

We believe that the Coast Guard in its studies has used incomplete data to support conclusions which were simplistic and preconceived. It has ignored the significant difference in average age of the nation's single-skin fleet vs. its double-skin fleet. The gross difference in average age was ignored in comparing the pollution experience of single- vs. double-skin barges. The Coast Guard ignores the lack of life-cycle experience with double skins.

We will detail the trends in tankbarge construction and explore the reasons why so many new barges have been built with double skins and so few with single skins. These reasons have to do with specific cargoes and their needs for heating and cooling. We will correct the erroneous assumption on the part of the Coast Guard that somehow double-skin barges are altogether safer and "better" and less polluting.

Further, we will review the design options which the industry has long recommended to the Coast Guard, but which have been ignored. These recommendations are the product of 50 years of experience with single skins.

National Marine's investment in double-skin barges at year-end 1979 was four times as great as its investment in single-skin barges. Clearly we are not just blindly antidouble-skin. As a result of many years of direct operating experience we know the advantages and disadvantages of both barge types and are convinced that the Coast Guard regulatory proposals are misguided and jump to a preconceived and erroneous conclusion. We will explore the potentially catastrophic economic consequences of these proposals.

The Coast Guard's proposals include the rapid phaseout of all existing single-skin barges and prohibition of construction of any further single-skin barges after a specified date. These proposals raise many important questions -- for instance:

- How old is the existing fleet?
- How many of each kind of barge are there?
- How many retirements would take place and on what schedule?
- How many replacements would be needed, and what would their costs be? Could replacements be economically justified?
- What would be the effect of the changes on pollution experience from tank barges?
- What would the effect be on the way oil products are moved in our country?

SUMMARY TANK BARGE FLEET DATA

VESSEL DISTRIBUTION - ACTIVE VESSELS

SOURCE: U. S. COAST GUARD COMPUTERIZED TANK VESSEL FILE

FEBRUARY, 1979

NUMBER OF VESSELS

FLEET	ALL SINGLE SKIN	ALL DOUBLE SKIN	ALL OTHER*	TOTAL
Mid-Continent River	1407	1352	363	3122
Non Mid-Continent River	296	32	36	364
Coastwise, Ocean and Great Lakes	289	56	54	399
National - Total	2035	1453	462**	3950

TOTAL CAPACITY OF VESSELS IN BARRELS

FLEET	ALL SINGLE SKIN	ALL DOUBLE SKIN	ALL OTHER*	TOTAL
Mid-Continent River	23,697,610	17,777,108	4,509,558	45,984,276
Non-Mid Continent River	3,797,735	450,594	265,849	4,514,178
Coastwise, Ocean and Great Lakes	10,951,216	1,280,529	1,834,016	14,065,761
National - Total	38,446,561	19,508,231	6,609,423**	64,564,215

*Includes most independent tank vessels.

**Includes more than 150 double-sided, single-bottom independent tank vessels.

ANALYSIS OF USCG TANK VESSEL DATA
 NATIONAL FLEET
 SINGLE SKIN VESSELS

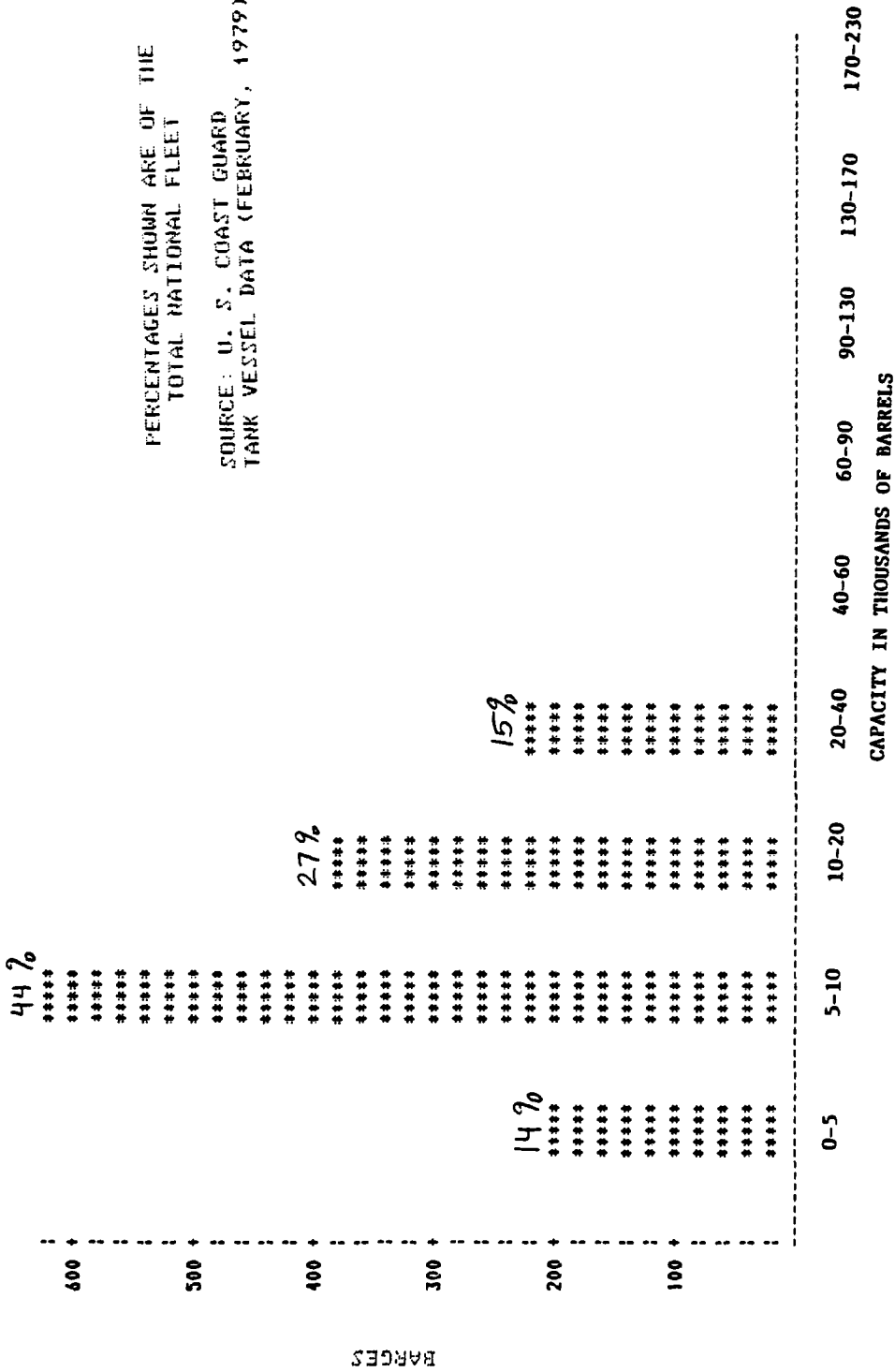
BARGES	PERCENTAGES SHOWN ARE OF THE TOTAL NATIONAL FLEET								
	0-5	5-10	10-20	20-40	40-60	60-90	90-130	130-170	170-230
600	19%	22%	33%	21%	1%	1%	1%	1%	1%
500	*****	*****	*****	*****	*****	*****	*****	*****	*****
400	*****	*****	*****	*****	*****	*****	*****	*****	*****
300	*****	*****	*****	*****	*****	*****	*****	*****	*****
200	*****	*****	*****	*****	*****	*****	*****	*****	*****
100	*****	*****	*****	*****	*****	*****	*****	*****	*****

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

ANALYSIS OF USCG TANK VESSEL DATA
 NATIONAL FLEET
 DOUBLE SKIN VESSELS

PERCENTAGES SHOWN ARE OF THE
 TOTAL NATIONAL FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

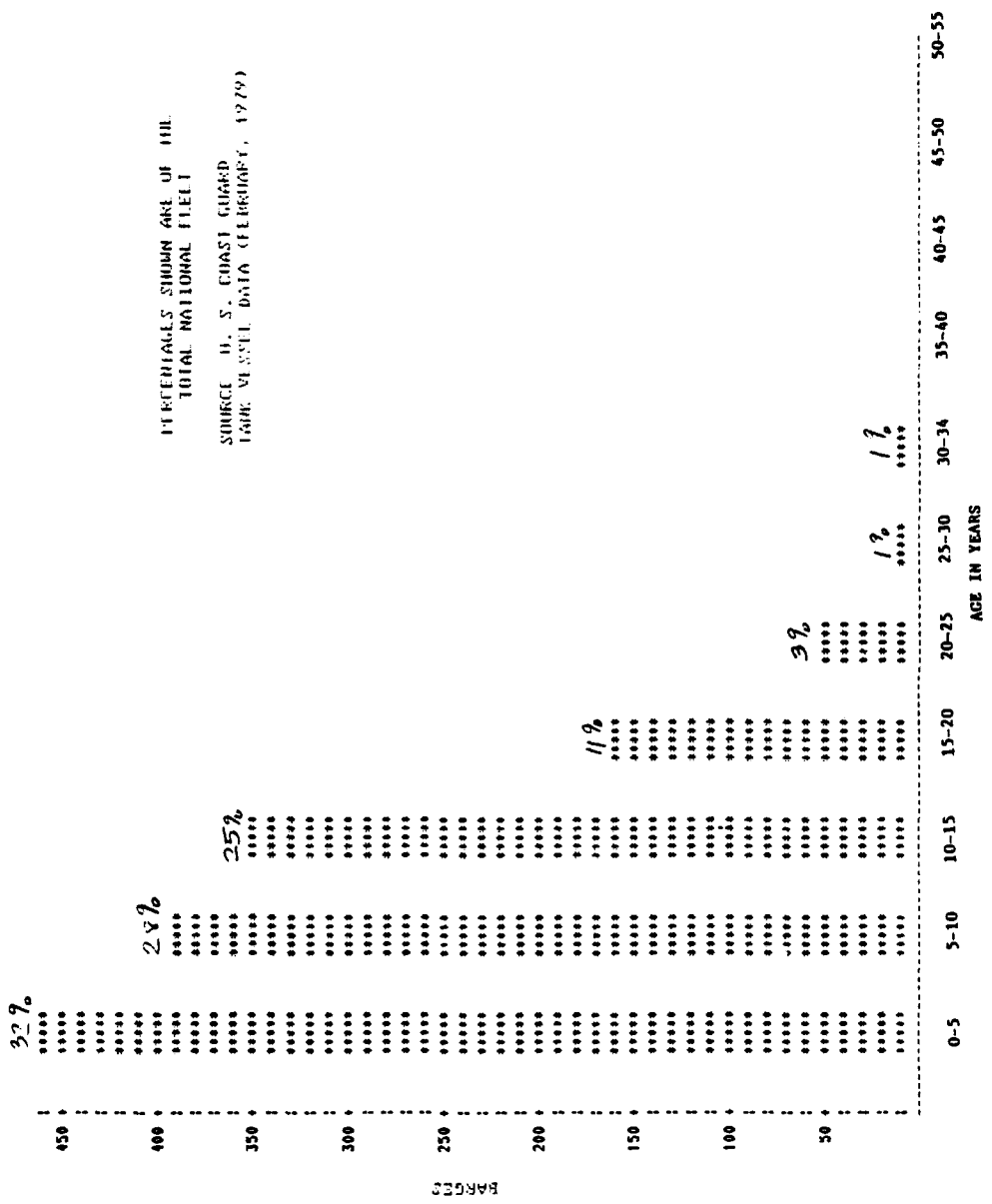


ANALYSIS OF USCG TANK VESSEL DATA
 NATIONAL FLEET
 SINGLE SKIN VESSELS

BARGED	PERCENTAGE SHIPDOWNS OF THE TOTAL BARGED FLEET										
	0-5	5-10	10-15	15-20	20-25	25-30	30-34	35-40	40-45	45-50	50-55
350	18%										
300	14%			15%							
250					13%						
200							10%				
150								7%			
100	5%								3%		
50										1%	1%

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (REVISION, 1979)

ANALYSIS OF USCG TANK VESSEL DATA
 NATIONAL FLEET
 DOUBLE SKIN VESSELS



PERCENTAGES SHOWN ARE OF THE
 TOTAL NATIONAL FLEET
 SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (CATEGORY, 1979)

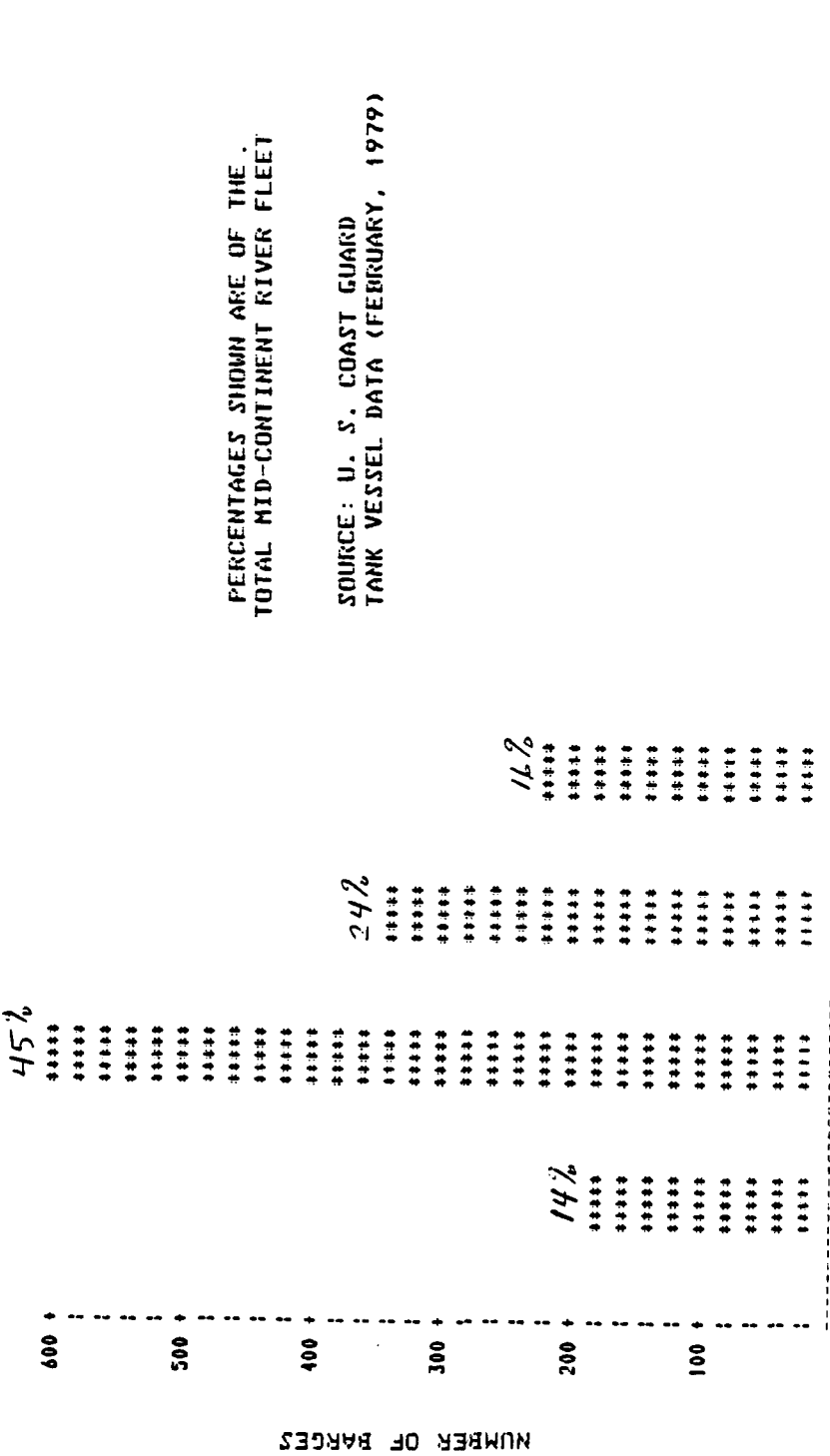
ANALYSIS OF USCG TANK VESSEL DATA
 MID-CONTINENT RIVER FLEET
 SINGLE SKIN VESSELS

PERCENTAGES SHOWN ARE OF THE
 TOTAL MID-CONTINENT RIVER FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

NUMBER OF BARGES	CAPACITY IN THOUSANDS OF BARRELS								
	0-5	5-10	10-20	20-40	40-60	60-90	90-130	130-170	170-230
500	16.9%	23.9%	36.9%	25.9%					
400	*****	*****	*****	*****					
300	*****	*****	*****	*****					
200	*****	*****	*****	*****					
100	*****	*****	*****	*****					

ANALYSIS OF USCG TANK VESSEL DATA
 MID-CONTINENT RIVER FLEET
 DOUBLE SKIN VESSELS



PERCENTAGES SHOWN ARE OF THE
 TOTAL MID-CONTINENT RIVER FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

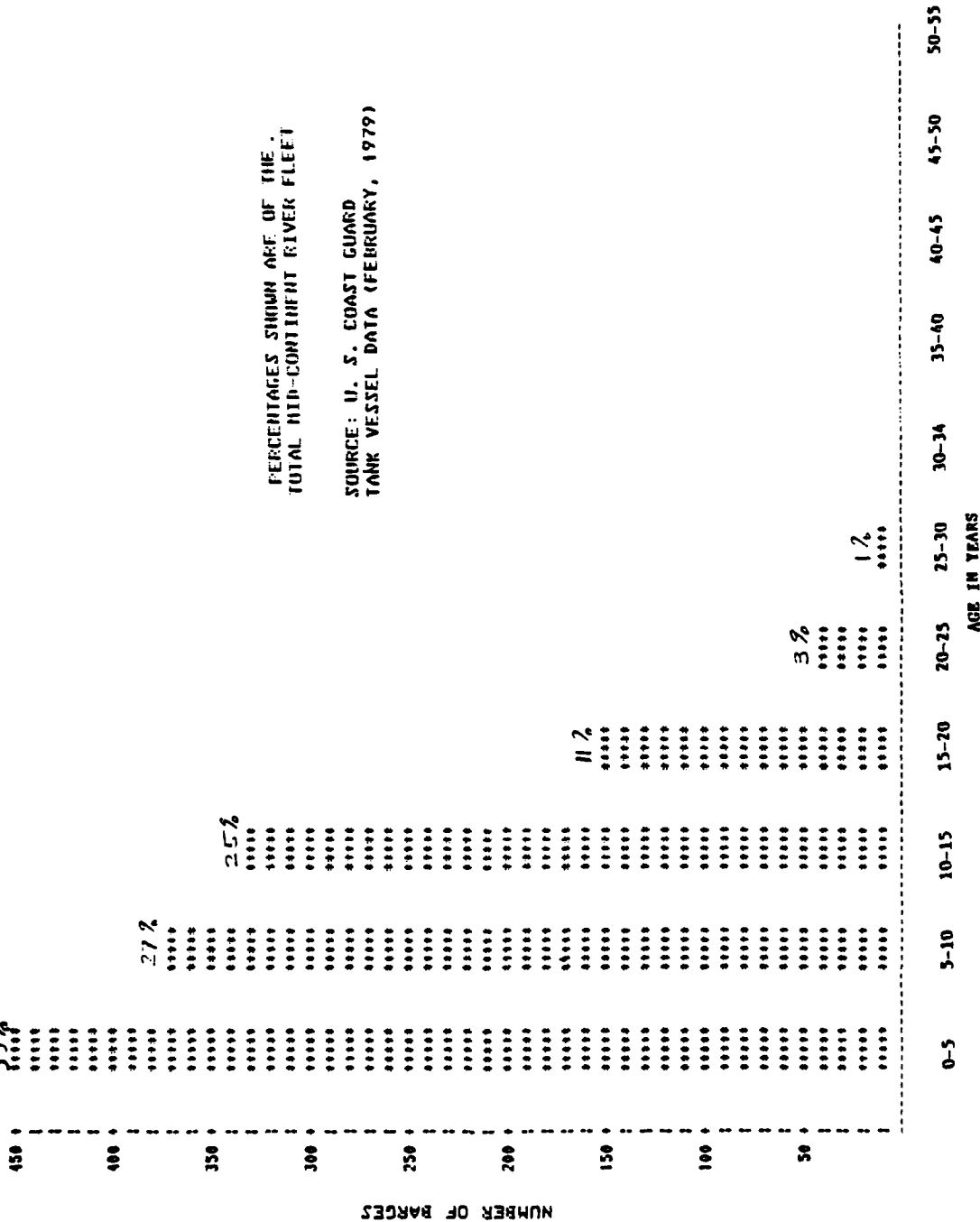
TABLE 12.4.3.3.3
 MID-CONTINENT RIVER FLEET
 SINGLE SKIN VESSELS

PERCENTAGES SHOWN ARE OF THE
 TOTAL MID-CONTINENT RIVER FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

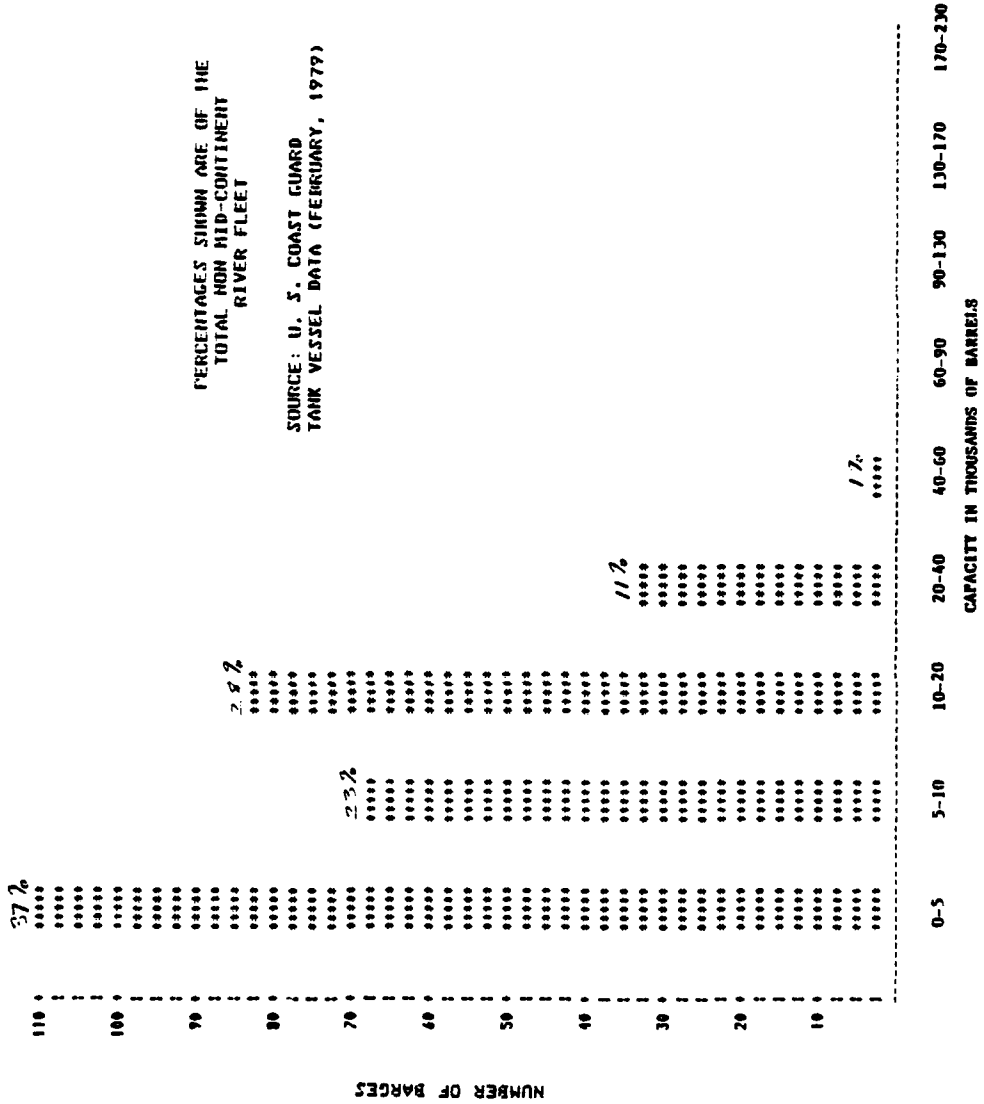
NUMBER OF BARGES	AGE IN YEARS										
	0-5	5-10	10-15	15-20	20-25	25-30	30-34	35-40	40-45	45-50	50-55
270	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%			
240	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%		
210	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	
180	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	
150	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	
120	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	
90	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	
60	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	
30	4.5%	13%	20%	15.5%	12.7%	13.2%		7.1%	3%	1%	

ANALYSIS OF USCG TANK VESSEL DATA
 MID-CONTINENT RIVER FLEET
 DOUBLE SKIN VESSELS



PERCENTAGES SHOWN ARE OF THE
 TOTAL MID-CONTINENT RIVER FLEET
 SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

ANALYSIS OF USCG TANK VESSEL DATA
 IN THE MID-CONTINENT RIVER FLEET
 SINGLE SKIN VESSELS



ANALYSIS OF USCG TANK VESSEL DATA
 NON MID-CONTINENT RIVER FLEET
 DOUBLE SKIN VESSELS

NUMBER OF BARGES	CAPACITY IN THOUSANDS OF BARRELS								
	0-5	5-10	10-20	20-40	40-60	60-90	90-130	130-170	170-230
13 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
12 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
11 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
10 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
9 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
8 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
7 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
6 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
5 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
4 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
3 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
2 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
1 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††
1 †	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††	†††††

11%

37%

16%

6%

PERCENTAGES SHOWN ARE OF THE
 TOTAL NON MID-CONTINENT
 RIVER FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

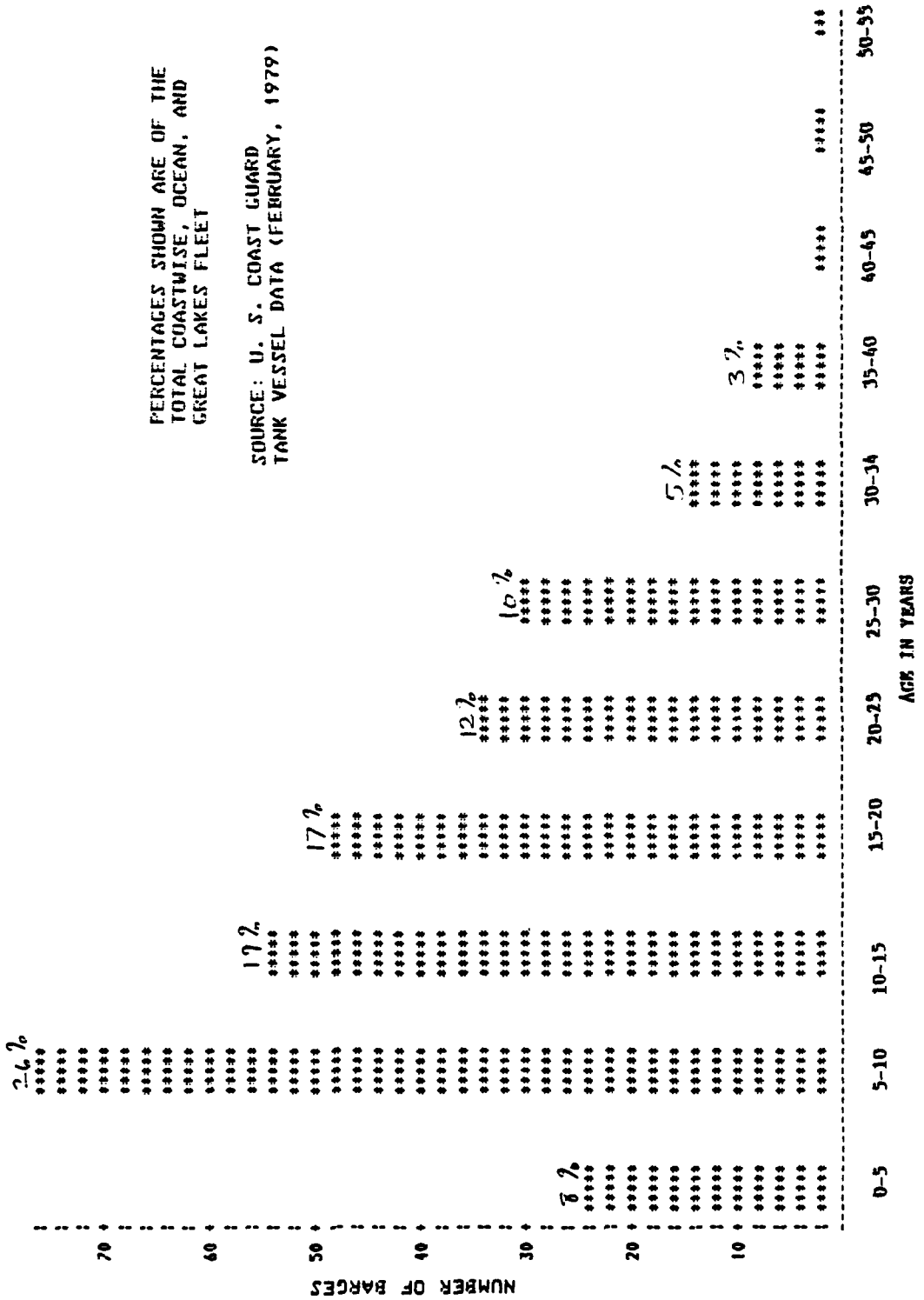
ANALYSIS OF USCG TANK VESSEL DATA
NON MID-CONTINENT RIVER FLEET
SINGLE SKIN VESSELS

PERCENTAGES SHOWN ARE OF THE
TOTAL NON MID-CONTINENT
RIVER FLEET

SOURCE: U. S. COAST GUARD
TANK VESSEL DATA (FEBRUARY, 1979)

NUMBER OF BARGES	AGE IN YEARS										
	0-5	5-10	10-15	15-20	20-25	25-30	30-34	35-40	40-45	45-50	50-55
50							18%				
40					15%	14%					
30		7%									
20			8%						8%		
10	2%										5%

ANALYSIS OF USCG TANK VESSEL DATA
 COASTWISE, OCEAN, AND GREAT LAKES FLEET
 SINGLE SKIN VESSELS



PERCENTAGES SHOWN ARE OF THE
 TOTAL COASTWISE, OCEAN, AND
 GREAT LAKES FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

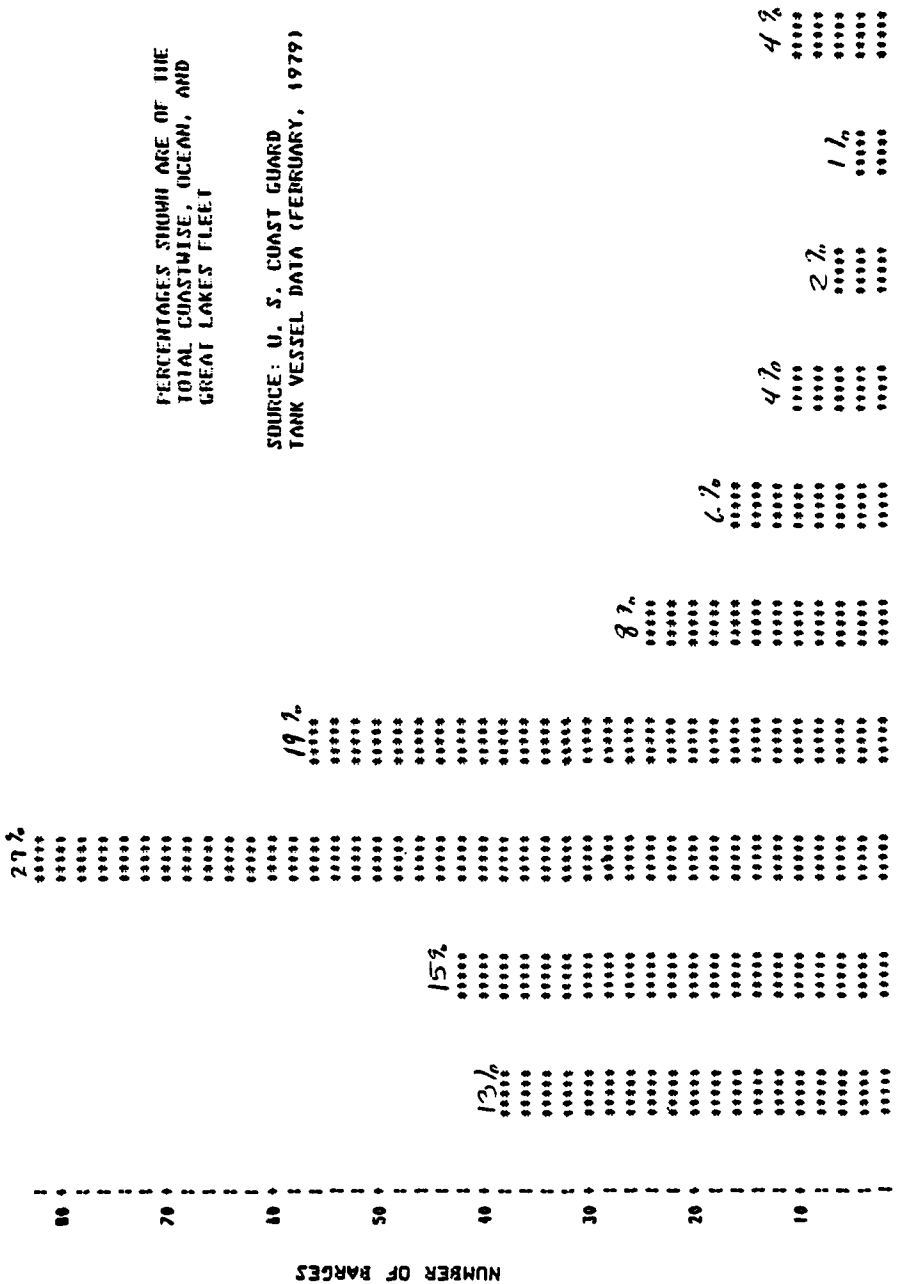
ANALYSIS OF USCG TANK VESSEL DATA
 COASTWISE, OCEAN, AND GREAT LAKES FLEET
 DOUBLE SKIN VESSELS

NUMBER OF BARGES	AGE IN YEARS										
	0-5	5-10	10-15	15-20	20-25	25-30	30-34	35-40	40-45	45-50	50-55
14 †				25%							
13 †				*****							
12 †			21%	*****							
11 †			*****	*****							
10 †			*****	*****							
9 †			*****	*****							
8 †			*****	*****							
7 †	13%		*****	*****							
6 †	*****		*****	*****							
5 †	*****		*****	*****							
4 †	*****		*****	*****							
3 †	*****		*****	*****							
2 †	*****		*****	*****							
1 †	*****		*****	*****							
			*****	*****	16%	4%					
			*****	*****	*****	*****	*****	*****	*****	*****	*****

PERCENTAGES SHOWN ARE OF THE
 TOTAL COASTWISE, OCEAN, AND
 GREAT LAKES FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

ANALYSIS OF USCG TANK VESSEL DATA
 COASTWISE, OCEAN, AND GREAT LAKES FLEET
 SINGLE SKIN VESSELS



PERCENTAGES SHOWN ARE OF THE
 TOTAL COASTWISE, OCEAN, AND
 GREAT LAKES FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

ANALYSIS OF USCG TANK VESSEL DATA
 COASTWISE, OCEAN, AND GREAT LAKES FLEET
 DOUBLE SKIN VESSELS

NUMBER OF BARGES	CAPACITY IN THOUSANDS OF BARRELS								
	0-5	5-10	10-20	20-40	40-60	60-90	90-130	130-170	170-230
15 +	28%								
14 +	*****								
13 +	*****								
12 +	*****								
11 +	*****	19%							
10 +	*****	*****							
9 +	*****	*****	20%						
8 +	*****	*****	*****						
7 +	*****	*****	*****						
6 +	*****	*****	*****						
5 +	*****	*****	*****						
4 +	*****	*****	*****						
3 +	*****	*****	*****		69%				
2 +	*****	*****	*****		*****				
1 +	*****	*****	*****		*****		4%		
	*****	*****	*****		*****		*****		
	*****	*****	*****		*****		*****		2%
	*****	*****	*****		*****		*****		*****
	*****	*****	*****		*****		*****		*****

PERCENTAGES SHOWN ARE OF THE
 TOTAL COASTWISE, OCEAN, AND
 GREAT LAKES FLEET

SOURCE: U. S. COAST GUARD
 TANK VESSEL DATA (FEBRUARY, 1979)

ANALYSIS OF U.S. COAST GUARD TANK BARGE DATA
 SINGLE, DOUBLE, AND OTHER SKIN TYPES
 NUMBER OF VESSELS AND CAPACITY (BARRELS) BY OWNER
 NATIONAL FLEET

Source: USCG Tank Vessel Data (February, 1979)

005	010	020	030	040	050	060	070	080	090	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
005	010	020	030	040	050	060	070	080	090	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
005	010	020	030	040	050	060	070	080	090	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
005	010	020	030	040	050	060	070	080	090	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
1	ASHLAND OIL INC	117	07	5	2630079	1248431	01481	3940791	209	1																
2	INTERSTATE AND OCEAN TRANS	37	2	4	2454512	00485	261009	2817064	43	2																
3	EXXON CORPORATION	07	16	3	2199146	376024	01682	2450052	100	3																
4	CENTIN TRANSPORTATION INC	67	40	6	1400654	413590	101713	2085967	121	4																
5	MOGAN TRANSPORTATION CO	47	44	10	1247424	012927	351367	2431720	109	5																
6	DIXIE CARRIERS INC	30	20	3	1031407	343744	54745	1452996	67	6																
7	LEBOUF BROS TOWING CO	50	0	2	1027435	0	4000	1033635	60	7																
8	PORT ARTHUR TOWING CO	34	0	3	739943	0	994	740937	37	8																
9	SABINE TOWING AND TRANS CO	25	0	6	728341	0	107040	074201	31	9																
10	MATL MARINE SERVICE INC	34	73	2	692799	956245	40600	1409732	109	10																
11	HOLLYWOOD MARINE INC	26	5	3	656092	42457	20941	719490	34	11																
12	CENAC TOWING COMPANY INC	40	0	4	572012	0	94997	667009	52	12																
13	MOGAN OCEAN SYSTEMS INC	2	0	0	543492	0	0	563492	2	13																
14	DOUGLARD TRANSPORTATION	13	0	0	517410	0	0	537410	13	14																
15	NIMES INCORPORATED	22	10	2	505491	172404	32130	710225	34	15																
16	ALLIED TOWING CORPORATION	14	2	3	478117	20000	132103	611100	19	16																
17	TEXACO INC	14	0	2	475093	0	271150	747943	18	17																
18	VALLEY TOWING SERVICE INC	19	0	0	470775	0	0	470775	19	18																
19	IRLAND OIL TRANSPORT CO	17	22	1	432420	429593	25090	000111	40	19																
20	SUN TRANSPORT INC	4	0	0	390911	0	0	390911	4	20																
21	MOBIL OIL CORPORATION	10	4	0	300750	95310	0	404040	22	21																
22	ALAMO CHEMICAL TRANS CO	20	19	4	346249	344293	91740	822302	51	22																
23	CANAL BARGE COMPANY INC	21	34	33	320500	555412	471974	1355095	00	23																
24	SILABE INC	14	0	0	327900	0	0	327900	14	24																
25	DELCHEM TOWING COMPANY	19	0	0	323374	0	0	323374	19	25																
26	PORT EVERGLADES TOWING	1	0	0	320000	0	0	320000	1	26																

ANALYSIS OF U.S. COAST GUARD TANK BARGE DATA
 SINGLE, DOUBLE, AND OTHER SKIN TYPED
 NUMBER OF VESSELS AND CAPACITY (BARRELS) BY OWNER
 NATIONAL FLEET

SOURCE: USCG Tank Vessel Data (February 1979)

008	0PWH	85K	95K	01N	85SC	01HC	ICAP	1WE8	01N	
27	COASTAL TOWING INC	10	0	0	272750	0	0	292750	10	27
28	GATEWAY BARGE LINE INC	15	0	3	271344	0	128577	397895	10	28
29	UNITED TRANSPORTATION INC	8	0	0	241980	0	0	241980	0	29
30	MAXLER TOWING COMPANY INC	14	0	0	258597	0	0	258597	14	30
31	UNION CARDINE CORPORATION	22	128	24	254187	1413403	175395	204478	174	31
32	MORAN MARITIME ASSOC	1	0	0	250000	0	0	250000	1	32
33	STEWART TRANSPORTATION CO	7	2	1	235060	8712	20200	337712	10	33
34	SPEYTHOUSE FUEL TRANS	7	1	4	231722	11100	85047	328191	12	34
35	ARTHUR SHIIM CORPORATION	15	11	1	230880	133420	20000	304500	27	35
36	US ARMY CORPS ENG	50	0	0	223180	0	0	223180	50	36
37	PITTSBURGH MARINE TRANSPORT	4	0	1	218452	0	48507	246761	7	37
38	SEABOARD SHIPPING CORP	4	0	0	218420	0	0	218420	4	38
39	DRENT TOWING COMPANY INC	8	24	4	208137	519510	113375	841022	38	39
40	UNITED TOWING COMPANY	11	0	0	205281	0	0	205281	11	40
41	UNION MERCHANT CORP	15	93	2	204248	1042872	19750	1287870	110	41
42	COASTAL MARINE TRANS	1	0	0	184427	0	0	184427	1	42
43	PUGET SOUND TUG AND BARGE	12	0	0	173887	0	0	173887	12	43
44	MARINE TOWING AND CO	2	1	0	171080	12780	0	183760	3	44
45	PUERTO RICO SUN OIL CO	2	0	0	158211	0	0	158211	2	45
46	POLING TRANSPORTATION CO	3	0	0	156783	0	0	156783	3	46
47	DAYTON CITY BARGE LINES	9	0	0	154604	0	0	154604	9	47
48	THOMAS MARINE COMPANY	8	29	0	149264	534901	0	404107	37	48
49	HEDDINGHAM MARINE SERVICE	13	0	0	149133	0	0	149133	13	49
50	MARSHALL MARINE TRANSPORT	4	4	10	148572	114374	203751	550437	20	50
51	OSWEGO BARGE CORP	1	0	0	148000	0	0	148000	1	51
52	GULF STATES OIL TRANSPORT	7	0	0	146700	0	0	146700	7	52

ANALYSIS OF U.S. HARD TANK BARGE DATA
SINGLE, DOUBLE, AND OTHER SKIN TYPED
NUMBER OF VESSELS AND CAPACITY (BARRELS) BY OWNER
NATIONAL FLEET

SOURCE: USCG Tank Vessel Data (February 1979)

005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	
005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	
005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	
005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	
53	BLADDERS BARGE LINE INC	7	3	0	145500	47401	0	213101	10	53																
54	MARINE TRANSPORT COMPANY	7	7	0	141230	187742	0	331000	14	54																
55	CONSOLIDATED EDISON CO	0	2	1	140140	25400	11624	177164	11	55																
56	GULF INTERCOSTAL MARINE	6	0	0	140800	0	0	140800	4	56																
57	MARINE EXPEDITING COMPANY	7	0	0	138957	0	0	138957	7	57																
58	TURECARD TANKERS INC	3	0	1	137179	0	22875	140954	4	58																
59	M AND S TRANSPORTATION CO INC	7	0	0	134354	0	0	134354	7	59																
60	MORANIA OIL TANKER CORP	6	1	2	129441	21500	42780	173741	9	60																
61	MISSISSIPPI MARINE TRANS	0	1	6	129235	30347	187201	346783	11	61																
62	MONTAUK OIL TRANSPORTATION	1	0	1	123037	0	0	123037	2	62																
63	TIDEWATER BARGE LINES INC	9	2	1	118189	4007	292	122478	12	63																
64	OLD MAN RIVER TOWING	5	0	0	114744	0	0	114744	5	64																
65	MCALLISTER BROTHERS INC	4	0	0	113543	0	0	113543	4	65																
66	NEW JERSEY BARGING CORP	3	0	0	112932	0	0	112932	3	66																
67	HANHAM INLAND WATERWAY CO	5	4	0	111000	123000	0	234000	9	67																
68	B NO 115 CORPORATION	1	0	0	108362	0	0	108362	1	68																
69	B NO 125 CORPORATION	1	0	0	108362	0	0	108362	1	69																
70	FOSS LAUNCH AND TUG CO	10	1	2	107471	389	11983	120043	13	70																
71	SOUTHERN TOWING COMPANY	5	13	6	104824	259231	99437	465692	24	71																
72	BEHAUER TRANSPORTATION	5	0	2	105520	0	41400	146928	7	72																
73	PETROLEUM TRANSPORT 4HC	4	0	0	103306	0	0	103306	4	73																
74	CHEVRON OIL CO	7	1	0	100423	8600	0	109823	8	74																
75	PROUD MARINE SERVICE INC	3	0	0	100292	0	0	100292	3	75																
76	VICKERS TOWING CO INC	4	0	1	100060	0	21700	121740	5	76																
77	DINTON MARINE SERVICE	4	1	0	99100	10473	0	109773	5	77																
78	LOBION INC	5	3	0	94200	49370	0	145570	8	78																

ANALYSIS OF U.S. COAST GUARD TANK BARGE DATA
 SINGLE, DOUBLE, OTHER SKIN TYPES
 NUMBER OF VESSELS AND CAPACITY (BARRELS) BY OWNER
 NATIONAL FLEET

SOURCE: USCG Tank Vessel Data (February 1979)

000	OPNWH	SSK	DSK	BTN	SSKC	DSKC	BTNC	ICAP	IVES	N
79	TRIANGLE BRIST AND FL SER	4	0	2	95700.0	0	55660.0	151560	8	79
80	REICHHOLD CHEMICALS INC	1	1	1	95000.0	10550	10872.0	115622	3	80
81	DAY CITIES TRANS COMPANY	4	0	0	94540.0	0	0.0	94540	4	81
82	HECHER SHELL COMPANY	1	0	0	94000.0	0	0.0	94000	1	82
83	ET DUPONT BENEHOUS AND CO	4	23	0	90053.0	244633	48881.6	403587	37	83
84	PALMER BARGE LINE INC	3	0	1	87105.0	0	32400.0	119785	4	84
85	BOSTON FUEL TRANS INC	4	0	0	86845.0	0	0.0	86845	4	85
86	O L SCHMIDT BARGE LINES	4	0	0	83500.0	0	0.0	83500	4	86
87	MORANTA TUG AND BARGE INC	1	0	0	82400.0	0	0.0	82400	1	87
88	AMOCO OIL COMPANY	4	0	0	81200.0	0	0.0	81200	4	88
89	BULK FOOD CARRIERS INC	1	0	0	77754.0	0	0.0	77754	1	89
90	L AND L MARINE SERVICE INC	3	1	0	76004.0	0	0.0	76004	4	90
91	DKI JOINT VENTURE	7	16	0	75868.5	165315	0.0	241183	23	91
92	DELTA BARGE LINES	9	0	0	74300.0	0	0.0	74300	9	92
93	14TH CITY BARGE AND TOWING	4	9	1	74193.0	176988	25600.0	274781	14	93
94	GEORGIA TRANSPORTERS INC	4	0	0	72022.0	0	0.0	72022	4	94
95	DELLAN TOWING COMPANY	3	0	0	70929.0	0	0.0	70929	3	95
96	UNION OIL CO OF CALIF	4	2	0	70700.0	39000	0.0	109700	6	96
97	SIMMS BROTHERS TOWING CO	4	0	0	70000.0	0	0.0	70000	4	97
98	WARREN PETROLEUM CORP	4	0	10	69714.3	0	83286.3	152503	14	98
99	COLUMBIA MARINE SERVICE	7	0	1	68933.0	0	11354.0	79389	8	99
100	TEX TOW INC	3	0	0	63725.0	0	0.0	63725	3	100

N-100
 OUT24: END OF FILE

OPERATORS	SINGLE SKIN VESSELS	SINGLE SKIN CAPACITY (BBLs)	DOUBLE SKIN VESSELS	DOUBLE SKIN CAPACITY (BBLs)	OTHER VESSELS	OTHER VESSELS CAPACITY (BBLs)	TOTAL CAPACITY (BBLs)	TOTAL VESSELS
"Top 100" Companies in single skin capacity	1309 57.1%	31,536,221 67.1%	778 33.95%	11,466,211 24.4%	205 8.95%	3,990,498 8.5%	46,992,931	2292
Next 569 Companies	718 43.2%	6,910,339 39.3%	676 40.7%	8,042,019 45.8%	267 16.1%	2,618,929 14.9%	17,571,283	1661
All Companies (669)	2027	38,446,561	1454	19,508,231	472	6,609,422	64,564,215	3953
% of Total	51.3%	59.5%	36.8%	30.2%	11.9%	10.3%		
Avg. Capacity	18,967		13,417		14,003			

NATIONAL FLEET

Tables 1 through 19 present statistics developed from the Coast Guard's own computer tape on the U.S tankbarge fleet as of February 1979. This information gives us some insight into the nation's fleet and helps to answer some of the questions listed above. Significant points made by the data in the tables may be summarized as follows:

- Table 2: Most single-skin barges are from 15,000 to 42,500 barrels capacity -- averaging about 20,000 barrels. There are a significant number of very small barges and a few very large barges -- as large as 250,000 barrels.
- Table 3: Most double-skin barges are small as compared to single-skin barges -- illustrating that they are engaged in different trades. None is larger than 42,500 barrels.
- Table 4: About 66 percent of all single-skin capacity would be obsolete by proposed Coast Guard regulations as of 1985. Barges of 40 to 50 years of age are not at all uncommon.
- Table 5: Double-skin barges are much younger. They are a relatively new idea, and there is very little actual operating experience with double-skin barges more than 20 years old. Experience comparisons usually compare older single-skin barges against younger double-skin barges. If like-age comparisons could be made, the alleged or apparent advantages of double-skins would disappear.
- Table 6: There are no very large barges in the midcontinent fleet -- barges are limited by the size of the waterways and their structures -- locks, bridges, bends, shallow depth, etc.
- Table 7: Double-skin midcontinent barges are even smaller than single-skins because they are engaged in different trades, i.e., not in petroleum trades, where volumes are large, but in chemical trades, where volumes are small and specialized.
- Table 8: Midcontinent single-skin barges have been built consistently for 50 years, but construction tapered off substantially after 1973 as domestic oil production declined and as the future of single-skin barges was threatened by regulatory action.
- Table 9: Rates of construction of double-skin barges are increasing to meet growing chemical demand and to meet the government's then-regulatory push for conversion of main-line power plants from coal to residual oil -- later reversed but not until many barges were built -- 56 big ones (30,100 barrels each) for one public-utility job alone. Those barges were equipped with heaters and would

operate on the Illinois River in cold winter weather and had to be double-skin for thermal reasons.

- Table 10: Non-midcontinent river fleet -- Hudson, Potomac, James, Connecticut, Columbia, Sacramento -- tend to be smaller than Mississippi River midcontinent fleet barges.
- Table 11: There are very few non-midcontinent double-skin barges. The reason is that there are very few chemical-barge operators outside the Mississippi River System and residual fuel operations outside the midcontinent area remain few.
- Table 12: Most non-midcontinent river vessels are single skin and are older -- nevertheless, a steady number of new ones has been built in recent years while many old ones -- as old as 52 years -- continue to operate.
- Table 13: There are very few (32) non-midcontinent double-skin vessels, but those that do exist vary from 52 years old to brand new. They are special-purpose vessels built for special trades as needed.
- Table 14: Construction dropped off sharply after domestic oil production dropped and after national policy to switch main-line generator plants from coal to oil was reversed; but about 50 percent of the fleet would be more than 20 years old in 1985.
- Table 15: While there are relatively few double-skin coastwise, ocean, and Great Lakes vessels, there appears to have been a drop-off in construction similar to that for single-skin barges after the reduction of domestic oil production and the reversal of government policy on coal vs. oil.
- Table 16: While there are very few large barges, by far the bulk of the barges are relatively small, i.e., 15,000 barrels -- only 10 percent are over 100,000 barrels.
- Table 17: There are only a few double-skin coastwise, ocean, and Great Lakes vessels, and these are quite small; only 5.5 percent are over 100,000 barrels, and about 85 percent below 35,000 barrels.

What do all these statistics prove?

1. There are more single- than double-skin barges -- 51.3 percent to 36.8 percent.

2. There is more single- than double-skin capacity -- 59.5 percent to 30.2 percent.
3. The average single-skin barge is 21.3 years old while the average double-skin barge is 10.0 years old. Single-skin barges range from 2 to 77 years of age and double-skin from 2 to 53 years of age.
4. Double-skin barges are smaller on average than single-skin by 13,417 barrels to 18,967 barrels.
5. Single-skin barges are designed and used for large-volume clean and crude petroleum trades, while double skins are used for residual oils and asphalt, which must be heated, or for chemicals which may need to be heated as in the case of caustic soda or sulfur, or which must be kept free of water as in the case of sulfuric acid.

Double skins are also used for specialty chemicals which do not move in large enough volume to warrant dedicated barge equipment and thus require tank cleaning prior to each loading to assure product purity.

These same specialty chemicals may also require special tank linings -- zinc coating, rubber lining, epoxy-phenolic linings. Both tank cleaning and tank lining are more practical and of better quality if the surface to be cleaned or lined is entirely smooth -- uninterrupted by structural members. It is this fact, together with the need for heating mentioned earlier, which leads carriers to build double- vs. single-skin barge equipment.

With these thermal, cleaning, and tank-coating advantages why not build all barges double-skin? There are at least two good reasons why not, and we will explore them at some length.

1. The economic reason: double-skin barges cost about 54 percent more than single-skin, and they use more steel per ton of capacity -- about 19 percent more -- and therefore carry a smaller payload on any given set of dimensions. Because double-skin barges are larger and heavier per ton of capacity, they also require more towing horsepower per ton of cargo capacity. In other words, at a time of raging inflation, recession, fuel shortage, and resource shortages, double-skin barges can be described as expensive, fuel wasting, and resource extravagant as compared to single-skin where single-skin equipment would be suitable.

In today's market, large, uncomplicated, inland petroleum tankbarges cost about \$26 per barrel for single hull and about \$40 per barrel for double hull. Double hulls cost about 54 percent more than single hulls, a major increment of additional cost, not the minor one to which the Coast Guard refers. Our single-skin fleet capacity is about 675,000 barrels, and its replacement cost at today's market of

\$40/barrel for double hull would be \$27 million or \$9.450 million more than the cost of comparable single-skin equipment.

Our analysis of the industry's total tankbarge fleet shows that on January 1, 1985, 1,354 barges with 19,136,458 barrels of capacity will be over 20 years old and would have to be replaced at a cost in 1979 dollars of \$765.5 million, or, using the 12.6 percent annual inflation factor which has applied to inland-barge construction for the past six years, \$1.4 billion in 1985. The financial impact is great but even greater when you realize that the companies affected will have lost the collateral value of their older single-hull equipment. It will have been rendered worthless even though much of it will be in excellent condition and perfectly suitable to meet the public need for economical petroleum transportation.

Why would 20-year-old equipment be in good condition, suitable for many years of continued operation? The answer is that all tankbarges are inspected and certificated by the U.S. Coast Guard at two-year intervals throughout their lives with only a slightly less complete inspection at the mid-period. In other words, there is a comprehensive annual inspection. In addition, barges are inspected on dry dock every three years. They are also inspected whenever any repair work is performed, without regard to the regularly scheduled inspections. To keep barges in adequate condition for continued certification, major capital and repair expenditures have to be made throughout the life of the vessel. Typically, bottom knuckles are replaced at about 10-year intervals, side-shell plating at about 15-year intervals, and bottom plating at about 20-year intervals. Frequently owners elect to replate with heavier than original steel thicknesses. Accordingly, a 20-year-old barge may have heavier shell plating and be in better condition for petroleum carriage than when it was new but less heavily plated. Nevertheless, the Coast Guard wants to throw away all single-hull barges at age 20 without regard to the cost of such waste to the operator and ultimately to the petroleum-consuming public. How much does an operator typically spend on a barge over its lifetime? Table 20 shows National Marine's actual costs for a fleet of 31 single-skin barges.

The statistics of Table 20 demonstrate that National Marine's single-hull barge fleet has been continually rebuilt and maintained. We believe the industry's fleet has been similarly maintained and improved through regular capital expenditures. The single-hull barge fleet represents a more valuable asset than realized by the Coast Guard, which ignores the continuing investment of new capital made by the owners. In National Marine's case that investment amounts to over 90 percent of new costs in 20 years, over and above normal maintenance, which averages over 11 percent of new cost per year.

Some of the equipment shown in Table 20 was built under MARAD mortgage guarantees with 25-year mortgages. Clearly MARAD does not expect these barges to be retired in 20 years, nor would it expect the

<u>Barge</u>	<u>Age</u>	<u>Original Cost</u>	<u>Additional Capital</u>		<u>5-yr Avg. Maintenance Cost</u>	
			<u>Amount</u>	<u>% of Orig. Cost</u>	<u>Average Amount/Year</u>	<u>% of Orig. Cost/Year</u>
1	16.6	\$ 79,500	\$ 101,518	127.7	\$ 12,250	15.4
2	16.6	47,500	58,324	122.8	4,920	10.4
3	16.6	47,500	104,216	219.4	11,871	25.0
4	16.6	80,500	226,955	281.9	20,117	25.0
5	16.6	109,000	98,841	90.7	11,730	10.8
6	16.6	122,000	80,102	65.7	9,200	7.5
7	16.6	149,000	170,340	114.3	1,653	1.1
8	27.1	206,274	203,665	98.7	10,139	4.9
9	27.2	209,181	14,032	6.7	12,729	6.1
10	27.1	206,478	182,451	88.4	2,625	1.3
11	27.2	135,387	57,519	42.3	2,375	1.7
12	25.9	151,413	135,417	89.4	11,394	7.5
13	25.9	192,136	217,493	113.2	12,325	6.4
14	25.1	87,000	140,191	161.1	8,461	9.7
15	25.1	102,658	80,602	78.5	17,387	16.9
16	25.1	125,689	134,033	106.6	23,866	19.0
17	25.1	114,666	169,607	147.9	15,262	13.3
18	25.1	123,988	89,767	72.4	21,168	17.1
19	25.1	126,612	110,952	87.6	20,687	16.3
20	24.2	100,251	205,159	204.7	20,158	20.1
21	24.2	100,291	171,505	171.0	11,955	11.9
22	22.3	52,500	85,675	163.2	18,584	35.4
23	22.3	52,500	212,464	404.7	13,336	25.4
24	25.0	70,000	226,080	323.0	11,113	15.9
25	9.2	247,328	133,797	54.1	34,812	14.1
26	9.2	247,968	141,211	57.0	35,047	14.1
27	9.1	250,182	141,849	56.7	26,881	10.7
28	9.0	248,280	113,316	45.6	34,845	14.0
29	8.9	259,587	69,061	26.6	24,421	9.4
30	8.9	259,581	61,012	23.5	18,831	7.3
31	7.1	67,543	22,396	33.2	6,467	9.6
TOTAL	606.6	\$4,372,993	\$3,958,550	90.5	\$486,609	11.1
Average	19.57	\$ 141,064	\$ 127,727	90.5	\$ 15,697	11.1

barges to expire at the end of the mortgage term, especially in view of the capital which is being invested throughout their life to keep them in good operating condition.

It should be noted here that were the Coast Guard's proposals to be implemented, all further capital improvements and all possible repair expenditures for single-skin barges would be cancelled. The impact of this action could only be to the detriment of the overall condition of the single-hull barge fleet as it approached oblivion by regulation. The result would be more oil spills, not fewer.

Another fact ignored by the Coast Guard in its presentation is the added steel needed per barrel of double-hull capacity. A typical 295-ft-long double-hull oil barge requires about 625 short tons of steel; a comparable single-skin barge of the same size requires only 525 short tons. In other words, because of their additional steel weight, double-hull vessels require 100 tons or 19 percent more steel than comparable single-hull vessels.

But is that the whole story? Is that all there is? No! Let's now take a look at the second reason for not building all barges with double skins.

2. Safety. All barges, single- or double-skins, can and do develop leaks in their outer shells. They develop through years of wear and tear against docks, bridge fender works, locks, and other structures as well as from sudden violent contact (collision) with other vessels or structures. So, new or old, single- and double-skin barges share the same problem, i.e., their hulls can develop leaks.

When a single-skin barge develops a hull leak in the cargo area, a cargo leak is often the result. It is for this reason that the Coast Guard has suggested eliminating the single-skin barge. But what about the double-skin barge -- what happens when its hull leaks? This is a complex question, but basically the void space between the outer hull and the inner hull or "tank" will fill with water, thus increasing the draft of the barge and increasing its effective loading. This further loading on an already loaded hull structure, in addition to increasing draft, can also put an unbearable strain on the vessel's hull. Such circumstances have led in a number of well-documented cases to the sudden structural failure of the barge with resultant serious pollution of the waters. Yet the Coast Guard suggests that double-skin barges could prevent some 90 percent of all vessel-caused pollution.

The Coast Guard arrived at that simplistic and erroneous conclusion as a result of a "survey" made by its inspection officers who were asked to make a judgment when inspecting single-skin barges which had experienced cargo leaks as to whether double-skin construction would have prevented the leak. Of course, the inspectors knew the answers their supervisors were after, and in 90 percent of the cases they said

"yes." Only those collision cases where the barge had been cut in half, seriously damaged, or deeply penetrated resulted in a "no" answer.

The consequences of flooding the void spaces of the imagined double-skin barge were not considered at all. Neither were other single-skin design alternatives, such as heavier plating at strategic wearing or grounding areas of the barge, or closer frame-spacing, or continuous rubbing strakes, or overlapping deck and bottom knuckle plate to provide a double-wearing thickness and protect the side shell from rubbing-type wear, or any combination of these alternatives. It isn't that alternatives such as enumerated above weren't offered to the Coast Guard years before. In fact, they were formally proposed in writing, first in February 1975 and again in November 1976 by the Towing Industry Advisory Committee of the Marine Safety Council of the U.S. Coast Guard, an industry advisory committee since abolished. A system of heavier scantlings is a viable alternative which deserves full study and testing. See Exhibit A, which follows.

EXHIBIT A

5 Nov. 1976
TASK No. 12-

TASK SHEET
TOWING INDUSTRY ADVISORY COMMITTEE

COMMITTEE COMMENT - 27 Jan. 1977

SUBJ: Tank Barge Construction and Design Standards for Pollution Abatement

On February 17, 1975, the committee filed a three page written comment on this subject which concluded as follows:

"In summary, we propose more stringent construction standards for single skin barges, continued frequent inspection of single skin barges and a package of incentives for industry to build and use double hull and double wall barges. In this fashion we believe the minor oil pollution attributable to single skin barge construction can be almost entirely eliminated. No standards can provide absolute protection for the environment without bankrupting the industry."

We believe this comment remains valid and we emphasize that the transition from single skin to double side or double skin barges can be speeded up by providing economic incentives for their operation. As it now stands, the Coast Guard does not appear to differentiate between single skin and double skin barges in requiring hull repairs or drydockings. Further, in the recent embargo on tank barge movement or loading during Ohio River ice conditions the Coast Guard did not differentiate by hull type but rather by cargo. The cargoes which were required to be discharged were chlorine and ammonia loaded in independent tanks mounted in Type I and Type II hulls respectively. The single skin oil barges most vulnerable to damage or to developing "a myriad of small leaks" in the ice clogged river were not the subject of any special requirements. Single skin barges remain the industry standard for oil carriage and are likely to remain so until double side or double skin barges are offered operating advantages which will permit them to compete with less costly single skin equipment.

TOWING INDUSTRY ADVISORY COMMITTEE
TO THE
UNITED STATES COAST GUARD
MARINE SAFETY COUNCIL

William C. McNeal, Chairman
Box 52708
New Orleans, La. 70152
Telephone 504-899-1521

Captain Richard Brooks
Executive Secretary
U.S. Coast Guard (G.CMC/82)
Washington, D.C. 20590
Telephone 202-426-1477

February 17, 1975

Rear Admiral W. M. Benkert, Chief
Office of Merchant Marine Safety
United States Coast Guard
Washington, D. C. 20590

Dear Admiral Benkert:

At our December 12 meeting, you requested that we offer suggestions for revising the rules for construction of tank barges used on the Mississippi River system and the Gulf Intracoastal Waterway. This letter is to give you the Committee consensus.

In 1971 several proposed rules were published as a part of CGFR 71-160. One result was a recently published MARAD/Coast Guard tank barge study. We have used this document in our considerations and recommendations here.

Although our recommendations are aimed at pollution prevention, we all must recognize that design of tank barges is a minor factor in that effort. As we interpret various published oil spill data, we conclude that less than 15% of the spills would have been prevented by barge hull construction standards different from those presently in effect. Our own many experiences as tank barge operators confirm this. However we do recommend to you certain inland tank barge construction standards to be effective for vessels contracted for after January 1, 1976. These are as follows:

1. Barges built in the double hull and double wall configurations shall meet ABS standards, as a minimum, as generally done now.
2. Barges built in the single skin hull configuration shall be built with a minimum 1/2" plating on the sides, with minimum 1/2" bilge and deck knuckles (or equivalent), with minimum 6" knuckle radii, with minimum 1/2" bottom plating on the outboard 30% of both sides and with appropriate framing and rub bars to reduce side wear and

indentation. ABS minimum standards now published are not sufficient for single skin barges in those areas noted.

We resolved, at our December 12 meeting, to assist you in the compilation of inflation impact facts pertaining to new rules. Transportation of oil in single skin barges is the most economical method, hence it has the least inflational impact. Double wall and double hull barges cost 15% to 25% more to build. Since such barges are heavier than single skin barges and since the typical inland tow is loaded to a restricted draft, a double hull or double wall barge carries less cargo per trip. This increases the per ton or barrel cost of each shipment. In our experience, oil shippers generally have been unwilling to pay a premium for "double" style barges. This is because the cost of petroleum barging is now close to the cost of transportation by certain competitive modes.

But we do believe that construction of double wall and double hull barges can be encouraged by you by providing cost-reducing incentives in new rules such as:

1. Revise the drydock period for double wall barges from the present 3 years to 4 years.
2. Revise the drydock period for double hull barges from the present 3 years to 6 years.

Since you require bi-annual inspections and have the authority to require other inspections or drydockings at any time, this will not reduce your ability to prevent polluting vessels from operating.

As a further incentive to construction of double wall and double hull barges, we propose you eliminate the mid-period field inspections of such barges. In lieu of this we recommend an owner inspection with a letter to you certifying that the owner has done such and that the barge fully meets your regulations. This will save manpower and money for you and the industry. And, here again, your authority to inspect at any time is still in effect. It may serve to start regular "self inspection" plans by industry.

In 1972 the various drydock periods for barges in the service being considered here all were revised and shortened to 3 years. We propose this continue for single skin barges along with the present bi-annual and mid-term inspections as is now done.

Since single skin barges now operating are examined at least annually (and much oftener in practice) and drydocked at least every three years, we know the present single skin fleet gets very close scrutiny. As such, we recommend these vessels continue in service as long as they can meet existing requirements. No controversial, subjective repair and renewal restriction, such as were in the preamble to CGFR 71-160,

are needed. In practice such requirements would be impossible to uniformly enforce.

In summary, we propose more stringent construction standards for single skin barges, continued frequent inspection of single skin barges and a package of incentives for industry to build and use double hull and double wall barges. In this fashion we believe the minor oil pollution attributable to single skin barge construction can be almost entirely eliminated. No standards can provide absolute protection for the environment without bankrupting the industry.

Very truly yours,

William C. McNeal

WCMcN:gp

End Exhibit A

What do the underwriters have to say about all this?

One would expect that the underwriters who insure barge carriers for the cost of oil-spill cleanup would have the best and most comprehensive record of single-hull vs. double-hull spill-cleanup costs. You would also expect the underwriters to offer much lower premiums for double hulls than single if they agreed with the Coast Guard assumption that double hulls were somehow safer and less polluting than single. But the underwriters do not agree. In fact, they state that among their worst pollution-cleanup cases were those involving double-hull barges. To confirm their point of view, which is based on the record, they charge the same premium for cleanup insurance for double-hull barges as they do for single.

The Coast Guard admitted in a public meeting this year in St. Louis that it had not thought to ask for the statistics of WQIS (Water Quality Insurance Syndicate) and "probably wouldn't take them seriously anyway because those fellows use black magic to determine their rates." The Coast Guard seems determined to bask in its own ignorance where double-hull vs. single-hull barges are the subject.

What WQIS has learned is that double-hull barges do provide a measure of protection against small hull leaks from cracked welds and small punctures, but that they are vulnerable to more serious failures. Because double-hull barges have empty void spaces they lose buoyancy when holed or when a lead develops. This increases their draft and puts them harder aground; or, if they remain afloat, they may lose stability from void-tank flooding. Added weight in the hull may cause hull failure through buckling, and loss of stability may cause capsizing with a serious pollution incident the inevitable result. There are a number of recent examples of just such failures in new double-skin barges which were built up to the highest standards of the Coast Guard and the American Bureau of Shipping.

Double-hull barges have advantages in certain special services, but they have their disadvantages, too, as the insurers and operators can confirm.

To go back to the question of hull leakage, we must not assume that a double hull is a panacea. Most hull leaks are the result of mere cracks in welds that "seep" very small quantities rather than "leak" large volumes in the traditional sense. While undesirable, these seeps do not represent a significant problem. They can be controlled in single-skin barges by reducing the cargo level in the affected tank below the outside water level, so that any leakage will be inward, i.e., water into the cargo rather than the reverse.

In the case of catastrophic collision-type penetration damage, the potential cargo loss is obviously greater but is limited by the size of the damaged compartment in the case of the single skin-barge. In the case of the double-skin barge suffering the same collision-type

penetration damage, one or more void spaces may be damaged, causing the barge to sink deeper in the water and risking both penetration of the tank shell by structural members in the void space or by the colliding vessel or structure itself, as well as risking failure of the hull girder by overloading. The risk of total cargo loss is significantly greater in the case of the double-skin barge.

The Coast Guard is well aware of this, or was when it argued against the double-bottom Regulations for Tank Vessels Engaged in the Carriage of Oil in Domestic Trade, published in August 1975 and rejecting the concept of double bottoms for ocean tankers, which had been proposed as a criterion for tank vessels trading from Valdez, Alaska, to Puget Sound with North Slope crude oil. If it seems that the Coast Guard's right hand doesn't know what its left hand is doing, perhaps it's because the system of personnel transfers every three years assures a lack of continuity and expertise in all technical areas -- in this case in naval architecture and marine engineering. But what did the Coast Guard argue in that case? Some pertinent excerpts appear in Exhibit B, which follows.

EXHIBIT B

Excerpts from: "FINAL ENVIRONMENTAL IMPACT
STATEMENT-REGULATIONS FOR TANK VESSELS ENGAGED
IN THE CARRIAGE OF OIL IN DOMESTIC TRADE"
Published in August 1975

Double Bottoms

The question of how effective the installation of double bottoms, double sides, or both might be in reducing oil outflows due to tanker accidents has received considerable attention. Until very recently, there were no double bottom tankers, and so there is no accident experience to rely on. Estimates of effectiveness of these measures must rest on (1) our knowledge of how past accidents of conventional tankers have resulted in oil pollution, and (2) estimates of how effective a double bottom or side installed in such a vessel might have been in preventing penetration of the cargo space and subsequent oil outflow. Tanker accidents, which everyone agrees occur all too frequently, are for statistical purposes relatively rare events, subject to the usual hazards of drawing inferences from relatively small samples. Table 10 presents information developed by the Coast Guard on tanker accidents over the five-year period, 1969-1973. Several important conclusions can be drawn from this information:

- a. Side-damaging accidents (collision and rammings) resulting in oil outflow occur with greater frequency than those resulting in bottom damage, the ratio being 1.4 to 1. Frequency of occurrence is one measure of pollution potential.
- b. Estimates of the total quantities of outflow from these two types of accidents, e.g., side and bottom damage, are about equal and are both large enough to warrant equal concern as to design measures to mitigate outflow.
- c. Structural failures have resulted in the largest amount of outflow. These are being explored further to look for causal factors.

It is important to note that the major portion of the outflow (80 percent) resulted from a small portion (2 percent) of the total number of involvements which resulted in total loss of the vessel as indicated in Table 10.

As a check on the validity of these figures for worldwide accidents, information on incidents occurring within 50 miles of the U.S. coastline is presented in Table 11. The correlation between the data is good in the area of frequency of incidents and relative outflow by accident type.

Certain known statistical factors about casualties in U.S waters must be kept in mind. First, collisions are the prevalent accident type, overall. Also, the surrounding physical characteristics of a port area have a great deal to do with accident types to be anticipated. Where channels are wide and the water deep, collisions would be expected to dominate. Where water is shallow with respect to the using vessel's drafts, groundings should be expected. There is a wide diversity of conditions encountered in U.S. ports and even within individual port areas. It is known that most accidents to tankers do not involve breaching of the hull. Likewise, a small number of accidents involve such high energy levels that no reasonable combination of construction features would be effective.

Effectiveness of Double Bottoms

Several attempts have been made to examine reports of tanker groundings and assess after-the-fact how effective a double bottom installed in the vessel might have been in preventing oil outflow. A major problem in any such effort is obtaining the necessary information. So is the statistical design of the study. A study of vessel accidents occurring in U.S. waters, involving tankers of all sizes which suffered bottom damage resulting in pollution during the period 1969-1973, revealed 30 such incidents (15). In 27 of these 30, that is, 90 percent of the cases, the extent of the vertical damage was less than 1/15 of the vessel's beam. For this sample, then, we can infer that double bottoms having a height of B/15 might have been 90 percent effective in preventing oil outflow. No similar such study has been done for tanker collision involvement.

Problems of Double Bottoms

Two potential problems arise with double bottoms: Flooding of double bottom tanks as a result of grounding could lead to loss of buoyancy and heeling due to unsymmetrical flooding making refloating and salvage more difficult, increasing risk of loss of the vessel and greater pollution. Internal leakage of cargo into double bottoms through access fittings or cracks in inner bottom could result in accumulation of explosive vapors creating an explosion hazard and toxic vapors creating a personnel hazard for anyone entering the tank. Again, because of the lack of operating experience it is difficult to assess how serious these problems are. Installation of inert gas systems serving double bottom tanks would reduce possible hazard of explosion. [The Coast Guard has issued a notice of proposed rulemaking proposing that inerting systems be required on crude oil carriers over 100,000 DWT and crude oil combination carriers over 50,000 DWT. (12)]. Overall, the Coast Guard feels that these problems do not represent grounds for rejections of the double bottom concept.

The cost of incorporating double bottoms has been variously estimated at between 2 percent and 13 percent of new construction cost. Some of the higher estimates quoted are for providing both segregated ballast and double bottoms, so the incremental cost of double bottoms for ships already incorporating segregated ballast would be lower than the high estimates of reference (13).

The Coast Guard is not opposed to double bottoms, but at the time proposed rule were published in June, 1974, felt that from the accident data available, no particular type of damage so dominated the accidental release of oil that a single design solution should be stipulated in law or regulation. The data support the need to place greater emphasis on designing tank vessels from the point of view of minimizing accidental oil pollution. New tank vessels over 70,000 DWT must be designed with up to 20 percent additional volume in order to meet the segregated ballast draft and trim requirements contained in the proposed regulations. (The exact amount of additional volume depends on a number of factors including ship size, amount and location of fuel carried, and the amount of water ballast the ship carried anyway.) The Coast Guard recognized optimizing the location of this volume as defensive space could provide significant improvement toward reducing accidental outflow. A special group was convened to review the problem and examine possible regulatory approaches capable of improved protection in accident circumstances, but without specific constraints which would inhibit future development of promising design concepts not yet identified. The results and recommendations of this group are contained in Appendix C and have been incorporated in regulations setting criteria for distribution of segregated ballast.

Tank Size Limits

The alternative of reducing tank size limits is discussed in reference (17), page VI-56.

Halving of tank size limits will affect both accidental oil spillage and operational discharges. Based upon IMCO studies, reducing the tank size by a factor of two would reduce accidental oil outflow from a standard 250,000 DWT tanker by approximately 17 percent. Increasing the number of bulkheads will increase the complexity of piping and create more surface area to which oil cargo can cling during the discharge operation. This increases the amount of oil which must be cleansed from the tank and separated out during LOT and sludge removal operations. Therefore, further subdivision of cargo tanks will tend to increase the amount of oil pollution due to tanker operations thereby offsetting the reduction from accidental pollution. In addition to increased complexity of piping systems, other disadvantages of reducing tank size are increased steel weight of vessel (reduced DWT), increased chance for overfilling a tank during tank loading operations and longer loading times.

The formula adopted for segregated ballast distribution criteria does require decreased tank sizes in some constructing opinions. For example, should a designer choose to use a staggered wing distribution of ballast, tank sizes must be considerably reduced for the vessel to meet the distribution criteria.

Structural Failures

As indicated in Table 10, structural failures resulted in the largest amount of outflow from tanker accidents over the five-year period, 1969-1973, and the bulk of this was from ships which were total losses. Table 12 presents results of a separate survey of 47 tankships lost, showing that loss of ship as a result of structural failure of the main hull girder was the largest single source of oil outflows.

There are a number of factors which affect the overall structural integrity of tankers over their service life. The initial strength of the vessel depends on the ship designer, ship builder, and the classification society and regulatory agencies they work with. During the vessel's operating life, its strength may be affected by the amount and distribution of the weights it carries, the weather and sea conditions it operates in, and the deterioration due to corrosion or other causes.

The structural design of ships is a complicated process. Merchant ships must have adequate structural strength for the service they are to see, with margins for unknowns and normal wear and tear. There is little virtue in excessive strength beyond this point, since it involves excess weight, higher transportation costs, and less efficient operation. The problem is to determine "adequate structural strength" and the required margins. There are two basically different approaches to structural design -- "evolutionary" and "deterministic." The first of these develops satisfactory rules and procedures on the basis of trial, experience, and modification. In the "deterministic" approach, as many of the factors affecting the structure throughout its life as possible are determined, and this information is used to prepare a design with a minimum of reference to previous experience. Loading on the ship, material properties, corrosion rates, detailed response of the structure to each state of loading, and much more must be quantified, and then the effect of these things on the probable behavior of the structure during its lifetime taken into account, largely by calculation (18).

Ship structural design currently uses a combination of these two approaches, with a growing tendency toward "deterministic" methods where no relevant previous operating experience exists. A completely deterministic approach is not feasible, however. In general, the data and statistical techniques for calculating risks of failures are not presently available. Uncertainties concerning loadings, quality of material and construction, and accuracy of analysis are taken into account by the use of margins of safety against damage selected by the

designer with the help and supervision of the classification societies and regulatory agencies. Once information needed to calculate risks of failure is available, the problem of determining "What is an acceptable risk of failure?" will remain. (18)

Strength during a vessel's life may be affected by overloading, improper load distribution, encountering rougher weather or seas than it was designed for, or deterioration of structure due to corrosion.

Limiting draft of a vessel may be determined by structural strength, freeboard needed to prevent damage due to boarding seas, or reserves of buoyancy or stability needed after loss of hull integrity. The 1966 Loadline Convention contains no strength standard, inasmuch as the various assigning authorities were not in agreement as to a proper standard. There was a universal feeling that for larger ships freeboards could safely be reduced. The final freeboard table for large ships, particularly for tanker and similar types, showed greatly reduced freeboards at the upper limit of length. However, in order to obtain the reduced freeboard, a ship must meet certain standards of subdivision and stability in a damaged condition. As a result, it is generally felt that ships will be safer, despite the reduced freeboards, because of the subdivision requirement. (19)

The requirement contained in the 1966 Loadline Convention for load distribution information to be provided to the Master of a ship will help to eliminate improper load distribution, perhaps a greater risk than overloading.

Deterioration of a ship's structure due to corrosion or wastage is also a complicated problem. In the past it has been taken into account by including a wastage allowance in the ship's scantling. The proper allowance, being based on a predetermined period before the strength of the structure is reduced to the established minimum, is impossible to determine with exactness. Corrosion itself is a complex electrochemical phenomenon affected by a multitude of factors. (20) Loading systems, cathodic protection, and materials improvements have been used in various ways to reduce corrosion effects. Periodic inspection and maintenance to locate and correct abnormal wastage problems are also essential.

Collection and analysis of accident statistics as a check on the structural performance of tankers is important, but this information has not generally been collected and made public worldwide, although presumably the classification societies have a good deal of such information. To provide input for revising requirements (either loadline or wastage allowance requirements) this information should include information on factors noted above.

Studies of tanker accidents seem to show an age dependency of structural failures with most failure occurring after ships are over 12-15 years of age. This is probably due to the combination of a

number of factors -- latent design and construction defects, deterioration of vessel's structure with age, extreme sea conditions, or other factors we do not know about. (One of the most troublesome problems is obtaining information after an accident has occurred.) Accidents involving U.S. vessels or foreign vessels in U.S. waters are investigated and published by the U.S. Coast Guard and the National Transportation Safety Board. Some other maritime nations similarly investigate and publish reports of serious accidents involving their vessels. A number of countries do not, so information on many accidents is very sketchy or nonexistent. Are these accidents the result of conditions which do not apply to other tankers (poor workmanship in one construction yard during one time period, design details unique to one vessel or class of vessel, lack of or failure of protective coating, etc.) or to more general conditions (widespread overloading, corrosion, etc.)? No one really knows.

What alternatives are available for reducing tanker structural failures? For new ships, greater initial strength could be required (increased safety factor), but how much? This would result in an increase in the amount of steel used in these ships, increased weight, increased cost, etc. The allowable loading of new and existing vessels could be reduced by increasing required freeboard and changing loadline assignments. (Unknown here is how widespread the practice of overloading is at present. It is difficult to detect overloading. Mere observation of a vessel at start and end of a voyage is not sufficient to determine that a vessel was not overloaded at some point in the trip because of the route and loadline zones transited. Many masters may be unaware of the hazards of overloading. The effects of overloading may be cumulative -- a vessel may be overload and still complete the voyage safely for many voyages before it is lost.) The periodic inspection of a tanker's hull to detect signs of deterioration which might lead to structural failure is a major task and it is growing as larger tankers enter service. The immensity and difficulty of this task alone may require a change in design allowances for corrosion and safety factors.

End Exhibit B

Keep in mind that the words and conclusions in Exhibit B were written by the same agency which now proposes to eliminate all single-skin barges as rapidly as possible and require not only double bottoms but double sides as well.

Why is there so much confusion and even self-contradiction on the part of the Coast Guard and indeed others in this area of single- vs. double-hull characteristics and advantages? Perhaps it's because so little actual design analysis has ever been done regarding barges.

Following the catastrophic failure of a Type II double-skin oil/chemical barge in the National Marine Service fleet in May 1976 in Galveston Bay involving a major pollution incident, National Marine inquired into the nature of the Coast Guard design-approval and construction inspection. It turned out that while the builder was required to submit to the Coast Guard for approval certain calculations having to do with hull girder strength, damage stability criteria, and "pinnacle" grounding survivability, the calculations submitted were incomplete, and though they had never been checked, they were nevertheless approved. Similarly, the American Bureau of Shipping (ABS) simply "filed" the calculations -- never checking them for accuracy or even reasonableness. In fact, the Coast Guard and the ABS later admitted that no scientific work had ever been done in the area of tankbarge structural analysis nor had any tests, full scale or otherwise, ever been conducted on the thousands of tankbarges in existence. Barges had been built and approved in the same basic way for years without any major problems, so no scientific engineering study had ever been done.

Before rebuilding our failed barge, National Marine tried to bring the case to the attention of both the Coast Guard and the ABC technical staffs. After much pressure from National Marine, ABS finally reviewed the matter and acknowledged that while the barge had been classed Maltese Cross Al Lakes, Bays and Sounds, the highest ABS classification, and had been confirmed as a Type II hull under Coast Guard and ABS rules, the subject double-skin barge in fact could not sustain the required compressive deck stresses which it has experienced, but which were less than the stresses the barge was classified as capable of surviving -- namely the pinnacle grounding stresses. Eventually, the Coast Guard "bit the bullet" and condemned all 40-odd double-skin barges of the same type and required that all be strengthened.

National Marine, having lost confidence in the regulations and classifications which governed tankbarge construction and in an effort to develop some hard data on which to base an important business decision, conducted some full-scale tests. National Marine, largely on the basis of those tests, believed then and believes now that the required and approved strengthening was inadequate and on its own barges added more than twice the additional strength recommended by the ABS and agreed to by the Coast Guard. National Marine then ran

full-scale tests on the strengthened (to National Marine standards) barges. The tests referred to here are a mere scratch on the surface of real tankbarge design analysis, but may represent an important first step toward the kind of responsible design review and evaluation which is necessary before any sweeping changes are recommended by anyone.

An interesting and revealing sidelight on all this is that the structural changes required by the Coast Guard applied to these barges only if they were to be in chemical service -- the agency was willing, and is willing still, to permit them to continue in petroleum service without any strengthening whatsoever, even though the failure in question occurred while the barge was in oil service and the residual oil spill from the double-skin barge required \$200,000 of cleanup effort! Was the Coast Guard and/or the ABC motivated by a desire to avoid embarrassment for its own design-review procedures, or the lack of them, rather than by concern to reduce future pollution incidents? We are not sure. The fact that is most surprising is that following such a confidence-shaking experience, and without any further comprehensive technical evaluation, the Coast Guard would proceed to propose that all future barges be built double-skin.

What about National Marine's record? We operate both single- and double-skin barges -- how do they compare relative to pollution incidents in the carriage of petroleum? We have carefully reviewed our record and first have eliminated all spills resulting from tank overflow. These spills results from tankerman error and have nothing to do with hull configuration. During the Coast Guard's sample period, the years 1973 through 1978, using the Coast Guard criteria including only those spills involving more than 100 gallons, we find there were 10 incidents. Two incidents involved double-hull vessels with a total of 2,010 barrels spilled; eight incidents involved single-hull vessels with a total of 5,490 barrels spilled. But single-hull capacity represented more than 70 percent, whereas double-hull represented only 30 percent. Therefore, on the basis of barrels spilled per barrel of capacity, the results were nearly equal, even though the average age of the single-hull equipment was about four times that of the double-skin. Further, the most serious single-hull accident by far, involving 66 percent of the total oil spilled in all 10 incidents, was the result of a ship collision which would have had the same result had the barge been double-hull.

For that kind of advantage, if there is one, the Coast Guard would have us discard the majority of the existing domestic petroleum-barge fleet without even exploring alternatives. It would require us to build all our new vessels in a configuration which is more than 50 percent more expensive and uses 19 percent more steel, but can't show any appreciable advantage, nor does the only insurance underwriter see any advantage in the proposals the Coast Guard has made!

Let's refer back to the Coast Guard's record of National Marine's spills of more than 100 gallons during the four-year sample period. The Coast Guard listed three, all involving single-hull barges, but there were 10, eight of which involved single hulls and two of which involved double hulls. The five missing single-hull spills were by far the most prominent of all the spills which occurred during the period. They received significant coverage on television and radio and involved large cleanup efforts. How could they have been overlooked by the Coast Guard? Perhaps they were excluded because they did not support the Coast Guard's preconceived conclusion. Whatever the reason, the fact that the Coast Guard's statistics were so sloppy, or so biased, completely invalidates any conclusions drawn from those statistics.

National Marine has a major commitment to and investment in double-skin barges. We have 26 on order now and took delivery of 22 new ones last year. But also last year (1979) we suffered two accidents which resulted in total cargo loss. Both barges were relatively new, both were the highest category (Hull Type I) of double-skin barge. No major collision was involved in either case. We also had a number of incidents involving release of cargo from single-skin barges, but none of those involved any significant cargo loss, even though the single-skin barges in our fleet are on average well over 20 years of age. With this background you will understand why we do not agree that simply jumping to the conclusion that "two skins are better than one" will solve any of our pollution problems.

There is an enormous absence of fact, documentation, or statistical backup in comparing single vs. double skins which makes rational decisionmaking impossible. For instance, who among us can answer a question very basic to our subject, namely, "What percent of the oil moved by barge moves in single skin and what percentage in double skin?"

Also, what percentages of the following products move single vs. double skin? -- clean oils, crude oils, residual oils, lube oils, asphalt. Neither do we have any statistics which compare the number or quantity of all cargo spills or all oil spills from single- vs. double-skin barges.

The development of these facts would appear to be absolutely essential to any logical decisionmaking process. To make a decision in their absence would be like diving off a dock in the darkness. You run the risk of landing on a rock! The Coast Guard has been guilty of writing regulations in the dark. It has made no effort to develop these basic facts.

The industry believes that the Ivory Soap percentage of clean and crude petroleum products moves in single-skin barges. The industry believes that long-haul (i.e., Gulf to Chicago) and cold-water residual-oil movements tend to take place in double-skin barges for thermal reasons. Double skins provide some insulation and reduce fuel costs for cargo heating. Most asphaltic materials also move in

double-skin barges to minimize heat loss and cargo-steaming time and expense. The majority of "chemicals" moves in double-skin barges. But all things considered, we believe that about 80 or 90 percent of oil moved by barge moves by single-skin barge.

The Coast Guard would have us believe that the industry is only building double-skin barges, but its own data file shows that in the five year period ending February 1979, 66 new single-skin barges with a total capacity of 2,775,224 barrels were built. And many more single-skin barges have been built this past year as well.

How can these industry impressions be documented? This paper shows a great deal of data from the Coast Guard computerized tank-vessel file relative to barge-hull types. That same file shows cargo certification of all tank vessels. The U.S. Corps of Engineers gathers data on a monthly basis from all waterway users showing which operators and which vessels use what waterways carrying what broad category of cargo (oil, chemical, fertilizer, grain, coal, etc.). Perhaps these two complementary data banks could be brought together cooperatively to seek the answers to the vital questions enumerated above. Having the facts always beats stumbling around in the dark. If the National Academy of Sciences study or workshop we are all engaged in here accomplishes nothing else but to establish the procedures for obtaining the necessary facts for a recent sample period of not less than a year it will have more than earned its fee.

Tankbarge transportation of oils and hazardous cargoes is the lowest-cost, most energy-efficient, and safest surface mode of transportation. At a time of raging inflation, recession, energy shortage, and environmental concern we need to encourage it through rational regulation and scientific engineering design and operational development, not destroy it by blind, uninformed, militaristic, regulatory overkill.

NOTE: A word about the statistics in this paper. National Marine (NMS) has obtained a copy of the Coast Guard computer tape which contains its domestic tank-vessel file. The tape used was updated to February 1979 and is of the type regularly used by the Coast Guard for a variety of purposes, one of which is publishing periodically a List of Inspected Tank Barges and Tank Ships, CG-499. That publication is organized alphabetically by barge name and is useful in that form for those seeking information about a particular barge. But there is no summary information published. What NMS has done is to design programs which organize the information by barge type, by operator, by age, by capacity, by area of certification, etc.

The information is accurate in total, but individual barge companies may find discrepancies between their own fleet and the listing of their fleet. Some of these discrepancies can be explained by chartered barges, which may be shown under the charterer's rather

than the owner's listing. Many operators' names have been combined into one which we believe to be of the same management. For instance, NMS had 10 or 12 separate listings because of Coast Guard misspellings and abbreviations as well as separate corporate names which are part of the same basic company. We consolidated those listings in our own case and in other cases where we had the necessary information.

We found many errors in the individual data, many omissions, many un-coded members. For instance, capacity is listed in some cases in gallons (g), in other cases in barrels (b), and elsewhere in tons (t). The numbers, therefore, are followed by the identifier (g), (b), or (t). But many capacity numbers have no identifier, or in some cases the identifier exists but there is no number. We have made many calls to the Coast Guard computer group in Washington and to individual operators in an attempt to correct apparent errors, to fill in missing information, or to seek clarification. We believe the results are satisfactory for our purposes here. We hope the communication which we have had with the Coast Guard will result in its doing a more careful, complete, and accurate job of posting data in the future than in the past. The Coast Guard personnel in the computer group have been extremely cooperative and helpful.

We also hope that in the future the Coast Guard will use the data which it alone can collect through its tank-vessel inspection program to develop background information before regulations are written rather than after.

National Marine has several Coast Guard tapes, one from 1975, one from 1978, and one that was used in preparing these data which are as of February 1979. A new tape, updated through March 1980, is now being obtained. We are also working on the development of programs which will make it possible to compare data from tape to tape to accurately identify vessels which have been retired or lost, as well as to identify rates of new construction by type, by trade, and by area.

NMS will be glad to use these data to help develop any information which NAS may need in its work on this project.

SOME ALTERNATIVES TO DOUBLE HULLS

William C. McNeal
Consultant

At the beginning of this brief presentation, I would like to tell you about my experience with inland tankbarges and with Coast Guard rulemaking for tankbarges and other aspects of towing operations.

I am a certified tankerman. I have been since 1953. I have worked as a barge tankerman. So my dissertation today may be light on theory, but it is heavy on experience. Additionally, I served on the Coast Guard's Western Rivers Panel and then on its Towing Industry Advisory Committee from 1968 to 1977 including a two-year tour as chairman of the latter group. These committees looked at most of the regulatory ideas proposed during that decade of regulatory explosion.

History shows us that operators of tankbarges always have been the group most concerned with the safety of the barges and the cargoes. This goes hand in hand with the fact that operators have the most to lose. Given the high cost of barge construction and repair and the high cargo values of today, operators are still the most concerned and the most innovative in suggesting and implementing tankbarge and cargo-safety measures. Let's take a look at two stories from the past.

In the early 1960's, Exxon evolved a plan for shutting down barge-pump engines from a location on the barge well away from the pump well. The idea came from experience. There was a barge fire in the pump area while a barge was discharging. Nobody could get to the cargo pump to stop it. The cargo hoses burned. The pump kept fueling the fire and creating pollution.

The Exxon remote shutdown idea is now part of the tank vessel rules in 46 CFR 32.50-35. This requires a shutdown mechanism located at least 100 ft. (or half the barge length) from the pump. The first shutdowns were activated by pulling on the end of a long cable, generally running inside tubing. Now, most operators have eliminated the tubing, since the cable sometimes rusted in the tubing and, more importantly, because the exposed cable can be pulled anywhere along its length to stop the engine.

When I first saw a tankbarge, there were no facilities on the barges to catch the oil that might spill when the cargo hose was disconnected from the barge header. At that time, there was no particular concern about spilling oil, but there was concern about injury from falls on oil-slick decks. So industry persuaded the Coast Guard to allow fixed drip pans to be built on deck under the hose connection points. After a few years, and much discussion, the Coast

Guard determined that the drip pan was a substantial fire hazard if filled, or partially filled, with oil. So they made industry remove all the fixed drip plans from the barges.

Early in the 1970's, the concern with oil pollution brought about another bureaucratic reversal and drip pans are now required on barges. I guess the prevention of oil pollution is thought to be more important than the possibility of fire or explosion.

This triple play illustrates the changing emphasis in regulation, with the attendant cost and confusion. Tankbarge operators thought drip pans were a fine idea in 1950; they think so today. Such consistency was not reflected in the government sector. It should have been.

One very important consideration with respect to my suggestions here is that they apply to tankbarges carrying oil, products regulated by Subchapter D and so enumerated in 46 CFR 151.01-10(d). They do not apply to the chemical-carrying tankbarges, regulated under Subchapter O. Some of the oils carried in tankbarges pose no particular hazards; fish oil is an excellent example. Others, like asphalt, have heating requirements that virtually preclude the use of double-hull barges because of heat expansion problems. The oils vary in weight from about 5 to 10 pounds per gallon. Obviously, double-hull construction for the very light products would result in monster vessels, uneconomic and probably less safe than conventional sizes.

I urge you to approach the matter of oil-barge design with such practical considerations in mind. There is an old automobile advertising slogan, "Ask the man who owns one." This is sound advice in the oil tankbarge business, too. Since I have owned at least part of a barge, and since I have loaded and pumped many others, let me offer some ideas for improvement of current barge design and regulations to promote safety and prevent pollution. There are plenty of untried alternatives to the double-hull idea. I believe some would be even more effective in preventing oil pollution.

At a meeting of the Towing Industry Advisory Committee in December 1974, a Coast Guard representative challenged the committee to provide him with suggestions for revising American Bureau of Shipping rules to make oil barges stronger. The committee responded in a letter dated February 17, 1975, and followed up with a letter dealing with economics and dated May 21, 1975. To my knowledge, no response has ever been made to the suggestions.

One of the first industry suggestions was that single-skin tankbarge skin-plating thickness be increased. I believe sides and bottoms should be a minimum of 1/2 in. thick and that decks should be a minimum of 3/8 in. thick on any newly constructed single-skin barges. Obviously the framing should be commensurate with plate thickness. Actual framing size cannot be specifically stated here since it depends

on frame spacing, length, and depth. There are guides in the American Bureau of Shipping rules with respect to scantling size in relation to plate thickness. Sectional modulus is a major consideration.

A big source of oil pollution is cracking of both the deck and the bilge knuckles as a result of bumping or rubbing docks, lock walls, and the like. Barges with sharply bent knuckle, such as the 1 in. radius common a few years ago, tend to crack more easily because of the built-in building stress. Extreme cold weather accentuates the problem by adding brittleness. No single-skin barge should be built with round knuckle of less than 6-in. radius. I have had experience with heavy angle-iron knuckles; they resist cracking and damage very well. I prefer angle iron, but there are drawbacks. Either should be permitted.

Side rub bars should be installed top and bottom continuously the full length of the barge. This rub place should be centered on a longitudinal side frame in both locations. I have seen single-skin barges built with rub plates welded to the skin without framing backing. This creates side distortion and cracking as the rub plates are pushed into the side plating.

Usually the longitudinal framing common in single-skin oil barges is made of serrated half channels or angles. There is no need for serrated side framing. Bottom framing will need some limber holes, but this should be kept to a minimum and certainly the framing should not be serrated. The serrated frames cause thin spots and weat spots in the attached plating. Using solid framing, with limber holes where needed, will prevent this and not significantly interfere with cargo drainage, especially when combined with a minimum 6-in. bottom deadrise. Remember that, in discharging, a barge is tilted at various angles, and very little of the cargo is trapped by the floor framing.

On-deck pipeline headers should be slanted inward to drain toward and into the vertical loading riser. This will eliminate virtually all of the spill possibilities when hoses are disconnected.

Inland barges should be divided, either longitudinally or transversely, into cargo compartments not exceeding 6,000 barrels capacity. In a recent collision in the New Orleans area, a double-hull barge was severely damaged on a bow corner, allowing about 9,000 barrels of crude oil to spill. Had the damage been done to a normal, single-skin barge, the cargo loss would have been 50 to 60 percent less because of normal subdivision. Compartmentation may not stop oil spills, but it can limit a spill size. Of course, ocean barges comply with IMCO subdivision standards, so they do not have the same problem.

There are certain design features that can make a barge easier to pump and load. One is to have 12-in. diameter ullage holes. No tankerman can see well through the 6-in. holes now required by the rules. The larger openings would help prevent overfilling. Another design feature is to insure easy access to each cargo-tank ullage

opening and valve. This is rather simply done by confining the on-deck lines for such things as steam, vapor, and cargo to one side of the barge and by making sure the walkways on trunked barges run the full length of the barge as well as to the ullage hatches.

All the foregoing have to do with tankbarge design and construction. It seems to me that one other idea advanced in 1975 is worthy of consideration, although it got none from the Coast Guard then. The idea is simply to reduce the inspections required for double-skin and double-side barges to promote such construction on economic grounds. The cost of gas-freeing, cleaning, and dry-docking is very high. If an operator could have half as many Coast Guard inspections requiring such work, much shipyard cost could be avoided. Operators might choose to build double-side or double-skin barges if such cost incentives were a part of Coast Guard regulations.

There is one related idea I would like to advocate in closing. In the event of an oil spill, barge personnel call the Coast Guard. They expect a response from the Coast Guard, which is generally located close to the waterway where a spill might happen. But in most river areas, the Environmental Protection Agency is designated as the group in charge by the National Contingency Plan. For example, if a spill happens at Memphis, the local Coast Guard has to whistle up an EPA representative from Atlanta to come on scene and take charge. This is sheer foolishness. It begs for a logical change. I hope you will so recommend.

OBSERVATIONS ON POLLUTION-PREVENTION PERFORMANCE
OF
DOUBLE-SKIN TANK BARGES IN RIVER SERVICE

C. Van Mook
Manager - Marine Engineering
Dravo Corp.

Preface

Since the author joined Dravo in 1964, that yard has built 25 single-skin tankbarges; 9 single-bottom, double-sidewall tankbarges; and 445 double-skin tankbarges. All 445 double-skin tankbarges were designed as Type II barge hulls under U.S. Coast Guard Regulations Subchapter "O". All were placed in river and lakes, bays, and sounds service.

The author's background and experience are, therefore, deeply committed to double-skin tankbarge design for service on the great rivers. This paper is based on that experience. The author recognizes that the operational environment of tankbarges in offshore service is different from that in river service; therefore, the needs of and requirements for those barges ought to be considered separately and independent of river-service requirements.

Size Limits and Service Demands Imposed by the Rivers

All barges in service on the Mississippi River system and its tributaries are subject to certain common limitations imposed by the operating environment:

A. Size Limits

1. Draft is limited by available water depth in navigation channels and over lock sills. A draft of 9'-0" is generally accepted as representative, subject to variation resulting from seasonal or local water-depth changes.
2. Freeboard from 9'-0" load waterline to main-deck edge is usually 3'-0". Hull depth of 12'-0" at side is currently most common for general service; 13'-0" is common for predominantly Lower Mississippi service.
3. Width is limited by the width of lock chambers. The most common tankbarge widths are: 35 ft for small tankbarges,

which will fit three abreast in a lock chamber; and 50 ft, 52'-6", or 54 ft for large tankbarges, which will fit two abreast. A legal limit of 55-ft width prevails in parts of the Gulf Intracoastal Waterway.

4. Length is limited by two considerations:
 - a. Lengths to fit in 600-ft- and 1200-ft-long lock chambers. The 35-ft-wide barges are usually 195 to 200 ft long, the same size as hopper barges, so they are readily integrated in common mixed product tows.
 - b. A length-to-hull-depth ratio of about 25 is desirable for large tankbarges. The usual length of the large tankbarges is 290 to 300 ft.
5. At 9'-0" draft in fresh water, the cargo-tonnage capacity of the two most common double-skin tankbarge sizes is:
 - a. 195' x 35' x 12' barge -- about 1450 short tons.
 - b. 297.5' x 54' x 12' barge -- lead unit about 3350 short tons; long-box unit about 3800 short tons.

B. Service Demands

1. All river-service barges are subject to "light grounding" on sand or mud river-bottom ridges in shallow areas. These ridges can form in a matter of hours and disappear as quickly. They are plowed up by the lead barges in any tow, are unavoidable, and are a fact of river navigation.
2. All river-service barges are subject to contact with other barges, docks, lockwalls, rock-cut banks, etc. The severity of damage resulting from such contact or "bumps" is really a function of the tow-handling skill exercised in the pilot house, the pilot's ability to correctly read and assess the effects of locally prevailing current and wind conditions, and the maneuvering characteristics of the towboat.
3. All river-service barges run the risk of collision with:
 - a. Other vessels, such as barges, towboats, and ships in certain areas.
 - b. Fixed objects, such as bridge foundation piers, bullnose or lockwall, moored or sunken barges, dock structures, etc.

In this case, collision is defined as involuntary contact with enough energy to cause significant structural damage requiring repair. In general, collisions with other vessels are the result of communication failure, equipment failure, or failure to correctly anticipate or assess the local conditions on the approach to or at the meeting point, on the part of one or more vessels. The latter two causes apply to collisions with fixed objects as well. However, in defense of the river navigator it must be said that some man-made fixed objects appear to have been placed in the river with regard to the needs of the navigator.

4. Finally, all river barges run the risk of bottom damage from severe grounding on sand or gravel bars, rip-rap, rocks, or sunken objects, including barges.

Avoiding severe grounding means staying in the navigation channel and maintaining deliberate control of the tow. This is an acquired skill that can be learned only by observation and practice; I doubt it it can be taught. It also requires that the channel be maintained and clearly defined by properly and timely maintained marking. It is very difficult to stay in an unmarked, uncharted channel, or a channel with markers out of place.

In summary, river navigation is beset by the many, continuously present hazards of shallow water, restricted channels, everchanging bottom contours, current, wind, man-made obstacles, and other vessels. On the rivers we do not command the luxuries of open space and time that our seafaring brethren so often enjoy. On the other hand, we do not have to contend with big waves, and we're never seasick. Well -- hardly ever.

How effective are double-skin tankbarges
in preventing pollution in river service?

Double-skin tankbarges in river service are subject to two categories of shell damage:

1. Damage to sides and ends from contact with floating or fixed objects, such as other barges, boats, lockwalls, docks, etc.
2. Damage to bottom due to grounding on the river bottom or submerged objects such as rocks, rip-rap, sunken barges, etc.

Voluntary side and end contact is an unavoidable condition in river towing. Tows have to be made up and disassembled, locks transited, and barges landed at terminal docks. Bumps and dents are unavoidable, and the extent of damage is mainly a function of the skill and experience

of the towboat operator. Normal operational damage to double-skin tankbarges is not significant structurally, does not result in shell or cargo-boundary leaks, and therefore presents no pollution risk. It is normal wear and tear.

Involuntary contact, with an impact sufficient to cause significant damage, exhibits a typical progression in degrees of structural failure. First, the internal shell-framing system buckles and distorts; second, the shell plating may be torn open; and third, the cargo boundary suffers a major breach. Experience shows that a major cargo-boundary failure results only from a major collision with deep penetration of the striking object into the voids.

Damaging groundings can be divided roughly into two kinds:

1. Groundings in which the bottom shell is not holed, but in which leaks may occur in the cargo-tank boundaries from fractures caused by upset or distortion of the double-bottom structure. No pollution occurs, but cargo will find its way into the voids.
2. Severe groundings in which the bottom shell is holed, and the cargo-tank boundaries leak product through fractures. With products lighter than water, a pollution incident usually does not occur, but a difficult salvage and repair problem may ensue.

The lead or forwardmost tankbarge in an integrated liquid-cargo tow bears the brunt of grounding damage. The barges behind the lead unit normally do not go aground unless the tow is broken up and the barges are scattered.

The small 195' x 35' x 12' double-skin tankbarges are frequently mixed with hopper barges in common-carrier tows. If such loaded tankbarges can be placed anywhere but on the head of the tow, their grounding risk can be minimized.

Major grounding or collision damage, particularly on lead barges, may result in cargo leaks into the void spaces in the damaged area of the barge.

Examples of Severe Damage to Double-Skin Tankbarges

1. A lead unit collided with another tow. The side shell was torn open just above the waterline over a distance of about 90 ft. from the headlog. The barge remained afloat, the cargo was pumped off to other barges, and the barge moved to a repair yard. Some small fractures were discovered in the tank boundaries, and some oil was found in the affected voids, but no pollution incident occurred.

2. A lead unit ran hard aground, collapsed the forward double-bottom structure, holed the bottom shell, and fractured the inner-bottom tank boundary. Congealing oil was found floating on top of the water in the flooded void. After a tedious and careful pumping effort to remove the congealing cargo of oil, while keeping the damaged voids flooded and temporarily covering the gaping holes in the bottom to prevent escape of the oil in the voids, the barge was salvaged and repaired. No pollution incident occurred.

3. A lead unit struck a submerged object and tore open the bottom over a length of about 100 ft. In this case no leaks were evident in the cargo boundaries since no oil was found in the flooded voids. The barge was partly off-loaded to another barge and traveled to its destination, where the remainder of the cargo was discharged. The barge was then moved to a repair yard. No pollution incident occurred.

Our experience indicates that double-skin tankbarges can and do survive extensive shell damage to sides and bottoms without causing a pollution incident. That is not to say that serious side-shell or bottom damage, combined with some leakage through the cargo boundary, does not present salvage and cleanup problems to the operator.

Problems with Double-Skin Tankbarges in River Service

There is one little phrase in double-skin tankbarge survey reports that provokes an unprintable response from barge-company operations managers. That phrase is, "Product in the void(s)."

Whatever the cause, this condition can have serious consequences:

1. If the product is volatile and flammable, an explosive mixture of gases may develop in the voids. If the product is light, cleaning and gas-freeing will be easy, but until that is done, an explosion hazard may exist.
2. If the product is very viscous or solidifies in the voids, the cleaning of the double bottom particularly becomes a Herculean task.

No incidents involving an explosion of cargo vapors in the void of a loaded barge in transit are known to the author. Probably this is due to a natural tendency of the deck crew to button-up the affected void to prevent escape of the gases. The result is that the vapor-air mixture quickly becomes too rich to ignite readily. The other reason is the absence of sources of ignition in uneventful transit.

These are comforting conjectures, but we should study and better understand the magnitude of the risk and the natural phenomena involved before we dismiss the explosion hazard as nonexistent. We do know that

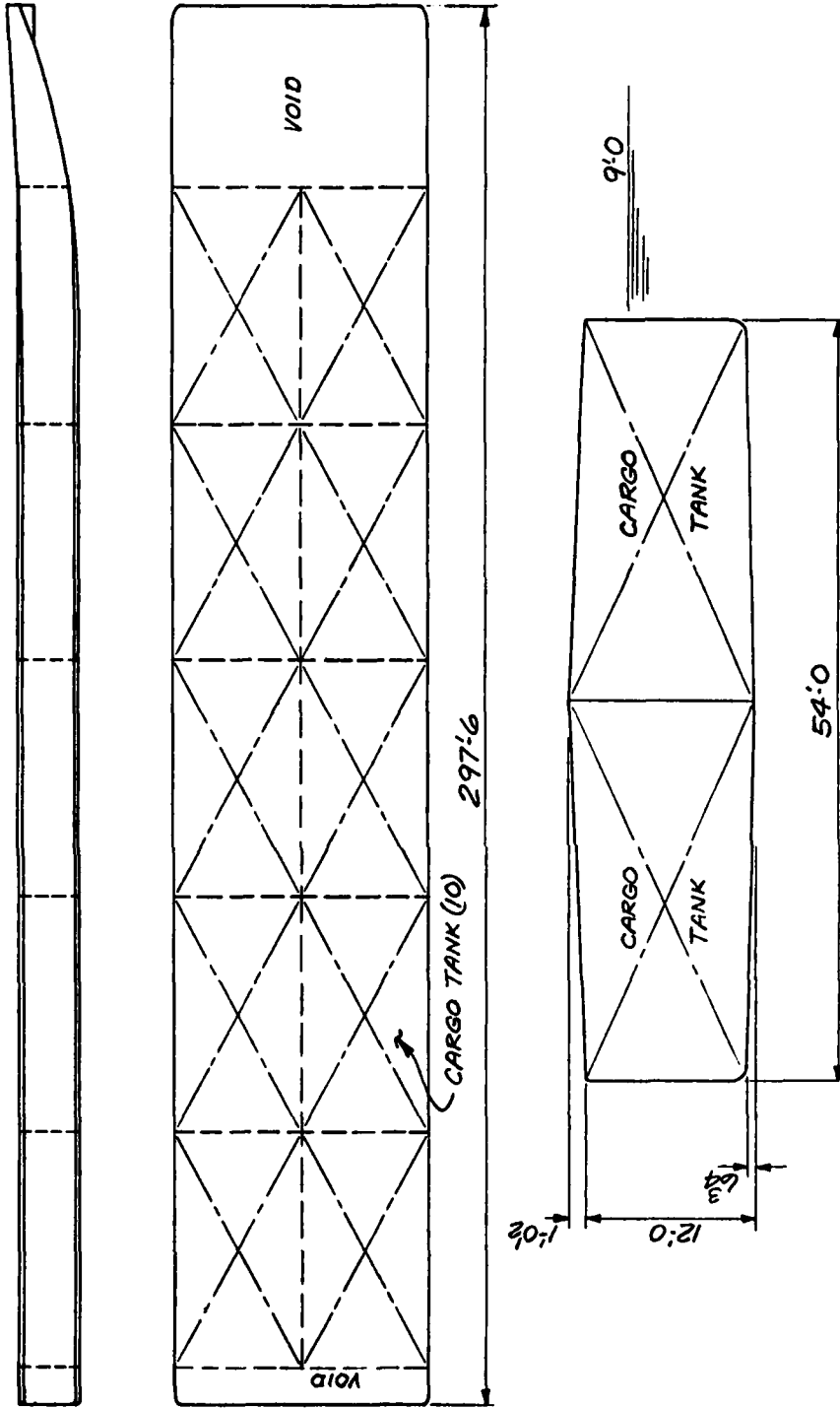
explosions can occur in the course of cleaning, stripping, or repairing gassy voids.

Viscous or solid products, such as polymerized styrene, coaltar, or cold asphalt are very difficult, if not impossible to remove from the typical river tankbarge double bottom. Polymerized styrene and condensed solid coaltar-vapor crystal formations must be hacked out mechanically. Solid cold asphalt has to be removed by tilting the barge in drydock and melting the asphalt by applying heat to the bottom. The cleaning costs in these cases are substantial, on the order of \$30,000 to \$50,000 or more per barge.

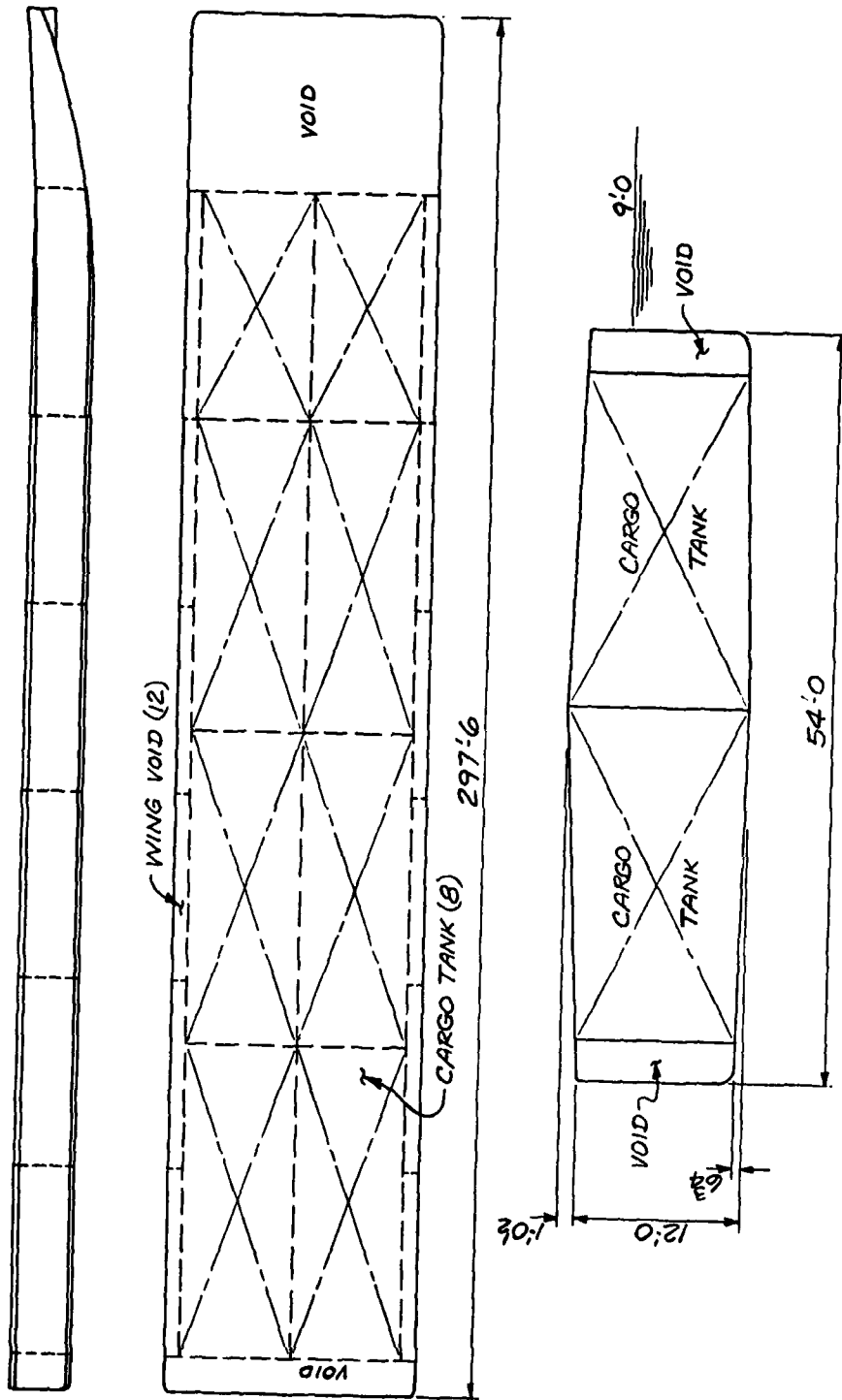
Rather than decree double-skin construction as a minimum standard for all river tankbarges, the problems attendant on carrying products that solidify at ambient river or air temperature should be given special consideration. While owners may elect to use a double-skin tankbarge for heavy asphalt in order to take advantage of the thermal insulation provided by separating the cargo from the river water by the air-filled voids, this decision should be made on its technical and economic merits, not by fiat. A double side-wall, single-bottom tankbarge, with the forward bottom of a lead unit especially reinforced against grounding, may be sufficient for any such products.

Summary

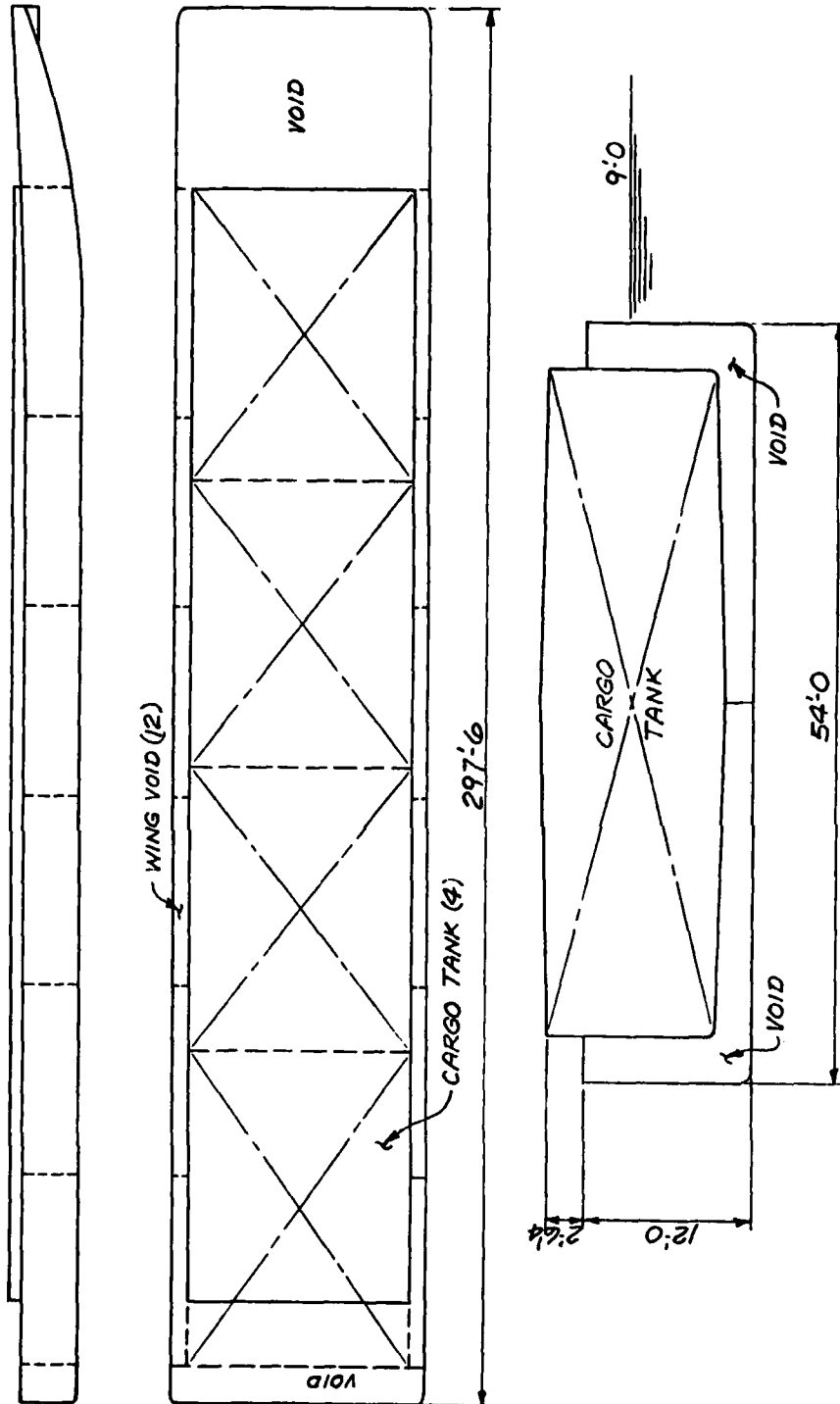
1. Tank barges in river service are always subject to bumps and wear along ends and sides. Void spaces at ends and along the sides significantly reduce the risk of pollution from shell damage.
2. Tankbarges in river service are subject to grounding in various degrees of severity. Double bottoms have been successful in preventing pollution incidents in cases of severe bottom damage.
3. All double-skin tankbarges can be expected to develop fractures in the cargo-tank boundaries at some time in their useful life. The ability of double-skin tankbarges to contain such cargo leaks within the void spaces has been good; pollution incidents have been prevented.
4. There is an unresolved question on the magnitude and severity of the potential explosion hazard caused by the presence of flammable product vapors in void spaces of double-skin tankbarges.
5. Expensive cleaning procedures are necessary to remove cargoes that are very viscous or solidify at ambient air or river temperature, particularly from double bottoms when cargo leaks through the cargo boundaries. These products should be identified, and the use of single-bottom, double-wall tankbarges should be considered for such cargoes.



SINGLE SKIN TANK BARGE



SINGLE BOTTOM · DOUBLE SIDES TANK BARGE



DOUBLE SKIN TANK BARGE

INSPECTION AND REPAIR OF TANKBARGES IN BULK OIL SERVICE

LCDR Kenneth A. Rock
Office of Merchant Marine Safety
U.S. Coast Guard

Under the authority of 46 USC 391a, the U.S Coast Guard regulates all commercial tankbarges carrying flammable or combustible liquid cargoes in bulk. This statute requires inspection of each barge at least biannually to insure that it is suitable for navigation for the succeeding two-year period in the service and route intended. Additionally, a mid-period inspection has traditionally been conducted by the Coast Guard between the 10th and 14th month to insure that the vessel remains properly equipped and in satisfactory physical condition. The Port and Tanker Safety Act of 1978 amended Coast Guard authority and now requires an annual inspection. This change actually results in little more than a paper change, since an annual inspection was conducted as normal practice as a mid-period inspection.

Tankbarges are required to be dry-docked for Coast Guard examination on a cycle which varies from 24 to 36 months depending on the amount of service time in fresh or salt water and on vessel age. In the case of double-hulled tankbarges, the first required dry-docking and each successive alternate dry-docking may be waived in favor of a satisfactory internal examination with hull-plate gaging when necessary. Thus, the Coast Guard may allow a six-year actual dry-docking interval for double-hulled tankbarges in good repair when operated principally in fresh water routes.

A certificate of inspection is issued only when a Coast Guard Officer-in-Charge Marine Inspection (OCMI) is satisfied that a tankbarge:

1. Has been constructed in accordance with Coast Guard approved plans.
2. Is equipped as required by regulation.
3. Has hull and installed machinery in satisfactory condition.

All alterations or repairs to certificated tankbarges must be done under the direction of the cognizant OCMI as per 46 CFR 30.10-10. To this end, and in further clarification of the Coast Guard's implementation of 46 USC 391a, a Navigation and Vessel Inspection Circular (NVC 7-68) entitled "NOTES ON INSPECTION AND REPAIR OF STEEL HULLS" was published in October 1968. It was distributed to all interested parties. It disseminates for Coast Guard marine inspectors, vessel owners, and shipyards general information relating to good

practice in the inspection and repair of steel-hulled vessels. This information is furnished for guidance purposes. Where specifics are given, it should be understood that mandatory application is not necessarily intended and that nothing contained in NVC 7-68 should be taken as amending applicable regulations or as prescribing or limiting the authority and responsibility of the OCMI in the exercise of his good judgment. However, NVC 7-68 has been shown to be a good comprehensive guide in the 12 years since its publication.

The Coast Guard itself has gone through a period of difficulty in maintaining experience levels of inspectors as the missions of the Coast Guard have expanded. Since recognition of inspection deficiencies is often subjective, this lack of experience created a lack of uniformity in the levels of compliance required for barge owners during the past decade. At present, our 12-week resident training program, coupled with the mandatory three-year training tour of duty for junior officers and senior petty officers entering the marine inspection field, is beginning to supply a new cadre of second- and third-tour qualified personnel.

Prior to the current nationwide environmental awareness and the increase in waterway usage, tankbarges used in river and other limited (sea state and weather) exposure services were not necessarily maintained to as high a standard as those barges operating in more severe conditions. This philosophy resulted from the knowledge that damaged or leaking barges could be beached or abandoned if they sank in deep water, with minimal risk to human life and with no obstruction to navigation. Only economic loss of barge and cargo were considered. Concern for the marine environment was not a factor. However, in recent years such practices have been simply unacceptable. With the aid of new statutory awareness, greater numbers of qualified inspectors, and responsible barge and towing owners and operators, the Coast Guard and others have undertaken a concerted effort to improve our environment. As a result, the scope of Coast Guard attention to tankbarge inspection and repair standards now reflects these concerns.

It is the desire of the U.S. Coast Guard, in complying with Congressional intent and statutory authority, that all unnecessary and avoidable pollution from tankbarges be eliminated. To this end, we hope to pursue every necessary, practicable, cost-effective, and achievable regulatory course of action which will assist in providing a safe and clean environment, a safe workplace, and a sound maritime industry.

IN-SERVICE DOUBLE-HULL TANKBARGE
POLLUTION-PREVENTION EFFECTIVENESS SURVEY AND
OVERVIEW OF OIL-SPILL DATA ANALYSES

LCDR Alan E. Spackman
Office of Merchant Marine Safety
U.S. Coast Guard

Background

In 1974 a joint Maritime Administration/Coast Guard tankbarge study (1) was prepared. A portion of this study investigated the effectiveness of double hulls in preventing cargo-tank penetration. The study concluded that a double hull would be 96.6 percent effective in preventing spills. This effectiveness figure was based on a special tankbarge damage survey conducted for the study during 1973. A similar figure (95.5 percent) was obtained by a comparison of the spill rates for double-hulled and single-hulled tankbarges listed in the Commercial Vessel Casualty (CVC) files for fiscal year 1973.

The study concentrated on only one year and a relative small number of reportable incidents (61) involving double-hulled barges. It was decided that further analysis was warranted, and that it would be useful to approach the question of effectiveness from the standpoint of the in-service performance of double-hulled barges, as well as to expand the scope of the review to include all casualty records available for review.

Reference (1) completed a cost-effectiveness analysis in terms of the cost necessary to prevent penetration of a cargo-compartment boundary, but was unable to assess the cost-effectiveness on the basis of the cost necessary to prevent a spill incident involving a defined volume of oil spilled because of a lack of sufficient oil-spill data for tankbarges.

Current Oil-Spill Data Analyses

The current Coast Guard regulatory proposal (2) has attempted to refine the tankbarge oil-spill data to a usable form. A great deal of effort was expended in trying to match reported spills in the Pollution Incident Reporting System (PIRS) with CVC reports, and to develop a profile of tankbarge oil spills. However, as pointed out by E. G. Frankel (3), there are still considerable inaccuracies in the PIRS data which render direct usage difficult and results obtained therefrom questionable. E. G. Frankel further refined Coast Guard data and presented the data as a volume-to-incident percentile distribution in

Figure 2.1 of reference (3). It is highly unlikely that the general form of this distribution will be significantly altered by further data refinement. In fact, not only would the raw data, if plotted, produce a similar distribution, but so would the long-term data for accidental spills from oceangoing tankships. At this time, lacking justification for further refinement of the data, or significant additional data, this study will accept Figure 2.1 of reference (3) as representing the distribution.

Measures of Effectiveness

The regulatory analysis (2) for the current Coast Guard proposal has received criticism for overstating the effectiveness of double hulls. In attempting to quantify the effectiveness of double hulls, the volume percentage of spills attributable to hull damage was multiplied by the effectiveness of double hulls as determined in reference (1). Unfortunately, the value (89 percent) thus obtained was misinterpreted as representing the volume of transport-related spillage which would be prevented. This was in error, since it assumed a linear relationship between volume and incident percentile, the 45-degree line on Figure 2.1 of reference (3), rather than the more probably relationship shown by the Lorenz curve.

Figure 2.1 was developed using only those transport-related incidents involving hull damage contained in Appendices D and E of reference (2). This curve can be used to approximate the minimum volume percentile of spills which would be preventable by double hulls. The effect of the current Coast Guard regulatory proposal can be assessed by entering as the incident profile the "effectiveness" of double hulls (95 percent) obtained from reference (1) and determining the corresponding volume percentile (47 percent); this may then be multiplied by the volume percentile of spills attributable to hull damage (94 percent) obtained from reference (2) to obtain a 44 percent anticipated reduction in total volume of oil spilled. Thus, based on reference (1), it could be stated that the use of double hulls could be expected to prevent 95 percent of the cargo-tank penetrations; this would result in a 47 percent (minimum) reduction in the volume spilled due to transport-related incidents involving hull damage and a 44 percent reduction in the total volume spilled.

Reference (3) states that about 20 percent of tankbarge hull-failure pollution is preventable by the use of only double hulls; this corresponds to an 82 percent incident percentile. Stated in other terms, reference (3) indicates that double hulls could be expected to prevent 82 percent of the cargo-tank penetrations, which would result in a 20 percent reduction in the volume of oil spilled due to transport-related incidents.

The above discussion serves to emphasize the sensitivity of the effectiveness, if measured in terms of volume reductions, to the

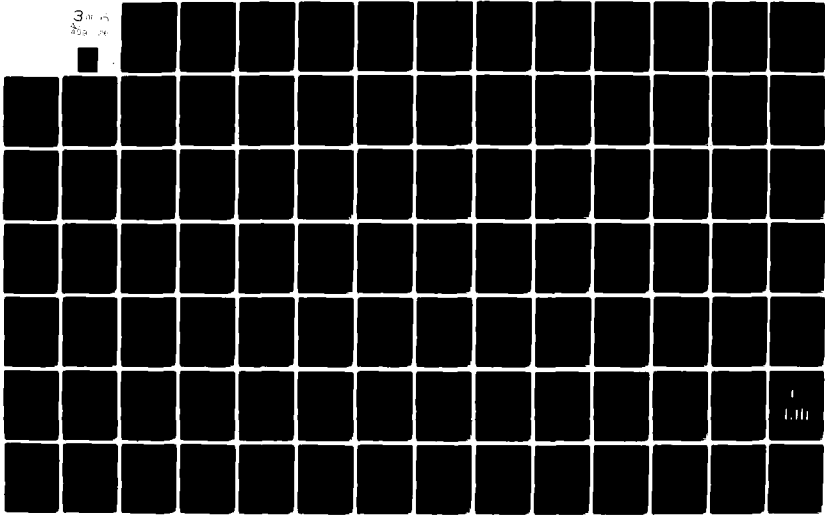
AD-A096 126

NATIONAL RESEARCH COUNCIL WASHINGTON D C MARITIME TRA--ETC F/G 13/2
WORKSHOP ON REDUCING TANKBARGE POLLUTION. APRIL 15-16, 1980.(U)
AUG 80 N00014-75-C-0711

UNCLASSIFIED

NL

3 of 15
205 24



1
1.11

effectiveness of double hulls. This sensitivity was a major factor in the decision to expand further the double-hull effectiveness analyses.

An additional point worthy of note in the above discussion is that, by using the Lorenz curve in this manner, only the lowest-volume percentile spills are considered preventable by double hulls. Table 2.2 of reference (3) indicates that even some high-volume percentile spills might have been preventable by double hulls. Whether more incidents than are indicated by Table 2.2 may have been preventable by double hulls is a matter of interpretation of reports of events, generally long past and some poorly documented, and will not be belabored.

Further, as was noted in reference (1) with regard to the first Proposed Rulemaking in this area (a proposal to require double walls which was printed in the Federal Register on December 24, 1971), the proposed regulations were designed "to eliminate the myriad of leads from barges in the inland waterways from routine operational side and end damage" and "to substantially reduce the oil spills resulting from minor vessel collisions."

There will be those catastrophic casualties, such as severe collisions, barges overturned on bridge abutments by the current, etc., which are not preventable by barge design. Catastrophic high spill volume casualties occur both in the barge and ship trades. Fortunately, they do not occur frequently, but because of the high volumes involved they severely skew oil-spill data. For almost each year, a single barge casualty has provided 20 percent or more of the total spill volume attributable to hull damage. Reference (3), Table 2.2, provides a listing, by rank order of volume spilled, for tankbarge casualties. The top five of these casualties account for 44 percent of the oil spilled because of hull damage in the five-year period. Somewhat ironically, there is little to distinguish the events leading to these massive spills from the more numerous incidents that resulted in little or no oil spillage.

Addressing the environmental impact of these high-volume spills, comparing the environmental impact of these spills to the more numerous smaller-volume spills, and comparing the level of response and effectiveness of cleanup efforts based on spill size is beyond the scope of this paper. These items deserve consideration, however, because there are differences; there are valid reasons to go beyond the simple "dollars per barrel of spilled oil prevented" in determining the effectiveness of oil-pollution prevention measures.

Expanded Double Hull Effectiveness Survey

A sort, by computer, of the "List of Inspected Tank Barges and Tankships" was performed in order to compile a listing of those tankbarges having double hulls (4). This produced a list of 1269

active and inactive double-hulled tankbarges. The numbers of barges certificated for the various routes are shown in Table 1. For comparison, a listing obtained from reference (2) of all tankbarges that may carry oil is also shown.

Table 1
Tankbarge Populations by Route

<u>Route</u>	<u>Route Code</u>	<u>Double-Hulled Barges</u>	<u>Total Oil-Carrying Barges</u>
Lakes, Bays, and Sounds (LBS)	LL	1098	2997
Great Lakes/LBS	LG	99	191
Coastwise/LBS	LC	12	33
Great Lakes	GG	7	20
Oceans	OO	28	241
River	RR	27	262
Coastwise	CC	5	105
Coastwise/Great Lakes	CG	1	33
TOTAL		1277	3882

Source: Coast Guard List of Inspected Tank Barges

It should be noted that the list of double-hulled barges developed for this survey includes both active and inactive barges and includes some barges not certificated for the carriage of oil. The totals therefore differ slightly from those indicated by reference (2).

A sort of the Commercial Vessel Casualty (CVC) file for fiscal years 1974 through 1978 was next performed to obtain a listing of reports of collisions, rammings, groundings with damage, and material failures involving vessel structure. Such reports do not list all incidents. They are required only for the following reasons: (1) actual damage to property exceeds \$1500.00; (2) seaworthiness of the vessel is affected; (3) stranding or grounding has occurred; (4) there is a loss of life; or (5) there is an injury causing incapacitation of a person for a period in excess of 72 hours.

The two lists were then cross-referenced to identify those incidents which involved double-hulled barges. The CVC case file for each incident involving a double-hulled barge was then reviewed to determine if either the Casualty Report from or supplemental reports in the file contained information regarding the damage sustained, if any, by the inner or outer hulls. The preliminary review of the data produced the following information:

Total incidents reported	- 691
CVC files not available for inspection	- 115
Insufficient information in case file	- 104

The CVC files for the remaining 472 incidents were then examined further to determine the location and the extent of the damage sustained, if any, to the inner and outer hulls. The results are shown in Table 2.

Table 2
Double-Hulled Barges
Collisions, Rammings, Groundings, and Material Failures
Nature and Extent of Damages, FY '73-'78

Incident Type	No Damage	Damage w/o Penetration	Bow, Stern, or Deck	Side	Bottom
			(Holed Outer Hull/Holed Inner Hull)		
Collisions	94	26	55/2	26/2	1/0
Rammings	80	20	59/0	27/2	1/0
Groundings	25	5 ^a	14/0	17/4	8/1
Material Failure	0	2	0/0	1/1	0/0
Others ^b	<u>8</u>	<u>1</u>	<u>0/0</u>	<u>2/0</u>	<u>0/0</u>
TOTALS	207	54	128/2	73/9	10/1

- a. Includes one incident where inner hull was ruptured.
- b. Includes unclassified failures and some barge breakaways.

Source: Commercial Vessel Casualty File

The case files of those incidents involving penetration of either the side or bottom were then examined further to determine the condition of lading of the barge. The barge was laden in more than 75 percent of the incidents involving penetration of the outer hull. Detailed results of this screening of only laden barges are shown in Table 3.

Table 3
 Loaded Double-Hulled Barges
 Collisions, Rammings, Groundings, and Material Failures
 Bottom and Side Penetration, FY '73-'78

<u>Incident Type</u>	<u>Side (Holed Outer Hull/Holed Inner Hull)</u>	<u>Bottom (Holed Inner Hull)</u>
Collisions	20/1	0/0
Rammings	17/1	0/0
Groundings	16/3	6/1a
Material Failure	1/1	0/0
Others ^b	<u>1/1</u>	<u>0/0</u>
TOTALS	55/6	6/1

a. Load condition of one barge unknown.

b. Includes unclassified failures and some barge breakaways.

Source: Commercial Vessel Casualty File

Penetration of the cargo tanks did not take place in nearly 90 percent of the incidents involving penetration of the side. The percentage is slightly lower (89 percent) when only laden barges are considered. The added momentum possessed by a laden barge apparently only degrade slightly the effectiveness of the double side in preventing penetration of the cargo tanks.

Penetration of the inner bottom did not occur in 90 percent of the incidents involving penetration of the barge bottom. Understandably, this percentage is reduced (83 percent) when only laden barges are considered because of the larger loads applied to the hull. For both laden and empty barges the effectiveness compares favorably to that observed for double sides.

Those 83 incidents during which double-hulled barges sustained penetration of the side or bottom were categorized according to the certificated route of the barge and the type of waters on which the incident occurred in an attempt to further define the population of damaged barges. The results are shown in Table 4.

Table 4
 Double-Hulled Barge Incidents Resulting in Side or Bottom Penetration
 Classified by Route and Location of Incident

Location of Incidents ^a	Number of Incidents (by route) (Holed Outer Hull/Holed Inner Hull)				
	<u>LL</u>	<u>LG</u>	<u>LC</u>	<u>GG</u>	<u>OO</u>
Inland Atlantic	3/0	1/0			
Inland Gulf	20/3	3/1	1/0	1/0	
Western Rivers	46/4	1/0	2/1	2/0	
Great Lakes	1/0				
Atlantic Ocean	—	—	—	—	1/0
TOTALS	70/7	5/1	3/1	3/0	1/0

- a. There were no incidents causing penetration of the hull of double-hulled barges reported to the Inland Pacific, in foreign waters, or in the ocean waters of the Pacific, Arctic, Caribbean, or Gulf.

Source: Commercial Vessel Casualty File

The frequency of occurrence of an incident causing penetration of the hull is approximately the same regardless of route for which certificated. There are no exposure data available to allow determination of the amount of time spent in the various locations by either single- or double-hulled tank barges. No conclusions regarding comparative risk can be made.

Additionally, the barge length, route, subchapter of certification, and hull types were determined for the 79 barges involved in these 83 incidents. It was hypothesized that this information might be useful in determining a relationship between hull type and/or subchapter and the occurrence of cargo-tank penetration. The results are shown in Table 5.

Table 5
 Characteristics of Double-Hulled Barges
 Having Sustained Side or Bottom Penetration
 (Barges with Holed Outer Hull/Barges with Holed Inner Hull)

Length (feet)	Route					Subchapter			Hull Type		
	<u>LL</u>	<u>LG</u>	<u>LC</u>	<u>GG</u>	<u>OO</u>	<u>D</u>	<u>O/D</u>	<u>O/I</u>	<u>1</u>	<u>2</u>	<u>3</u>
86-135	2/0					1/0	1/0			1/0	1/0
136-170	2/0	1/0					3/0		1/0		2/0
171-215	34/3	2/0	2/1			9/1	28/3		2/0	18/1	17/3
216-270	9/2	1/0		2/0		5/1	6/0	1/0		5/0	7/1
271-305	21/3	1/1			1/0	13/2	11/2		1/0	12/4	11/0
>305	1/0					1/0					1/0
TOTALS	69/8	5/1	2/1	2/0	1/0	28/4	50/5	1/0	4/0	36/5	39/4

Source: Coast Guard List of Inspected Tank Barges

The nine size ranges in Table 5 were chosen because they conform to the sizes used in reference (1) and (4). Lacking data in a similar form for the entire double-hull tankbarge fleet, it is not possible to determine if these 79 barges are representative of the fleet as a whole.

Conclusions

- In 265 of the 472 (56 percent) reportable incidents studied, penetration of the outer hull did occur. Penetration of the bow, stern, or deck occurred in 128 out of 472 (27 percent) of these reportable incidents. Present Coast Guard regulations permit the loading of petroleum products in the end spaces of nonself-propelled vessels. In view of this 27 percent penetration rate in reportable incidents it is concluded that the carriage of oil in these spaces presents an unacceptable risk.
- It is concluded from Table 2 that in a reportable incident, the fact that the vessel involved is double hulled can be expected to prevent the immediate breach of the cargo-tank boundaries in more than 88 percent of the incidents. It is significant that when only laden vessels are considered, as in Table 3, the percentage of cases where the inner hull is penetrated is degraded only slightly. Using the volume percentile distribution of reference (3), Figure 2.1, and 88 percent reduction in the number of incidents would correspond to a reduction of 28 percent in the volume of oil spilled if all tankbarges were double hulled. In actual service conditions it is concluded that a double hull can be extremely effective in preventing penetration of the cargo tanks and the subsequent release of oil.

References:

1. Joint Maritime Administration/Coast Guard, "Tank Barge Study," October 1974; NTIS COM-75-10284/AS.
2. Department of Transportation, U.S. Coast Guard, Draft Environmental Impact Statement and Regulatory Analysis, "Design Standards for New Tank Barges and Regulatory Action for Existing Tank Barges to Reduce Oil Pollution Due to Accidental Hull Damage," CGD 75-083 and 75-083a.
3. Frankel, E. G., "Evaluation of United States Coast Guard Draft Regulatory Analysis Design Standards for Tank Barges-Structural and Statistical Assessment," performed for the American Waterways Operators-Tank Barge Conference.
4. Department of Transportation, U.S. Coast Guard, List of Inspected Tank Barges and Tankships, COMDT Note M16711 (computer listing generated to obtain current date).

OCEAN/COASTAL VERSUS INLAND TANKBARGE
DESIGN, INSPECTION, AND OPERATING STANDARDS

Kent D. Woodward
Interstate and Ocean Transport Company

Our company, Interstate and Ocean Transport Company, is the largest independent transporter of petroleum in the United States. We operate along the East and Gulf Coasts and in the Delaware and Chesapeake Bay system. Our barges range in size from 10,000 barrels to almost 300,000. Most have coastwise or ocean loadlines; however, many of the smaller ones, below 30,000 barrels, do not. These latter ones are similar in construction to inland waterway barges, although unlike river type operations, our are operated in single barge tows.

We carry the full range of petroleum cargoes: crude oil, residual (black) oil, asphalt in heated barges, clean products such as gasoline and aviation fuel and petrochemicals. Most of the barges are single-skin, although some in our ocean fleet are double-skin or double-bottom with single-skin sides. We also operate some double-skin inland tank barges.

Examination of current regulatory and industry practice reveals that operating, design, and inspection standards for coastal and ocean barges are already different than for inland barges. In design, the American Bureau of Shipping publishes different rules for ocean (steel barges for offshore service) and for inland barges (river rules). Use of these rules to determine, for example, the thickness of bottom plate for a small barge in ocean service can result in a rule thickness almost 50 percent greater than for a river barge of the same size.

U.S. Coast Guard inspection standards are also different. Ocean barges, because of their service in salt water, must be gas-freed and dry-docked for a thorough inspection of the hull and internal tanks every two years. Inland barges are allowed three years between dry-dockings. In actual operation, each coastal and ocean barge typically has permanently assigned crews who either live aboard the barge or, in the case of unmanned barges, follow it from port to port on the tug. This practice, which is unlike river operations, provides a highly effective, continuous method of monitoring the barges' seaworthiness, including conditions which may develop which could lead to a pollution incident.

The difference in standards for ocean and inland barges has evolved over the years because the Coast Guard, the American Bureau of Shipping, and the owners, operators, builders, and designers of ocean barges have recognized the very substantial differences in the operating environment of ocean and coastwise barges. In fact, we

believe it was this recognition which led the Coast Guard, in its initial studies of double hulls, to exclude ocean and coastwise barges from consideration. This operating environment, i.e., the ocean, has also led ocean operators to take a different approach on double-hull barges. The result can be seen in the fact that far less of the ocean fleet is double-hull than is the case with the inland fleet. Ocean operators face most of the difficulties with a double-hull barge that inland operators do and some unique ones as well.

In several respects a double hull offers real advantages. It is easier to clean when incompatible cargoes are to be loaded on consecutive voyages. It also provides far better insulation when heated cargoes must be carried. For these reasons, double hulls have found favor in some trades. For example, one of our asphalt barges was built with a double bottom in order to save a quarter million gallons of fuel a year for cargo heating. These benefits are not, however, free. Double-hulled ocean barges cost substantially more to build as Booz-Allen confirmed. Because of their higher construction cost, the insurance premium each year is also higher.

Besides higher costs, there are safety reasons for deciding against double hulls. One is the possibility of groundings which penetrate the outer hull and result, because of the large loss of buoyancy, in a much more severe grounding than would have occurred in a single-hulled barge and increase the chances of a catastrophic loss of the barge and her cargo. These and similar problems with double hulls have been well documented in the American Institute of Merchant Shipping booklet, "Tanker Double Bottoms - Yes or No?", which is appended to this report.

Besides these drawbacks to double hulls in both ocean and inland tankbarges, there are several unique to ocean barges. Ocean barges must be designed to operate in heavy seas. Current American Bureau of Shipping rules assume hull stress in a barge in a seaway at roughly twice what that barge would be subjected to in calm water. An ocean barge must be both strong enough and flexible enough to withstand these bending forces. A double bottom is inherently much less flexible, and local structural failures, such as cracks in the inner bottom, can and do occur. Our concern in this case is that, with crude oil and light petroleum product cargoes in particular, potentially toxic and explosive vapors can be introduced into the double-hull voids.

Operating in the ocean environment can lead to other types of structural damage of double-hulled ocean barges. These barges, unlike tank ships, do not ballast. This not only saves considerable fuel, but eliminates the need for a shoreside facility to receive and treat the dirty ballast. An ocean barge is, however, subjected to tremendous slamming forces each time the barge pitches in the seas. These impacts, repeated countless times, can lead to damage of the inner bottom in the forward cargo tanks.

Besides slamming and bending damage to the hull, the salt-water ocean environment can also lead to rapid corrosion in the double-hull voids, which are difficult to coat during construction and almost impossible to recoat because of the difficulties with accessibility.

All in all, double hulls in ocean and coastal tankbarges have not been and are not attractive alternatives because of their higher cost certainly, but also because of the special hazards they present to their crews, to repairers and cleaners, and to the environment itself. When it comes to double hulls, different standards for ocean barges are indeed indicated.

tanker double bottoms YES OR NO?

In the past three to four years numerous proposals have been made for protecting the marine environment from oil pollution by tankers. In AIMS' view, the most important of these have been tentatively agreed at a landmark 79 nation IMCO conference held in London last fall which drafted "The International Convention for the Prevention of Pollution from Ships, 1973."

One measure not accepted at the IMCO conference, yet frequently suggested in the United States is a mandatory requirement that new tankers be built with double bottoms. Double bottom advocates have continually stressed that this construction feature would prevent a very high percentage of oil being spilled when tankers strike the bottom. Despite strong technical arguments to the contrary, opposition to mandatory tanker double bottom requirements is frequently attributed solely to oil and shipping interests, who are described in the U. S. as being motivated only by economic concerns and as having a callous disregard for environmental protection.

Careful review of the basic technical factors and all available accident records leads us to a very different conclusion:

- > While there are substantial advantages, primarily operational, for double bottoms in passenger and dry cargo ships, by and large these would not be applicable to tankers.
- > While double bottoms in tankers might be directionally helpful in some minor grounding accidents in preventing oil outflow, they would offer no protection in more serious accidents currently producing over 60% of oil spilled in tanker groundings, and conceivably they could increase the amount of oil spilled.
- > There are a number of operational and traffic measures available with high potential for preventing accidents of all types involving

existing as well as new ships. Mandatory adoption of such measures represents a far more effective approach to preventing accidental pollution from tankers than the use of mandatory double bottoms in new tankers.

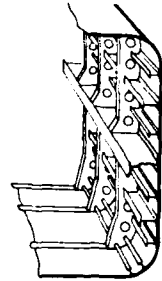
Based on these factors which are developed further herein, we are opposed to a mandatory requirement for double bottom construction in new tankers. We feel the use of double bottoms in new tankers should continue to be optional since there are circumstances under which this construction will be found desirable operationally.

AIMS feels that it is time to speak out on the double bottom issue in a direct and candid fashion. We hope by so doing to help resolve the issue on supportable technical grounds, and not simply on the basis of public appeal.

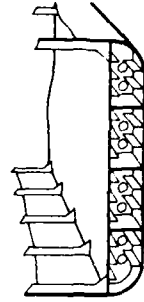
What is a Double Bottom and Why is it Used?

A double bottom is a cellular construction at a ship's bottom in which a flat inner skin, or tank top is placed above and parallel to the ship's bottom covering the bottom framing members. This construction results in a series of "double bottom" tanks underneath the vessel's cargo holds and machinery spaces, and it also affords a flat tank top, or floor, on which dry cargo can conveniently be loaded.

Without the double bottom and its smooth tank top, the bottom of a ship's hold would be a maze of interconnecting structural members more or less resembling the underside of a large steel highway bridge—a structure totally unsuitable for storing dry cargo. The requirement for a smooth floor or deck on which to place cargo is the fundamental reason why so many ships have double bottoms. It is a practice adopted late last century in the early days of iron ships.

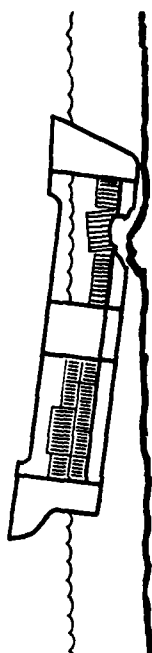


Single bottom
Tough to stow cargo

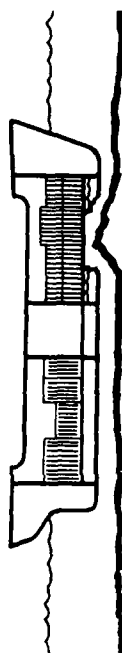


Double bottom
Smooth top—Messy below

around the cargo. When these spaces are flooded a ship will settle very deeply in the water. This can directly endanger its ability to stay afloat, or complicate efforts to salvage a grounded vessel partially full of water. Accordingly such ships have frequently been "floated in" on their double bottoms when they remain intact.



Serious flooding may sink this ship

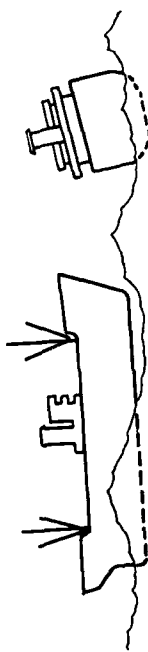


Double bottom may save this ship

Conventional Tankers and Groundings

The situation is entirely different when a conventional loaded single bottom tanker grounds. If there is a hole in the bottom of loaded cargo tanks, rather than sinking deeper into the water, or settling more firmly on the bottom, the tanker actually rises slightly out of the water. Since it becomes more buoyant it will generally be easier to salvage than it would be if empty tanks had been pierced. This happens with a tanker because most of the oil in the pierced cargo tanks will remain inside the ship floating on top of the water due to pressure at the bottom without any loss of buoyancy. A relatively small amount of oil will escape to the sea from fully loaded tanks until the pressure of the lighter oil inside the pierced tank is equal to the outside water pressure at the bottom. It is the minor oil loss which by reducing the loaded weight of the tanker causes it to rise slightly out of the water. This factor, together with the greater number of cargo

Another important advantage to double bottoms is that they provide the ideal place for carrying liquid ballast and fuel in dry cargo and passenger vessels. Most ships when not loaded with cargo must take on ballast preferably near the bottom, to maintain stability and reduce susceptibility to overturning.



Empty ships are unsafe ships



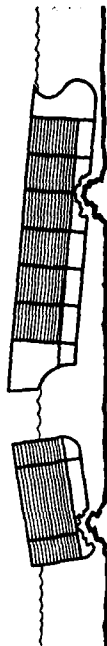
Ballasted ships are safe ships

The Safety Factor and Double Bottoms in Cargo Ships

While ease of cargo stowage and ballast capability are the two basic reasons for using double bottoms in the vast majority of passenger and cargo ships, this construction was long ago found to provide an additional safety factor for dry cargo ships. In grounding accidents where the smooth top of the inner bottom is not pierced or ruptured, the ship does not lose nearly as much buoyancy, or settle as deeply into the water, as it would if a full cargo hold is breached. This is of particular importance to dry cargo and passenger ships as contrasted to tankers since the holds of these non-tankers are not only very large in comparison to tankers but they provide little resistance to flooding from the sea. Even the loaded hold of a dry cargo ship resembles a warehouse or storeroom which has a great deal of empty volume

Greater Sinkage and Less Stability with Double Bottom
 Putting empty double bottom tanks beneath the length and breadth of a loaded tanker ensures that in any grounding where the bottom is pierced the tanker will sink deeper into the water, even if its cargo holds are not ruptured.* Because of flooding in empty double bottom tanks the tanker will almost certainly heel or lean over substantially to one side or the other, further complicating its problems or impaling it on the bottom. It is crucial to recognize that quick action to free and float a grounded ship before it can break up and spill its entire cargo is nearly always the key to successful salvage.

After Bottom Damage



Flooded double bottom - Loss of buoyancy - Ship settles deeper

A firmly grounded double bottom tanker might therefore have to jettison substantial amounts of oil cargo in order to be saved from catastrophic loss and major pollution of the seas. For the double bottom tanker to maintain buoyancy and stability equivalent to the single bottom tanker, the amount of oil which would have to be transferred to a lightering vessel, or jettisoned if no lighter is available, may well be 6-8% of its total cargo. This equates to roughly 15-30,000 tons for a single VLCC—an amount roughly 1/4 to 1/2 the total oil outflow from all tanker groundings in a given year. Obviously if the double bottom vessel cannot be quickly salvaged, and breaks up even partially, the potential oil spillage could greatly exceed total worldwide spillage of some 50,000 tons which the U.S. Coast Guard currently estimates from tanker groundings.

*The sinkage problem will also be a factor in new segregated ballast tankers with empty ballast tanks. Since the probability of rupturing these tanks is only 20-30% of that with double bottoms however, it is an acceptable drawback in the segregated ballast concept which has other significant advantages.

holds or compartmentation in tankers, has generally made tankers far more able to withstand grounding, and collision damage than ordinary dry cargo ships—a fact clearly supported by total loss accident records for the two types of ships. Lloyds records for recent years clearly demonstrate this point.* By comparing total losses in relation to ships at sea of each type the records indicate:

- > over 4 times as many dry cargo ships are wrecked as a result of grounding as tankers
- > nearly 9 times as many dry cargo ships founder (flooding loss at sea) as tankers.
- > over 2 times as many dry cargo ships are lost following collisions as tankers.



Loss of cargo - Ship rises

Tankers and Double Bottoms—Will it Work?

What then would the situation be if a double bottom construction were used for tankers? At first glance it would appear to be "the best of all possible worlds" combining the inherent double bottom safety factor found by many years of dry cargo ship experience with the greater compartmentation and flooding resistance traditionally found in tankers. To the extent that this could happen without any harmful side effects it would seem to benefit both the tanker's own safety, and to minimize oil outflow to the sea.

Unfortunately, it appears likely that there will be several substantial and harmful "side effects."

**Analysis of World Merchant Ship Losses." W. J. Beers, formerly Editor of Statistics, Lloyds Register of Shipping, RINA, 1968.

What Do Accident Records Show about Double Bottoms?

While the circumstances described above assume that the inner bottom of the grounded tanker would not be ruptured, experience shows that in many groundings the inner bottom probably would be breached. In fact, the more extreme or serious the grounding, the more likely this would be, and here again U.S. Coast Guard data,* and logic, show that it is these very serious accidents which produce the great majority of oil released accidentally. Some other relevant figures are worth recording:

> IMCO has estimated that in 57% of dry cargo ship strandings a double bottom tank has been breached despite the fact that in something less than 20% of these accidents was estimated bottom penetration equal to or greater than the height of the double bottom. There seems to be a clear, and logical implication that because of the integral structural connection between the two skins, initial damage to only the outer bottom itself can distort and tear the inner bottom.

> The U.S. Coast Guard in expanding on the IMCO work estimated that a lesser amount of oil might flow out of a double bottom than a single bottom ship even if both were holed under similar circumstances. Overall this led them to conclude that the tanker double bottom might be roughly 60% effective—that is, it might save 60% of a total 50,000 tons lost in groundings each year—or a maximum of 30,000 tons annually.**

None of the above estimates reflect the following vital points:

> Any single incident in which a double bottom tanker has salvage or stability difficulties of the type described above might cause a greater oil spillage than the total estimated savings for all ships in any given year.

*U.S. Coast Guard estimates from Dept. Transportation, U.S. Coast Guard Draft Environmental Impact Statement, Pursuant to Section 102(2)(c), P. L. 91-190, etc., June 1974.

**In later estimates presented in 1973/4 the Coast Guard upped their estimates of effectiveness to 90%, or 45,000 tons saved annually. It was also acknowledged, however, that "present conventional single skin construction was at least 75% effective in preventing plating rupture."

> The severity of a grounding is crucial in regard to oil spillage. Coast Guard data for 1969-72 show that of 171 groundings causing oil outflow, only 13, or 8%, resulted in total ship loss. This 8% of incidents however produced over 60% of the oil spillage from all groundings.

> Over 60% of the groundings incidents, and 50% of those causing oil outflow have occurred in shallow and narrow harbors and entrances to which crude tankers are increasingly unable to trade, thereby removing them from the most accident-prone surroundings.

> The fact that groundings, however important, have accounted for less than 22% of the accidental oil released from tankers.

> The fact that other accident prevention and safety measures such as traffic control, better personnel training and licensing procedures, and new navigational equipment hold very high potential for reducing not only grounding but collision accidents as well.

In our view, the conclusion to be drawn from these factors is inescapable. Tanker double bottoms can probably mitigate spillage in a number of minor groundings currently accounting for on the order of 20,000 tons per year. They would almost certainly, however, turn a small number of initially minor incidents into major or catastrophic losses, thereby increasing the amount of oil spilled from tanker groundings.

Possible Double Bottom Safety Hazard in Tankers

There is an additional safety consideration. Both crude oils and many refined products which constitute upwards of 85% of petroleum moved by tankers can produce highly explosive vapors in confined spaces. Despite the most rigorous construction and maintenance procedures leaks can and do occur, particularly in the internal structure of all types of ships. If double bottoms were placed beneath cargo tanks there is always the possibility that some oil cargo will leak into these empty spaces and produce explosive and toxic vapors representing a hazard both to people and to the ship itself. Though frequently cited as evidence of no safety problem, the experience with dry cargo ships carrying

In a report of comprehensive hearings issued by the Senate Committee on Commerce on March 28, 1972 there is the statement:

"*Double Bottoms*. Perhaps the clearest instance of a standard presented at the committee's hearings that must be seriously considered, is that of double bottoms. Groundings, such as that of the *Torrey Canyon*, can be serious causes of catastrophic oil spills."

There seems to be the clear implication here that the Senate Commerce Committee felt double bottoms might be effective in an accident as extreme as the *Torrey Canyon* disaster. Yet in hearings before the House Committee on Merchant Marine and Fisheries on June 6, 1973 a Coast Guard witness stated categorically that the double bottom construction would not have saved the *Torrey Canyon*. Their testimony generally supports industry views that it would be of little use in what Coast Guard described as "high energy" groundings—that is, the high speed, serious accidents. As previously noted, it is the small number of serious accidents which historically have produced 60% of grounding spillage.

Turning to the question of additional cost so often cited as the basis for objections to fitting double bottoms, the 1972 Senate Commerce Committee hearings concluded "that the additional cost of double bottom construction would be approximately 4% (but) the Committee also received somewhat higher estimates." The Committee went on further to state "even the highest of these estimates would be a minuscule factor in terms of petroleum cost because of the tiny proportion of total petroleum cost that is represented by tanker transport."

These values may be contrasted with estimates supplied by the Coast Guard for the House Merchant Marine and Fisheries hearings a year later in which a percent cost increase of 8¾% was presented. Furthermore the House Committee, referring to long haul crude tanker traffic, estimated transportation cost at "about 20% of the total cost as a minimum of landed product."

While AIMS believes the higher Coast Guard estimates to be

fuel in double bottoms is irrelevant. Normal ship bunker fuel produces no explosive vapors and in fact usually won't even burn if a match is dropped in it. Many large crude tankers now use inert gas to protect against the explosion hazard, and this technique could be used in tanker double bottom spaces. It would, however, only compound the personnel problems, and because of the catacomb-like structural arrangement in double bottom tanks, there is no assurance that inert gas procedures would represent as effective an explosion precaution measure as it does in conventional cargo tanks.

Are Double Bottoms Ever Desirable for Tankers?

Despite these factors, there have been and will continue to be circumstances in which certain types of smaller tankers will find double bottoms operationally advantageous, despite the complications they present in serious grounding. For small "drug store" tankers and specialty ships which carry many different cargo grades over short distances, a double bottom may facilitate faster cargo handling, due to better tank drainage. The smooth tank bottom can also minimize the need for tank washing which is difficult for these specialty ships in short coastwise service. Lastly, because of their smaller size, the possible salvage complications following grounding described above are not likely to be nearly so severe for smaller vessels as for larger crude tankers. For these operational reasons, AIMS would not agree with the suggestion by one influential delegation at the opening of the 1973 IMCO conference that double bottoms should be outlawed for tankers. Rather we feel use of this construction should continue to be optional and be adopted for those circumstances where sound operational reasons indicate its value to help in cargo drainage, or tank washing particularly in short coastal voyages.

Some Views on the Tanker Double Bottom

Having described the major technical considerations, let's review some significant viewpoints expressed over the last four years of the "double bottom debate."

more nearly correct, we also believe that capital increments of this order would not represent an unreasonable burden for industry or consumers—if the double bottom could assuredly do what its advocates feel it could. Faced, however, with the prospect of little improvement at best, the additional cost and additional steel requirements on the order of 6,000 tons for each double bottom tanker of 200,000-300,000 tons, represent a wasteful misuse of capital and steel at a time of pressing shortages of each.

Finally, it is important to consider how marine regulatory experts outside of the United States view this proposal from an environmental protection viewpoint. On his return from the 1973 IMCO Marine Pollution Conference the leader of the U.S. delegation, the Hon. Russell Train, appeared before hearings of the Senate Committee on Commerce held on November 14, 1973. In reference to questions about the IMCO decision *not* to require double bottoms, Mr. Train said:

"While I was not present in the technical committee where most of this discussion took place, I think it is fair to say that there is a very strong difference of opinion with the United States on the subject of double bottoms. Not simply from the standpoint of the additional costs involved, but I gathered real differences of opinion as to effectiveness of double bottoms as a means for reducing accidental discharges.

"There were those who feel, for example, that with double bottoms if a ship goes on a reef and the double bottom is breached and fills with water, even though this is not mixing with oil and there may be no discharge of oil at that point, the ship will settle more positively, if that is the phrase, upon the reef and be that much more difficult to get off.

"It may well be that the use of the double bottom in such cases could be a detriment rather than an advantage in terms of protecting the seas."

In our view Mr. Train summarized very well the principal points made by the world's marine regulatory experts. At the IMCO deliberations U.S. proposals for mandatory double bottoms were put to a vote on two occasions. They were both defeated, first by a vote of 22 to 9 as a requirement for larger tankers, and later by a vote of 21 to 5 for the smaller tankers.

Summary

The preceding discussion covers generally all significant arguments made both for and against a requirement for double bottoms in tankers. It will never be possible to absolutely prove whether or not this construction would provide at least some measure of protection or whether it would turn out to be a step backwards in preventing oil pollution of the seas. The preponderance of actual evidence and technical information strongly suggests that double bottoms would be of no value whatsoever in major grounding accidents which though fortunately small in number cause the larger share of oil spillage from groundings.

Though not discussed herein, it seems clear that other measures now receiving serious consideration can definitely bring about a positive reduction in *both* grounding and collision accidents in the most sensitive coastal areas, and be applicable to all tankers, not just new ones.

Chief among these measures with high potential for preventing accidents are:

- > Harbor traffic control using shore radar and positive communications with all ships.
- > Better ship navigational equipment for position fixing and communication.
- > Improved training programs for personnel.

The potential for preventing accidents by such measures should be obvious, but has only recently been recognized in the United States. AMS supports steps in this direction now being taken by our Coast Guard and looks for them to be effective in the near future. Such steps based on sound technical and human engineering should be pursued as a matter of high priority.

July 1974

GROUP III
PERSONNEL STANDARDS, TRAINING, AND ENFORCEMENT

TANKERMAN QUALIFICATIONS

CDR Richard T. Hess
Office of Merchant Marine Safety
U. S. Coast Guard

The Coast Guard derives its authority from 46 USC 391A with respect to the manning and the duties and qualifications of the crews of all vessels, whether self-propelled or not, that shall have on board any flammable or combustible liquid cargo in bulk. Under the present regulations derived from this law, all licensed officers, which includes master, mate, pilot, and engineer, by virtue of holding a license are considered qualified to act as a tankerman on inspected vessels of the United States without having a separate certificate as tankerman.

Those individuals who do not hold a license and wish to obtain a certificate as tankerman shall furnish satisfactory documentary evidence to the Coast Guard that they are trained in and are capable of performing efficiently the necessary operations on tank vessels which relate to the handling of cargo. The applicant is then required to present a certificate from a medical officer of the United States Public Health Service or other reputable physician attesting that eyesight (including color vision), hearing, and general physical condition are such that he/she can perform the duties of a tankerman. The applicant then must prove by an oral or written examination that he or she is familiar with the general arrangement of cargo tanks, suction and discharge pipelines and valves, and cargo pumps and cargo hose and has been properly trained in the actual operation of cargo pumps, all other operations connected with the loading and discharging of cargo, and the use of fire-extinguishing equipment. The applicant must also demonstrate knowledge of pollution laws, procedures for discharge containment, and clean-up.

Certificates are issued for grades "A", "B", and "C" for flammable liquids, grades "D" & "E" for combustible liquids, and "LFG" for liquefied flammable gas. The endorsement on a merchant mariner's document for a rating of tankerman is limited to the grades of liquid cargo that the applicant is qualified to handle. If a person's document reads "Tankerman (Grade A and all lower grades)," it means that person is considered competent to handle all grades of flammable or combustible liquids.

The Coast Guard does not under present regulations require any formal training for an endorsement as a tankerman, only the presentation of documentary evidence that the individual has been trained. This training may be either formal or on-the-job. Once a

person is issued a tankerman's endorsement, the Coast Guard does not require the person to renew it, except in the case of a licensed officer who is required to renew a license every five years.

When product to be transferred does not meet the definition of flammability or combustibility, but is categorized as a hazardous liquid cargo, the Coast Guard shall be furnished documentary evidence that the person doing the transfer is trained in, and capable of performing competently, the necessary operations which relate to the transfer of such cargo. This person is not required to possess a merchant mariner's document, nor does the individual receive a certificate as a tankerman. As evidence of the person's qualifications the Coast Guard currently accepts a letter or document from the person's employer that he or she is proficient in handling one or more products.

To ensure that better-trained personnel are involved in the handling of petroleum products and hazardous liquid cargoes, the Coast Guard is preparing proposed regulations governing the qualifications of personnel.

The Presidential initiatives message of March 1977 calls for upgrading the qualifications of personnel serving aboard vessels carrying hazardous cargoes. The Port and Tanker Safety Act, passed by Congress in 1978, mandated that regulations dealing with this aspect of marine safety be promulgated. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (IMCO STCW) requires, in detail, minimum qualification and training standards for personnel engaged in the handling of hazardous materials. The proposed tankerman regulations are in conformity with those listed in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978. Under the authority of the Port and Tanker Safety Act of 1978, these regulations may be implemented without waiting for the convention to become effective.

The purpose of the proposed regulations is to effect a significant reduction in pollution in the navigable waters of the United States resulting from human error and lack of awareness of hazards in handling and transferring dangerous liquid cargoes in bulk aboard ships and barges. Improved qualifications for personnel in charge of, and assisting in, these operations should lead to a reduction in marine pollution and personnel and vessel casualties. These regulations speak not only to U.S. vessels, but also to foreign vessels when transferring oil or hazardous materials in any port or place subject to the jurisdiction of the United States.

The proposed regulations will do away with the designations of grades of tankerman endorsements such as Grade A, B, etc. Instead, they will designate three categories of tankerman: flammable/combustibles, dangerous liquids, and liquefied gases.

The regulations will require all persons directly involved in transferring cargo to hold certificates as tankerman. The regulations will require a tankerman on all ships, with very limited exceptions, when transferring dangerous bulk-liquid cargoes. The cleaning and gas-freeing of cargo tanks shall also be supervised by a tankerman. Those persons who have gained their experience predominantly aboard tankbarges will receive a certificate limited to tankbarges.

The regulations will also require detailed service and experience and, in addition, attendance at an approved product course and an approved fire-fighting course. Except for the endorsement of flammable/combustible, examinations administered by the Coast Guard will be discontinued. All individuals seeking the remaining two endorsements must attend approved training schools, and all persons, regardless of the endorsement, must attend an approved fire-fighting school.

The endorsement will be valid for a period of five years, after which the person shall, for renewal, attend a refresher course at a product school and a fire-fighting course.

The proposed regulations will recognize the difference between tankships and tankbarges. Consequently, the qualifications and training standards for these two types of vessels will differ.

The Coast Guard believes that product training courses will assure a consistent minimum level of understanding of the nature, handling characteristics, and safety procedures of the product applied for. It is expected that the fire-fighting training will give the individual a better understanding of marine fire-fighting equipment and its application. The course is not intended to train personnel as firemen, but rather to provide them with the basic background in order that they might take action in preventing a minor fire from developing into a fire of major proportions.

PERSONNEL STANDARDS AND TRAINING FOR TANKERMEN

Charles F. Nalen
Director of Vocational Education
Harry Lundeberg School of Seamanship

The prevention of pollution of marine environment is fundamentally the responsibility of people. Government laws, rules, and regulations can be established to require more seaworthy vessels, invulnerable cargo containment and transfer systems, and proficient merchant-marine personnel. Compliance and enforcement of these mandates become the burden of government, labor, and management. It is apparent that people and their performance play a salient role in this process.

Findings of statistical studies and analysis of vessel casualties conclude that "It has been recognized that over eighty percent of maritime accidents are caused by human error."¹ While vessel casualties are a prime source of oil pollution, "most of the minor spills are caused by human error rather than equipment failure."² These conclusions imply that improved human performance can promote safe nonpolluting, efficient, and effective vessel operations.

A conclusion drawn from a recent study of tankbarge oil pollution incidents is quoted below:

"The primary causes for both minor and major spills are related to personnel errors. In the case of minor spills, personnel error usually involves mishandling of equipment and insufficient attention to regulations and operating procedures during cargo-transfer operations. For major spills, misjudgments by barge pilots lead to collision or grounding incidents with subsequent hull damage and large oil-spill volumes. Improved personnel performance could have been effective in preventing a large number of both minor and major oil-spill incidents reviewed in this study."³

Additionally, this study made the following recommendation concerning tankbarge operating personnel:

"Continue the ongoing efforts to upgrade the performance capability of personnel involved in tankbarge cargo-transfer operations. Intensified training and qualification programs must be integrated into the existing Coast Guard regulatory and operational system to ensure attainment of the desired improvement in performance"³

Research findings indicating personnel error as a primary cause of tank barge oil pollution serve to emphasize that our present merchant-marine personnel qualifications are inadequate. Eligibility, knowledge, and skill requirements for the operating personnel responsible for the transport of tank barges and the transfer of oil cargo need to be evaluated.

Present Coast Guard "Rules and Regulations for Licensing and Certification of Merchant Marine Personnel" establish the following knowledge and skill requirements for certification as tankerman:

"Trained in, and capable of performing efficiently the necessary operations on tank vessels which relate to the handling of cargo.

"Prove by examination, familiarity with and proper training in the general arrangement of cargo tanks, suction and discharge of cargo, and the use of fire-fighting equipment.

"Demonstrate knowledge of pollution laws and regulations, procedures for discharge containment and clean-up and methods of disposal of sludge and waste material from cargo and fueling operations."

These qualification requirements briefly encompass general tankerman job tasks. They are the present requirements from which Coast Guard examinations for certifications of tankermen are developed. More specific tankerman job tasks indicating performance standards and training functions should be established as a basis for regulatory training requirements and qualification examinations.

The tankerman training program offered at the Harry Lundeberg School (HLS) was designed cooperatively by the school, the Seafarers International Union, AFL-CIO, and its contracted barge-industry companies. Merchant-marine personnel successfully completing this training program represent a significant number in comparison with the Coast Guard tankerman endorsements issued, as indicated in Figure 1.⁵

Our experience with maritime-industry training has necessitated a systematic approach to the development of training programs. The tankerman training objectives presented in Figure 2 are the result of Barge Industry Advisory Board analysis of tankerman job tasks.

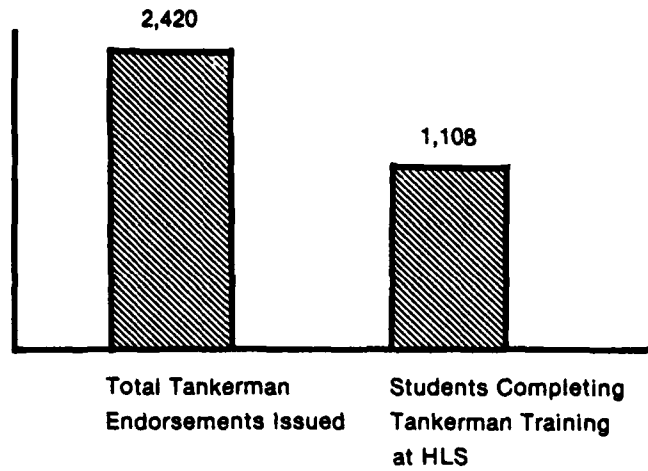
The tankerman training objectives indicated in Figure 2 specify knowledge and skills a study will achieve upon successful completion of this program. These terminal objectives are further designed in our training program to include behavioral conditions and minimum levels of achievement. As illustrated in Figure 3, the framework of a tankerman training program consists of establishing instructional

behavioral objectives and the methodology for determining the student's performance.

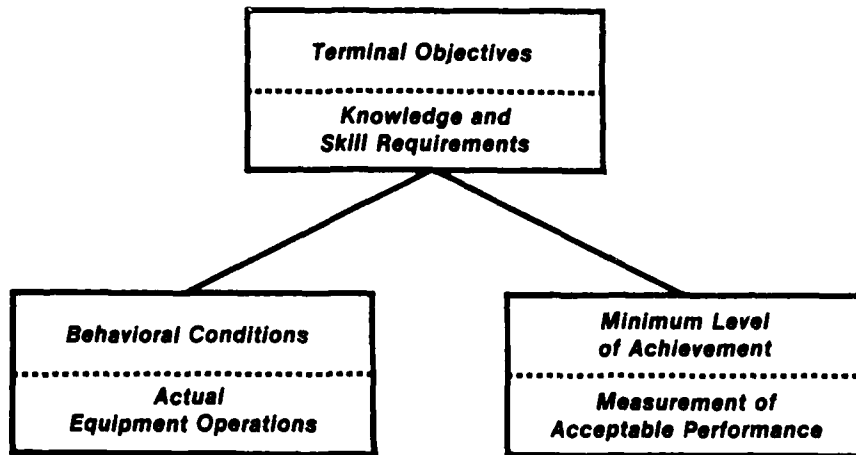
Upon referring to the tankerman training objectives (Figure 2), it becomes apparent that not all of these requirements can be satisfied by classroom teaching and evaluation. Therefore, training of tankermen utilizing actual tankbarges or simulation is necessary. The tankbarge used in the Harry Lundeberg School Tankerman Training Program is a 10,500-barrel barge with a common piping system and two diesel-driven cargo pumps. A shore manifold is used to pump seawater for cargo transfer operations. Each student must successfully complete all of the performance objectives using actual tankbarge equipment.

Minimum levels of achievement must be determined in order to define quantitative and qualitative attributes of performance. This is the most critical section of the tankerman training model shown in Figure 3. The measurement of human performance in a training program must specify that each student will perform the required tasks to a certain specification within a prescribed limited of time. An advantage of a structured training program using minimum levels of achievement as an evaluation of performance is that uniformity and standards of training can be maintained.

While many factors are involved in the prevention of tankbarge oil pollution, the reduction of personnel error appears to be the most significant. The tankerman training program presented in this paper promoted safer tankbarge operations and protection of the marine environment through improved human performance.



**Number of Merchant Marine Personnel
Passing USCG Tankerman Examinations
in FY 1979**
Figure 1



**Framework of Tankerman
Training Program**
Figure 3

Performance Objectives	Knowledge Objectives
<ul style="list-style-type: none"> - Complete Red Cross multi-media First Aid exercises - Properly wear and operate an oxygen breathing apparatus and a fresh air mask and pump - Draw a schematic of a tank barge piping system - Complete a tank barge declaration of inspection - Conduct a transfer conference - Inspect an operational petroleum barge - Rig a bonding cable - Line up a tank barge piping system and prepare for transfer operations - Secure overboard discharges/sea suction valves - Start and stop a diesel cargo pump - Control diesel cargo pump operations - Sound tanks, voids and rakes - Load a tank barge to a predetermined draft - Top off a cargo tank - Completely discharge and strip a tank - Secure scuppers and drains - Tend vessel moorings - Check unused piping components - Complete MARAD practical fire fighting course 	<ul style="list-style-type: none"> - Understand the tankerman's responsibilities - Recognize the importance of tankerman training - Identify and demonstrate use of all six Coast Guard publications important for tankermen - Recognize general types of dangerous cargoes - Recognize specific grades of cargo and how each grade is determined - Understand the basic hazards involved with bulk liquid cargo - Recognize the hazards involved with working in enclosed spaces - Understand basic First Aid principles - Identify and use various breathing apparatus - Recognize the general hull classifications - Understand tank barge piping diagrams - Recognize the importance of cargo planning prior to loading dangerous cargo - Knowledge of responsibilities involved in transferring cargo and carrying out related operations onboard a tank vessel in a safe, pollution free manner - Knowledge of prescribed Coast Guard procedures concerning the transfer of dangerous cargo - Knowledge of laws and regulations associated with pollution - Knowledge of responsibility in controlling the accidental discharge of hazardous materials - Recognize approved methods for containment and removal of spilled oil - Knowledge of proper oil spill reporting procedures - Understand hazards of handling LFG - Recognize different types of LFG - Understand hazards of certain bulk dangerous cargoes - Recognize the basic safe handling requirements used with bulk dangerous cargoes - Recognize different classes of fires - Understand the proper use of fire fighting equipment - Knowledge of fire fighting procedures

Tankerman Training Program Objectives
Figure 2

REFERENCES

- 1 IMCO News "Convention on standards of training certification and watchkeeping for seafarers adopted at IMCO Conference", Number 4, 1978. Pages 6 - 7.
- 2 Department of Transportation, Coast Guard, "Oil Pollution Control for Tankerman CG-480" June 1975. Page 4.
- 3 Department of Transportation, Coast Guard "Draft Regulatory Analysis and Environment Impact Statement" May, 1979. Page 4-1 and 4-2.
- 4 Department of Transportation, Coast Guard, "Rules and Regulations for Licensing and Certification of Merchant Marine Personnel, CG-191" November 1976. Page 67.
- 5 Department of Transportation, Coast Guard "Proceedings of the Marine Safety Council" Volume 37, Number 1, January 1980. Page 13.

LICENSING OF OPERATORS OF UNINSPECTED TOWING VESSELS

CDR James R. Norman
Office of Merchant Marine Safety
U. S. Coast Guard

In 1972, because the high rate of casualties involving human error on uninspected towing vessels, the Congress enacted the Towing Vessel Licensing Act, which was signed into law on July 7, 1972. The Act required the licensing of operators of uninspected towing vessels and stipulated that six months after promulgation of implementing regulations, the provisions therein would become effective. To this end, since September 1, 1973, all commercial vessels of 26 ft. or more in length engaged in the service of towing have been required to be under the actual direction and control of persons licensed by the Coast Guard. However, the Act does exempt from this requirement uninspected towing vessels of less than 200 gross tons engaged in a service to the offshore mineral and oil industry.

The Coast Guard supported this legislation as a means of achieving greater safety for towing vessels and believes that the licensing of operators of uninspected towing vessels offers a substantial contribution to marine safety. At the time of this legislation there were more than 5,000 towing vessels operating with no requirement whatsoever for the operator to be licensed or to demonstrate any evidence of competency. These vessels often propel a fleet of barges having a carrying capacity equal to that of a large freighter or tankship and with cargoes having various degrees of hazard. Their operation for the most part is in highly congested inland waters and often in close proximity to large cities. The Coast Guard has, over the span of several years, supported legislation which included the objectives of this law. It is our belief that this law was a stride forward in promoting maritime safety and should reduce the possibility of casualties involving towing vessels.

The issuance of a license in itself is no guarantee that there will be a reduction in marine casualties. However, the issuance of an operator's license does provide for a level of competency that previously was not required. An operator's license is issued based on evidence that the applicant has shown qualifying experience on towing vessels and has passed a professional examination and a physical examination. In addition to being evidence of competency, the issuance of a towboard operator's license provides a measure of control which was previously lacking. Once an operator's license is issued, the Coast Guard has the authority, through appropriate administrative procedures, to suspend or revoke a license in cases of

proven misconduct, negligence, or incompetence on the part of the holder.

In general, the licensing regulations for towboard operators are patterned after existing regulations applying to all other facets of the maritime industry. Application procedures are clearly outlined and related to qualifying requirements with respect to age, citizenship, experience, physical condition, and professional examination.

During the period from September 1, 1972, to April 1, 1975, special provisions were included to phase in the licensing requirements for towboard operators. The intent of this phasing in period or grandfather clause of the regulations was to provide for the licensing under reduced requirements of those persons currently serving as towboard operators in order to avoid a disruption of the towing industry. During this period those persons with one year's experience in charge of a towboat were allowed to qualify for an operator's license under reduced requirements for experience, relaxed medical standards, and with only a brief examination on Rules of the Road in place of the more comprehensive professional examination.

Since April 1, 1975, an applicant for a license as operator of uninspected towing vessels has been required to meet the full requirements of the licensing regulations for that license. Two operator's licenses were created in this regard. The first, an operator's license, requires an applicant:

1. To be at least 21 years of age.
2. To have at least three years of experience on towing vessels.
3. To pass a professional examination covering a variety of subjects ranging from Rules of the Road and navigation to fire-fighting and pollution prevention.
4. To meet the present Coast Guard medical standards for an original license.

An applicant who meets all of these requirements is issued an operator's license for use in one or more of the following geographical areas, depending on his experience:

1. Inland Waters
2. Western Rivers
3. Great Lakes
4. Oceans
5. Oceans, not more than 200 miles offshore
6. A limited local area designated by the Officer in Charge, Marine Inspection [in the case of an applicant requesting a limited local-area endorsement, the professional examination is modified to cover only that area.

A second-class operator's license is issued to an applicant who:

1. Is at least 19 years of age instead of 21
2. Has at least 18 months' experience on towing vessels instead of 3 years
3. Passes the same professional examination as is required of an applicant for an operator's license
4. Meets the present Coast Guard medical standards for an original license

The holder of a license as second-class operator of uninspected towing vessels may not operate a towing vessel unless a holder of a license as operator of uninspected towing vessels or a master, mate, or pilot is on board that vessel. The holder of a second-class operator's license is issued an operator's license at such time as the person meets the necessary requirements for age and total experience.

An applicant's experience, in order to be accepted, must be properly documented by certificates of discharge or by letters of service from employers stating the inclusive dates of employment aboard towing vessels. Only actual underway service on towing vessels is creditable for licensing purposes, with 360 days representing one year. The requirement for three years' experience on towing vessels for an operator's license means actual underway time on towing vessels totaling 1080 days. However, for those applicants whose normal workday on a towing vessel is 12 hours, it is the Coast Guard's policy to accept such time as 1-1/2 times the normal day of employment.

The administration of this new licensing program during the initial licensing years conformed to schedule and is considered to have been a success. The success, in large part, is attributed to the individual desires of the operators for a license, to management and labor-organization encouragement of their employees or members to obtain a license, and to those training institutions who prepare applicants for the license examination.

MARINE PERSONNEL TRAINING

James H. Sandborn
Interstate and Ocean Transport Company

Interstate and Ocean Transport Company is the largest independent marine transporter of petroleum products in the United States. Founded in 1928, the company has pioneered the economic employment of large oceangoing tug/tankbarge units and today operates the largest fleet of coastal tankbarges in the world. Operating on the Atlantic and Gulf Coasts of the United States, 22 of Interstate's 53 barges exceed 50,000 barrels in capacity and 11 of its fleet of 56 tugs are in excess of 4000 horsepower. Twelve of its fleet of barges currently in operation and two now under construction exceed in capacity the popular T2 tanker. Interstate claims an outstanding record of safe, economical tankbarge and tug operation. The consensus at Interstate is that the company training program for both tug and barge personnel has been a key factor in achieving this success.

The purpose of this discussion is to outline in rather general terms the training programs for pilot-house and tank barge personnel. Discussion of the content of the training, the objectives, purposes, etc., is contained in Exhibit A, which is attached to this report. The key to the success of the training program is twofold: First, all new marine employees of Interstate must undergo company training in order to address the specific operations of this company and its fleet of vessels. The emphasis is on the demonstration of the capability to perform. Second, the success is further enhanced by follow-up of shoreside supervisory and management personnel in the operating and the personnel areas.

Pilothouse Personnel Training

Pilothouse personnel, who include licensed mates and masters, must successfully meet a variety of requirements before being qualified to operate these vessels. It should be noted that all who join Interstate as candidates for positions as pilot-house personnel must undergo on-the-job training. Before being accepted for entry into the on-the-job training program, all must meet Coast Guard requirements for licensing and health and must also have at least three years' operational experience in the marine tug and barge industry. If the candidate is a graduate of an accredited maritime academy, or one of the schools conducted by unions with which Interstate has collective bargaining agreements, he must serve on board Interstate vessels for a minimum of six months.

After being recommended for the training program by both seagoing and shoreside supervisors, the trainee is required to serve a minimum of six two-week tours, during which he stands watch in the pilothouse under the direct supervision of the tug master. The training program outlines both knowledge and performance requirements which are expected of the trainee. Included in the first category are such items as piloting, safety, emergency, and watch-standing procedures, as well as the use of navigational aids including electronic aids to navigation. In the later category are requirements that the trainee demonstrate satisfactory expertise in maneuvering the tugboard and its barges in each phase of operations.

At the conclusion of each tour of training, the captains under whom the trainee has served are required to submit a formal training-progress report. Additionally, Interstate's port captain visits the tugboard at least twice during the training period and evaluates the trainee's progress.

The trainee's progress on board Interstate's tankbarges is monitored by shoreside management. The marine personnel manager, the quality control/cargo handling manager, and the operations manager are all required to have supervisory personnel of their staff visit the trainee on board the barge and discuss with him and the barge captain, the trainee's progress. Upon the completion of the at-sea phase, the trainee must study for and successfully pass a company written examination before even being recommended by the operations manager to sit for the U.S. Coast Guard tankerman certification exam.

Interstate's training program does not come to an end after a person becomes qualified on one of the tugs or barges. The company has an ongoing program of semiannual one-week training seminars for tug captains, tankbarge captains, and tug engineers. These seminars provide an opportunity for presentation of technical subjects such as radar navigation, rules of the road, care and maintenance of reduction gears, and other technical operating areas, as well as review and discussion of current company operating policies and procedures. Most importantly, the seminars provide a format for management and operating personnel to discuss fleet problems and possible corrective actions.

Interstate continuously updates its policy and procedures (operating) manuals, which have been written for both tug and barge operations, and which provide all operating personnel with concise written instructions for the proper operation and maintenance of Interstate vessels. Training programs emphasize this manual as a textbook for safe operations. Training news is also disseminated quarterly to all operating personnel through the company's newsletter.

The company's training program utilizes several media, and can be seen from the description of the materials used outlined in Exhibit A. Interstate utilizes films, video tapes, and other audiovisual aids

as well as governmental publications and personnel instruction provided by shore-based supervisory and operations personnel. In addition, the company has undertaken to produce its own videotapes on operations which are considered essential to the safe operation of its vessels and are specifically tailored to Interstate operations. The library of video tapes also includes those drawn from other firms. Special facilities are available for individual study as well as for small classroom-type programs.

This entire effort has been conducted to achieve one very basic objective: to provide the best trained personnel which will insure the safe, economical, efficient transportation of petroleum products in waters of the United States.

Summary of Small Vessel Operations Training Programs Offered at Sample of Maritime Academies

Interstate & Ocean Transport Company looks to several sources for its tug deck officers, tug engineering officers, and tankbarge personnel. There is promotion from within; new employees also come from other firms in the same business; experienced personnel also come from unions with which we enjoy collective bargaining agreements, and from schools which unions conduct and are supported financially by contracting companies; and the company receives personnel from the several state and the federal maritime academies.

In all cases, we insist on successful completion of a training program for the various positions as referred to in the first section of this report.

The purpose of this section is to illustrate in very similar terms the rules of programs and their aims which are offered at three (3) representative maritime academies: the U.S. Merchant Marine Academy at Kings Point, N.Y.; Maritime Maritime Academy at Castine, Maine; and the New York State Maritime College at Ft. Schuyler, N.Y.

Small vessel operations training is not new to government maritime education. It is interesting to note that at least one of these institutions has been offering, for approximately 10 years, training and/or courses of study in small-vessel operations (which includes tugs and barges). All have recognized a continually growing need for highly trained and highly skilled deck and engineering personnel and have undertaken to provide the tug and barge industry with such candidates who are career oriented toward that facet of the maritime industry.

A. UNITED STATES MERCHANT MARINE ACADEMY

At Kings Point the opportunity is afforded members of the student body to engage in a minor course of study in small vessel operations. The genesis of this program dates to 1971. It started as a result of the review of a government study which demonstrated clearly a rising need for deck and engineering personnel in the growing inland, and coastwise tug and barge industry of the United States. Exhibit B is attached hereto to illustrate by example, the course of study which is offered in this minor program in small vessel operations.

Approximately 40 students are enrolled in the minor program each year. The emphasis is on practical vessel operations training. The course of study consists of 12 hours in four 3-hour sections. For more detail refer to Exhibit B.

The minor is the result of a joint effort by the Departments of Nautical Science and Marine Engineering. In addition to this program of small vessel operations, it should be added that in normal course of study in cargo operations, training is provided in tank vessel operations at not only Kings Point, but all of the schools.

The U.S. Merchant Marine Academy conducts its small vessel operations in two phases. Small Vessel Operations I is conducted aboard the M/V NEREID a former U.S. Army tug, 65' length, 100 gross tons and powered by a 300 HP diesel main engine. This vessel is also rigged for cargo work with a boom and diesel winch; as a fire boat with 1000 gpm diesel driven pump; and for towing, fitted with bits and towing gear. Small Vessel Operations II is conducted aboard the M/V Kings Pointer, a former Navy ATA of 960 gross tons. This is an ocean-going vessel powered by a diesel electric system and equipped with bow thruster.

B. MAINE MARITIME ACADEMY

While Maine maritime utilizes a training vessel for most at sea training of its cadet student body, the academy in 1967 started a cadet shipping program whereby top students were able to obtain training on commercial vessels. Shortly after the institution of the program, this training was expanded to include ocean towing vessels of the tug and barge industry. Major corporations contributing and taking part in this cadet training have included Moran Towing and Transportation of New York, Crowley Transportation of San Francisco, Foss (Dillingham) of Seattle and Interstate and Ocean Transport of Philadelphia. This program is offered at the end of the second year for those cadets interested in pursuing careers in the tug and barge industry. A sea project is required summarizing training in this area. This sea project completion is a requirement of the U.S. Coast Guard in order for this training to be considered as credit for sea time. At this juncture, in order for this training to be accepted by

the U.S. Coast Guard, engineering cadets must serve on ocean tugs of no less than 4000 shp under the supervision of a licensed engineer, and deck cadets must serve on tugs equipped with electronic aids to navigation, and also under the direction of a licensed deck offer. This training may not exceed 60-days of the total at-sea training of cadets. The balance is conducted aboard the Academy's training ship. Company support of this program has been very substantial.

The emphasis on this entire program is in training, that is, obtaining experience in maneuvering, operation, engineering, and navigation of tugs and barges.

In addition to training aboard ocean tugs, Maine maritime cadets have the opportunity to serve aboard U.S. flag ocean tankers to learn safe and proper tank vessel operations.

In addition to the at-sea training on tank vessels, a tanker operations course is offered at the Academy. A tanker model is utilized for simulation of loading and discharging operations.

As part of their program of continuing education, Maine maritime is undertaking to generate a course for post-graduates (licensed deck and engineering personnel) on oil spill prevention and control. This program has not yet started, but has the support of many in industry.

C. NEW YORK STATE MARITIME COLLEGE

Effective 1 January, 1980, Ft. Schuyler offered an elective course in towboat and inland operations. This program was started after the chairman of the transportation department perceived from an experienced tug master and other sources, a growing need for tug captains. And furthermore, the need would be for the highly trained individual which is common of the graduates of the maritime academies.

The course is only offered to seniors who have completed all requirements for their third mate's license examination.

It is open to those who are interested in pursuing a career in the tug and inland tug and barge industry.

The course itself consists of 45 semester hours. The course is conducted by a licensed tug master (an Academy alumnus). Thirty hours of lecture are delivered on ship-handling techniques, manning, company organization, and other operational type subjects. These lectures are augmented by guest lecturers drawn from the tug and barge industry. In addition, 15 hours of laboratory (hands-on experience) are required. Cadets serve short tours as cadet observers aboard commercial towing vessels.

When a survey was conducted relative to interest among the student body in the fall of 1979, approximately 17 of the class expressed interest. It is interesting to note that on 1 January 32 students enrolled in the program.

EXHIBIT A

Synopsis of Interstate and Ocean Transport Company's training policies for mates and tankermen extracted from Co. policies and procedures manuals.

INTERSTATE AND OCEAN TRANSPORT CO.

Training Policies

I.O.T. hires marine personnel through union schools, union halls, merchant marine academies, or walk-ins with experience. Due to the nature of our business, additional training is required of all persons. I.O.T. has taken the initiative to formulate and directly training our employees to meet the standards of our industry and our company. The following is a synopsis of our training programs for mate and tankerman trainees.

I. MATE TRAINING PROGRAM

- A. In order to be enrolled in the program, an individual must meet the following minimum criteria:
1. License--U.S.C.G. Operator of uninspected towing vessels upon oceans not more than 200 miles off shore and the inland waters of the U.S. or higher.
 2. Service with company
 - A) Three years continuous marine service with I.O.T. and/or affiliated companies, or
 - B) Graduate of an accredited maritime academy and six-months service as able bodied seaman on I.O.T. tug boats.
 3. Recommendations--The applicant shall produce a letter or testimonial prepared by a captain under whom he has served. The applicant must also have recommendations from the port captain or higher company official.
 4. Knowledge requirements
 - A) Rules of the road, international and inland,
 - B) Piloting,
 - C) Use of navigation aids and charts
 - Radar
 - Loran
 - D) Application of compass error,
 - E) Tug boat seamanship
 - Tow configurations
 - Rigging - lines, etc.
 - Proper handling & maneuvering of barges
 - F) Use of communications equipment,
 - G) Emergency signals,
 - H) Lifesaving and first aid,
 - I) Fire fighting equipment and procedures, and

J) Regulations and laws application to the operation of towing vessels including pollution prevention and control

B. Candidate Selection: Selection is based on qualifications, seniority and recommendations.

C. Duration of Individual Training Program: Each trainee is required to serve a minimum of six (6) two (2) week tours working six hours on and six hours off on the captain's watch.

D. Nature of Training: The trainee is expected to perform the routine boat handling operations and piloting under the careful observation and instruction of the captain. The trainee will begin by handling the light tug boat advancing to the making up and letting go of barges through docking and sailing of light and loaded barges. He should advance in all phases of tug handling as listed here:

- Docking, sailing and piloting light tug,
- Docking, sailing and piloting small and medium loaded and empty barges in he alongside and stern pushing mode,
- Docking and sailing barges from ships on the hawser,
- Going from pushing and alongside towing to hawser,
- Going from hawser to alongside and stern pushing, and towing barges stern first.

During his watch periods the trainee will advance in the areas of instruction at the discretion of the vessel's captain under whom he is training. The level of training progresses with his skill, ability and self-confidence. A goal has been set so that by the end of the fourth tour he shall become familiar with and be able to perform docking/undocking procedures, stern pushing, hip and hawser towing, and lightering operations. Each trainee is also expected to be aware of the administrative responsibilities as well as the necessary paper work and proper reporting procedures that accompany the position of mate. The company policy and procedures manual outlines his duties and responsibilities.

E. Monitoring and Follow-up of Progress: At the conclusion of each tour of training, the captain or captains under whom the trainee has served is required to submit to the marine personnel department a formal mate-training progress report. It is expected that these reports will be fair and accurate evaluations of each trainee. In addition, the port captain evaluates the training a minimum of two times during training (if possible during the fourth and sixth tours of training).

F. Completion of Training Program: At the completion of the sixth tour of training, each individual trainee is evaluated by the operations and personnel departments. The basis of the evaluations

takes into consideration the individual's skills and ability to perform the duties of mate based upon the evaluations outlined above.

If the individual is qualified to work in the position of mate, he will be assigned a mate's position.

If the individual is not qualified to perform the duties of mate, he will be returned to his normal assignment and given future consideration for re-entry into the mate training program for further training.

G. Materials Available for Training

1. Hands on training and experience.
2. Company policy and procedures manual is required reading for the individual to comprehend the company's requirements and policies which encompass the following:
 - I.O.T. training policies
 - A) Responsibility of the crew,
 - B) Safety and watch standing procedures,
 - C) Emergency wheelhouse check list,
 - D) Care and use of deck equipment,
 - E) Electronic aids,
 - F) Reporting and record keeping, and
 - G) Ordering of deck supplies and stores.

II. TANKERMAN TRAINING PROGRAM

- A. Purpose--To establish the requirements necessary to train individuals in the safe handling of petroleum and chemical cargoes.
- B. Objective--Training program to be utilized as an entry level for individuals who have limited experience in the industry.
- C. Requirements
 1. Endorsement--Must hold a valid merchant mariner's document with a minimum endorsement of ordinary seaman.
 2. Physical--A current certificate of health provided by any authorized U.S. Public Health Service Hospital.
 3. Experience--Should be a graduate of some type of marine industry school or at least be slightly acquainted with the industry.
- D. Candidate Selection--Candidates will be selected by use of S.I.U. hiring hall as well as recommendations from I.O.T. employees and former employers of the individual. All prospective candidates will be screened and processed by the marine personnel department.

- E. Duration of Individual Training Program--Each trainee is required to serve a minimum of three (3) two (2) week tours of hands-on training, with one (1) week off between tours.
- F. Area of Training--All tankerman trainees are placed aboard any I.O.T. equipment in the east coast fleet. Every effort is made to place trainees aboard as many different vessels engaged in different operations in order to get a wide scope of experience: Example:
- 1) One tour aboard a vessel which is engaged in lightering service.
 - 2) One tour aboard a vessel which is engaged in multi-grade clean oil service.
 - 3) One tour aboard a vessel engaged in harbor service such as bunkering.
- G. Nature of Training--Each trainee is expected to work the watch with the vessel's captain. During tours of training, the trainee advances in areas of instruction at the discretion of the vessel's captain under whom he is training. The level of training will progress as does the trainee's skill and ability and self-confidence. By the end of his third tour of training, he must be familiar with and able to perform the following:
- 1) Loading/discharge operations
 - 2) Routing maintenance
 - 3) Mooring procedures
 - 4) Line handling
 - 5) Understand the company's special cargo handling and static accumulator instruction
 - 6) U.S. Coast Guard rules and regulations
 - 7) Administrative responsibilities
 - 8) Proper reporting procedures
- H. Monitoring and Follow up of Progress--There shall be a minimum of three (3) supervisory checks during the individuals training. These checks should be in the form of discussion and practical examination.
- I. Outline of Visiting Procedure
- 1) First visit will be made by a member of the marine personnel department during the trainee's first tour of duty.
 - 2) The second visit will be made by the quality control/cargo handling superintendent during the trainee's second tour.
 - 3) The third and final visit will be made by the barge supervisor during the trainee's third tour. Each supervisor will confer with the vessel's captain for a

critique of the trainee's skill, ability, attitude and progress. Each supervisor is required to complete and forward to the marine personnel department a trainee check list corresponding to his visit.

- J. Completion of Training Program--At the completion of the third tour of training, each individual trainee is required to successfully complete the I.O.T. written tankerman's examination. Following the exam, the trainee is evaluated by the operations and personnel departments. The basis for evaluation is his skill, ability and knowledge to perform the duties of tankerman.

EXHIBIT B

U.S. Merchant Marine Academy
Dept. of Nautical Science
Course Outline:
Minor Program in Small Vessel Operations

N.B. This exhibit was obtained from USMMA. It is not something prepared by Interstate.

DEPARTMENT: NAUTICAL SCIENCE
MINOR PROGRAM IN SMALL VESSEL OPERATIONS

The Departments of Nautical Science and Marine Engineering offer jointly the following courses which constitute a minor in Small Vessel Operations; consisting of nineteen (19) quarter credit hours for Deck Midshipmen and eighteen and a half (18-1/2) quarter credit hours for Engineering Midshipmen.

Deck Midshipmen

<u>Course Number</u>	<u>Course</u>	<u>Prerequisite</u>	<u>Credit</u>
D424	Small Vessel Operations I		3
D425	Small Vessel Operations II	D424	1-1/2
D426	Small Vessel Maintenance		1-1/2
D494	Domestic Shipping		3
E444	Small Vessel Engineering I		3-3/4
E445	Small Vessel Engineering II		3-3/4
E101B	Electrical Engineering Preliminaries		<u>2-1/2</u>
			19.0

Engineering Midshipmen

D424	Small Vessel Operations I		3
D425	Small Vessel Operations II	D424	1-1/2
D426	Small Vessel Maintenance		1-1/2
D494	Domestic Shipping		3
D251	Marine Electronics I		3
D129	Nautical Science III		5
E466	Internal Combustion Engine Maintenance	E465	<u>1-1/2</u>
			18-1/2

FACULTY MEMBERS AVAILABLE FOR COUNSELING AND PROGRAM PLANNING

Lt. Commander T. Haendel
 Lt. Commander G. Kingsley

D424 SMALL VESSEL OPERATIONS I Credit: 3

Practical understanding of handling small vessels, vessel construction and stability in preparation for careers in offshore oil, inland river, harbor and coastal industries. Participants spend one half of the course time afloat aboard the Academy's training vessels practicing docking and undocking, maneuvering in close quarters and developing competence to handle engine room operations.

Elective.

2 Lecture hours a week

2 Laboratory hours a week

D425 SMALL VESSEL OPERATIONS II

Credit: 1-1/2

Advanced techniques of maneuvering small vessel's handling in narrow channels; shipwork utilizing tugs advantageously; use of anchors to maneuver, handling barges.

Elective. Prerequisite: D424

3 Laboratory hours a week

D426 SMALL VESSEL MAINTENANCE

Credit: 1-1/2

Planning of specific maintenance projects, preventive maintenance afloat, scheduled yard maintenance; deck machinery; removal of surface coatings; exterior surface coatings; interior maintenance, fouling, cathodic protection; drydock operations.

Elective

3 Laboratory hours a week

E444 SMALL VESSEL ENGINEERING I

Credit: 3-3/4

Diesel engine design and construction; the combustion process and chamber design; fuel injection systems; governors, air intake systems and filtering; exhaust, cooling, lubricating and starting systems; reconditioning and trouble shooting.

Elective for Deck Midshipmen Only

3 Lecture hours a week

3 Laboratory hours every other week

E445 SMALL VESSEL ENGINEERING II

Credit: 3-3/4

Marine engineering theory and operating practices applicable to small vessels. Topics include: refrigeration, heating and ventilation, piping systems and pumps, propulsion systems, hydraulic principles, steering systems, deck machinery, sanitation systems and pollution control.

Elective for Deck Midshipmen Only. Prerequisite: E444

3 Lecture hours a week

3 Laboratory hours every other week

D494 DOMESTIC SHIPPING

Credit: 3

This course analyzes the tow boat operations on the inland rivers, coastwise shipping and vessels of the Great Lakes. Included are the special designs and characteristics of the varied watercraft, techniques for locking and open-water operations, regulatory organizations involved, and the crew manning and safety requirements. Analysis is also made of the impact of domestic trade on the U.S. economy.

Elective

3 Class hours a week

E466 INTERNAL COMBUSTION ENGINE MAINTENANCE ENGINEERING Credit: 1-1/2

Tear down of diesel engine to survey work required for complete repair report, with all data taken during teardown and rebuilding: cylinder wear, ring wear, piston clearances, bearing wear check with leads, crank shaft alignment. Complete rebuilding and final tuning of engine systems. Analysis of maintenance problems and causes.

Elective. Prerequisite: E465

3 Laboratory hours a week (Limited to 10 students per course section.)

D129 Nautical Science III

Credit: 5

An introduction to piloting and celestial navigation. Coordinate systems, the nautical chart and publications, dead reckoning and piloting. The celestial sphere, celestial lines of position, time, the sextant and azimuths.

4 Class hours a week

2 Laboratory hours a week

D251 MARINE ELECTRONICS I

Credit: 3

General principles of radio communications and electronic navigation followed by an operational emphasis on the following systems: radiotelegraph and radiotelephone transmitters and receivers, AM-FM-SSB; auto-alarms; lifeboat portable transceivers, Loran A; radio direction finders; depth finders. The course also includes coverage on communications procedure, pertinent FCC rules and regulations, and an introduction to radar operation including the plots for collision avoidance.

2 Class hours a week

2 Laboratory hours a week

E101B ELECTRICAL ENGINEERING

Credit: 2-1/2

This course is a brief survey of the electrical principles necessary for an understanding of operating systems and techniques, maintenance testing, and trouble-shooting procedures that are practiced aboard ship.

2 Class hours a week

2 Laboratory hours on alternate weeks

SMALL VESSEL OPERATIONS MINOR

Quarter Course	1	2	3	4
D424 Sm. Ves. Ops. I		D425 Sm. Ves. Ops. II	D425 Sm. Ves. Ops. II	D424 Sm. Ves. Ops. I
		D426 Sm. Ves. Maint.		
+E444 Sm. Ves. Eng. I		+E445 Sm. Ves. Eng. II	+E444 Sm. Ves. Eng. I	+E445 Sm. Ves. Eng. II
			+E101B Elect. Eng. Prelim.	+E101B Elect. Eng. Prelim.
*D251 Marine Electr. I				
			*D129 Nautical Sci. III	*E466 Int. Comb. Maint.
			*E466 Int. Comb. Maint.	*D129 Nautical Sci. III
				D494 Domestic Shipping

NOTE: + Indicates for Deck Midshipmen

* Indicates for Engineering Midshipmen

SMALL VESSEL OPERATIONS

Year	Quarter	1	2	3	4
A	Split	+E444 Sm.Ves.Eng.I	+E445 Sm.Ves.Eng.II		
3					
		D424 Sm.Ves.Ops.I	D425 Sm.Ves.Ops.II	AT	SEA
2					
		*D251 Marine Electr.I	D426 Sm.Ves.Maint.	+E101B Elect.Eng.Prelim. *E466 Int.Comb.Maint.	D494 Domestic Ship. *D129 Nautical Sci.III
1					
B	Split			+E444 Sm.Ves.Eng.I	D424 Sm.Ves.Ops.I.
3					
		AT	SEA	D425 Sm.Ves.Ops.II	+E444 Sm.Ves.Eng.II
2					
		*D251 Marine Electr.I	D426 Sm.Ves.Maint.	+E101B Elect.Eng.Prelim. *E466 Int.Comb.Maint.	D494 Domestic Ship. *D129 Nauti. Sci.III
1					

NOTE: +Indicates for Deck Midshipmen
*Indicates for Engineering Midshipmen

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINTS, NEW YORK 11024

DEPARTMENT OF NAUTICAL SCIENCE
D424 - SMALL VESSEL OPERATIONS I

Elective

Offered: First and Fourth Quarters
Credits: 3 - Two Lecture and 2 Laboratory hours per week
Objective: This course deals with the seamanship skills and the overall ship handling techniques of the numerous small vessels utilized within the maritime industry such as: harbor/docking tugs, river towboats, offshore supply, fishing, survey, crew, utility yard oilers, self-propelled barges/lighters.

Text(s): Primer of Towing, G. Reid, Cornell Maritime Press, 1975.
Big Load Afloat, The American Waterways Operators, Inc.

Reference(s):

Tugs, Towboats and Towing, Edward M. Brady, Cornell Maritime Press, Inc., 1967.

Knight's Modern Seamanship, John V. Noal, Van Nostrand Reinhold, 15th edition, 1972.

The American Merchant Seaman's Manual, Cornell Maritime Press, In., 5th edition, 2964.

United States Navy Towing Manual, Vol. I & II, Naval Ship System Command, 1971.

Rules of the Road, International and Inland, CG-169, 1972.

Rules of the Road, Great Lakes, CG-172, 1966.

Manual for Lifeboatman, Able Seaman, and Qualified Members of the Engine Department, CG-175, 1973.

Rules of the Road, Western Rivers, CG-184, 1966.

OUTLINE

<u>Week</u>	<u>Topic - Lecture</u>
1, 2	• Types of Vessels and their construction.
3	• Gear and Rigging for coastwise and ocean towing.
4	• Ship work
5	• Barge handling
6	• Making and breaking tow The multiple tow
7	• Inland and River Towing
8	• The Tug at Sea Salvage and Rescue
9	• Anchor Work
10	• Handling very large Barges "Tips on Towing"
	<u>Topic - Laboratory</u>
1	• Applicable Occupational Safety and Health Administration Codes and Regulations. • Familiarization and survey of vessel when first reporting aboard.
2	• Small Vessel Characteristics • Engineroom Procedures
3	• Small Vessel seamanship techniques and skills
4	• Steering Techniques
5	• Momentum and stopping ability • Maneuvering characteristics
6	• Getting underway and landing - port side to
7	• Getting underway and landing - starboard side to
8	• Mooring

9

- Making up to and maneuvering with a tow ahead, alongside.

10

- Making up to and maneuvering with a tow astern.

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINTS, NEW YORK 11024

DEPARTMENT OF NAUTICAL SCIENCE
D425 - SMALL VESSEL OPERATIONS II

Elective

Offered: Second or Third Quarters

Credits: 1-1/2 - Three Laboratory hours per week

Prerequisite: D424 - Small Vessel Operations I

Objective: This laboratory course will enable midshipmen to develop the proficiency in the advanced techniques of maneuvering service vessels.

Text(s): None

Reference(s): Tugs, Towboats and Towing, E. M. Brady, Cornell Maritime Press, 1967.

Ship Handling in Narrow Channels, C. J. Plummer, Cornell Maritime Press, 1966.

Naval Shiphandling, R. S. Crenshaw, Naval Institute Press, Fourth Edition, 1975.

Primer of Towing, G. Reed, Cornell Maritime Press.

OUTLINE

<u>Week</u>	<u>Topic</u>
1	Vessel orientation, construction and layout. Safety systems. Engine room procedures.
2	Anchor windlass. Motor launch lowering/raising and operating procedures. Steering systems. Pilot house equipments and check out.
3	Vessel operating characteristics: Turning circle Advance

Transfer
Stopping distance
Speed vs. shaft revolutions.

- 4 Methods of Man overboard recovery-
Backing and Filling.
- 5 Methods of Man overboard recovery-
Backing and Filling.
- 6 Sea painter drill.
Raising lowering motor launch underway.
- 7 Docking and undocking procedures.
- 8 Precision anchoring.
- 9 Piloting exercise (day).
- 10 Piloting exercise (night).

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINT, NEW YORK

DEPARTMENT OF NAUTICAL SCIENCE

Small Vessel Maintenance D426
Course Outline

ELECTIVE

Three Laboratory Periods per Week

1-1/2 Credits

Catalogue Description:

Planning of specific maintenance projects, preventive maintenance afloat, scheduled yard maintenance: deck machinery, removal of surface coatings; exterior surface coatings; interior maintenance; fouling, cathodic protection; dry-dock operations.

Assignment Texts:

- B1 Boatswain's Mate 1 & C, United States Navy, NAVTRA 10122-S, 1973
B2 Boatswain's Mate 2 & 3, United States Navy, NAVTRA 10121-F, 1976
H1 Hull Maintenance Tech 1 & C, United States Navy, NAVTRA, 10574, 1972
H2 Hull Maintenance Tech 2 & 3, United States Navy, NAVTRA, 10573, 1972

MOVIES

<u>Week</u>	<u>No.</u>	<u>Title</u>
1	MN 2352A	Shipbuilding Skills - Prep. for Dry Docking
1	MN 2352B	Shipbuilding Skills - With Keel & Bilgeblocks
1	MN 9032	Floating Docks
2	MN 10341	Painting Aboard Ship
3	MN 61AA	Damage Control - Principles of Shoring
3	MN 4920D1	Investigation of Damage
3	MN 9537C	Plastic Repair
4	MN 6774	Methods of Unwatering Flooded Compartments Damage Control:
4	MN 11077B	Portable F.F. Equipment - P250 Pump
4	MN 11077D	Portable Dewatering Suction Pumps
5	MN 11077A	Hoses and Equipment
5	MN 11077C	F.F. Agents

ACADEMIC YEAR
1979-80

3rd quarter

<u>Week</u>	<u>Topic</u>	<u>Reading</u>
1/21	Introduction Check of portable & fixed CO2 system Check forward mast shrouds	
1/28	Drydocking procedures	
2/4	Painting Guest speaker from International Paint	B1/13, B2/16
2/11	Damage control, emergency repairs, shoring, etc.	H1/9, 10, 11 H2/19, 20, 24
2/18	Holiday	
2/25	Dewatering	H2/22
3/3	Underway, compass adjustment	
3/10	Preventive maintenance programs check rigging on after mast & boom	B2/11
3/17	Range anchor chain on pier, test and paint shots	B2/5
3/24	Renew falls on Gravity Davits	B2/6

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINTS, NEW YORK 11024

DEPARTMENT OF NAUTICAL SCIENCE

D426 - SMALL VESSEL MAINTENANCE

Elective

Offered: Second or Third Quarters

Credit: 1-1/2 - Three laboratory hours per week

Prerequisite: D424 - Small Vessel Operations I

Objective: This laboratory course deals with vessel maintenance embracing: safety, seaworthiness, operating efficiency cleanliness and appearance.

Text(s):

Reference(s): Deck Machinery, P.W. Smith, Cornell Maritime Press, 1973

Recommended Practice for Protection of Ship's Underwater and Boat-Topping Plating from Corrosion and Fouling, British Ship Research Association, 1966

OUTLINE

<u>Week</u>	<u>Topic</u>
1	<ul style="list-style-type: none">• Planning of Specific Maintenance Projects• Preventive Maintenance Afloat• Scheduled Yard Maintenance
2	<ul style="list-style-type: none">• Deck Machinery<ul style="list-style-type: none">Anchor WindlassCapstanTowing Machinery• Standing Rigging
3	<ul style="list-style-type: none">• Removal of Surface Coatings from Exterior Surfaces

- 4
 - Exterior Surface Coatings
 - Paints
 - Oils
 - Prime Coatings
 - Finish Coatings
- 5
 - Interior Maintenance
 - Removal of Surface Coatings
 - Deck and Bulkhead Coatings
 - Planning/watches
- 6
 - Fouling
 - Effect on vessel performance organisms
 - Prevention
 - Cathodic Protection
 - Sacrificial-anode system
 - Impressed-current system
- 7-9
 - Drydock Operations
 - Types of drydocks
 - Reasons for drydocking
 - Process of drydocking
 - Inspection of Vessel on Drydock
 - Health and Safety Measures
- 10
 - Yard Visit(s)
 - Vessel under construction
 - Vessel undergoing inspection
 - Vessel undergoing maintenance and/or repairs

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINT, NEW YORK 11024

DEPARTMENT OF MARINE ENGINEERING
E444 - SMALL VESSEL ENGINEERING I

Elective for Deck Midshipmen Only

Offered: First or Third Quarters

Credit: 3-3/4 - Three lecture hours per week
Three laboratory hours every other week

Objective: The objective of this course is to instruct Deck Midshipmen in the theory and operating practices Diesel machinery applicable to small vessels. This marine engineering education is essential and mandatory for the Deck Midshipmen in as much as they may find themselves being the sole watch standing officer aboard such vessels; they may be responsible for the daily maintenance and operation of engine equipments and in addition must know the procedures to follow in the event of engineering failures and emergencies.

Text(s): Diesel Fundamentals, Service, Repair, W. K. Toboldt,
The Goodheart-Willcox Company, Inc., 1973.

Reference(s): Diesel Engineering Handbook, K.W. Stinson, Business,
Journals, Inc. 12 Ed., 1973.
Diesel Engine Operation and Maintenance, V. L. Maleev,
McGraw-Hill Book Company, 1954.

OUTLINE

<u>Week</u>	<u>Topic</u>
1	Basic Design and Engine Construction <ul style="list-style-type: none">• Component Terminology• Basic Engine Cycles
2	Combustion Process and Chamber Design
3	Fuel Injection Systems <ul style="list-style-type: none">• Basic Requirements• Types<ul style="list-style-type: none">BoschCummins Pressure/TimeGeneral Motors Unit Injector

4	Governors <ul style="list-style-type: none">• Mechanical• Hydraulic
5	Air Intake Systems and Filtering <ul style="list-style-type: none">• Two Stroke Cycle• Four Stroke Cycle• Supercharging
6	Exhaust Systems
7	Cooling Systems
8	Lubricating Systems
9	Starting Systems
10	Reconditioning and Trouble Shooting
	<u>Laboratory Topics</u>
1	Bosch Fuel Pumps and Injectors
2	General Motors Unit Injectors RoosaMaster Fuel Pumps
3	Engine Timing and Balancing
4	Engine Testing
5	Shipboard Enginerroom Operations

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINT, NEW YORK 11024

DEPARTMENT OF MARINE ENGINEERING
E445 - SMALL VESSEL ENGINEERING II

Elective for Deck Midshipmen Only

Offered: Second or Fourth Quarters

Credit: 3-3/4 - Three lecture hours per week
Three laboratory hours every other week

Objective: The objective of this course is to instruct Deck Midshipmen in Marine Engineering theory and operating practices applicable to small vessels. This marine engineering education is essential and mandatory for the Deck Midshipmen in as much as they may find themselves being the sole watch standing officer aboard such vessels; they may be responsible for the daily maintenance and operation of engine equipments and in addition must know the procedures to follow in the event of engineering failures and emergencies.

Text(s): Principles of Naval Engineering, Bureau of Naval Personnel, U.S. Navy, NAVPERS 10788-B, 1970

OUTLINE

<u>Week</u>	<u>Topic</u>
1	Refrigeration
2	Heating & Ventilating
3 & 4	Piping Systems & Pumps <ul style="list-style-type: none">• Fire• Bilge• Potable Water• Valves & Fittings
5	Propulsion Systems <ul style="list-style-type: none">• Shafting• Propellers• Shaft Bearings• Thrust Bearings• Gears & Clutches

- 6 Hydraulic Principles
- 7 Steering Systems
- 8 Deck Machinery
 - Windlass
 - Capstans
 - Winches
 - Towing Machines

- 9 & 10 Air Compressors
- Keel Coolers
- Bunkering Practice
- Sanitation Systems
- Pollution Control

Laboratory Topics

- 1 Tools and Nomenclature
- 2 Refrigeration
- 3 Valves, Pipe Fittings and Tubing
- 4 Piping System Analysis
- 5 Steering Engine and Hydraulics

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINT, NEW YORK

DEPARTMENT OF NAUTICAL SCIENCE

COURSE OUTLINE

D494 DOMESTIC SHIPPING

This course analyzes the tow boat operations on the inland rivers, coastwise shipping and vessels of the Great Lakes. Included are the special designs and characteristics of the varied watercraft, techniques for locking and openwater operations, regulatory organizations involved, and the crew manning and safety requirements. Analysis is also made of the impact of domestic trade on the U.S. economy.

Elective

3 class hours a week

Credits: 3

Textbook: "Big Load Afloat", U.S. Domestic Water Transportation Resources, Publication by The American Waterways Operators, Inc., 1250 Connecticut Ave., Washington, D.C.

References: Guardians of the Eight Sea, A History Of The U.S. Coast Guard on the Great Lakes, O'Brien, Michael T., U.S. Coast Guard Publication

Domestic Shipping, 1974 Spring Meeting, Society of Naval Architects & Marine Engineers, 74 Trinity Place, N.Y., N.Y.

Tugs, Towboats & Towing, Brady, Edward M., Cornell Maritime Press, Inc., Cambridge, Maryland, Second Printing, 1974

A Pictorial History of the Great Lakes, Harland Hatcher & Erich A. Walter, Bonanza Books, New York

Great Lakes Shipping, The Story of the Lakes Vessel Industry, The Lake Carrier's Assoc., Cleveland, Ohio

TOPIC OUTLINE

- I. Introduction, Comparisons and Projections
 1. MARAD Responsibility
 2. Sub-divisions of Domestic Shipping
 3. Volume and Comparisons with Other Modes
 4. Future Projections and Direction

- II. History of Inland Waterway Traffic
 1. Progression of Water Transportation Vehicles
 2. What Constitutes Inland Waters, "Western" Rivers, and Atlantic Intercoastal Waterway System
 3. Today's Traffic - Ton-Miles, Cargoes, Depth Limitations, Locks and Dams

- III. Towboats and Their Tows
 1. Self-Propelled, Non Self-Propelled
 2. Towboat Hull Design, Propulsion Units, Maneuvering Capabilities; Flanking and Steering Rudders
 3. Barge Construction, Design, Sizes, Arrangements In Unit Tows and Underwater Configurations

- IV. Crew Work and Safety Practices
 1. Deck Nomenclature
 2. Securing Methods
 3. Hours of Work and Living Arrangements

- V. Great Lakes Boats
 1. Design Characteristics
 2. Self Unloading Mechanism
 3. Great Lake Boats vs Deep Sea Vessels; Support Arrangements

- VI. St. Lawrence Seaway and Great Lakes
 1. Atlantic Entrance Routes to Seaway
 2. Draft Limitations, Locks, Distances, Pilot and Pilotage Requirements

- VII. Domestic Oceans
 1. Definition and Areas
 2. Integrated Tug-Barge Arrangements
 3. Various Systems In Operation and In The Design Stage

UNITED STATES MERCHANT MARINE ACADEMY
KINGS POINT, NEW YORK

DEPARTMENT OF ENGINEERING

COURSE OUTLINE

INTERNAL COMBUSTION ENGINE MAINTENANCE
ENGINEERING E466

for
MIDSHIPMEN (E), FIRST CLASS

- TEXTBOOK:** "Diesel Engine Operation & Maintenance",
V.L. Maleev, McGraw Hill Book Co.
"Diesel Engineering Handbook", Karl Stenson,
Kiesel Publications, Inc.
- HOURS:** Laboratory - 3 per week
- CREDIT:** 1-1/2
- OBJECTIVE:** Tear down of a diesel engine to survey work required
for complete repair report to be turned in by
student with all data taken during teardown and
rebuilding: cylinder wear, ring wear, piston
clearances, bearing wear check with leads, crank
shaft alignment. Complete rebuilding and final
tuning of engine systems. Analysis of maintenance
problems and causes.
- COURSE CONDUCT:** Grade will be based on quality of work in
laboratory and final report of the analysis of
maintenance problems, causes and recommendation for
repair.
- PREREQUISITE:** Internal Combustion Engines E472
- First Week:**
- Removal of head and valve servicing. Analysis of valve and associated
equipment problems and causes.
- Second Week:**
- Removal of piston, checking of liner wear and fitting of rings.
Analysis of causes and types of liner wear and methods of limiting
wear. Discussion of Magna Flux Method of checking piston cracks.

Third Week:

Taking leads and checking and adjusting connecting rod bearing clearances. Discussion of various methods of adjusting bearing clearances and methods of fitting bearings.

Fourth Week:

Removal of main bearing caps and checking bearing wear with bridge gage and bearing clearances. Discussion of causes of bearing wear, effects on engine operation, lube oil consumption and engine efficiency.

Fifth Week:

Checking crankshaft alignment with distortion gage. Calculations of bearing adjustment and wear by formula.

Sixth Week:

Reassembly of all main bearings. Proper use of torque wrench and explanation of results on bearing wear and failure.

Seventh Week:

Reinstallation of pistons. Discussion of proper procedure, effects of improper ring fit, piston seizure and crankcase explosions.

Eighth Week:

Reinstallation of heads. Discussion of results of improper torque of heads. Effects on head stud stretch, cylinder liner distortion and wear rates.

Ninth Week:

Fuel Injection Timing and Injector testing. Analysis of fuel injection problems and effects on engine combustion and engine efficiency.

Tenth Week:

Operation and tuning of engine. Use of laboratory and ship type instrumentation for engine testing, performance analysis and evaluation.

TRAINING, LICENSING, AND ENFORCEMENT

Frank T. Stegbauer
Chairman of the Board
National River Academy

The National River Academy (NRA) was established in 1970 at Helena, Arkansas. The impetus for the birth of NRA was a growing realization on the part of the inland barging industry that it must have more and better-trained vessel crews for the number of vessels then being built. The industry was going through a period in its history where rapid expansion was the order of the day to meet the requirements for barge transportation in a rapidly expanding national economy.

NRA was the proposed solution. The concept was for companies in the industry to fund the NRA and set up its operations. This concept is still in force. No funds of any sort have ever been sought nor received from any government entity. Funding has been from member companies through dues and assessments, private foundation grants, and tuitions from students at the NRA.

NRA went through some horrendous birth pangs, but the NRA today is well worth the anguish, trials, and tribulations NRA's member companies suffered. Today, NRA is a smooth-running, well-equipped school for deck crews, tankermen, supervisory training for future river pilots, and an outstanding fire-fighting facility and cardio-pulmonary resuscitation (CPR) training course. This year NRA expects to train more than 800 crewmen in various categories. These people will go on vessels with valuable training experience that will enable them to be safe workers; to protect themselves and perform their duties in a competent and efficient manner; to protect their shipmates; and to protect and promote environmental quality. To train this type of person is the sole reason for NRA's existence.

Perhaps a brief description of NRA facilities is in order. NRA is located in a rather remote area, 10 miles south of Helena, Arkansas. NRA requires its students to live on campus. To this end, NRA has on-campus dorms and dining facilities. The administration and classrooms are on campus. Classrooms have excellent facilities for audiovisual training. We have an in-classroom model tankbarge that can be loaded and unloaded in the classroom. We have CPR training equipment for hands-on training, and classroom training for use of various types of fire-fighting equipment, all staffed by competent, full-time instructors.

NRA has outstanding simulator training equipment installed on our campus. We have two barge-tow mock-ups to train deck personnel to make up tows of barges employing conventional barge rigging using cables, chain links, rope lines, ratchets, and winches. Training is also done at night so students will not be strangers to the hazards of nighttime tow work. As stated before our fire-fighting course for inland marine workers is outstanding, and our facilities are second to none.

Our pride is our simulator for hands-on tankerman training. This unit is designed to simulate tankbarge loading and unloading operations, night or day. The simulator consists of a dock for loading and receiving cargo and two small tankbarges, floating in a large pool of water, with cargo-transfer pumps. This facility was designed to duplicate all conditions of transferring cargo and to simulate spills. We can simulate spills of the following kinds: cargo-tank overfills, leaking valves, cargo-pump packing leaks, and cargo-piping and cargo-hose spills. Spills are contained in our pool, and water is used for cargo with dye mixed to reveal the spilled material.

This unit provides hands-on training that could not otherwise be provided unless an actual tankbarge in the river were used. An actual barge would, of course, preclude the simulation of spills. The ability to simulate spills and the need for vigilance in transferring cargo demonstrate to the student just how easy it is to have a spill unless one is constantly on the alert.

The Coast Guard has said repeatedly that from 80 to 85 percent of spill incidents occur because of human error. Not all of these are from transfer operations. Some are from equipment damaged in accidents as a result of human error. However, many spills do occur as a result of transfer operations, as these operations present a golden opportunity for a spill to occur. This, then, is our goal: to provide training to a tankerman to show him how easy it is to have a spill, and to show him how easy it is to prevent a spill. One of our most difficult challenges in tankerman training is to impress upon students the absolute necessity for stopping spills, and that the responsibility rests with the tankerman in charge of a cargo-transfer operation, in the absence of a failure of equipment. We will comment later on problems industry has with enforcement of pollution-prevention regulations as now practiced by the Coast Guard.

NRA strongly believes that our training programs are making a significant contribution to the prevention of cargo spills into the navigable waters of the United States. Industry has made sizeable financial commitments and heavy commitments to provide students to receive training. Many companies have established a policy of not hiring personnel for tankerman and deck crew unless they have had academy training. The NRA is the concrete evidence that industry is committed to the proper training of its crews with special emphasis on crew safety and protection of the environment.

Industry is currently awaiting the promulgation of a new set of regulations for the licensing of tankermen. These regulations have been in the regulatory process for some six years. The Coast Guard asked for and received assistance from industry in consulting on what the new standards should be. Frankly, we believe that to take six years to develop a set of regulations to license tankermen is utterly ridiculous. We can only attribute this to the fact that proposed regulations must be reviewed and passed on by the Coast Guard's legal branch. As we all know, lawyers can take something simple and workable and make it into something complex and unworkable, given enough time.

We are afraid that after having a proposal for several years, heaven only knows what will surface. At this time, with the new regulations impending each month, industry is in a quandary as to what will surface. With this in mind, after six years, we do not really know what the Coast Guard's proposal will contain in regard to personnel standards. From what we have gleaned from the Coast Guard, tankermen will have to be more formally trained vis-a-vis on-the-job training, as was the requirement in the past. This need is long overdue. NRA has been providing this type of training to its students for several years.

NRA feels strongly that companies who send their employees for formal training get better people who are aware of their responsibilities to themselves, to their fellow man, and to the environment. We are given to understand that under the new tankerman regulations a license will have to be renewed every five years. If so, candidates for license renewal should be required to show evidence that they have been actively participating in cargo transfers during their license-issue period or, alternatively, be required to attend a remedial training course. Such course would include hands-on cargo transfer, either actual or simulated, and instruction in the latest pollution prevention regulations and applicable laws for the protection of the environment. This is necessary to maintain proficiency in cargo transfer and to keep the candidate up-to-date on applicable laws and regulations, which often change in our fast-moving world.

We strongly urge that all tankermen be required to be able to read and write the English language. If one cannot, then he cannot comply with applicable pollution-prevention regulations, or he cannot read them. All tankermen should have fire-fighting training, oriented to the use of fire-fighting equipment available to them on board tank vessels. At license renewal, tankermen should attend a refresher course in fire-fighting and CPR procedurs.

In one's efforts to prevent pollution incidents, one has to ask if more regulation is necessary. The answer to this question is no. The pollution-prevention regulations now in force (33 CFR Parts 154, 155 and 156) are well-thought-out regulations and are doing the job they were intended to do, when they are complied with. However, as with every other law or regulation, these regulations do not of themselves

assure compliance. Well, then, how do we correct noncompliance? The answer to this question is better enforcement. No governmental entity can put out a law or regulation and get 100 percent compliance. This is why we have policemen. The Coast Guard does not have trained policemen in adequate numbers. More policemen is one answer, but there is another, more serious problem than untrained policemen.

This problem is the manner in which the Coast Guard chooses to enforce the applicable regulations. The Federal Water Pollution Control Act (FWPCA) of 1972 made the owner, operator, third-party actions, or demise charterer of a vessel responsible for any water pollution emanating from that vessel, with the exception of certain statutory exemptions. If, for example, a tankerman let a cargo tank overflow, and even if that tankerman was not an employee of the vessel owner, the vessel owner was held responsible for the spill and the resultant fines and clean-up costs. Obviously, this situation was manifestly inequitable to the owner of the vessel, who had nothing whatsoever to do with the spill, nor did his vessel.

The real sad part of this example is that most often the truly guilty party, the tankerman, went off scot-free or at best with a light slap on the wrist. This was a true disincentive to a tankerman to prevent pollution. Industry pleas to the Coast Guard for an appropriate fine to be levied on the guilty tankerman, to give him an incentive to not pollute, were met by the Coast Guard with the fact all they could do was suspend or revoke his tankerman license. They could not, by law, fine him.

One of the best ways an enforcement officer has to obtain compliance with a law or rule is to be able to hit an offender in his pocketbook. It works with owners, and it would certainly work with individual tankermen. If the law prevents fining an offender, then the Coast Guard should seek a change in the law to allow the levy of a fine for pollution incidents on that person whose action caused the pollution incidents.

In 1977, the FWPCA was amended. Among many changes made by the Congress was the phrase designating who was responsible for a spill. The change made responsible any owner, operator, or person in charge of any vessel from which oil is discharged. Person is defined in the law as including an individual, firm, corporation, association, and a partnership (Sec 311(a)(7) FWPCA.)

This was a long step toward correcting the inequity for the vessel owner, previously referred to. The only catch is that the Coast Guard is still laying it on the owner and letting the negligent tankerman off free. This is poor enforcement procedure and breeds nothing but contempt for the enforcement officer. This should stop at once, and the person in charge of a cargo transfer must stand up and be charged for his negligence in causing a pollution incident. I believe that proper enforcement on the person or vessel causing the pollution

incident would be a great incentive to individuals to exercise more care in their operation of tank vessels.

This same principle would apply to a pilot in charge of the navigation of a vessel who causes a pollution incident by negligent navigation. If two vessels collide and the fault is sole or mutual in any degree, one or both pilots on watch, as the case may be, should be fined for a pollution incident, not the vessel owner.

The enforcing agency will never achieve compliance by fining the owner. The individual who causes the pollution incident must be taught that he must devote the highest degree of care to the performance of his duties. The owner can only fire the individual for his failure to perform his duties properly. This accomplishes nothing. The individual simply goes to work for another vessel owner, because jobs are easy to come by owing to manpower shortages. The vessel owners need this help in enforcement. The Coast Guard should give this help to vessel owners.

The Port and Tanker Safety Act of 1978, in Section 5, amends Sec. 4417a(1)(D) to the effect that standards developed through regulations shall incorporate the best available technology and shall be required unless clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation and vessel safety or protection of the marine environment. We believe the efforts of industry to train better vessel personnel, and the results we have achieved, deserve recognition as one of a series of alternatives to such radical decisions as junking all single-skin tankbarges at a certain age and time frame. The economic impact of such an act at this time of economic crisis in our nation's history would be foolhardy and catastrophic. There are better alternatives available as tools to prevent pollution incidents. Among these tools are better training; a better licensing procedure and criteria for licensing persons responsible for handling oil in its various forms; and better, more equitable enforcement procedures against individuals causing pollution incidents.

The NRA pledges its full effort to turn out qualified vessel crewmen. Industry companies are dead serious about stopping pollution incidents by in-house pressure on individuals engaged in the handling of oil in transportation by barge and by better training. We still need Coast Guard help in enforcement. The Coast Guard has adequate regulations for enforcement of safe handling of oil by individuals. The Coast Guard has adequate authority under the Port and Tanker Safety Act of 1978 to enforce these regulations. The Coast Guard should proceed to toughen up its enforcement against individuals causing pollution incidents while industry bears down on its training of individuals.

The NRA thanks the National Academy of Sciences and the U.S. Coast Guard for the invitation to come before you and present our views on

this multifaceted problem. We hope our input will present to you a solid program, in our field, for pollution prevention without such radical surgery as has been proposed.

CONSIDERATIONS INVOLVED IN THE
CREW DEVELOPMENT AND TRAINING
OF A "LIQUID CARRIER" INLAND WATERWAY
TRANSPORTATION COMPANY

Donald L. Sullivan
Vice President of Operations
Chotin Transportation, Inc.

Introduction

Chotin Transportation, Inc., founded at the turn of the century, is one of the largest transporters of petroleum and liquid chemicals on the inland waterways of the United States. In 1979, we transported about 4.8 billion ton-miles of such commodities with a fleet of 13 river towboats, 132 liquid river barges, and one offshore tug barge unit. Our barges were involved in about 4,600 liquid-cargo transfers in 1979.

The Water Quality Improvement Act of 1970, the Ports and Waterways Safety Act of 1972, companion safety and pollution statutes, pursuant regulations, and an increased public awareness all serve as ever-constant reminders to responsible individuals at all levels within our industry that operations must be conducted in a safe and pollution-free manner. Early on, it became obvious that if any company were to survive within the scope of these new realities, its skills, methods, and equipment would need to be carefully reviewed and, where necessary, upgraded. In this paper, we will comment on the impact which these legitimate public concerns have had on personnel development and indicate where we feel additional improvement could be realized.

Industry Structure

The liquid barge industry is a complex structure of several hundred companies which operate in excess of 3,800 tankbarges with a total capacity in excess of 9.5 million tons. Some of the diversity which you will find within the range of these operations is as follows:

1. Small companies which operate one to three barges, up to large conglomerates which operate in excess of 100 barges.
2. Some operations mix liquid and dry cargo in the same tows, others operate exclusively liquid fleets.

3. There are both shipper-owned dedicated fleets and carriers for hire.

4. Some operate both towing vessels and barges, while others operate barges only and hire others to tow.

5. Some operators employ their own tankermen, others use outside services, and many use a combination of in-house and outside service.

6. Some operations are designed to handle a specific or small range of commodities, while others handle a wide range of commodities.

Regulations which apply to personnel standards, licensing, and certification, while serving their intended purpose, should be flexible enough so as not to place an unreasonable burden on any segment of the industry.

Government Role

Dealing with pollution and safety problems in a democracy such as ours demands that we somehow establish appropriate roles for both government and industry. If this is done properly, we can maintain the safe, healthful environment which the public demands and do so at a cost which a knowledgeable public is willing to pay.

Disincentives placed on industry and individuals can be very effective in making it unprofitable to maintain operations which are unsafe or prone to illegally pollute. However, the disincentives must now, in and of themselves, be so onerous that they create an unacceptable business-risk climate. I see three important advantages to this approach.

1. Enforcement and administrative costs are minimized.
2. It allows for a variety of imaginative and creative approaches to compliance.
3. It works.

In order to minimize pollution from spills or accidental discharges, industry must above all have a properly motivated well-trained work force. The Federal Government now has on stream powerful disincentives which directly and indirectly are bringing about the desired results. I would call to your attention the following:

1. Current fines and penalties to the owners or operators of barges involved in spills have \$5,000, \$50,000, and \$250,000 thresholds.
2. Clean-up liability now has \$125,000 and \$250,000 thresholds.

3. Equipment downtime revenue loss while dealing with spill problems can run from \$800/day for one barge to more than \$10,000/day for a tow.

4. Cargo loss: value of cargoes ranges from approximately \$50.00 a ton to more than \$600.00 a ton.

5. Loss of business: oil and chemical shippers will no longer do business with an operator who has a record of spilling or contaminating cargoes.

6. Suspension or revocation of operator license or tankermen's certificates.

Any liquid barge operator who is not concerned with the training and competency of the people handling his equipment will not economically survive, and that probably is as it should be.

A further assurance that key individuals meet specific standards is proved by Coast Guard regulations requiring licensed operators aboard all towing vessels and certified tankermen to handle transfer of flammable, combustible, and hazardous cargoes. The tankerman program is currently undergoing revision. There are comments which we will make about Coast Guard licensing programs later.

Basically, government has already filled its primary role in assuring that industry will provide individuals who are competent to properly handle liquid cargoes. Even without licensing requirements, companies could not afford to put unqualified or ill-trained people aboard their vessels.

Industry Role

The Coast Guard quite properly sets some minimal personnel standards through its licensing and certification programs. However, this cannot assure with complete certainty that an individual will perform satisfactorily, anymore than we are assured of a good doctor or attorney simply because they pass state exams.

In the final analysis, individual companies must decide, within the framework of operations and available resources, how they are going to provide the necessary qualified people. There is no one royal road. Some companies find it convenient to hire only experienced, trained individuals; others use industry training schools; while still others have decided to set up formal in-house training programs. Probably the largest group simply concentrates on supervision and on-the-job training. The important thing is that the job gets done, not so much how an individual company may solve its problem.

Chotin's approach to providing qualified crews for our liquid tows has been to establish a somewhat formal in-house training program. As

an example of one approach out of several alternatives, I will briefly describe Chotin's program.

Cadet Mate Training Program

The cadet mate training program is the portion of our overall program that involves the largest number of trainees. The normal avenue of progression is from entry-level deckhand to the tankerman position, then on to head deckhand, and finally to the level of mate. We have also provided a senior mate position which can be attained only by outstanding performance. As will be developed later, an individual may progress through this entry-level training program into more advanced training and ultimately become a pilot and captain on one of our vessels.

An employee's promotion is assisted by the company at every step of the way. Initially, an entry-level deckhand is given a five-day intensive training period where he is introduced to the company by an orientation presentation. The employee is then extensively taught the basic skills necessary for his successful entry into the marine industry.

Interwoven with these basic skills are the constant reminder and instructions concerning the hazardous nature of the products being moved, as well as the absolute necessity for working in a safe and healthful manner. To amplify this emphasis, one full day is devoted to formal instruction in the safety rules and regulations that are strictly enforced by the company. This period of instruction on safety is conducted by a safety professional employed by the company on a full-time basis to supervise our overall safety program. The remaining four days of the deckhand training is conducted by our training director, who is well qualified for this important role by having served as mate aboard numerous inland marine vessels for more than 20 years. He is highly respected in the field of deck training and is particularly expert in the area of tankerman training and the essential requirements of oil-spill prevention and clean-up.

Probably just as important as the hands-on training given to entry-level deckhands is the counseling and guidance provided while in training. Knowledgeable assistance is given these new employees in regard to the type of work environment they will be facing, as well as the attitude and work behavior expected of them in the new environment aboard a towboat. A five-page description of the cadet mate training program is shown in Exhibit A at the conclusion of this report.

We have assembled a myriad of educational tools and instructional aids to better equip our training department to do the job of properly introducing new employees to the world of work on the boats. Audiovisual aids such as films, film strips, transparencies, slide presentations (narrated for our particular purposes), videotape

machines, and other aids are used extensively during the training sessions. Other training aids, such as our Mock Tow, are used to help the trainee visualize and actually "feel" the job that has to be done. The Mock Tow is a concrete pad that has been made up with actual hardware and rigging to realistically simulate several liquid-petroleum barges and their appropriate vessel. The Mock Tow training aid has recently been made even more realistic with the addition of a large petroleum barge that has been outfitted with additional training materials and equipment that will enable training actually to take place on a floating barge. The addition of this training barge will enable the training director to instruct deckhands and tankermen, first hand, in the proper methods of handling liquid products and to directly instruct our deck personnel in the proper ways to prevent, contain, and clean up any oil spills. Exhibit B, at the conclusion of this report gives the reader a full bibliography of the materials used in our Cadet Mate Training Program.

On-The-Job Training Program

Following their five-day intensive training program, deckhands are placed throughout the fleet to assume their duties as apprentice deckhands. They will be evaluated periodically from that point on. Evaluations will be received from our vessels at one month, three months, six months, nine months, and after one year. These evaluations serve a very meaningful purpose in that they enable us to identify outstanding employees for purposes of advancement and promotion, and also to pinpoint those individuals who require additional training and counseling. Our company is particularly well equipped to assist individuals needing counseling, in that our personnel staff has two professionally trained individuals in the field of guidance and counseling to assist our employees in this area.

After at least six months and after careful evaluation, the experienced deckhand may become eligible for advanced tankerman training. At that time, the individual will return to our training facility and receive two days of additional training in the classwork necessary for passage of the required Coast Guard examination. In addition, the prospective tankerman will be intensively worked and supervised by the director of training in the actual loading and unloading of petroleum barges. At this time, the candidate will be taught the proper tankering methods as regards the safe and efficient transfer of liquid cargo. Again, special emphasis is given to the prevention of oil spills as well as to the methods to employ in the event of an accidental spill. During this training period, the prospective tankerman is evaluated constantly, and his performance must measure up to our own rigid standards. Unless the person can pass our own strict standards for tankering, he will not be recommended for Coast Guard examination. He will be directed to return to his assigned vessel and continue to improve his skills, and at appropriate later

date he will be given another opportunity to demonstrate his skills for our approval.

Upon certification by the U.S. Coast Guard as a tankerman, the individual will be returned to his assigned vessel for additional on-the-job training (OJT) from his boat supervisors. The OJT is an ongoing process from entry-level deckhand through the steersman program (pilot training). Following the acquisition of the tankerman's endorsement, an individual may be promoted to the head-deckhand (junior-mate) position and then on to the mate's position. These promotions are conditioned upon the speed with which an individual can acquire the work and managerial skills necessary to handle the job. One is assisted through OJT by supervisors and by constant monitoring through the evaluation system, as well as by the training director through his frequent visitations to the vessels. Once a mate develops seniority and demonstrates outstanding work and managerial ability, he becomes eligible for consideration for entry into the next level of training for the deck department, the steersman program.

Steersman Training Program

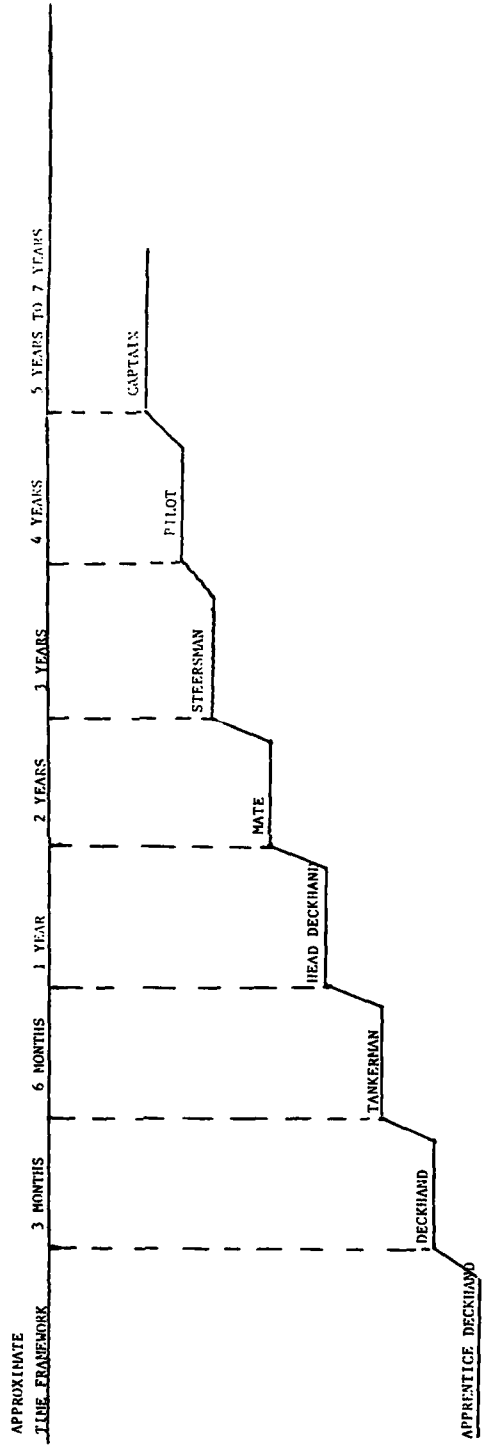
Qualified mates have been given the necessary training encouragement and support essential for them to secure a required operators license. Having attained the mate or senior-mate level and having acquired an operator's license, an individual with appropriate skills will then be eligible for entry into the steersman program. On the basis of seniority and other entry requirements, outstanding mates are brought into this training program to allow them to develop the boat-handling skills that will enable them to become full-time regular pilots with the company.

While enrolled in the program, the trainee or steersman operates the vessel under the close control and supervision of an experienced captain, who in turn relays the progress of the steersman to his supervisor, the marine superintendent. The trainee's progress is monitored continually by highly trained and experienced vessel personnel. The steersman has no job on board other than to improve his piloting skills. This is the type of educational plan that is followed by many other companies in the industry that see the need to train pilots.

After months of training, sometimes as long as two years, the steersman may, after careful evaluation, be judged competent for duty on his own. At that time, he is released from the program and assigned for duty aboard one of our line vessels. Figure 1 shows the average advancement opportunities and corresponding approximate time frames at Chotin.

Before Chotin will place one of its mates into such a steersman training program, the person must possess an operator's license issued

AVERAGE CHOTIN ADVANCEMENT OPPORTUNITY AND TIME FRAME



by the Coast Guard. This is where industry training institutions throughout the country lend invaluable assistance to companies in helping training individuals to acquire the skills and knowledge necessary to pass Coast Guard requirements. Vocational institutions such as Houston Marine Consultants, Inc., of New Orleans, the National River Academy at Helena, Ark., the Louisiana Marine and Petroleum Institute at Chauvin, Louisiana, and the Western Rivers Training Center at St. Louis, just to mention a few, provide essential assistance to those seeking careers on the river.

Historical Reference for Cadet Mate Training Program

At the end of 1972, Chotin, like many towboat companies, was experiencing excessive turnover of vessel personnel. It was certainly one of our most serious personnel problems. In that particular year, 1972, we hired 293 employees to fill 75 deck positions. The average deckhand remained with company for an average of only 2.2 months, and 55 percent of the deck force had less than three months' service. On many boats, the only experienced deck personnel were the mate and a licensed tankerman, while the other deck crewmen were inexperienced personnel.

Another important aspect of our operation also needed prompt attention. Our safety record was reviewed and found to be less than enviable. In 1972 we had experienced 36 lost-time-injuries that resulted in excessive time away from the job. This high accident frequency, together with a 3.9 turnover rate, made it very clear that some drastic changes and improvements in the vessel-personnel areas were needed.

The approach to solving and correcting these problems was thought to be the development of better methods of acquiring personnel as well as instituting the cadet mate training program. The program was begun in April of 1973, and after seven years of operation we feel confident that our program has achieved the basic goals established at its inception.

Objectives of the Cadet Mate Training Program

Objectives for the cadet mate training program were outlined at the inception of the program in April of 1973. With appropriate updates and revisions, those same objectives are still applicable today. They are as follows:

1. Upgrade hiring practices to obtain better-caliber employees by:
 - a. Extensive interviewing.
 - b. Being more selective in hiring.
 - c. Detailed checking of references.
 - d. Use of pre-employment physical exams.

2. Establish training as an essential ingredient in the corporate structure by:
 - a. Orientation to boat life.
 - b. Explanation of company benefits and policies.
 - c. Emphasize basic skills necessary for boat work.
 - d. Strongly emphasize safety training.
 - e. Hands-on training on Mock Tow.
 - f. Hands-on training on actual oil barges.
3. Observation and continuous evaluation of trainees to evaluate ability, willingness to work, personal habits, work habits, and compatibility with vessel crew and work, thereby eliminating some potentially disciplinary problems or unfit individuals before they get to the boat.
4. Develop and upgrade existing on-the-job training.
5. Develop supervisory training for masters, pilots, and deck supervisors.
6. Establish a program of periodic evaluation and counseling of new employees to assist in their development.
7. Development of additional training sessions for jobs such as tankerman and steersman.
8. Provide an experienced, professional deck force.

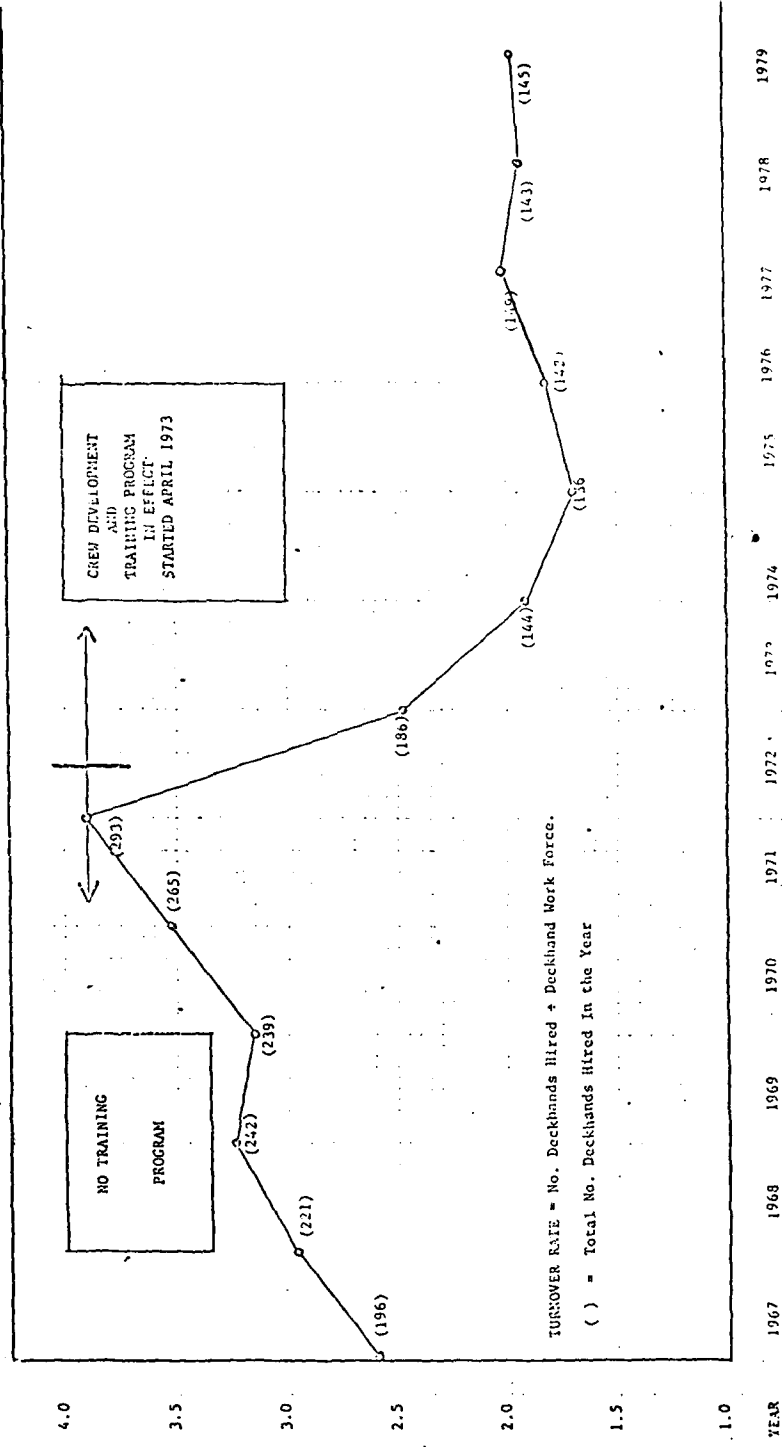
The provision of an experienced, safety-oriented deck force is the primary goal of the cadet mate training program. With this basic goal in mind, we can review the history of our training program.

In reviewing the results of our cadet mate training program, we first look at the results for last year. In 1979, we saw a continuation of a trend that started soon after the inception of the training program in April of 1973. This past year's experience can be described as follows:

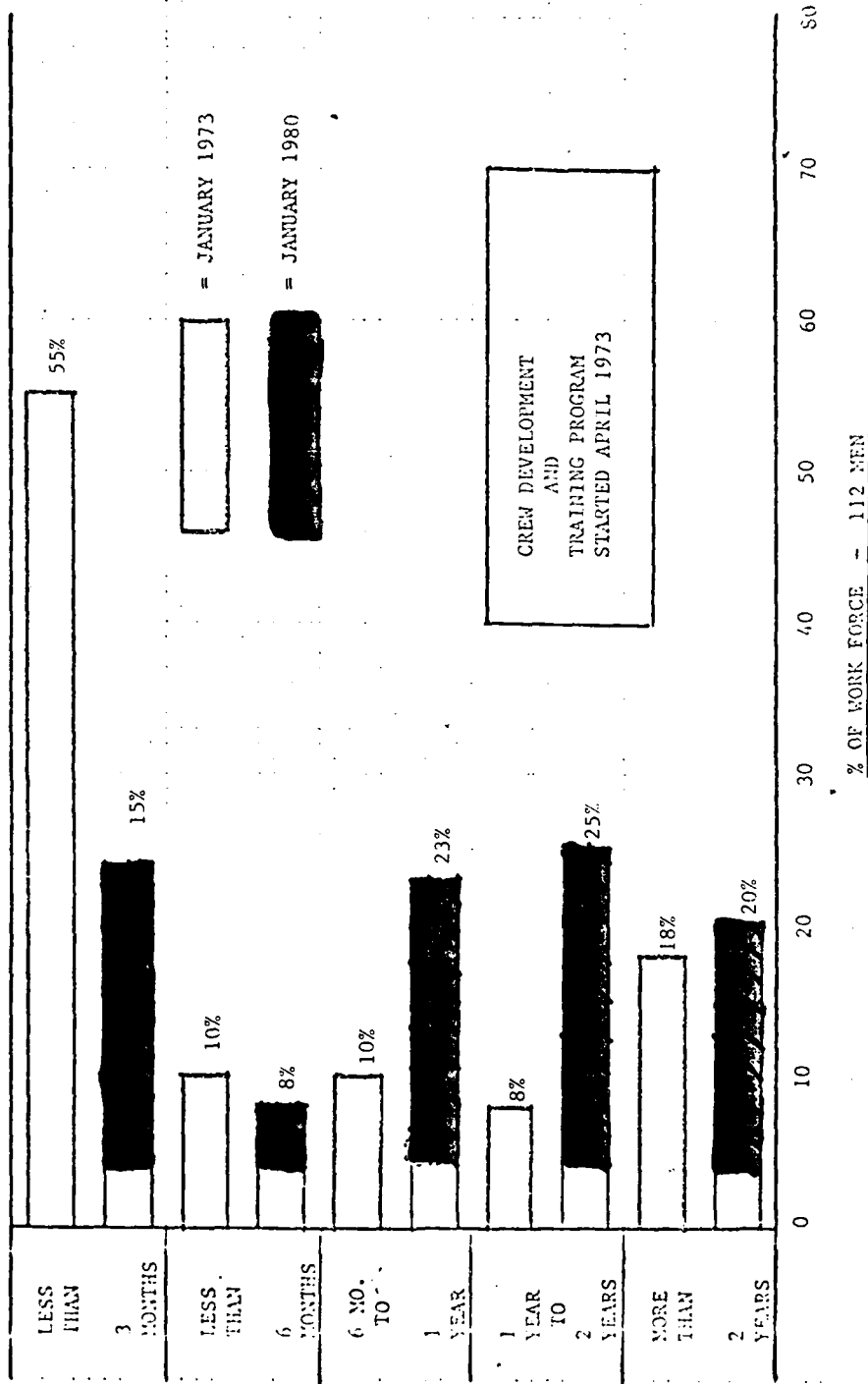
- a. The turnover rate in 1979 was 1.93 (Figure 2).
- b. The experience level in the deck force indicates that better than 45 percent of these individuals have more than one year of service (Figure 3).
- c. The average length of service by the deck force is now approximately 12 months. The pretraining school length of service (1972) was 2.2 months.

Graph # 2

COMPARISON OF YEARLY DECKHAND TURNOVER 1967 to 1979



WORK EXPERIENCE OF DECK DEPARTMENT
 JANUARY 1973 VS. JANUARY 1980
 (INCLUDES SUPERVISORS)



- d. The lost-time days from injury in 1979 were 16 days as compared to an average of 34 days in the six years prior to the inception of the cadet mate training program.
- e. Since 1973, which marks the beginning of the training program, Chotin has averaged 23.7 lost-time days from personal injury on board the vessels (Figure 4).

As one will readily see from the statistics and other data to follow, the turnover and accident rates have been reduced substantially following the institution of the cadet mate training program. As will be noted in particular, the turnover results have leveled out in recent years at a stage that resists further reduction. However, we continue to review our program and will always be looking for additional ways in which to improve the results.

Evaluation of the Cadet Mate Training Program

Personnel-turnover studies have been made regularly since the inception of the training program. At the end of 1972, prior to beginning the program, a review of turnover of deckhands for the previous five years, 1967 through 1972, was made using the following formula:

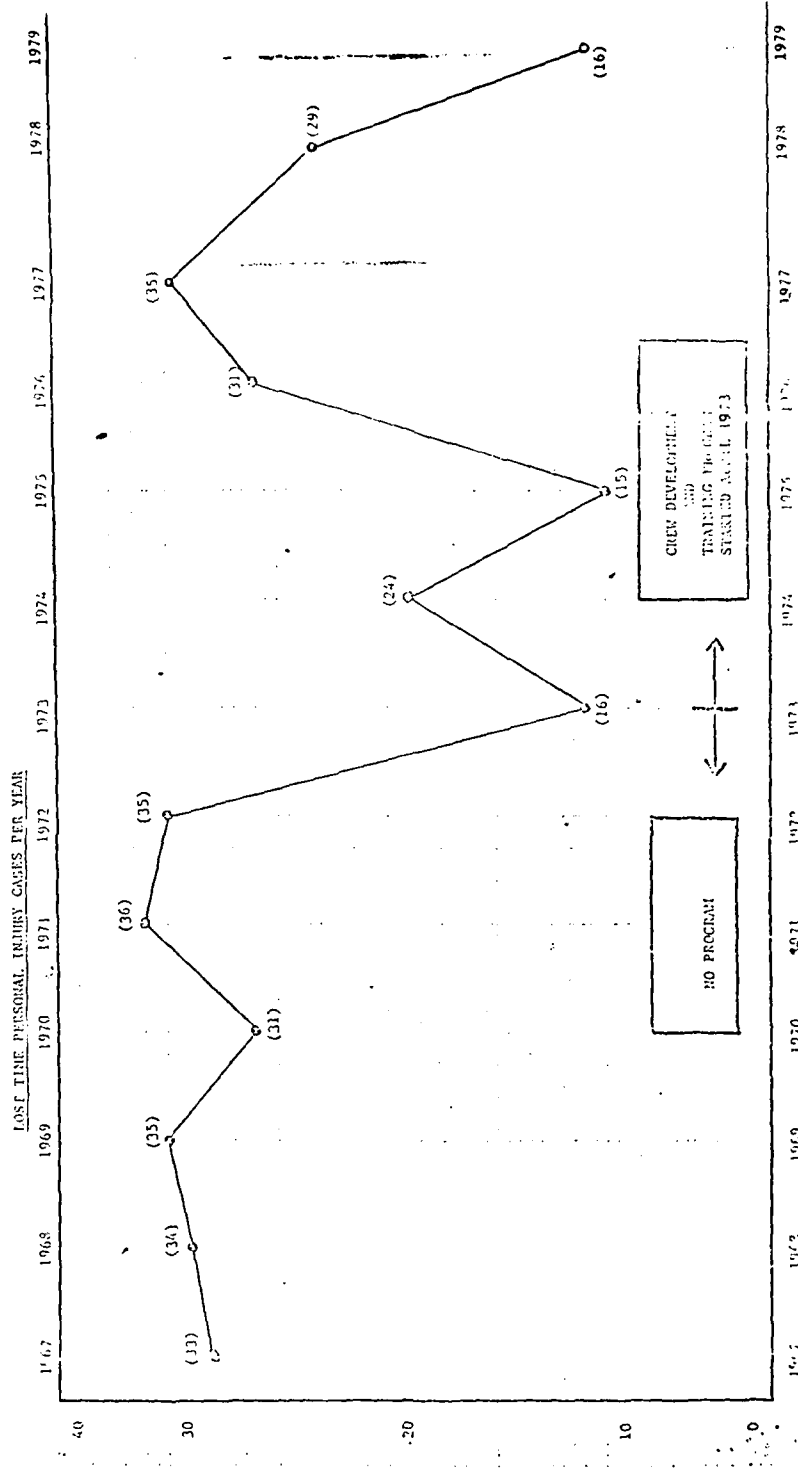
$$T = H/M \text{ (T-Turnover; H-Hires; M-Total positions in a class)}$$

To man the deckhand classification, we needed a total of 75 deckhands -- 50 on the vessels at any point in time and 25 off on free time. The following table shows the turnover rate or the number of deckhands hired each year for each position.

<u>YEARS</u>	<u>TURNOVER RATE</u>
1967	2.61
1968	2.94
1969	3.22
1970	3.18
1971	3.52
1972	3.90
1973	2.48
1974	1.92
1975	1.70
1976	1.90
1977	1.98
1978	1.91
1979	1.93

The above figures indicate that we hired 1.93 deckhands in 1979 for every one deck position to be filled. While still large, this turnover rate reflects a better than 100 percent improvement from the extremely

Graph # 4



high turnover rate of 3.90, or almost four men hired per position, in the pretraining year of 1972.

With a 1.93 turnover rate for 1979, Chotin was able to continue to maintain a more stable work force as indicated by the data in Figure 3. Prior to our training program, the deck force was being retained at an average of only 2.2 months per man. In 1979, the average length of service in the deck force was approximately 12 months. On January 1, 1973, only 24 percent of the entire deck force had one year or more of experience. As of January 1, 1980, 45 percent of our deck force had year or more of experience.

Safety Program of Chotin Transportation Company

Chotin's safety program is a highly organized operation involving a wide range of people, from top executives to the deckhands aboard our vessels. The participation of these individuals is coordinated by a full-time professional safety director. He holds a safety-professional designation from the American Society of Safety Engineers and has had more than 15 years' experience in safety engineering in the petroleum and chemical industries.

Objectives of the Safety Program

The primary aim of our safety program is to identify and correct unsafe working practices and hazardous mechanical or physical conditions responsible for accidents. This basic objective encompasses both shoreside and vessel facilities. In order to achieve this aim, the following objectives and requirements have been implemented:

1. Full backing, support, and involvement of top management.
2. Establishment and direction of the program through the Executive Safety Committee.
3. Enforcement of the program through the Division Safety Committee.
4. Basic safety training and personal-accident-prevention training through participation by the safety director in the various training programs such as tankerman training and spill prevention.
5. Accident prevention and promotion of general safety education by bulletins, posters, and safety literature.
6. Communications to employees and their families through quarterly company newsletter, the Sternline.

7. Control of unsafe working practices and unsafe mechanical conditions through supervisors, principally captains, pilots, mates, and chief and assistant engineers.
8. Development of effective first-aid and CPR capabilities.
9. Regular safety meetings on the boats.
10. Periodic inspections of all vessels and their equipment and all shoreside facilities by the safety director, with written reports of findings.
11. Compilation of accident reports and loss statistics by the safety director with appropriate analysis to measure results.
12. Use of screening devices and preemployment physicals to eliminate undesirable risks either from physical or personal reasons.
13. An awards program for accident-free service by individuals as well as vessels.
14. An effective safety-shoe program.

The vital importance of the control of unsafe working conditions through supervisors (item 7, above) is particularly noteworthy. Because the active participation of supervisors is so important, different supervisors are scheduled to attend the Supervisors Occupational Safety Development Course, such as the one presented by the Occupational Safety and Health Division of the Metro Safety Council of the city of New Orleans, Louisiana. Other supervisory training programs, with emphasis on safety as well as development of better managerial and human-relations skills, are being developed internally as well as currently being provided by organizations such as the National River Academy at Helena, Arkansas.

Important adjuncts to the overall safety program are memberships in professional safety organization membership and the safety publications subscribed to by the safety director. Our safety staff holds memberships in the American Society of Safety Engineers, the American Waterways Operators Safety Committee, and the National Safety Council. We subscribe to a number of professional safety journals such as Professional Safety Monthly; National Safety Council (Marine Section); and the Bureau of National Affairs-Job Safety and Health. These memberships and publications are vitally important in continuously updating our practices and knowledge relating to safety.

Barge Maintenance Procedures

The Barge Maintenance Division of Chotin has the responsibility of guaranteeing the seaworthiness of all barges in our fleet. This function is handled expertly by a staff of highly skilled professionals with many years' experience in the care and maintenance of barges and their equipment. These supervisors are ably assisted by engine-repair mechanics who are responsible for the actual repair and servicing of the barges and their engines and other equipment.

In addition to regular inspection by the Barge Maintenance Division, the oil tows are inspected each trip and continuously en route. The condition of the containment system, pump engines, valves, flanges, hatch covers, dogs, void compartments, deck hardware, wires, etc., is monitored continuously. Anything of a routine nature that can be repaired en route will be taken care of by the individual boat crews. Should a barge need repairs not within the scope of the crew, the master fills out a Bad Barge Report. This report will then be forwarded immediately to the Barge Maintenance Division where the barge will be set up for repair as soon as the nature of the repair dictates.

Cargo Transfer Procedures

The cargo-transfer procedures are supervised closely by a certified tankerman. All equipment to be used in the cargo transfer has been checked out thoroughly by the tankerman in charge of the operation and has been found to be in satisfactory working order. A Declaration of Inspection must be signed by both the barge tankerman and the person in charge of the facility operations. A copy of this form is shown in Exhibit D.

Spill Reporting Procedures and Statistics Retention

In spite of the extensive training, with emphasis on spill prevention, accidental oil spills occasionally do occur. When such an infrequent accident occurs, our first consideration is to minimize the effects of the oil spill. This is where the hours of training and containment expertise come into play. Chotin's vessels are manned by individuals who have had such training and experience, and that type of background continues to pay important dividends in maintaining and protecting the environment in such spill situations.

Besides the absolutely essential human element, Chotin has assembled a wide assortment of containment equipment on board each of its vessels. The personnel on board have been trained in the use of this equipment since their initial training session when first employed by the company.

The type of containment equipment on board would be as follows:

Absorbent booms	Mops and brooms
Various sized pumps	Buckets
Absorbent sheets	Skimmers
Hoses of various sizes	Protective clothing
	Absorbent Hy-Dry

The Operations Department of Chotin is responsible for monitoring and reporting spills of oil and designed substances which various governmental agencies require to be reported.

Shipboard responsibility for reporting such spills falls to the master of the vessel. To assist the master in properly reporting any such spill, a detailed flow chart, Exhibit C, has been prepared and placed aboard all our vessels. This flow chart is to be used as a guideline for the proper procedure in reporting cargo spills and leaks. In addition, a spill leak report is filled out by the master outlining the details of the spill or leak, and is forwarded to the marine superintendent for retention in the files.

Besides preparing the spill leak report, the marine superintendent will prepare a separate, detailed report on each such spill or leak and further outline any and all circumstances surrounding the accident. Detailed statistics concerning the size of the spill and the disposition of any fines or other such penalties that may be levied are maintained by the marine superintendent and are updated continuously as any other developments arise.

The Operations Department is responsible for preventing oil spills. An important tool by which the marine superintendent reinforces the need to prevent spills is through company sponsored vessel-personnel meetings. At least twice a year, those individuals responsible for boat management are assembled for instruction in such areas as spill prevention and reporting. In addition, directives from the various captains of the port are conveyed to our vessel managers at these meetings and through directives to the boats. Further, the marine superintendent makes use of in-house company employee manuals to impart those responsibilities to our employees that are necessary for them to work in a safe and accident-free environment.

To my knowledge, no serious spill reporting was undertaken until the Coast Guard brought its PIRS system on stream in 1971, at about the same time the oil pollution prevention regulations were promulgated. Therefore, it has not been possible to determine just how effective the efforts of government and industry have been in reducing pollution over time.

Chotin started an in-house reporting systems in 1973, and we have seven years of reliable statistics to draw on for comparison. For the

purpose of this paper, I will set out what Chotin's data reveal about spills in the area of human error, as follows:

AVERAGE PER YEAR
(Over 7 year period)

Product moved	4.4 million tons
Cargo transfers	4.660
Total cargo spilled (all causes)	446 tons
Spills as percent of cargo moved	.000106%
Number of spills from tankerman error	6
Total gallons spilled from tankerman error	164 gallons
Number of spills from pilot error	3
Total gallons spilled from pilot error	85,797 gallons

SPILLS FROM TANKERMAN ERROR

$$\text{Frequency } \frac{4660}{6} = 776.6$$

One spill per 777 cargo transfers

$$\text{Quantity } \frac{164}{4660} = .0352 \text{ gallon}$$

Average 4-1/2 ounces spilled per cargo transfer

SPILLS FROM PILOT ERROR

$$\text{Frequency } \frac{4,400,000}{3} = 1,466,666$$

One spill per 1.47 million tons of cargo moved

$$\text{Quantity } \frac{85,797}{4,400,000} = .0195 \text{ gallon}$$

Average 2-1/2 ounces per ton of cargo moved

Historical Review of Towing Industry

The Coast Guard has been given the task of regulating the industry and in particular of establishing the framework for issuing Operator's Licenses under 46 CFR 10.16 and Tankerman Certificates under 456 CFR 12.10. The Coast Guard, with its experience and knowledge in deep-sea operations, has been given the task of regulating an industry that is

very different from the area of expertise wherein it has functioned comfortably for many years.

The past several decades have produced a literal explosion of technology development within the inland marine industry. Simultaneous with that development has been the equally prodigious development of the Coast Guard's regulatory arm. However, as we will develop, the Coast Guard has never been able adequately to bridge the gap between its deep-sea background and the need to modify this experience to serve the inland marine industry effectively and practically.

Currently, the Coast Guard lacks experience in the essentials of the inland marine industry and continues compulsively to force the implementation of broad, deep-sea applications on the very specialized inland marine industry.

Differences between the traditional roles of deep-sea vessel employees and of inland-marine-vessel employees are shown in table 1. This table depicts the differences related to the capability of safely handling the respective operations.

TABLE 1
Differences in Traditional Roles of Deep-Sea Employees
vs.
Inland-Towing Vessel Employees

Type Operation	<u>Deep Sea Employees</u> Continuous operation over long distances in open waters	<u>Inland Towing Employees</u> Intermittent operation over short distances or over river and canal systems (a)
Waters Traversed	Open; pilots taken aboard for congested waters & maneuvering	Congested, in and around harbors, inland waterways
Crew Size	28 - 45	2 - 12
Watch Schedule	Three watches, 4 on, 8 off	Tow watch, 6 on & 6 off; or one 12-hour or 8 hour watch in harbor operations.

Work Schedule	Voyage or time contract (sign on & discharge)	(Time shown in days) 7 on, 7 off; 15 on, 7 off; 30 on, 20 off; 30 on, 30 off
Deck Watch	Mate, 2 AB's & ordinary seaman	Mate, or Operator Deckhand
Primary Deck & Wheelhouse skills Needed	Long distance navigation & cargo handling	Boat handling and maneuvering in congested pilot waters. Knowledge of long reaches of river and channels, current, bridge draws, and locking.

- a. For inland towing vessels, operation may be almost continuous, but personnel are rotated.

Scope of Examinations and Licensing

In general, there are no problems perceived with the Coast Guard policy of licensing towing operators over a broad area. Under this policy, an individual can, by acquiring Inland and Western River Licenses, operate a vessel anywhere on the waters of the United States. However, the Coast Guard, through federal mandate (the Towing Vessel Licensing Act of 1972) can utilize "Limited Local Area" authority to tailor-make individual needs to match local-area needs. The use of "Limited Local Area" authority is explicitly set forth in the Towing Vessel Licensing Act of 1972. Further, in the final rule published in the Federal Register on March 7, 1973, page 5,747, it is stated:

"Finally, in response to comments that the proposed geographical areas might prove too broad in scope, the Coast Guard points out that an applicant may request a more limited route or an Officer in Charge may limit a license commensurate with the experience of the applicant. In such cases, the OCMI will administer an examination he considers appropriate for the limited license to be issued."

Thus, under the regulations, the OCMI has the authority to designate a "Limited Local Area" and, by so doing, tailor individual areas needed to fit individual licensees. This authority has been somewhat inhibited through internal Coast Guard actions, and some Officers in Charge, Marine Inspectors (OCMI's) have refused to exercise

their "Limited Local Area" authority. These internal policies are reflected in Navigation and Vessel Inspection Circular 3-74 (March 25, 1974) and further in CG-467, which appears to limit the OCMI's discretion to less than the authority contained in the regulations.

License Content

Inland towing vessels have different problems and different equipment than seagoing vessels. Examinations that purport to test individuals who man inland vessels and use that equipment should properly coincide with appropriate terminology and nomenclature. According to a recent study of individuals taking the examination for Western River Towing Operator, a large number of inappropriate questions are now appearing on the test. Captain Billy Hutto, President of Western River Training Centers, Inc., of Greenville, Mississippi, conducted the survey by way of feedback from students, previous experience, and from their documentation (Proceedings of the Marine Safety Council). Some examples of questions containing inappropriate material are as follows:

1. Some questions have referred to lighthouses. There are no lighthouses on the Western Rivers.
2. Specific questions on anemometers. This type of equipment is not used on the Western Rivers.
3. Complex weather questions directed to and with specific implications for deep-sea vessaels.
4. One question on Test #5142 General represents the highly unlikely situation of using tangent bearings and a radar range of a rocky island to obtain a position. Radars are not even required on Western River vessels.
5. On Test #5143 General, the applicant is asked about characteristics relating to "Ocean Currents" and "Ocean Waves."
6. Test #5142 Navigation, besides containing irrelevant materials not needed on Western Rivers, also contains double-jeopardy questions. In other words, if you miss one question you will automatically miss another. In view of the fact that applicants are permitted to miss only one question, this double-jeopardy situation certainly makes for poor testing procedures.
7. Besides numerous instances of inappropriate testing content, it has been reported by many individuals sitting for the Operator's License that, at times, proper reference books necessary for taking the open-book portion of the test are not available in all licensing offices.

It appears that the Coast Guard exams for the Operator's License do not properly test the special knowledge required of a Western River towing-vessel operator. Inappropriate questions, as outlined above, tend to confuse and even anger the applicant. The manner in which the Operator's Examination is presently constructed serves to retard the acquisition of the license by the inclusion of irrelevant materials that do not allow the licensees to relate their unique experience and specialized knowledge to many of the general questions.

Any educator or other professional person dealing with the intricacies of testing will agree that all tests must have two basic ingredients. First, they must be reliable. That is, they must, over a period of time and repetitious use, continue reliably and accurately to test for the knowledge necessary to perform the functions. Secondly, any testing mechanism must be valid. The examination must be designed to test the skills and knowledge that the applicant has acquired through appropriate study and work experience. Any test that includes materials not pertinent to the work experience and necessary knowledge must be considered invalid.

We seriously doubt that the tests currently being used by the Coast Guard have been appropriately validated by working professionals within the industry who have demonstrated the expertise essential in the selection of pertinent subject matter for these examinations.

Improved testing materials and procedures will better allow the companies that make up the inland towing industry to direct their training efforts more accurately and concentrate on the real information and training needs of their employees, instead of requiring inappropriate studies.

Turnover of U.S. Coast Guard Personnel

The Coast Guard's military organization and structure contribute to the confusion and problems relating to licensing within the towing industry. Basic to the problems generated within the licensing functions of the Coast Guard is the practice of constantly rotating personnel within the licensing offices.

The military organization dictates that licensing personnel within the Merchant Vessel Personnel (MVP) Division at Coast Guard headquarters regularly rotates every two to four years. This same type of turnover exists in district offices as well. With this constant turnover of personnel, it seems logical that a lack of continuity of purpose would exist within these organizations. The situation is appalling and could not be withstood by anything but an organization that is not judged by its efficiency or profitability. Certainly no commercial organization could survive with such an unenviable record of turnover of key people.

The situation that constantly develops is that inexperienced personnel come into the licensing offices, train for two to four years until they begin to reach some degree of competency, and then are replaced by new, inexperienced people, and the cycle begins again.

Suggestions on Improving Coast Guard Performance

It is obvious to those of us who manage the barge and towing industry that the United States Coast Guard has little or no competence in the regulation of our area. This was recognized many years ago when the Coast Guard first became involved with river transportation. To alleviate this condition, the Western River Panel was organized. This panel was, in fact, a forum where the Coast Guard could meet with professional river people to pick their brains and learn where the problems were and how to solve them.

The Western Rivers Panel was dissolved, and at the same time the Towing Industry Advisory Committee was established. That committee functioned with merit and provided the government with free professional advice in areas where there was little government expertise. There was a continuing dialogue to the advantage of all concerned. When the Towing Industry Advisory Committee was abolished, both the government and the industry lost a most valuable tool. We have ceased to consult freely and on a continuing basis.

Such infusion of expert advice and experience is also available to the Coast Guard under Public Law 109. Under this federal statute, the Coast Guard has authority to recruit and hire civilian personnel who would have the knowledge and expertise necessary for performing some of the more technical jobs relating to licensing as well as other administrative duties. By so doing, the Coast Guard could acquire the services of long-term, career personnel who would not have to be reassigned every two to four years as is the case at present. This concept has not met with any enthusiasm within the Coast Guard, and the industry has seen little by way of infusion of personnel along these lines. Perhaps one very good reason why civilian experts have not been included are the requirements of extensive testing, artificial administrative barriers, and inappropriate deep-sea experience before one can even be eligible for the program. Such requirements effectively eliminate the vast majority of civilian experts in the inland towing industry who could provide essential experience.

In addition to making more effective use of PL 219, the Coast Guard needs to consider hiring civilian personnel with the skills and experience required to properly implement the regulations that apply to the inland marine industry. It appears that the Coast Guard is attempting to do too much with inadequately trained personnel, and its performance obviously suffers.

Gentlemen, I assure you that the management of the inland towing industry, if given the opportunity, is anxious and willing to assist the government in solving these legitimate public concerns.

CADET MATE SCHEDULE

DAY ONE

<u>TIME</u>	<u>SUBJECT</u>
0830	Introduction to Chotin Cadet Mate Program Policies, Procedures and Rules
1000	BREAK
1010	Company Benefits Pay Schedule, Employment Forms, Communication Procedures Discussion Period
1200	LUNCH BREAK
1300	Area's of Responsibility , Chain of Command, Complaint Procedure.
1400	Knowing your boat and it's equipment. Proper clothing, Barge and Fittings.
1600	The Ratchet & Winch
1700	Assignment 19-26 and 31-38, Pages 1-6 and 10-15, Deckhand's Manuel
1705	Clean-up

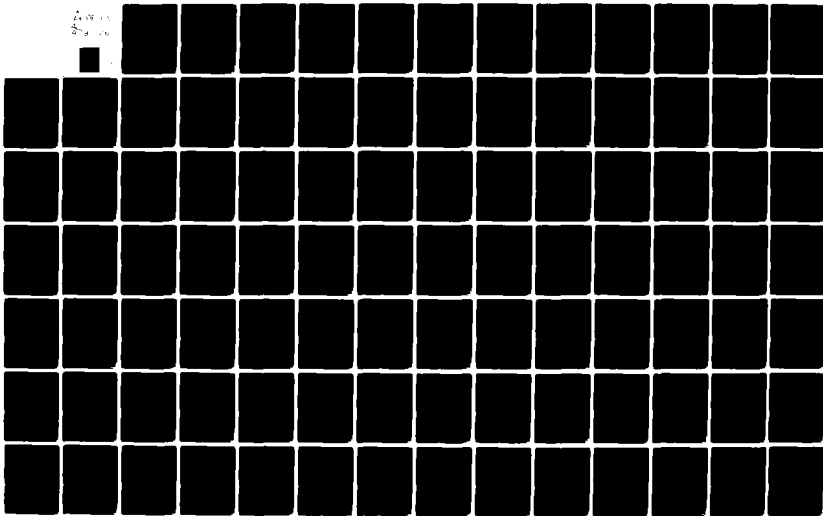
AD-A096 126

NATIONAL RESEARCH COUNCIL WASHINGTON D C MARITIME TRA--ETC F/G 13/2
WORKSHOP ON REDUCING TANKBARGE POLLUTION. APRIL 15-16, 1980. (U)
AUG 80 N00014-75-C-0711

UNCLASSIFIED

NL

AD-A096 126



CADET MATE SCHEDULE

DAY TWO

<u>TIME</u>	<u>SUBJECT</u>
0830	Testing - Boat Equipment
0930	Proper Lifting and Carrying Lines Knots Splicing
1030	BREAK
1045	Safe Line Handling Film "Locks and Lines" Proper Line Placement
1200	LUNCH BREAK
1300	Line Practice "Tow Simulator"
1700	Deckhand's Manual Assignment 39-47, Pages 16-18 and 27-30
1705	Clean-up

CADET MATE SCHEDULE

DAY THREE

<u>TIME</u>	<u>SUBJECT</u>
0830	Lines Testing "Rigging Usage"
0930	Tow Make-up (A) Facing up (B) Making a coupling (C) Typical Tows (D) Picking up a barge (E) Dropping
1030	BREAK
1045	Wires (A) Fork and Aft Wires (B) Towing (C) Backing (D) Cross and Breast
1200	LUNCH BREAK
1300	Wire Practice "Tow Simulator"
1700	Assignment - Pages 20-25 and 48-55
1705	Clean-up

CADET MATE SCHEDULE

DAY FOUR

<u>TIME</u>	<u>SUBJECT</u>
0830	Testing "Hard Rigging" "Wires"
0930	Locking (A) Making a Lock. (B) Working a Lock Line (C) Single Locking (D) Double Locking
1030	BREAK
1045	Film - "Awearness of Safety" Proper Work Habit Working at Night
1200	LUNCH BREAK
1300	Tow Simulator Practice
1700	Assignment Pages 56-64
1705	Clean-up

Exhibit A

CADET MATE SCHEDULE

DAY FIVE

<u>TIME</u>	<u>SUBJECT</u>
0830	Testing - "Safety Aids" "Obey Rules"
	Film - "Towboat Tips"
1000	BREAK
1015	Fire Fighting First Aid
1200	LUNCH BREAK
1300	Review - Tow Simulator
1700	Clean-up

BIBLIOGRAPHY OF
TRAINING AND RESOURCE DOCUMENTS

"A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products"; Department of Transportation, The United States Coast Guard; September, 1976; CG-174.

"Oil Pollution Control for Tankermen"; Department of Transportation, The United States Coast Guard; February, 1973.

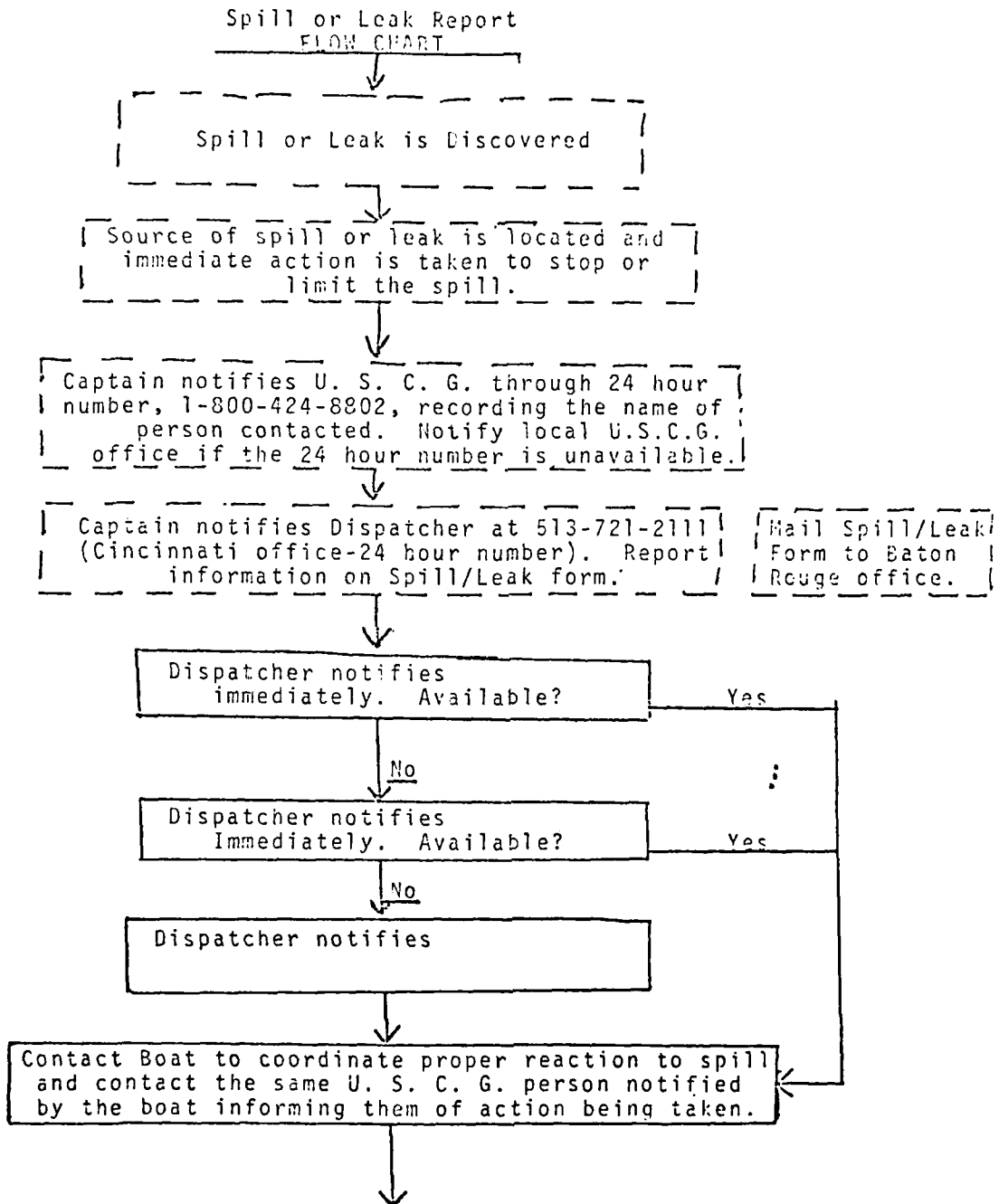
"Fire Fighting Manual for Tank Vessels"; Department of Transportation, The United States Coast Guard; January, 1974; CG-329.

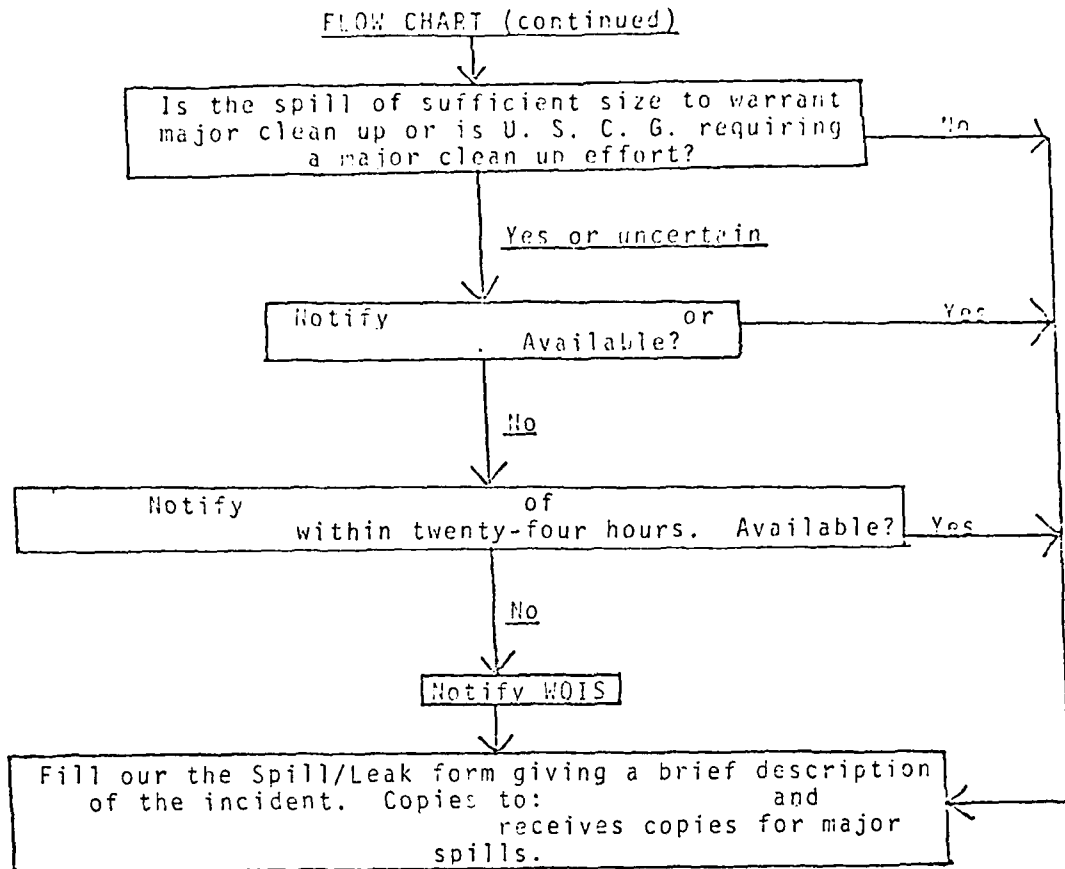
"When You Enter That Cargo Tank"; Department of Transportation, The United States Coast Guard; March, 1976; CG-474.

"Barge Tankerman Oil Spill Prevention"; American Petroleum Institute; January, 1979.

"Oil Spill Control Procedures"; Texas A & M University System; 1975.

CHOTIN TRANSPORTATION, I
SPILL REPORTING PROCEDURE
Effective January, 1979





Vessel personnel should be concerned with the procedures which are enclosed by dotted lines.

Notification to state agencies will be made by office personnel.

On determination that a spill is of a serious nature counsel is to be immediately dispatched to the scene.

GROUP IV
OPERATING ENVIRONMENT

A COMPARISON OF THE VOLUME OF PETROLEUM HYDROCARBONS INTRODUCED INTO
NAVIGABLE WATERS BY THE UNITED STATES BY BARGE ACCIDENTS AND
BY NONACCIDENTAL CAUSES

Charles C. Bates
Consultant in Earth Sciences and Environmental Management

Introduction

The purpose of this paper is to compare the volume of oil [better termed petroleum hydrocarbons (PHC)] introduced into navigable U.S. waters by tankbarges with that volume introduced by nonaccidental causes, such as that released during routine operations of oil refineries, other major industrial plants, urban runoff, urban sewage plants, etc. Such a comparison is believed necessary is thoughtful, well-balanced cost-benefit and environmental-impact analyses are to be incorporated into the options developed by the workshop. This consideration is particularly important, for it will be shown that the average annual release of PHC pollutants from tankbarges averages about 57,100 barrels per year. This is less than 2 percent of the total amount of similar pollutants introduced, according to an earlier NAS Workshop (1), into the waterways of the nation by nonaccidental causes, i.e., approximately 6.5 million barrels. In addition, it should be remembered that of the approximately 2.24 million barrels of oil accidentally released into navigable U.S. waters during the 1971-1977 period, only 17 percent was released by barges (2, 3).

Regulatory Background Pertaining to the Need to Reduce Oil Pollution
From Tank Barges

The Coast Guard released in May 1979 a "Draft Regulatory Analysis and Environmental Impact Statement (EIS)" (3) entitled: Design Standards for New Tank Barges and Regulatory Action for Existing Tank Barges to Reduce Oil Pollution Due to Accidental Hull Damage. This draft statement specifically announced:

"The Coast Guard is committed to reducing in a timely fashion the amount of transport related oil pollution which results from single hull barges."

The U.S. Coast Guard based this proposed action on provisions contained within two key laws, the Federal Water Pollution Control Act Amendments of 1972 and the Ports and Waterways Safety Act of 1972. Section 311(b) (1) of the first law states:

"The Congress hereby declares that it is the policy of the United States that there should be no discharges of oil or hazardous material substances into or upon the navigable waters of the United States...."

while Section 4417a (1) of the second law states:

"(A) that the carriage by vessels of certain cargoes in bulk or in residue creates substantial hazards to life, property, the navigable waters of the United States (including the quality thereof) and the resources contained therein...

"(B) that existing standards for the design, construction, alteration...of all such vessels...must be more stringent and comprehensive for the mitigation of hazards to life, property, and the marine environment;

"(C) that standards developed through regulations shall incorporate the best available technology and shall be required unless clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation and vessel safety or protection of the marine environment."

(NOTE: UNDERLINING BY AUTHOR OF REPORT TO STRESS KEY POINT.)

In the Environmental Impact Statement associated with the proposed double-bottom regulation, the USCG is extremely vague regarding the economic benefits to be derived from improvements in the marine environment should the double-bottom regulation be placed into effect. For example, Section 4.2.2 of the EIS (page 66) states:

"The economic benefits of the environmental improvement that should result from these proposals are the most difficult to assess. The current knowledge of the relationship between oil inputs to the marine environment and risk of environmental damage does not permit direct evaluation. There are also other pollutants, i.e., hazardous substances, sewage and thermal, that affect the quality of the inland waters. While tank barges represent a large single source of oil pollution, the best that can be stated is that the elimination of the majority of tank barge oil pollution will improve the quality of the water. This effort coupled with other efforts will effect a gradual improvement in the waters of the U.S."

Magnitude of Oil Pollution from Tank Barges (1971-1977)

According to Table 1 (page 11) of the USCG's draft EIS, 371,147 barrels of oil were reported lost during tankbarge operations in and around U.S. waters during the time period 1971-1977 inclusive. This number, although somewhat questionable because of underreporting and other loss of accuracy in the data files, may still be considered, on

the basis of experience, to be correct to within 90 percent of the actual amount spilled. For the purpose of this report, the above amount may therefore be rounded conservatively upwards to 400,000 barrels, or approximately 57,100 barrels per year.

Magnitude of Riverine and Coastal Petroleum Hydrocarbon (PHC) Runoff Within U.S. Waters

In a thoughtful paper by L. H. Myers (4), Chief of the Industrial Section at the U.S Environmental Protection Agency's Kerr Environmental Research Laboratory, he notes:

"Sources and distribution of hydrocarbons in the aquatic environment include the daily activities of the nation's population. There are natural occurring hydrocarbons from decaying plants, industrial discharges from oil-dependent industries, and there are discharged hydrocarbons from municipally operated sewage treatment systems. These discharges represent the three basic sources of hydrocarbons: animals, mineral, and vegetable."

Thus in any study of oil pollution, it is first necessary to define what is meant by "oil." As late as 1975, the American Petroleum Institute noted that there were 20 methods available to determine oil (or petroleum hydrocarbons (PHC) in water using 11 different solvents or solvent combinations (5). However, the most common of these methods is the one stated in the water chemist's bible, "Standard Methods for the Examination of Water and Wastewater," published by the American Public Health Association in 1971. This technique uses a simple solvent-extraction (n-hexane)/gravimetric analysis and gives a value which includes both "oil and grease" content. However, this value can be broken down further regarding oil content by assuming that the amount of PHC present is 75 percent of the total "oil and grease" measured in urban runoff, and 50 percent of the total in the "oil and grease" content measured in municipal and industrial wastewaters.

The best data for establishing the magnitude of petroleum-hydrocarbon runoff within the riverine and coastal waters of the United States are probably those contained in the 1975 report, "Petroleum in the Marine Environment," by the U.S. National Academy of Sciences (1). Although published five years ago, these data are still considered valid and, if anything, conservative for even today's situation.* Table 1 shows the approximate annual PHC contributions to the ocean by the indicated U.S. sources.

*Personal statement of December 1, 1979, by Prof. Erman Pearson, former Chairman, Department of Sanitary Engineering, University of California (Berkeley), and also Chairman, Inputs Area, NAS Study on "Petroleum in the Marine Environment."

Table 1
Estimates of PHC Introduced Routinely Into U.S. Coastal Waters

<u>Source of PHC</u>	<u>Amount of PHC (Barrels)</u>
River Runoff	4,020,000
Urban Runoff Directly into Coastal Waters	760,000
Coastal Municipal Wastes	760,000
Coastal Refineries	490,000
Coastal Industrial Wastes (Nonrefining)	760,000
Total	<u>6,790,000</u>
Average Annual Accidental Releases Reported by USCG on page 23 of Reference (2) Less <u>Argo Merchant &</u> <u>Hawaiian Patriot</u>	
Adjusted Final Total	<u>-320,000</u> <u>6,470,000</u>

Source: Reference 1.

How these data have been arrived at is described in detail in the NAS study, as well as in a back-up paper by Storrs (6).

Although much of this NAS pollution budget was calculated in 1973, subsequent studies by Myers (4) and Whipple et al. (7) document the continued conservatism of this table. For example, Myers indicates that the amount of waste lubricating oil dumped either into a sewer or a nearby vacant lot may approach 6.7 million barrels on a nationwide basis. In addition, he reports that Environmental Protection Agency's Industrial Wastes Program has identified six industries as major dischargers of oil. These are: petroleum production, petroleum refining, chemical and allied products, blast furnaces and steel, food and kindred products, and textile mills.

For example, Myers indicates PHC releases from major industrial installations to be of the order of:

Petroleum refinery:	2.9 pounds of oil per 1,000 barrels of oil refined.
Steel industry:	2.8 pounds of oil per ton of steel.
Textile industry:	0.05 pounds of "oil" per ton of process water.
Chemical industry:	0.2 to 4 pounds of oil per ton of production depending upon chemical being formed.

Comparison of Volume of Petroleum Hydrocarbons Introduced into U.S. Waters by Tankbarge Operations and by Other Nonaccidental Sources

Based on the data presented above, it would appear that tankbarge operations annually release approximately 57,100 barrels of PHC into the nation's waterways, as compared to 6,470,000 barrels of PHC by causes other than accidental. Just what this industrial discharge of PHC into the nation's waterways amounts to has been addressed by Whipple and associates at Rutgers University. Using National Science Foundation funds, they specifically studied the Delaware Estuary for the following purpose:

"...to characterize and estimate all the principal sources of petroleum (contamination), including petroleum in urban runoff and various effluents."

Table 2 shows the measurable contributions of PHC they obtained (after the author of this paper factored out the "grease" content of the effluent).

Table 2
PHC Effluent Entering the Delaware Estuary (1974-1976)

<u>Source</u>	<u>Amount of PHC Effluent Released Annually</u> (In Barrels)
Petroleum Refineries	16,970 (with gradual reduction to 1,360)
35 Other Major Industries on the Estuary	7,540 (with gradual reduction to 5,030)
Storm Runoff from Philadelphia Metropolitan Area Only ^a	6,980
Sewage Plant Releases ^b	<u>13,950</u>
Total	<u>45,440</u>

a. Storm waters were found to have PHC content ranging from 2 to 4 parts per million with an average value of 2.32 parts per million.

b. This value is calculated on the basis that the Philadelphia-Camden metropolitan areas would contribute eight times as much PHC effluent as that measured at the Trenton sewage plant.

Source: Reference 7

Inasmuch as the total of 45,440 barrels per years in Table 2 does not include all of the storm runoff or sewage plant release, it may be assumed that the total baseload of PHC contamination exceeds 50,000 barrels per year into the Delaware Estuary. This amount is reasonably

comparable to the 80,000 barrels of PHC estimated by Pearson (8) to pass into the San Francisco Bay Estuary each year.

In their study, Whipple et al. also found that a case could be made for changing pollution-control priorities. For example, the petroleum refineries were having to reduce their PHC efficient loadings by 92 percent. In contrast, they found:

"Industries other than petroleum appear to have been treated much more leniently, since the percentages of reduction in effluent loadings of petroleum are much less, and the total loadings permitted are much greater.

"There are no limitation of petroleum pollution required of municipal treatment plants for the urban and industrial runoff, other than that of the oil companies."

In fact, they found that one particular industrial plant would be permitted to release more than 3,080 barrels of PHC annually in its effluent, even in future loadings.

In other words, the barge release would be about 0.9 percent of the total amount released by nonaccidental causes. Should one want to streamline this comparison and compare the barge release to just the amount introduced by river runoff, the ratio would be approximately: 57,100 : 4,020,000 or the barge release would be about 1.4 percent of the total released via river flow.

Some Biotic Aspects of Oil Spills in Inland Waters

While it is not the purpose of this paper to compare the biotic damage from PHC releases of the accidental and nonaccidental types, it will be noted that the location, immediate magnitude, and type of the PHC release is of great importance from the ecological point of view. In a slow-moving tidal estuary, for example, much of the PHC entering the water seems to be dissipated in a very few days with a large fraction of the hydrocarbon content removed through evaporation and in particulate form by sedimentation. In contrast, in fast-moving streams, the PHC effluent is rapidly distributed and, if miscible, quickly diluted with much larger volumes of water.

Undoubtedly, the most visual and tangible effect of most PHC spills is the impact on the local bird population. Birds, of course, suffer both from the impact on their feathers and on their feeding practices. On the other hand, PHC spills do not seem to impact heavily on fish. For example, Myers (4) reports that the EPA, when studying identifiable sources of fish kills during 1972, found that only 23,750 fish were killed by barge or boat releases as compared to 8,360,594 fish killed

by municipal activities and 4,414,390 fish killed by industrial activities.

Another interesting aspect of PHC-spill budgets is that only a generation ago the U.S. Public Health Service was extremely active in intentionally spilling PHC materials over still-water areas as a mosquito-control technique. Products used in such "oiling" varied, including light crude oil and kerosene. According to Herms (9), cattle could drink water sprayed with "water-white" kerosene and show no bad effects, while other types of spray products, such as "stove distillates," would, however, cause digestive disturbances and loss of weight. Oil films used in pollution control apparently were not harmful to fish, and Simmons (10) states that mosquito control had a good record for more than 50 years relative to not creating unusual dangers to most wildlife. It must be added, of course, that some biotic damage was noted not only to the mosquitoes but also to water beetles and similar water insects, and some gun clubs did complain about the adverse effects on ducks.

The amount of oil spilled intentionally by the Federal Government in the mosquito-control program actually approaches half of the amount now accidentally spilled by barges each year -- i.e., 57,100 barrels on the average -- according to the Federal Security Agency (11). For example, in 1945, 23,890 barrels of oil were sprayed over 49,000 acres at more than a thousand military establishments in 19 states and Puerto Rico as a special antimalaria measure.

In passing, one is forced to comment that it is certainly interesting how the federal system has gone from intentionally creating thousands of acres of oil films as a public-health measure in the early 1940's to considering "sheens of oil" as being "harmful amount of oil" under the provisions of the Federal Water Pollution Control Act Amendments of 1972 (12).

Conclusions

One may conclude from the foregoing:

- a. That any calculations of regional or national cost-benefits to be achieved by introduction of costly new barge designs or barge-refit practices should recognize that barge spills contribute less than 2 percent of the total volume of oil spilled into the nation's waterways.
- b. That there is some field evidence, based on more than 50 years of mosquito-control work conducted by the Federal Government, that intentional spillage of petroleum products over inland waters in amounts up to half that spilled annually by barges did only minor and temporary damage to the biota.

- c. That there is some indication with respect to national pollution-control priorities that municipal entities and industries other than the petroleum industry have been treated more leniently than has the petroleum industry with regard to the total PHC loadings authorized for release into the nation's waterways.
- d. That, as a matter of equity expressed by the policy of "The Polluter Pays!," the NAS Workshop should particularly explore options that concentrate to some degree on eliminating severe damage to the biota from accidental spills and on penalizing the actual transgressors of antipollution laws, rather than concentrating primarily on options that require expensive across-the-board protective measures across an entire industry.

Among options that may be worth exploring are:

- 1. Accelerating techniques, design and field practices, and use of new equipment that ameliorate the incidence and severity of tankbarge spills on the basis of positive cost-benefit ratios.
- 2. Accelerating techniques, field practices, and countermeasures that reduce the amount of PHC released when a tankbarge ruptures.
- 3. Introducing more massive and rapid clean-up rates for spills from ruptured barges.
- 4. Introducing as a regular practice the making of prompt replacement in kind (or dollars) of damaged biota of finite value, rather than conducting only "clean-up" per se. For example, in the case of extensive fish kills from causes other than oil spills, emphasis is normally placed on replacing the fish, not on resurrecting the injured fish. In California, this is known as the "replace-in-kind" concept.
- 5. Assessing stiffer fines and licensing penalties (as presently authorized) for persons and firms found intentionally violating antipollution and safe navigation laws and regulations.

REFERENCES

1. National Academy of Sciences, Petroleum in the Marine Environment, 107 pp., 1975. Washington, D.C.
2. U.S. Coast Guard, Polluting Incidents In and Around U.S. Waters, 1977. Commandant Instruction M16450.2 of 17 July 1978, 30 pp.
3. U.S. Coast Guard, Draft Regulatory Analysis and Environmental Impact Statement -- Design Standards for New Tank Barges and Regulatory Action for Existing Tank Barges to Reduce Oil Pollution Due to Accidental Hull Damage (Dockets #75-083 and #75-083a), 76 pages plus 4 appendices. May 1979. Washington, D.C.
4. Myers, Leon H., Sources and Distribution of Hydrocarbons in the Environment, Proceedings, Symposium on Sources, Effects and Sinks of Hydrocarbons in the Aquatic Environment, American Institute of Biological Sciences, pp. 66-83, August, 1976. Arlington, VA.
5. American Petroleum Institute, Review of Analytical Methods for Determination of Oil and Grease. July, 1975. Washington, D.C.
6. Storrs, P.N., Petroleum Inputs to the Marine Environment from Land Sources, Background Papers for Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, National Academy of Sciences, Volume 1, pp. 50-58, 1973. Washington, D.C.
7. Whipple, W., J. V. Hunter, and S. L. Yu, Hydrocarbon in Sewage and Urban Runoff -- Delaware Estuary, Proceedings, Symposium on Sources, Effects and Sinks of Hydrocarbons in the Aquatic Environment, American Institute of Biological Sciences, pp. 55-65, August, 1976. Arlington, VA.
8. Pearson, Erman, Personal statement to author on 1 December, 1979. (Note: Professor Pearson is former chairman, Department of Sanitary Engineering, University of California, Berkeley, and also served as Chairman, Inputs Area, NAS Study on "Petroleum in the Marine Environment.")
9. Herms, William Brodbeck, Mosquito Control: Practical Methods for Abatement of Disease Vectors and Pests, Commonwealth Fund, New York, N.Y., 317 pp. 1940.
10. Simmons, Samuel, Pest Control in Public Health, Symposium on Pest Control and Wildlife Relationships, National Academy of Science Publication 897, pp. 14-18, 1961. Washington, D.C.

11. Federal Security Agency (U.S. Public Health Service), Malaria Control in War Areas, 1944-45. Atlanta, Georgia.
12. U.S. Court of Appeals (5th Circuit), United States of America, Plaintiff-Appellee versus Chevron Oil Company, Defendant-Appellant, Case #76-4083, dated 16 November 1978 (Published by West Publishing Company). (Note: Issue is whether oil spill was not harmful, even though it caused sheen on the water.)

TRAFFIC-MANAGEMENT CONTROL SYSTEMS ON INLAND WATERWAYS

CAPT. Daniel B. Charter, Jr.
Office of Marine Environment and Systems
U.S. Coast Guard

Vessel Traffic Services (VTS) have been established in five of our major ports. The authority is contained in the Ports and Waterways Safety Act of 1972 and gives the Coast Guard a charge to reduce collisions, ramming, and groundings for the purpose of protecting the environment and reducing loss of life and property. No mandate exists to use VTS for any other purpose or combine it with other systems, e.g. navigation or communication systems, or to use it for any commercial purpose.

The basis of a VTS is a Vessel Movement Reporting System (VMRS) in which vessels pass their position and intentions over a communications net, and the VTS passes this information to other vessels to prevent surprise encounters. Information on navigation hazards, weather, and emergency conditions is also passed.

The system works quite well in an area which is limited geographically (as in a short length of channel) or in one where the traffic density is low. Systems like this are in operation in Sault Ste. Marie, Michigan; in Berwick Bay, Louisiana (on the Atchafalaya River); and on the Ohio River near Louisville, Kentucky. In the Berwick Bay system, a watch officer is positioned where he can see both ways. He clears vessels through the one-way section of the railroad bridge on channel 13. These systems are economical and effective.

When the VTS is expanded beyond the visual range of one or two men and the range of a single radio transmitter, costs will of course be greater. A more capable traffic center, microwave relay from remote radio transmitter/receivers, and perhaps even electronic surveillance will be needed. Where traffic is very dense, it is not possible for one man to process mentally all the information coming in and going out. A display may be required, whether it be a table with models, a board with cards in it, or even a computer. Experience has proven that in areas of high traffic density, television surveillance is needed in order to provide the accuracy-of-position information necessary to provide truly useful traffic reports to all vessels.

Some typical 1980 costs:

Basic VTS with single radio:	INITIAL:	\$ 50,000
	ANNUAL:	\$ 60,000
(Seven men, small center)	PERSONNEL:	\$100,000
Radio net with four xmtr/rcvrs	INITIAL:	\$200,000
	ANNUAL:	\$ 60,000
Television system (three cameras)	INITIAL:	\$1.5 million
	ANNUAL:	\$150,000
Traffic center with	INITIAL:	\$1.2 million
computer (30 men)	ANNUAL:	\$120,000
	PERSONNEL:	\$540,000

The Coast Guard studied U.S. waterways in 1973 in order to rank them according to accident level and the level of VTS needed to reduce these accidents based on the specific harbor/waterway configuration. The inland waterway system was difficult to analyze because of its continuous nature. Certain sections have virtually no accidents historically; other sections are known to be hazardous.

The study, which used a very conservative approach, produced the following ranking of ports:

1. New York
2. New Orleans
3. Houston-Galveston
4. Sabine-Neches (ICW 265-290)
5. Chesapeake Bay
6. Morgan City (ICW 80-99)
7. Cote Blanche (ICW 107-129)
8. Baton Rouge
9. San Francisco
10. Houma (ICW 50-69)
11. Chicago
12. Delaware Bay
13. Tampa

14. Puget Sound
15. Mobile
16. Detroit River
17. Vermillion River (ICW 155-179)
18. St. Louis
19. Long Island Sound
20. Los Angeles/Long Beach
21. Corpus Christi
22. Boston

The need for a VTS in any particular hazardous area is now evaluated by analyzing historical marine casualties (all accidents involving loss of life, property damage over \$5000) and the local circumstances cause those casualties. Based on our method of analysis, no additional areas appear to be candidates for a Vessel Traffic Service.

Our experience to date with VTS in U.S. waterways is that it is very effective and low in cost when used in small areas. When we expand our coverage, the requirements for sophisticated equipment, electronic surveillance, and personnel increase the cost of establishing and operating the system to the extent that serious questions are raised about its benefits in relation to its cost.

COAST GUARD AIDS TO NAVIGATION
AND
MARINE INFORMATION

CAPT. Leonard W. Garrett
Chief, Aids to Navigation Division
U.S. Coast Guard

Aids to Navigation

Aids to navigation are placed along the nation's coasts and navigable waterways to mark safe routes and to assist navigators to determine their positions in relation to the land and the underwater hazards. Within the bounds of necessity and reasonable cost, aids are designed to be seen or heard so as to provide adequate information to permit vessels to navigate safely.

Aids to navigation assist navigators in making landfalls, mark isolated dangers, make it possible for vessels to follow natural and improved channels, and provide a continuous system of charted marks for coastal piloting.

Aids to navigation occur in a variety of forms, designed to serve generalized navigational requirements and environmental conditions. Buoys vary from small unlighted types to the larger lighted types to large navigation buoys (LNB), which are equipped with high-intensity lights, horns, radiobeacons, and racons. Beacons (fixed structures) include offshore towers, lighthouses, harbor entrance lights, minor lights, ranges, and day beacons.

The operation and maintenance of marine aids to navigation has been a function of the U.S. Coast Guard since 1939, when the U.S. Lighthouse Service was merged into the Coast Guard. At that time, the aids-to-navigation system consisted of about 39,000 aids. Today, that number is nearly 48,000.

In addition to audiovisual aids, the Coast Guard is authorized to operate electronic (radio) aids. The first radio aids were radiobeacons intended to provide a position-fixing capability offshore. The radiobeacon network has been expanded and modernized to provide for mariners a simple, convenient, and low-cost supplementary system for coastal and harbor-approach navigation.

The primary coastal radionavigation system is Loran (Long Range Navigation). Loran-A was first developed to serve military purposes

during World War II. Following the war, it was expanded for civil maritime and aviation use in U.S coastal waters. The successor to Loran-A, Loran-C, also was developed to serve military needs, but because of its higher accuracy and longer range, it was chosen in 1974 to replace Loran-A as the government-provided, radionavigation system for the U.S. coastal zone and the Great Lakes. The new systems was completed this year when the Great Lakes chain commenced operation. It provides fix accuracies of 1/4 nautical mile or better in most of the coastal waters of the 48 contiguous states and Alaska south of the Bering Strait.

Marine Information

Coast Guard Notices to Mariners

Purpose: To inform the mariner community of:

1. The status of the aids-to-navigation system
 - a. Signal faults and other deficiencies
 - b. Alterations
2. Navigational-safety matters
3. Corrections to certain marine publications

Local Notice to Mariners

Announces:

1. Aid deficiencies which have not been corrected
2. Planned alteration of aid system; solicits user comment
3. Navigational-safety information
4. Changes to charts, light lists, and coast pilots

Distributed free of charge to any person or organization who applies for inclusion on the mailing list of a local Coast Guard District office

Broadcast Notice to Mariners

Periodic radio announcements of aids to navigation and other navigational-safety information which should be distributed to users without delay

Channel Reports

1. Contain channel conditions and sailing instructions for various sections of
 - a. Mississippi River below St. Louis
 - b. Missouri River
2. Prepared by Coast Guard aids-to-navigation units at the conclusion of each tender patrol
 - a. Mississippi River channel reports are transmitted by the units to the District Office and Group Office, Lower Mississippi River, for distribution
 - b. Missouri River Channel reports are distributed by the preparing tenders

Mississippi River Report

1. Describes significant navigation conditions on the river between Baton Rouge and Lock and Dam 26, plus high-interest matters that may occur on other rivers in the system. Is not a substitute for Broadcast and Local Notice to Mariners.
2. Prepared jointly by the Coast Guard and the Corps of Engineers
3. Report transmitted on daily basis (except Saturday, Sunday and holiday), whenever navigation conditions require (has been limited so far to winter-ice navigation), to a list of paying subscribers via Western Union TWX.

Marine information published by other agencies

Notice to Mariners

1. Scope: Worldwide, high seas, and coastal approach
2. Content:
 - a. Hydrographic information
 - b. Channel and aids-to-navigation changes
 - c. Information on safety of navigation

3. Published weekly by Defense Mapping Agency Hydrographic Typographic Center in cooperation with the Coast Guard and the National Ocean Survey

Arkansas River Channel Report

1. Prepared by Corps of Engineers from Corps and Coast Guard channel information
2. Distributed by Corps in two forms.
 - a. For flows less than 70,000 cubic feet per second, distributed by Corps channel-survey boats
 - b. For flows greater than 70,000 cubic feet per second, distributed by Corps lockmasters

Ohio River Division Information on Navigation Conditions

1. Developed by Corps of Engineers to provide real-time navigation information during heavy ice conditions in 1978 and 1979. Expanded to a year-around report servicing more than 30 subscribers by way of Western Union TWX

INITIAL AND MAINTENANCE DREDGING

William R. Murden, Jr.
Chief, Dredging Division
Water Resources Support Center
U.S. Army Corps of Engineers

Introduction

The dredging mission of the U.S. Army Corps of Engineers plays a vital role in maintaining the navigation system of the nation's waterways. The purpose of this paper is to provide an insight into the changing conditions that affect our ability to conduct our dredging mission and their relationships to navigation aids and the reduction of tankbarge pollution.

The paper describes the dredging mission of the Corps of Engineers to construct and maintain adequate dimensions in navigation projects to accommodate maritime traffic and the scope of the national dredging program required to accomplish this mission. In this connection, a decline in the workload of dredging-yardage levels during the period 1963 through 1979 and the adverse effects of this decline on the dredging industry are discussed.

The paper outlines the Industry Capability Program, which we initiated in December 1976. This program, which provides an opportunity for industry dredges to compete with Corps dredges, was implemented to encourage the industry to make the large capital outlays required to construct new dredges.

In addition, the legislative background and major provisions of Public Law 95-269 are presented. This law, which was enacted by the Congress in 1978, provides the guidance for the overall management of our dredging program. The paper includes the factors considered in the preparation of the "minimum-fleet" study.

Dredging procedures and navigation procedures which relate to improved and safer usage of the waterways are also discussed.

Navigation Mission

In 1824 Congress assigned the U.S. Army Corps of Engineers the responsibility for improving and maintaining the navigation channels of the nation's ports, harbors, and inland waterways. Since that time,

the Corps of Engineers has taken part in the construction, maintenance, and improvement of more than 25,000 miles of navigable waterways.

These waterways serve 130 of the nation's 150 largest cities and are utilized to transport one fourth of the nation's ton-miles of domestic cargo. Thus, they are essential to the economic well-being of the nation. Nearly 60 percent of our waterborne commerce is composed of energy products. Therefore, the waterways are also vital to our ability to meet the energy needs of the country.

There are 107 commercial ports and 416 small-boat harbors that include federally authorized channels. The ports and harbor of the nation handle nearly 2 billion tons of cargo annually and serve more than 7 million recreation craft.

The maintenance and improvement of the waterways to make them suitable for waterborne commerce is one of the major responsibilities of the Civil Works program of the Corps of Engineers. During the past three years an annual average of 286.7 million cubic yards of material were dredged at an average annual cost of about \$289.3 million. The major part of the annual dredging work (about 95 percent) is accomplished using Corps and industry cutterhead, dustpan, and seagoing hopper dredges. The remaining 5 percent of the annual dredging work load is accomplished through the use of bucket, dipper, and sidecasting dredges. In the case of the lower and mid sections of the Mississippi River and tributaries the work is performed primarily with the hydraulic-dustpan type of equipment since these dredges were designed especially to operate under conditions unique to these waterways.

The Corps of Engineers accomplishes the majority of the annual work load by utilizing industry equipment under competitive-bidding procedures and performs the remaining work (about 32 percent on a yardage basis and about 29 percent on an expenditure basis) with Corps-owned dredges. In 1979, the Corps operated a fleet of 36 dredges which removed 90 million cubic yards of material at a cost of \$95 million. During 1979 the industry owned 481 dredges and removed 192 million cubic yards of material at a cost of \$229 million.

Reduced Scope of the Annual Dredging Program

Since World War II there have been few instances in which the channels of the ports and inland waterways of the country have been widened and deepened to any significant extent. While there have been many deep-draft channels and harbors constructed for supertankers and large bulk-cargo ships in many parts of the world, there have been no such facilities constructed in the United States since World War II. Thus, the dredging industry of the United States has not had an opportunity to engage in large and lucrative port-construction operations such as those which have occurred at Rotterdam, The

Netherlands; Zeebrugge, Belgium; Dunkirk, Le Havre, and Gulf de Fos, France; and Botany Bay, Australia.

Because of the decline in the scope of the annual work load since World War II, the financial condition of many U.S. dredging firms has deteriorated significantly. A review of the annual yardage and expenditures indicates the magnitude of the downward trend in the dredging program.

Annual Improvement Yardage and Expenditures

During the period 1963 through 1979, industry dredges have performed, on an average, 87 percent of all the improvement or new-work dredging, and in 1979 the industry performed 94 percent of the improvement dredging.

The total annual improvement-dredging yardage decreased significantly, from 263 million cubic yards in 1963 to only 48 million cubic yards in 1979. This dramatic reduction in the improvement work load constituted the bulk of the overall decrease in the total dredging program for this period.

Annual expenditures for improvement dredging decreased from \$107 million in 1963 to \$83 million in 1979.

The unit cost for improvement dredging, which is probably the best factor to consider in evaluating cost trends over extended periods, was \$0.41/cubic yard in 1963 and \$1.78/cubic yard in 1979. Using 1963 as a base, the average annual escalation from 1963 through 1979 was 9.4 percent.

Annual Maintenance Yardage and Expenditures

During the period 1963 through 1979, the annual maintenance-dredging yardage experienced some upward trends with several significant peaks. However, the net result was a slight increase of 8 percent when comparing the 1963 maintenance-dredging work load of 217 million cubic yards to the 234 million cubic yards removed in 1979. During this period the industry performed 48 percent of the total maintenance yardage, and in 1979 the industry performed 63 percent of the total maintenance work load. Maintenance-dredging expenditures increased to \$241 million in 1979 from \$59 million in 1963.

The unit cost for maintenance dredging was \$0.272 in 1963 and \$1.03 in 1979, reflecting an average annual escalation of 8.6 percent.

Total Annual Yardage and Expenditures

The total annual work load decreased dramatically, from 480 million cubic yards in 1963 to 282 million cubic yards in 1979. Most of this decrease occurred from 1963 to 1967, and with the exception of some periodic peaks there was a continuing downward trend to the current level. Expenditures dipped from \$166 million in 1963 to \$110 million in 1967 and then climbed to a total of \$324 million in 1979, reflecting an average annual escalation rate of 7.7 percent.

Corps/Industry Distribution of the Annual Yardage and Expenditures

The Corps of Engineers has performed the majority of the total annual dredging work load with industry equipment for many years. The Corps/industry percentage distribution of the total annual work load yardage during the period 1963 through 1979 was 41/59 percent, even though the industry did not have any dustpan dredges during this period and only entered the hopper-dredge field in 1977. During this period, the Corps/industry percentage distribution of the total annual expenditures was 34/66 percent. Thus, on an outlay basis, the percentage distribution of the expenditures for 1963-1979 has been within the 25-35 percent Corps and 65-75 percent industry range cited in a recent management/consulting firm report as the optimum allocation of the dredging program between the Corps and the industry.

Effect of Workload Reduction in the Industry

In the perspective of a significant decrease in work load and the relative constancy of unit cost from 1963 through 1979, it is not surprising that the industry was reluctant to invest in new equipment or major improvements to existing equipment without some encouragement from the Corps of Engineers and the Congress, even though the industry performed the majority of the total declining work load. The Corps provided an incentive to the industry through the Industry Capability Program, initiated in December 1976, and the Congress provided further incentive in the passage of Public Law 95-269 in 1978.

Industry Capability Program

Based on information contained in a study of the national dredging program, the Chief of Engineers concluded that there was a need for a comprehensive program to determine the capability of the industry to accomplish a larger portion of the total dredging work load. A program to meet this objective was initiated on December 13, 1976, with the issuance of Corps of Engineers Circular EC 1125-2-358. This program, known as the Industry Capability Program, was initiated to accumulate detailed operational and cost information to reflect the efficiency of existing Corps dredges relative to the performance of industry dredges.

Opportunity for Industry to Compete with Corps Dredges

The Industry Capability Program provides an opportunity for the industry to bid competitively with all types of Corps of Engineers dredges over a broad spectrum of dredging work. Included in this competitive-bidding program are the types of projects traditionally accomplished with specialized Corps plant such as dustpan, hopper, and sidecasting dredges. The statistical data developed by this program will be used by the Congress to determine the relative relationship of the Corps/industry roles in carrying out future federal dredging requirements. Through the Industry Capability Program and the subsequent enactment of Public Law 95-269 we are encouraging industry to construct new dredging equipment. With the construction of new equipment the industry will be better equipped to assume an expanded role in meeting the dredging requirements of the nation together with the new minimum-fleet capability of the Corps, which is described later.

The results of the Industry Capability Program to date indicate that the industry has risen to the opportunity provided by this program, with five hopper-type vessels in operation and four hopper dredges under construction. Further, the industry has constructed one dustpan dredge and has under consideration the construction of additional new dredges.

Public Law 95-269

For many years the dredging program of the Corps of Engineers was accomplished under the provisions of 33 USC 622 and 33 USC 624. These laws required that the dredging work load be performed in the most economical or advantageous manner by use of either Corps dredging plant or industry plant. Public Law 95-269, which replaced the above cited statutes, includes similar language and the following provisions.

- That a study be undertaken by the Corps of Engineers to determine the minimum federally-owned fleet required to perform emergency and national defense work. The legislation indicates that the study is to be submitted to the Congress within two years after the enactment of Public Law 95-269, on April 26, 1978.
- That no dredging work shall be done by private contract if federally-owned plant is reasonably available to perform the work and the contract price is more than 25 percent in excess of the estimated comparable cost of doing the work with Corps plant.
- That when Corps plant is not reasonably available, no dredging work shall be done by private contract if the contract price is more than 25 percent in excess of the fair and reasonable cost of a well-equipped contractor doing the work.

- That the Corps shall retain a technologically modern minimum fleet of dredges to carry out emergency and national-defense work and that this fleet shall be kept in a fully operational status.
- That the Corps will retire its existing dredges in an orderly manner as the industry demonstrates an ability to perform an increased share of the annual work load in a timely manner and at reasonable cost.
- That the Corps may retain as much of the existing federally-owned fleet as long as necessary to assure the capability of the Corps and industry to carry out the national dredging program.

Public Law 95-269, along with the Industry Capability Program, has encouraged the industry to construct a significant number of new dredges. Further, we have every reason to believe that the industry will continue to construct additional new equipment. During the recent past we have retired several of the older Corps dredges, based on the progress which industry has made. As the dredging industry continues to demonstrate an increased ability to undertake an increased level of the dredging work load at reasonable cost and in a timely manner, the Corps will continue to decrease its dredging capability. This reduction will continue until the Corps' dredging fleet has been reduced to the "minimum fleet" of technologically modern dredges, sufficient in number, size, and type to respond adequately to the emergency and national-defense requirements of the nation as provided for in Public Law 95-269.

Minimum-Fleet Study

The improvement and maintenance of the nation's waterways through dredging involves many considerations. Dredging, like many other marine operations, is not understood very well by the public. This is understandable because marine operations are usually inaccessible to the public and often are conducted in areas either far from the shoreline or in entrance channels beyond the horizon. The factors considered in the preparation of the minimum-fleet study mandated by Public Law 95-269 reflect the many variables involved in most dredging projects. A summary of these factors is as follows:

- The geographical distribution of navigation projects in the United States and overseas deployment areas related to national defense.
- Project dimensions and operational conditions as related to the sizes and types of dredges needed.
- The frequency of the dredging cycle required at each project, i.e., biannual, annual, or multiyear cycles.

- The level of maintenance required on each of the projects. In those cases where the level of maintenance is minimal -- i.e., when the depth provided is only marginally greater than the depth required for marine traffic -- it is often necessary to dredge the channel more than once each year.

- Projects which have a rapid and extreme shoaling rate. In the lower Mississippi River and other major delta regions, it is not unusual for the shoaling rate during the runoff season to reduce the flotation depths by several feet in a matter of a few days.

- The haul distances from the navigation projects to the disposal areas. During the past 10 years there has been a significant increase in the distances from the dredging areas to the disposal areas. This increase is due primarily to environmental considerations.

- The dredging depths and the types of materials at the various projects.

- The requirements for direct pumpout operations. In certain situations it is necessary that the material excavated by dredges be unloaded into diked disposal areas. This type of operation is known as the direct pumpout dredging mode and results in a large increase in the dredge production time required. There has been a great increase in the use of the direct pumpout mode in the past 20 years because of environmental considerations and beach nourishment requirements. It is expected there will be a further increase.

- Limitations in the periods when dredging operations can be conducted. There are two factors which lead to this situation. First, there are areas in which dredging operations can be conducted only during given months because of environmental considerations such as the spawning seasons for marine species. Secondly, there are areas in which the wave conditions are so severe that dredging operations cannot be conducted during certain months of the year.

- The transit time required to move from one location to another. The distances in each of the three coastal regions and the Great Lakes are in the range of 1,000 to 1,500 miles. Therefore, the frequency of the dredging cycles and the coastal distances involved result in extended transit periods.

- The effective time rate of the dredges. Effective time is that spent during the actual dredging operations, including the pumping, loading, hauling, and disposal cycles. Therefore, the lesser the number of dredges available, the greater the percentage of time that must be spent in traveling between project locations and the greater the nonproductive time.

- The collision and sinking of hopper dredges. The Corps of Engineers' records indicate that a hopper dredge is lost through sinking once every 10 years. In addition, the number of collisions with other ships and groundings is in the range of two to three per year, on the average. In most cases the damages sustained are not major. However, lost time for repairs occurs in each case.

- A proposed minimum net bottom clearance. On May 6, 1976, the Coast Guard published in the Federal Register a proposed policy that there be a stated minimum net clearance between the hulls of vessels and the bottoms of the waterways. If a policy for a minimum net bottom clearance is implemented by the Coast Guard it could result in a significant increase in the total annual dredging work load.

- An increasing trend in the usage of hopper dredges on beach-nourishment and hurricane-protection projects. Since 1966 there has been a continuing increase in the use of hopper dredges on these types of projects. This trend is expected to increase in the future because of the need to obtain the materials for beach-nourishment and hurricane-protection projects from borrow areas in the offshore zone rather than from sources within the estuaries.

- The Federal Water Pollution Control Act (P.L. 92-500, 18 Oct. 1972), known as the Clean Water Act, and the Marine Protection, Research and Sanctuaries Act (P.L. 92-532, 23 Oct. 1972), known as the Ocean Dumping Act, in recent years have caused an increase in the dredge-production time required on navigation projects. Under the provisions of these laws, dredged materials are now classified as polluted or unpolluted by the Environmental Protection Agency. These laws have caused the dredge-production time at the various projects to increase because of two factors. First, it is necessary in most cases to haul or pump the dredged materials a greater distance to open-water disposal sites than in the past. Secondly, the requirement in some cases to place the dredged materials in diked disposal areas increases the normal cycle time by a factor of two to four.

Dredging Procedures/Techniques Which Relate to Improved Safety and Efficiency of the Waterways

The depths and widths of channels and the types of ships that use them are directly related. As the size of the ship hull, or ships' hulls in the case of passing vessels, approximates the limiting dimensions of the channel prism there are two consequences. First, the speed of the vessel in the limited flotation and surrounding depths available is reduced significantly from the speed that can be achieved when adequate dimensions are available. In this case the efficiency of transporting cargoes is impaired. In addition, the lower speed that can be attained reduces the maneuverability of the vessel when quick response is necessary under emergency conditions. In the latter case,

safety is a distinct consideration because the ability to take evasive action is impaired. Secondly, limited flotation and surrounding depths available can affect the directional stability of the vessel without regard to speed. In this case, the limited volume of water around and under the hull can result in the vessel's veering suddenly off course, which can result in collisions or groundings. Thus, dredging to provide adequate water volume has a direct relationship to the efficiency and safety of maritime traffic.

There are several areas in the dredging operations which tend to minimize these effects.

Advance Maintenance Dredging

Let's take an example. Assume that the project is dredged to the required or authorize depth with a tolerance factor of an additional 2 ft. of depth. If the shoaling rate of the hypothetical navigation project is rapid, and the length of the project is significant, which is often the case, the dredging operation is barely completed before the required or authorized depth is no longer available. In order to avoid this situation, the tolerance factor is increased, which allows the use of the waterway for longer periods and contributes to the improved efficiency and safety of the using traffic. For the most part, maritime companies and ports seldom report the types of problems discussed above. In the absence of justification from the maritime industry we continue to provide these depths which have been traditionally approved in our annual programs.

Increased Frequency of Dredging Operations

Adequate channel-prism dimensions can also be provided by increasing the frequency of the dredging cycle. In most cases, dredging is performed on an annual or longer basis. This again is based on historical experience. As the sizes of ships, tugs, barges, and other vessels have increased since World War II, the flotation and surrounding depths have been reduced. In those projects in which advance maintenance dredging is not practical, the project can be dredged on a more frequent basis, which provides the necessary channel dimensions to assure more efficient and safer usage of the waterways. However, if the maritime-traffic users do not advise us of this type of problem, we cannot recommend changes in our dredging procedures.

Channel Design

As we all know, the alignment tangents and training structures which were suitable for maritime traffic at the time the project was authorized and for many years afterward may not be entirely suitable for the larger vessels using the waterways today. We have taken action

in many cases to widen or construct flairs at acute turns in channel alignments. In other cases, we have widened or extended jetty structures to improve the safety of navigation. However, there may be other channels with this type of problem that we have not identified because of a lack of knowledge that difficulties are being encountered.

Improved Project Monitoring

Improvements in monitoring the controlling dimensions of the waterways can also contribute to the efficiency and safety of navigation channels. Some of the efforts which we have under way are discussed below:

- Hydrographic Surveying

We have made significant improvement in our hydrographic surveying techniques in recent years. New electronic horizontal-positioning equipment provides for precise and rapid position determination of the survey boat from which soundings are being recorded. Under test and development are ship-motion measuring and recording instruments that will help in providing more precise hydrographic survey measurements. Today, most of our hydrographic survey boats are equipped with data-processing and plotting equipment capable of providing a complete hydrographic survey chart of a navigation channel on board the vessel in a fraction of the time previously required. Further, in many cases the data from our survey boats is transmitted electronically to our district offices where data-processing and plotting equipment is used to produce a finished channel survey as an overlay on enlarged aerial photographs displaying important topographical features in the vicinity of a given section of a navigation channel.

- High Speed Survey Boat

In order to obtain the precise type of data needed to pay contractors for the removal of material from channels, our hydrographic surveys are normally performed at boat speeds of 8 to 10 mph. We have recently acquired a prototype 48-ft. catamaran surfact-effect survey boat that we hope will permit us to make reconnaissance surveys at speeds in excess of 20 mph. This vessel has conventional marine propulsion and rides on an air cushion to minimize hull resistance. It can cruise at 30 mph using about 20 percent less fuel than a conventional vessel of the same size. We often refer to this vessel as the captured-air-bubble boat. We have named it the "Bubble Dancer," but decided instead to honor Mr. Rodolf, who contributed significantly to the advancement of hydrographic surveying technology in the Pacific Northwest area. With the Rodolf, we believe we can double the number of line miles of surveying per year as compared to the productivity of existing vessels of the same size. This vessel will be outfitted with modern electronic equipment to facilitate rapid data acquisition and processing of charts on the survey boat.

- Laser Hydrography

Our quest to improve hydrographic surveying to provide even faster response, especially in the area of reconnaissance surveying, continues. In cooperation with the National Aeronautics and Space Administration, we plan to conduct a test and evaluation of the feasibility of using laser hydrographs to make reconnaissance surveys of navigable waterways. By using a laser mounted in an airplane, the channel depths will be measured, using laser-light speeds instead of the speed of sound. This operation is in the test and evaluation stage so we are not certain of the results, but just think of the potential for improved channel monitoring if we could accomplish reconnaissance surveys from the air at 150 to 200 mph. High-speed survey boats such as the Rodolf could then move quickly to potentially troublesome shoal areas to conduct efficiently the detailed surveys required for dredging operations. The availability of such information to the operators of ships and barge tows would permit more efficient and safer navigation.

- Passive Reflector Positioning System

To further improve our surveying and dredging techniques, we are testing a passive-reflector positioning system. Unlike other positioning systems, this system does not use active transponders. Instead, small microwave reflectors are mounted along the waterway at known locations. A regular ship's radar, together with a data-processing unit, uses the intense return signal from the shore-mounted microwave reflectors to determine the vessel's position. The fascinating advantage of this system is that a relatively inexpensive microwave reflector can be left in position for use by any other vessel, with little concern over the theft and power-logistics problems associated with systems requiring transponders. While we are investigating this system for use in support of our dredging and surveying efforts, it would appear that such a system might also have potential for us as a general navigation aid.

- Navigation Systems

Speaking of navigation systems, we are also testing a third-generation doppler navigation system for use as a positioning system to support our dredging and marine-plant operations. This system, connected to the ship's gyrocompass, and using sonar bottom soundings, can effectively determine vessel speed, direction of movement, and position from a given point. Our marine officers have found the system very effective in conducting dredging operations, monitoring vessel movements, and training new personnel. Again, there seems to be a potential for this system as a general navigation aid.

Conclusion

We are well aware that dredging operations are essential to efficient and safe navigation and are attempting to provide those channel alignments, depths, and widths which will optimize the usage of the waterways. We will appreciate any comments and suggestions which will assist us in performing our mission better.

NAVIGATION IMPROVEMENTS AND
POLLUTION REDUCTION

Harold D. Muth
Vice President - Government Relations
The American Waterways Operators, Inc.

The U.S. Coast Guard has contracted for a number of studies in recent years in an attempt to determine the causes of accidents to vessels and in some cases the causes of accidents to towboats and barges in particular. The studies, in some cases, covered both safety and environmental protection and provided recommendations for remedial action.

One such study (1) was performed by Automation Industries, Inc., of Silver Spring, Maryland. This study on oil pollution from tankbarges was completed in February of 1978. It concluded that the primary causes for both minor and major (oil) spills are related to personnel error. In the case of major spills (which they contended accounted for 82 percent of the volume of oil spilled in 416 incidents studied), misjudgments by barge pilots led to collisions or grounding incidents with subsequent hull damage and large oil-spill volumes. Improved personnel performance could have been effective in preventing a large number of both minor and major oil-spill incidents reviewed in this study, they said.

It would appear, then, that the Coast Guard might do well to look into ways and means of reducing accidents as one method of reducing pollution. However, the personnel errors that occur during waterborne transportation of petroleum are not completely preventable. Misjudgments stem from a wide range of circumstances, many of which are not easily foreseen.

There is not doubt in the minds of even those who are only slightly familiar with the business of going to sea that the operating environment for seafarers is often treacherous and unpredictable. The sudden formation of a deep low-pressure storm off the Carolina coasts and the swift sweeping movement of that storm toward the New England coast wreaks havoc on coastwise traffic in its path. The sudden onslaught of a line squall racing across a bay or river can drive unsuspecting vessels from the confines of a channel or harbor. Swiftly moving ice packs can likewise force vessels from their intended navigation courses. Pea-soup fog settling in on the lower Mississippi passes will cause pilots and ship masters to have a queasy sensation in the pits of their stomachs. Yet the maritime community cannot be

expected to "close shop" because of periodic accidents resulting from natural causes. Business must go on, customers must be served, and transportation of vital commodities must not be interrupted.

Recognizing that there is an ever-present element of risk in all forms of waterway commerce, it behooves both the industry and the federal sector of the country to see that every ounce of prevention that can be provided through the use of the best existing available technology in channel and harbor maintenance, and in aid-to-navigation services, is provided.

While the heavy seas which threaten deep-draft vessels are not a problem to the inland navigator, he must, nevertheless, maintain a constant state of alertness and awareness of the position of his vessel and the effects that might be placed upon his vessel or tow by strong currents and eddies. Therefore, the problem of giving our mariners the best protection against groundings and collisions is equally applicable to all navigable U.S. waters.

We note that a study (2) conducted for the Coast Guard by Battelle Columbus Laboratories of Columbus, Ohio, in 1975-1976, looked into the causes of groundings and rammings (collisions) during the calendar year 1973. This study, involving some 872 cases of rammings and groundings, found that the primary cause of about 36 percent of those grounding cases involved vessels that were unintentionally out of recognized channels. Also, it found that in about 16 percent of the grounding cases the initiating cause was that the vessel was simply navigated off the intended course or track line. This fact led to a conclusion that "the most promising area for reduction of grounding casualties is improved vessel navigation"

The Battelle Columbus study also found that about 22 percent of the ramming cases resulted from inadequate compensation for wind effects, current effects, and similar adverse influences on vessel navigation. Included in Battelle's recommendations for specific actions to provide corrective action were (1) the development of some improved type of vessel motion-sensing and display device that would provide measures of over-the-ground speed in three directions, fore and aft, athwartships, and swing; and (2) the consideration of entirely new methods of ship control on approaches to docks and locks. As an example, they mentioned "a funnel type lock-approach system that includes side guides that might force the alignment of incoming and outgoing traffic with the lock passage."

The report went on to state that the Coast Guard might consider the development of a significantly better method of vessel navigation as a long-range goal and observed that since about 50 percent of the groundings and 55 percent of the ramming cases involve tugs and barges, it was recommended that the initial effort on the development of an improved method of navigation be directed toward application to high-density tug and barge routes. Insofar as tankbarges are

concerned, it is interesting to note that they were involved in 17 percent of the ramming cases and 18 percent of the grounding cases. Also included in the study's recommendations was a suggestion that the new method include a sensing system other than visual sightings on markers, buoys, and lights to be more nearly independent of weather conditions.

All of the foregoing reinforces the findings of a study (3) conducted for the Coast Guard by another consultant on the problem of bridge collisions. This study, conducted by Operations Research, Inc., on river towboat collisions with bridges, was completed in November of 1976. It identified the primary cause of bridge collisions as a lack of control in high water and swift currents. Tows get "out of shape" and reach a critical angle of turn or rotation where recovery becomes impossible. The report states, "many of the bridge navigation problems could be eliminated by the design of a navigation system which specifically addresses the unique aspects of the bridge passage." Operators currently use a combination of visual aids to detect rotation or slide of a tow, some of which are of the makeshift variety.

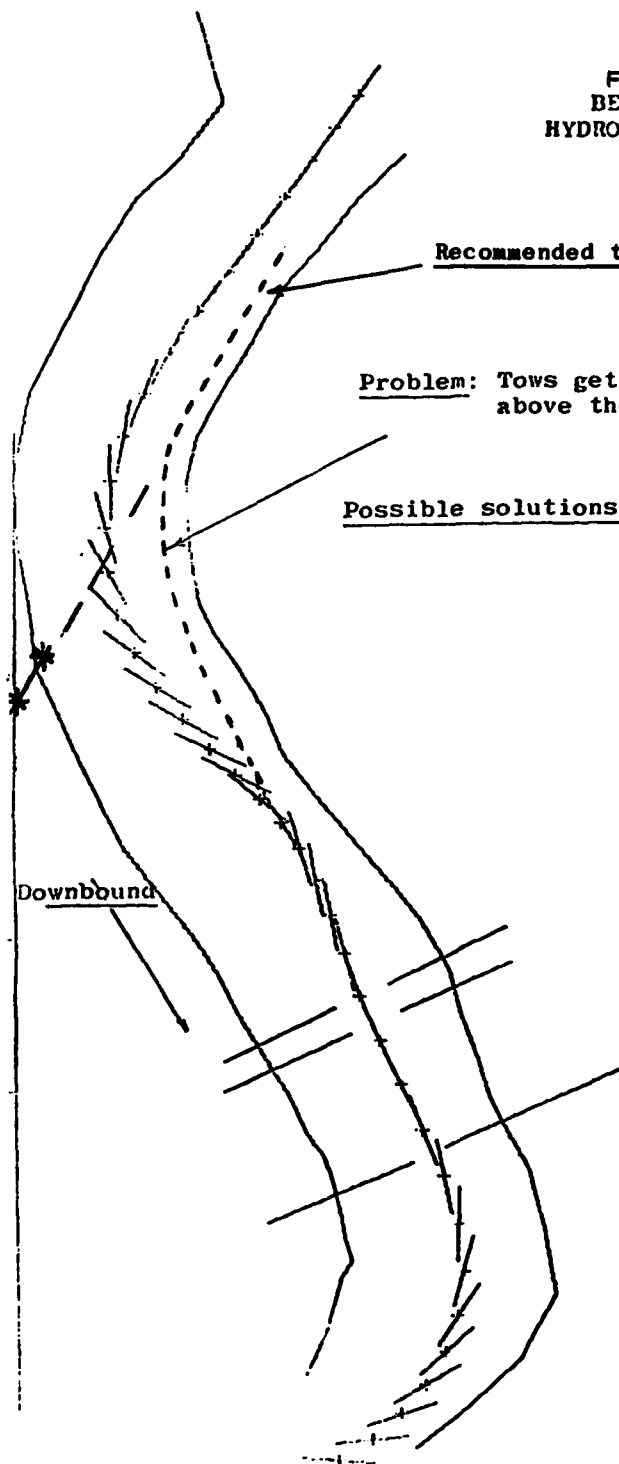
Figure 1 is a printout produced by a simulator on navigational problems encountered at the Berwick Bay bridges over the Atchafalaya River in Louisiana. Please note that the problem in navigating through these bridges develops well above the site of the bridges themselves, just as it does in the case of several other bridges that are notorious for accidents, such as the bridges at Greenville, Mississippi; Vicksburg, Mississippi; and Fort Madison, Iowa; all crossing the Mississippi River. I might point out that the alignment of the tow at the midpoint of rounding the bend (directly opposite the arrow) was very good. Its attitude was parallel to, and centered on, a course through the middle of the navigation span of the first bridge. It was at this point that rotation accelerated rapidly.

As mentioned in the Battelle Columbus study, there is a need for some methodology which would provide an early indication of slippage and swing to keep the tow from getting out of shape as it rounds the bend or approaches the bridge. Also, please note that the Operations Research study discussed the problem of tows getting out of shape and reaching a critical angle of turn or rotation. So both consultant, in effect, called for the design of a navigation system which would assist the navigator in avoiding a situation where recovery becomes impossible.

The simulator developed to model navigational problems at bridges and other critical areas within waterways is owned by the Coast Guard so we can assume that it is in the process of researching the problem.

The National Plan for Navigation of the Department of Transportation (4) makes reference to the need for investigation of the use of radio aids to navigation in the harbor and harbor entrance-area requirements. It also discusses the implementations of Vessel Traffic Services and a need for more precise buoy-positioning capability. We

FIGURE No. 1
BERWICK BAY BRIDGES
HYDRONAUTICS SIMULATOR



Recommended trackline

Problem: Tows get out of shape rounding the bend above the bridges.

Possible solutions: (1) Develop rate of turn data for various tow configurations and current flows.

(2) Install aids to navigation ranges to assist towing vessel operators.

Downbound

are also aware that the Coast Guard is currently researching and developing a more precise buoy-positioning capability.

In addressing rivers and waterways, the National Plan indicates that specific quantitative requirements for navigation on rivers and other inland waterways have not yet been developed, noting that visual and audio aids to navigation, radar, and intership communications are currently used to enable safe navigation in those areas. No change in that practice is expected in the immediate future.

Those who ply the Western Rivers in particular, I am sure, would look upon this attitude with some degree of concern. Over the past 15 to 20 years, there has been a great increase in the number of controlling works constructed in the Mississippi River system. Many of these controlling works take the form of rock dikes (a groin-like structure usually made of loose rocks extending from the riverbank into the river on a slope that places the end of the dike below the water's surface). The absence of buoys or any form of marker to locate these dike ends causes a considerable number of accidents. Over the years, attempts by the Coast Guard to develop a fast water buoy which would have the capability to maintain station off the dike ends has met with varying degrees of success, mostly on the negative side. This is just one area where improved aids to navigation would serve to prevent accidents.

A second area of concern, not only in the rivers but in the harbor areas as well, is the lack of an acceptable method of marking the center of the bridge navigation spans. Many bridge piers have been collided with during period of low visibility because of the inability of the pilot to locate them on his radar scope. We would like to see a continuing effort on the part of the Coast Guard to mark the center of the navigation spans by the use of radar transponders. Additionally, there is a constant threat to tows presented by inadequate and/or dilapidated bridge protection and fendering works. Oftentimes, barge bulls are ruptured through contact with concrete or steel protuberances, left exposed by a failure on the part of the bridge owner to effect repairs to these structures.

Radar transponders can also be used effectively to single out important navigational points such as junction buoys in coastal-confluence areas. A typical example of where this application might serve to prevent accidents and confusion is the entrance to the Virginia Capes, where the radar scope looks like a scattergram of blips. Channel markers, junction buoys, pilot vessels, naval vessels, fishing vessels, recreational craft, and commercial vessels all congregate around the entrance to Chesapeake Bay. This area, and approaches to other major seaports in the U.S., need improved aids-to-navigation services in the form of both electronic transponders and radionavigation technology.

A graphic illustration of what can be done in the way of oil-pollution prevention by enhanced aids to navigation is the upgrading of the aids in and around the approaches to Valdez, Alaska. The U.S Coast Guard, in preparation for the heavy volume of oil that would be transported by tanker from the southern terminus of the Alaskan pipeline at Valdez, made plans for a better system of aids to navigation prior to the completion of the pipeline. Existing lights were modernized by the use of more powerful lighting equipment, new navigational lights were constructed, and the overall system of aids to navigation was improved. I am sure that the enhanced system has paid off in the prevention of pollution which might have resulted from tanker groundings had no improvement taken place.

This same objective should be pursued in other major oil-port areas. We understand that there are plans by the Coast Guard to modernize and vastly improve the Delaware Bay/Delaware River system of aids to navigation which will, among other things, increase the candle power of range lights and increase the reliability of the aids. There is no doubt that this project will also prove beneficial in the prevention of oil pollution.

Speaking from a general viewpoint, it is our belief that an increase in the numbers of aids-to-navigation ranges, both in the coastal and inland river areas, would serve to prevent pollution from accidents.

We also can see a great potential in the use of electronics aids such as a "tightened up" Loran C system (similar to that which has been under trial in the St. Mary's River between Lake Superior and Lake Huron). We believe that the use of transponders within the Loran C system can be an effective tool in assisting navigators to maintain position within channels during periods of low visibility.

These, and other innovations which I am sure that the U.S. Coast Guard is working on within their research and development programs, should be looked upon as alternative methods for reducing tanker and tankbarge pollution stemming from accidents.

In summary, we believe just as many others do, that there are other measures that have a high potential for preventing accidents and reducing pollution. I have discussed the possibility of better ship or vessel navigation. Within the working group on personnel standards, training, and enforcement, I am sure that a discussion on recently improved training of personnel will be forthcoming. The Coast Guard in recent years has implemented a number of Vessel Traffic Services in harbor areas afflicted with a high accident and pollution history. The Coast Guard has also, a very short time ago, revised and strengthened its oil-pollution prevention regulations.

These alternatives, collectively, along with some degree of upgrading of the standards of tankbarge construction, most certainly should be studied and implemented, where indicated, before a single drastic action, such as the double-hull proposals, is forced upon a single sector of the waterborne industry.

Various studies of regulatory organization have been conducted for the Federal Government as far back as the Roosevelt Administration (5-7). A study on federal regulation (8), prepared by the Committee on Governmental Affairs of the United States Senate, and completed in December 1977, noted that "a common thread running through the Brownlow, Landis, and Ash studies ... is the need to impose some degree of political (i.e., Congressional and Presidential) influence on at least the policy-related activities of the regulatory bodies. It is commonly agreed that many of the tasks assigned by Congress to regulatory agencies are political in nature, involving critical choices of selecting among conflicting interests. Agencies must often decide which economic and social goals to pursue and at what economic and social costs. These are unquestionably political decisions."

The American Waterways Operators, Inc., feels that the severe economic impact, well in excess of \$2 billion over the next 40 years, which would result from the double-hull proposals, and the varying impact of this huge cost on companies of different sizes, is, indeed, an economic and social consideration to be taken into account by the U.S. Coast Guard as the rulemaking agency, and that the narrow remedial approach embodied in the double-hull standards should give way to a much broader outlook.

References

1. Tank Barge Oil Pollution Study, Automation Industries, Inc., dated February 1978, page v.
2. Final Report on Analysis of Ramming and Grounding Accidents Not Involving Bridges, Battelle Columbus Laboratories, Columbus, Ohio, dated March 1976.
3. Analysis of Bridge Collision Incidents, Volume II, Operations Research, Inc., 1400 Spring Street, Silver Spring, Maryland 20910, dated December, 1976.
4. Department of Transportation National Plan for Navigation, dated November 1977.
5. U.S. President's Committee on Administrative Management. Report with Special Studies. Washington, U.S. Govt. Print. Off., 1937. (Brownlee Report)
6. U.S. President's Advisory Council on Executive Organization. A New Regulatory Framework. Report on Selected Independent Regulatory Agencies. Washington, U.S. Govt. Print. Off., 1971. (Ash Council Study)
7. Landis, James M., Report on Regulatory Agencies to the President-Elect. Washington, 1960. Also, published as a Committee print by the Senate Judiciary Committee, 86th Congress, 2d Sess., Dec. 1960. (Landis Report)
8. Study on Federal Regulation, prepared pursuant to S. Res. 71, to authorize a study of the purpose and current effectiveness of certain federal agencies. Committee on Governmental Affairs, United States Senate, Volume V, Regulatory Organization, December 1977.

GROUP V
INSURANCE, LIABILITY, AND PENALTIES

INSURANCE, LIABILITY, AND PENALTIES

Lester C. Bedient
Senior Vice President
Crowley Maritime Corporation

As this paper is on the subject of insurance, liability, and penalties, I would like to begin with a short story which I will title, Who needs an oil spill?

In April 1978, a tankerman employed by one of our companies fell asleep while loading a barge. He had not worked a long shift, and prior to loading the barge, if he had felt in need of relief, he could have called the dispatcher and relief man would have been furnished.

At the time the tankerman fell asleep, he was aboard one of our tankbarges which was in the course of loading operations at an oil terminal. Since the tankerman was asleep at his post, he could not alert the oil terminal that the barge tanks were full. The tanks overflowed, filling the deck containment system, and the tankerman eventually awakened when heated oil in the deck containment system overflowed the tops of his shoes. By that time, however, between 40 and 164 barrels of oil had spilled into the water at night.

The tankerman immediately notified the shore to shut down the loading operations. Thereafter, he notified our company dispatcher of the oil spill. The company dispatcher, in turn, notified the Coast Guard that the oil spill had occurred. This notice to the Coast Guard satisfied the requirement of the Federal Water Pollution Control Act that the Coast Guard be given notice of any discharge of oil into U.S. navigable waters. Failure to do so subjects the violator to a fine up to \$10,000 and/or imprisonment for up to one year.

Our company dispatcher then notified a cleanup company to attend at the barge loading dock for the purpose of cleaning up this oil spill. The cleanup contractor arrived at the site of the oil spill within one hour after receiving notice from the company dispatcher. The Coast Guard dispatched an on-scene coordinator to the spill site, and the State of California sent representatives from its Department of Fish and Game and Regional Water Quality Control Board.

Since the water area was subject to strong tidal action, the oil spread from the immediate vicinity of the loading dock into small inlets and marsh areas located along the waterway. Oil also entered the city marina, fouling private boats and marine Styrofoam floats.

Our company was responsible for the cost of cleaning up this oil spill by reason of the liability imposed by the Federal Water

Pollution Control Act and the California Fish and Game Code. At the present time, the Federal Water Pollution Control Act states that the owner or operator of any vessel from which oil or hazardous substance is discharged is liable to the United States for cost of removal and mitigation, except where the discharge is caused solely by an act of God, act of war, negligence of the United States, or act or omission of a third party. This liability to the United States for cleanup costs is subject to a limit of the greater of \$125 per gross ton or \$125,000 for an inland oil barge and \$150 per gross ton for other vessels up to a maximum of \$250,000 for a vessel carrying oil or hazardous substances as cargo. If the owner of the vessel is guilty of willful negligence or willful misconduct, the foregoing limits of liability do not apply. The California Fish and Game Code contains no limits on the liability of a polluter for the costs of cleanup of oil spills.

The cleanup of oil from the water took a number of weeks and eventually cost approximately \$350,000. Since our company hired the cleanup contractor directly, this cost was payable by our company directly to the contractor.

We treated the fouling of private boats at the marina in a different manner. In order to avoid fraudulent claims, we hired a photographer who took pictures the following morning of more than 100 vessels in the marina in order to establish the extent of damage. In addition, we employed a marine surveyor who made himself available at the marina to settle claims with the private boat owners. Arrangements were made through a private contractor for boats to be cleaned and, in some cases, settlements were agreed on for those owners who desired to clean their own boats. Our final cost for cleaning these private boats was approximately \$100,000.

Our liability to the private boat owners was determined pursuant to existing common law which applies a negligence standard. Since it seemed apparent that our tankerman had been negligent in falling asleep, we undertook to clean these boats of private owners in order to minimize the amount of claims which might be submitted if they had each hired an individual contractors.

As the cleanup crews tracked oil into the local restaurant, we had to replace its carpets at the conclusion of the job.

In addition to the foregoing costs of cleanup which we incurred, our company suffered the usual adverse publicity which is attendant on an oil spill. Local television stations and newspapers carried extensive coverage of the oil spill and the damage which resulted. Our cleanup efforts, especially the manner in which we handled the claims of the private boat owners, were subject to scrutiny by the news media at each step.

After the cleanup operations had been completed, we received notification from the Coast Guard that they were assessing a civil penalty against us. Under the Federal Water Pollution Control Act, the Coast Guard is authorized to assess a penalty of up to \$5,000 per offense. In lieu thereof, the United States can institute a civil action to recover the penalty up to \$50,000 per offense, unless the owner or operator is guilty of willful negligence or willful misconduct in which case the penalty shall not exceed \$250,000. In our case, the Coast Guard retained jurisdiction of the civil-penalty phase of this oil spill.

After receipt of the initial notification, we requested and were granted a hearing to dispute the amount of the civil penalty. Our arguments for a lesser penalty were successful, and the civil penalty was adjusted to an amount which we believed was reasonable. If we had been unable to succeed on this level, our final source of appeal would have been the Commandant.

At the same time we were dealing with the Coast Guard regarding the assessment of a civil penalty under the Federal Water Pollution Control Act, the State of California proceeded against us on two fronts. First, the California Department of Fish and Game filed a criminal action in the Municipal Court. If found guilty, the California Fish and Game Code provides that a polluter can be assessed a criminal penalty of up to \$1,000 and/or imprisonment for up to one year. Eventually, our attorneys entered into a plea-bargaining arrangement with the local District Attorney's office, and we were able to settle this case for an acceptable fine.

In addition to the criminal action instituted by the California Fish and Game Department, the California Regional Water Quality Control Board initiated public hearings pursuant to the California Water Code to determine whether our case should be forwarded to the California Attorney General for collection of various penalties under the Water Code and Harbors and Navigation Code. One of the purposes of the public hearings is to make the news media aware of the results of the investigation by state officials. Thus, once again, a polluter is faced with the problem of adverse publicity.

In our experience, the staff officials of the State of California do not institute such a hearing unless they have a strong case for forwarding to the California Attorney General. After this public hearing, the local Board of the Regional Water Quality Control Board voted to forward this case to the California Attorney General.

The California Attorney General instituted a civil action in the Superior Court against our company to recover various civil penalties and the cost of cleanup expended by state officials. Since the state statutes are based on a strict liability scheme, our attorneys advised us that litigation would be fruitless, and we instructed them to seek settlement of the action. After a short period of time, an amicable

settlement of this action was achieved between the California Attorney General's office and our company.

The foregoing example is based on an actual incident which my company has experienced and is indicative of what goes on with an oil spill. It illustrates the range of possible damages and penalties with which a polluter is faced. In summary, these include the costs of cleanup; third party liabilities such as fouled boats and damage to marinas; state criminal penalties; and federal and state civil penalties. Also involved in most oil spills is adverse publicity, which we believe is a strong impetus to any company such as ours to avoid the occurrence of any pollution accidents.

What Are the Incentives and Disincentives of Insurance?

Obviously, there is an incentive to purchase insurance because of large financial obligations involved with respect to a cleanup, fines and penalties, and other legal liabilities resulting from an oil spill.

In 1970, the Federal Water Pollution Control Act became law with amendments in 1972 and further amendments by the Clean Water Act of 1977. This legislation requires that the owner of tankbarges file with the Federal Maritime Commission a certificate of financial responsibility for each tankbarge he owns to the extent of his liability under the Act for the cleanup of oil spills.

In the state of California, which is one of the areas where we operate tankbarges, we have additional laws that impose penalties over and above those imposed by federal regulations. These are the California Water Code, the California Fish and Game Code, the Harbor and Navigation Code, the California Health and Safety Code, and finally the California Penal Code. All of these I will elaborate on in the sections on penalties.

What Effect Does the Insurance-Rating System Have on Pollution Reduction?

When pollution insurance was first required by the Federal Water Pollution Control Act, there was no experience rating and, therefore, the operators could buy insurance at a base rate that was generally the same for everyone. Now, after several years of experience, the insurance underwriters have accumulated a statistical history. They are now rating pollution insurance on the same basis as the traditional hull and marine policies. In other words, he who spills the most oil, pays the most for his insurance. If a tankbarge operator persists in running a sloppy operation, he may find that he cannot buy insurance at a price that will allow him to stay in business. The only conclusion that one can draw is that the insurance-rating system has the effect of reducing pollution.

Do Current Penalties Work and Who Should Pay Them?

There is no doubt that penalties are a deterrent to oil spills, the same as fines or loss of a driver's license are incentives to most individuals who drive automobiles to drive safely and adhere to the rules and regulations of the state that they are in. I use the reference to driving an automobile for only one purpose, that being to examine how penalties are applied. In driving an automobile, the driver will be responsible for his actions regardless of fault (e.g., running a red light). In the case of the tankbarge owner, he is responsible for the fines and cost of cleaning up regardless of fault and even though the spill was caused by his employee.

When a pollution incident happens and the U.S. Coast Guard investigates the matter, the tankbarge owner pays a fine after he has already cleaned up the pollution. The regulations state that the amount of the fine can be based on the ability of the spiller to pay. Depending on the U.S. Coast Guard's mood, the more substantial operators are assessed fines up to the maximum of \$5,000, even though it is proven that the fault lay with personnel on the barge that were proven negligent. The personnel, generally the tankerman, may receive a warning or, if proven negligent on several spills, he may have his certificate suspended for some period of time--30, 60, or 90 days or more. There is no monetary loss to the individual, as he generally goes to work in some other capacity in the industry until his suspension period is over.

In my opinion, if the person in charge of the oil-transfer operation, where the majority of tankbarge spills occur, had a responsibility for monetary penalties as well as the tankbarge owner, you would see a major reduction in the smaller spills, as the personnel would be more diligent in their duties.

It seems to be the attitude of some federal and state legislators that the operators of tankbarges are all people who wear oil-soaked black hats and are not concerned with a clean environment. I believe our record will show that is not true and that we have made tremendous progress in cleaning up our operations with tankerman training and good supervision. We are concerned and want a clean environment, but larger penalties and more regulations are not going to accomplish the job. The industry can be legislated and penalized to the point that it is no longer economically viable to transport oil, such as happened in the state of Florida when they enacted a pollution law that imposed an unlimited liability on the spiller.

In conclusion on this subject, the bottom line is that, in the end, all of these costs of fines, penalties, corporate time, legal fees, insurance, etc., become part of the cost of doing business and are reflected in the transportation rates, which are paid for by the end-user of petroleum products, electricity, and manufactured items--John Q. Public. As long as there are people involved in this

or any other operations, there are bound to be accidents, and no amount of legislation, fancy mechanical systems, laws, or penalties can produce 100 percent effectiveness.

On the topic of whether license insurance provides a disincentive for pollution reduction, I would have to say that I do not believe it does. In tankbarge operations, tankermen will buy license insurance for two purposes: first, to have legal representation before the Coast Guard in the event they are involved in an oil spill; and second, as a hedge against lost wages if their license is suspended for a period of time. I am told by the brokers of this insurance that they will pay the first claim, but if a second incident takes place, and the person's license is suspended, they consider the individual a bad risk and insurance is cancelled. At best, license insurance is only good if the tankerman does a good job, not a bad job.

In conclusion, I would put forth my thoughts on what might be done to make improvements:

- First, make the Federal Water Pollution Control Act the only vehicle for fines and cleanup in pollution incidents and eliminate the double-dipping by state bureaucracies such as happens now. The environment is not any cleaner after they have extracted their pound of flesh, and all that has occurred is that the cost of doing business has increased, resulting in more inflation.

- Second, assess some monetary penalty against the negligent employee rather than a slap on the wrist with a ho-hum. If the government's philosophy that the best way to get the tankbarge owner's attention is to levy larger and larger monetary fines, then the same philosophy should hold true for the employee who is negligent in the pursuit of his duties. A minimum monetary penalty assessed against the negligent employee would directly encourage adherence to safe operating practices.

- Third, develop better consultation of the regulators with the industry before going public with proposed rules. Regardless of the Coast Guard's opinion of its own ability to assess the tankbarge industry and its ability to hire research and development firms to provide the answers in areas where it does not have the expertise, it seems to me that the Coast Guard falls far short of really understanding the whole problem and its ramifications. The issue that brings us here today is a shining example.

The money that has been spent by industry in order to set the record straight and refute the errors presented by the Coast Guard in the proposed rulemaking, amounts to many hundreds of thousands of dollars in attorney's fees, corporate time, travel expense, meals, hotels, etc. Again, this adds to the costs of doing business and results in more inflation of the public's transportation costs.

INSURANCE, LIABILITY, AND PENALTIES

W. Kenneth Elkins
Manager, Personnel and Safety
National Marine Service, Inc.

INTRODUCTION

The viewpoints concerning the effectiveness of current regulations in the area of pollution prevention are as diverse as the various organizations, special interest groups, industries, and governmental agencies which actively participate in the promulgation of those same regulations. We at National Marine Service Incorporated have repeatedly expressed our viewpoint, which is in total opposition to the proposals published June 14, 1979, in the Federal Register, concerning the requirement for double-hull constructions of new inland and seagoing tankbarges engaged in domestic petroleum trade, and to the Proposed Rulemaking to phase out all single-hull barges more than 20 years old after January 1, 1985.

National Marine owns and operates a fleet of 143 tankbarges. Of these, 90 are double-hull chemical or petroleum barges; 29 are single-hull petroleum barges; 18 are double-hull petroleum barges; and six are independent-tank refrigerated, anhydrous-ammonia barges. National Marine also operates 23 towboats. All of this equipment operates on the Western Rivers System including the Gulf Intracoastal Waterway. We have contracted for the construction of 20 additional double-hull tankbarges to be delivered later this year. We have been in business since 1927 and in the past have also operated tankships, tankbarges, and tugboats on the Atlantic Coast and on the Great Lakes. We also operate a major inland repair shipyard. Our experience has been extensive in the cleaning, gas-freeing and repair of all types of marine equipment, including both single- and double-hull tankbarges.

We offer these facts about ourselves to illustrate that we are not newcomers to the regulated tankbarge industry and that we are not blatantly anti-double hull. Simply stated, we know the "ins and outs" of our business; we know the advantages and disadvantages of both the double-hull and single-hull tankbarge; and we are convinced that the Coast Guard's regulatory proposals for double hulls were so misguided by their own biased "studies" that they had no alternative but to arrive at the preconceived notion that somehow double-hull barges are altogether safer and "better" and less polluting.

The basic framework for effective and enforceable pollution-prevention standards already exists. However, the

promulgation of a regulation requiring all tankbarges to be of double-hull construction, on the hypothesis that a double hull is the only answer to the standards, without first conducting competent and comprehensive analyses of: (1) industrywide pollution incident experience; (2) the effectiveness of the pollution-prevention regulations and policies already in existence; (3) viable alternatives to the double-hull supposition; and (4) viable alternatives to ineffective prevention/enforcement policies, would be a gross injustice to one of the safest, most energy-efficient, cost-effective and viable of our national resources.

This paper will address the subjects of insurance, liability, and penalties. To cover these subjects, this paper is divided into the following sections:

- Role of the U.S. Coast Guard
- Oil-spill liability and insurance incentives/disincentives
- Industry and regulatory-agency personnel
- Oil-spill penalties

While it was the original intent to confine this commentary to the published working group questions, it was found that it would be at best difficult, if not impossible, to do so since many of the comments must cross invisible boundaries into the working group topics or lose some degree of importance it is felt they deserve.

Role of the U.S. Coast Guard

The U.S. Coast Guard is the principal maritime law-enforcement agency and, as such, has been involved in the enforcement of the U.S. antipollution laws and regulations since their promulgation. The Coast Guard is also charged with ascertaining the material condition and seaworthiness of the hull, machinery, and safety equipment, as may be required of all U.S. flag tankships, tankbarges, and other vessels in ocean or inland service. In this role it conducts inspections of and certifies tankbarges at two-year intervals throughout the life of the vessel, with only a slightly less complete reinspection at some point between 10 and 14 months after the vessel was certificated. In simple terms, the Coast Guard conducts comprehensive annual inspections. In addition, tankbarges are inspected on dry dock every two or three years, depending on the time spent in salt-water service. The Coast Guard also inspects these vessels whenever any repair work is performed, which frequently is in addition to the regularly scheduled inspections.

In its port-security role, the U.S. Coast Guard will routinely board these tankvessels to verify their compliance with the current

pollution-prevention regulations, to monitor loadings and discharges, and to observe tankermen or other licensed personnel in the performance of their duties.

The Coast Guard is also charged with the responsibility of ascertaining that all tankermen, or otherwise licensed personnel, have been trained, had the required experience, and have demonstrated their qualifications through Coast Guard-administered tests.

What is the purpose of this role summarization? The answers are logical:

- If there is evidence that single-hull tankbarges are permitted to undergo a greater degree of material deterioration during their 20-year presupposed lifespan, then the Coast Guard should concentrate on improving the experience and qualification levels of its marine inspectors.
- If there is no evidence that single-hull tankbarges are cited on a more frequent cycle than double hulls for material or equipment compliance with the pollution-prevention regulations, then the Coast Guard should concentrate on improving the experience and qualification levels of its port-security boarding personnel.
- If there is no evidence that the frequency of oil spills attributable to personnel error is on the decline, then the Coast Guard should concentrate on improving the experience and qualification levels of the tankermen, or otherwise licensed personnel, and that of the Coast Guard personnel who approve those levels with their own inexperience and lack of qualification.

Prior to 1970, the principal direction of the Coast Guard in the tankbarge industry was "Marine Inspection." Deficiencies were corrected with an "835," not with the "Notice of Violation" and administrative monetary penalty of today. The "Marine Inspector" was your ally, who wore white coveralls and a white hat. He was experienced and qualified. While we may not have agreed with all of his decisions then, we did respect his opinion and his judgment. He was not afraid of his Commanding Officer because quite often he was the Officer in Charge of Marine Inspection (Commanding Officer).

Prior to 1970, pollution-prevention/enforcement laws were ineffective. The main reason was that the wording of the statute called for unpopular criminal punishment of the spiller. If the U.S. Attorney chose to take the case and was successful in its prosecution, then the convicted spiller would be fined from \$500.00 to \$2,500.00 and could be sentenced for up to one year in jail, or both (PL 87-167: Oil Pollution Control Act of 1961).

Public Law 92-500 corrected this situation with the Federal Water Pollution Control Act (FWPCA) as amended in 1972 while simultaneously providing for previously unavailable funding to effect oil-spill cleanup. Under the authority of the FWPCA and the Ports and Waterways Safety Act (PL 92-340), the Coast Guard placed into effect pollution-prevention regulations which dictated the requirements for equipment, training of personnel, vessel traffic system compliance, operating procedures, and vessel-design standards. These regulations initially had a moderate degree of success, primarily as a result of the Coast Guard's efforts to educate the industry and the public, which was supplemented by the traditional "white hat" image policy. In more recent years, that role was visibly redirected to a program of pollution prevention through arbitrary and capricious regulation writing, regulation enforcement, and application of the penalty provisions.

In 1980, the principal direction of the Coast Guard in the tankbarge industry is pollution prevention through enforcement. The "Marine Inspector" became the "Pollution Investigator." The white coveralls were now a tarnished blue, and even though he still wore a white hat, his image had the tarnished appearance of a "Black Hat." For the most part he was not experienced, and his qualifications were questionable. We also question his opinion and judgment. We are convinced that he is scared to death of his Commanding Officer because he won't make a decision on his own. This workshop is a result of industry's opposition to this redirection and its concern for the Coast Guard's shift from the "White Hat" to the "Black Hat" image. We also have a genuinely realistic concern that the Coast Guard's present pollution-prevention program is not cost-effective, which requires that we ask:

- Has there been a conscientious evaluation of all alternatives?
- Is there one or more cheaper alternatives which will achieve the same, or nearly the same, results?
- Will the benefits measure up to the costs?

Oil-Spill Liability and Insurance Incentives/Disincentives

The primary objective of oil-spill legislation is pollution prevention. The second objective is to ensure that governments, businesses, and individuals recover their respective economic losses from the oil spills of others. A part of this same objective is the requirement that the damaged environment be restored, where possible.

Logically, the spiller (custodian) of the oil is liable for these potentially enormous costs. This liability alone is sufficient reason for the management of a business to seek oil-spill insurance. However, since oil-spill liabilities fall into three basic

groups--clean-up, third-party damage claims, and reclamation of environmental degradation--the risks would probably be uninsurable without some method of limiting the extent of liability. Here the FWPCA, as amended, provides an incentive for insurance by limiting the liability of vessel owners and operators for an oil-spill clean-up.

The responsible and competent management of a business includes the protection of the stockholder's investment and all capital expenditures. No responsible business takes uninsurable risks. This does not mean that the business can afford to be operated in a careless or haphazard manner because it has obtained insurance. A poor track record would eventually increase the insurance costs alone to a point where the business could no longer be competitive, and when you can't be competitive, you can't stay in business.

In the tankbarge industry, there would be no carriage of oils without insurance. We are reminded of the television commercial depicting a very busy airport in the first scene and an empty field in the second. The announcer says during the second scene, "This is what the airport would look like without insurance coverage." In another commercial we see in the first scene streets crowded with people watching a parade. In the second scene we see only the empty street and hear, "Without insurance there could be no parade." Admittedly, these commercials were produced by and for insurance companies. The fact remains that what is depicted and said is the truth. The airport would not have been built and the parade would not have been held without insurance.

Doctors maintain malpractice insurance not because they expect that they will treat their patients in a less-than-professional manner, but because something unforeseen could happen. Without this insurance, doctors could lose everything they had worked for in their lifetimes as the result of one unforeseen incident.

What are some of the other incentive for insurance in the tankbarge industry? For one, we are responsible individuals who want to limit the costs associated with oil spills. These costs include cleanup, repairs, and third-party claims. We also want to limit the risk of excessive costs from sources such as (1) employee personnel error; (2) nonemployee-related spills involving, for example, collisions while the tankbarge is secured in a fleet, vandalism, and contract tankerman negligence or error; (3) the striking of uncharted, unknown, and non-visible submerged objects; and (4) sustaining polluting damage while the tankbarge is in the tow of another company's towboat. We note here and recognize that the FWPCA specifically addresses the availability of third-party litigation when an oil spill occurs as the result of another's action or inaction. However, when costs are eventually recovered through the courts, it is usually a long-drawn-out process, and not matter how you look at it, there is still and additional cost the business must absorb.

The tankbarge industry is highly competitive, and that's what the free-enterprise system is all about. But competition is needed in the insurance field too! Especially where a monopoly exists, as it does now in the Water Quality Insurance Syndicate (WQIS) cleanup coverage. Steps need to be taken to establish an experience-sensitive and competitive cleanup-insurance market. While on the subject of underwriters who insure barge carriers for the cost of oil-spill cleanup, you should expect them to have the best and most comprehensive record of single-hull versus double-hull cleanup costs. You would expect them to make available much lower premiums for double hulls if they agree with the Coast Guard's erroneous assumption that double hulls are safer and less polluting than single hulls. The fact is that the underwriters do not agree with the Coast Guard. In fact, they state that double-hull spills are among their worst pollution-cleanup cases. As a result, the underwriters charge the same premium for cleanup insurance for double-hull barges as they do for single-hull. We understand that they show no favoritism toward double-hull - no discounts or other insurance incentive to build double-hull barges - only added surcharges for fleets with poor track records.

When we evaluate the insurance program further, we actually come up with an incentive to build single-hull barges. The WQIS pollution-cleanup premiums are based on the barge gross ton. What this does is penalize the double-hull barge simply because it can't transport anywhere near the same quantity of oil as the comparable gross tonnage single-hull barge. Or to put it another way, it's cheaper to insure a ton of oil in a single-hull barge than it is to insure that same ton of oil in a double-hull barge.

We, as a responsible industry, want a readily available and reasonable cleanup type of insurance. We do not look upon this type of insurance as an incentive for pollution prevention, nor do we look upon it as a license to pollute at will. We look upon insurance solely for what it is - a way to limit the potentially excessive costs associated with risk.

Industry And Regulatory Agency Personnel

National Marine Service Incorporated is dedicated to a comprehensive pollution-prevention program. Each and every reported oil spill from one of our vessels is investigated. The facts are collected, and the data are analyzed. The primary objective of this program is to find out why an oil spill occurred in the first place and then to make appropriate material or procedural changes with the intent that a spill of that type will not occur again. To do this, we do not routinely accept an individual's Merchant Mariner's Document endorsed as tankerman as fact that the person is qualified. Our own experience has shown that we must verify those qualifications, and

more often than not we find that the person must go through our evaluation/training program before we are satisfied with his ability.

We are convinced that one very important alternative to the double-hull proposal is the reduction of oil spills attributable to personnel error. The U. S. Coast Guard, "Tank Barge Oil Pollution Study" (Report No. CG-M-2-78), dated February 1978, supports this contention in the section entitled, "Conclusions and Recommendations." It is important to note here that the conclusions stated:

- That most minor spills (less than 100 gallons) occur during cargo-transfer operations when the oil is being loaded or off-loaded and that these incidents contribute only a small portion of the total oil-spill volume.
- That most major oil spills (100 gallons or more) occur during underway operations, and while they represent only a small fraction of the total number of tankbarge oil pollution incidents, they contribute to the bulk of the total amount of oil spilled.
- That the primary causes for both minor and major spills are related to personnel error. Inattention to duty is the greatest single factor involved. Improved personnel performance could have been effective in preventing a large number of both minor (less than 100 gallons) and major (more than 100 gallons) oil-spill incidents reviewed in the study.
- And finally that tankbarge oil-pollution prevention efforts must involve consideration of the overall system and procedures utilized by the Coast Guard. This consideration should include personnel capabilities, equipment characteristics, operational procedures, structural design, and regulatory requirements.

We wish to point out that in The Coast Guard's "Recommendation" it states:

- Continue ongoing efforts to upgrade the performance of personnel involved in tankbarge cargo-transfer operations. Intensified training and qualification programs must be integrated into the existing Coast Guard regulatory and operational system to ensure attainment of the desired improvement in performance.

This is one important alternative which should have been acted on years ago and which had the benefit of full industry support and consultation during the time when there was still a forum for such consultation. The Coast Guard frequently points out that some 85 percent of the spill which occur are the result of human error during cargo-transfer operations. But it has done nothing to revise or

improve the existing tankerman regulations or training and certification procedures to assure a better qualified force of tankermen. This step could be taken without junking the industry's fleet and without imposing an economically disastrous and totally unacceptable requirement that all new construction be double-hull.

Further, the data in the Coast Guard's Tankbarge Oil Pollution Study support National Marine's own statistics, as shown in the following tables:

Tankbarge Oil-Pollution Incidents: Coast Guard Data

Minor Spills -- < 100 gallons

Cause	Number	%	Volume (gal.)	%
Hull Damage	380	28.8	7,590	23.9
Equipment Failure	176	13.3	2,807	8.9
Personnel Error	865	57.9	21,303	67.2
	-----	-----	-----	-----
TOTAL	1,321	100.0	31,700	100.0

Major Spills -- > 100 gallons

Cause	Number	%	Volume (gal.)	%
Hull Damage	147	45.1	3,781,651	93.8
Equipment Failure	28	8.6	29,136	0.7
Personnel Error	151	46.3	220,626	5.5
	-----	-----	-----	-----
TOTAL	326	100.0	4,031,413	100.0

Cause	Total			
	Number	%	Volume (gal.)	%
Hull Damage	526	32.0	3,789,241	93.2
Equipment Failure	204	12.4	31,943	0.8
Personnel Error	916	100.0	241,929	6.0
	-----	-----	-----	-----
TOTAL	1,646	100.0	4,063,113	100.0

Source: Pollution Incident Reporting System File: 1974-1976; 2nd, 5th, 8th, and 9th Coast Guard Districts.

INVOLVING TANKBARGE HULL DAMAGE

Cause	Number of Incidents	Total Spill Volum (gal)
Equipment Failure	1	8,4000
Personnel Error	32	1,531,000
Weather Conditions	4	607
Unknown	10	13,581
	-----	-----
TOTAL	47	1,553,588

NATIONAL MARINE SERVICE, INC., OIL-SPILL EXPERIENCE

Cause	Spills	
	1976-1978 Number	%
Hull Damage	66	32.35
Equipment Failure	54	26.47
Personnel Error	84	41.18
TOTAL	<u>204</u>	<u>100.0</u>

In 1978, only 19 percent of National Marine's oil spills were more than 100 gallons (U.S. Coast Guard dividing line for minor or major spills). Of these, 87.5 percent involved single-hull barges. This would appear to support the Coast Guard's preconceived notion about double-hull barges. However, 78.6 percent of the single-hull spills were the result of personnel error, which negates that erroneous support.

We have already expressed our opinion about the professional qualifications of our regulators. We have only one more comment to make, and it is in the form of an observation. It appears that the vast majority of the qualified and experienced Coast Guard personnel have been promoted to higher rank, and somehow this places them out of the hands-on field work and into an 8 to 4, Monday through Friday, ivory-tower office job. We know that in the industry we must continuously retrain and requalify our personnel or suffer the consequences. We suggest that the Coast Guard needs to do the same or, better still, get their qualified personnel out of the office and back into the field where they belong.

Oil-Spill Penalties

National Marine Service Incorporated is of the opinion that the current policy for the assessment of pollution penalties is ineffective. The penalties realistically are an administrative headache. They fail to meet what we feel is the intent of Congress, that of assessing reasonable and meaningful penalties. They are time-consuming to process and/or appeal. This fact alone means that some penalties are paid simply to get the Coast Guard off our back. The penalty-assessment branch of a Coast Guard District office is probably the least cost-effective department in the entire Coast Guard.

We welcome the opportunity to explore this avenue as a deterrent to oil spill, and we suggest that it would be effective if the penalties were assessed against the person-in-charge, for example,

the tankerman or dockman versus the owner of the barge or facility, where negligence or inattention to duty is the sole cause of the spill.

An example would be where an inattentive company employee permitted a cargo tank to overflow, and the oil subsequently entered the waters of the United States, thereby creating a visible sheen. A reasonable and meaningful penalty may be \$50.00 against the tankerman instead of \$500.00 against the owner or operator of the tankbarge. A penalty assessed in this fashion is meaningful in that it represents approximately one half day's pay for the tankerman, whereas the \$500.00 penalty may get the attention of a division president. It would only be a drop in the bucket of a mediumsize company's daily cash flow. In this same example, if the law precludes the assessment of a penalty against a tankerman, then logically speaking, a reasonable and meaningful penalty against the company would be something on the order of \$5.00. Until monetary penalties are assessed against the licensed tankermen, engineers, mates, and dockmen, they will never be effective as a deterrent for oil spills attributable to personal negligence or inattention.

Briefly addressing the subject of license insurance, it is our opinion that this type of insurance does not provide an incentive or disincentive for the prevention of pollution incidents or the increased frequency of pollution incidents. We estimate that less than 5 percent of our employees have ever obtained this type of insurance. All that this insurance can do is to provide a source of interim personal support, through legal representation and financial income, should the insured person have a license or Merchant Marine document suspended by the U. S. Coast Guard Administrative Law Judge.

COMMENTS ON INSURANCE, LIABILITY, AND PENALTIES

R. S. Lagattolla, President
Water Quality Insurance Syndicate

The intent of this presentation is to provide the workshop with the views of the Water Quality Insurance syndicate and some of the tankbarge pollution data acquired in the course of its close liaison in spill situations with vessel operators, their marine personnel, pollution surveyors, clean-up contractors, and the Coast Guard.

The Water Quality Insurance Syndicate (WQIS) is comprised of 28 insurance companies and was formed in 1971 for the specific purpose of insuring the liability for oil-spill removal costs imposed on vessel owners and operators by the Water Quality Improvement Act of 1970. With the enactment of the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act Amendments of 1977 and 1978, WQIS expanded its coverage to meet the new and increased liabilities brought about by those legislative changes. Today WQIS insures more than 17,000 vessels, the vast majority of which operate exclusively in the rivers, harbors, and coastal waters of the United States and of which 2,800 are tankbarges.

WQIS loss statistics are in substantial agreement with the Coast Guard's statements in its Draft Regulatory Analysis and Environmental Impact Statement of September 30, 1979, to the effect that more oil has been spilled from tankbarges in a small number of large spills than has been spilled in a large number of small spills. We agree, further, that the small number of large spills involve "transport incidents" as opposed to "transfer incidents".

Typically, tank overflows occur while a barge is alongside a pier. They are usually discovered quickly, and pumps and valves are usually shut down before much product is spilled overside. The oil that is spilled in a transfer incident quite often is kept from immediately dispersing, being confined by the barge and pier structure. In any event, containment and clean-up of spills occurring alongside a pier are facilitated.

On the other hand, a spill resulting from the "piercing" of a barge hull in a collision with another vessel or a fixed structure while the barge is under tow, generally cannot be abated. Depending on the severity and location of the impact, the entire contents of a tank, or indeed, or the barge, can be spilled virtually immediately. Fortunately, incidents where the entire contents of a tank, much less of a barge, are spilled are a rarity. However, the characteristic

rapid dispersal of oil spilled in a transport incident makes containment and clean-up of such spills difficult.

Ever since the enactment of the Water Quality Improvement Act of 1970, the Coast Guard, Congress, environmentalists, scientists, and, yes, even pollution-liability insurers, have attempted to keep records of the quantity of oil spilled in each incident. Unfortunately, in most spills an estimate (guestimate?) of the number of gallons or barrels spilled is highly subjective. The tankerman who slept past the moment when he should have turned a valve will swear that no more than 10 gallons went overside. The clean-up contractor who billed the vessel operator \$25,000 to clean up that spill will report that he recovered 100 barrels of product. A quantity of 12 barrels (500 gallons) of oil spilled in a "Transfer Incident," well contained in a berth area, will seem to be 10 times that amount (and reported as such) when seen spread as 2-foot band along 500 yards of levee after a spill from a "Transport Incident."

The reader of any oil-pollution study must keep in mind that in almost all cases, other than where the entire content of a tank is spilled, the quantity-spilled "statistic" is not a precise measurement and the degree of imprecision can be great.

In its Draft Regulatory Analysis, the Coast Guard reported that according to data from the Pollution Incident Reporting System (PIRS), during the period 1973 through 1977, there were 165 tankbarge transport incidents involving spills of 500 gallons or more with a total volume of 178,326 barrels spilled. WQIS records on "transport-incident" spills of 500 gallons or more during the same period from tankbarge insured by the Syndicate indicate the following:

	<u>CAUSE</u>	<u>INCIDENTS</u>	<u>TOTAL VOLUME (bbls)</u>
Collision	(with other vessel or fixed object)	28	113,930
Grounding	(Stranding, touching bottom or submerged object)	15	15,804
Hull Leak	(Unknown origin)	10	1,080
		—	—
TOTALS		53	130,814

One of the grounding incidents in the WQIS records involves a double-hulled barge which broke away from its tow in heavy weather near Cleveland and fetched up on a rock jetty. That incident resulted

in a spill estimated at 1,725 barrels and is not included in the PIRS data or the other casualty report in the Draft Regulatory Analysis. Until recently, WQIS loss records did not record whether the tankbarges involved were single- or double-skinned. That detail was recorded in the referenced case purely coincidentally.

WQIS is not in a position to state categorically that each of the 52 other spills from transport incidents, if they all involved single-skin barges, would have been avoided or abated had the barges been of the double-skinned type. Six of the most serious collision incidents, accounting for 96,500 barrels of the 113,930 total volume in that category, were investigated further and were found to involve single-skin barges. However, WQIS has concluded from discussions with its surveyors in connection with those six cases, that even if the barges were of the double-skinned type, they would not have resisted the force and mechanics of impact in each case, nor would there have been any reduction in quantities spilled. These six incidents are included in the PIRS and other casualty reports contained in the draft of September 30, 1979.

Since 1977, WQIS has been involved with three serious transport-incident spills from tank barges known to be double-skinned. In one case, the barge struck a bridge and spilled 2,500 barrels of oil; in another, the barge grounded and spilled 1,500 barrels. In the third incident, which occurred recently, the barge collided with another barge under tow and spilled 9,000 barrels of product.

The conclusion drawn by WQIS from its records is that the many low-volume spills that have occurred in transfer incidents and the few high-volume spills that have occurred in transport incidents would not have been prevented even if all the single-skinned barges involved were double-skinned. As for all lower-volume, single-skinned barge spills that have occurred in transport incidents, these cannot be persuasive in an argument favoring double-skinned barges, considering the low total volume spilled against all other incidents and the probability that half of them would have occurred even if the barges were double-skinned.

On the subject of pollution legislation, WQIS is proud of its record of having stepped up to meet the needs of its assureds under constantly evolving federal pollution legislation. In addition to insuring the liability for removal costs under FWPCA, WQIS also provides coverage against vessel liabilities under the Outer Continental Shelf Lands Act Amendments of 1978. These laws afford measurable liabilities and equitable defenses, factors that are essential to the continued availability of insurance against statutory pollution liabilities. The American marine-insurance market has voiced this position on a number of occasions in testimony before the House Merchant Marine and Fisheries Committee in connection with several versions of proposed comprehensive pollution legislation.

The primary function of liability insurance is to provide protection against the liabilities which can ensue from fortuitous occurrences. Those insureds with poor loss records generally pay more in premium for their liability coverage than those with good loss experience. Some may argue, therefore, that premium rating based on experience is an incentive to good operation. Lest this lead to undue reliance on the cost of insurance as a disincentive to poor operation, it must be pointed out that such reasoning is only skin-deep and does not consider that, in the absence of more positive incentives, poor operators may find it more economical to pay the higher premium than to implement maintenance procedures and loss-prevention programs.

IMPACT OF PROPOSED CHANGES IN TANKBARGE REGULATIONS
ON THE FEDERAL SHIP FINANCING PROGRAM

Mitchell D. Lax
Office of Ship Financing Guarantees
Maritime Administration

Introduction

The Federal Ship Financing Program or, as it is most often called, the Title XI Program, has been in effect since 1938. It is one of the oldest and most successful government-guarantee programs. The program is designed to be self-supporting. Initial filing and investigation fees along with yearly guarantee fees, analogous to yearly insurance premiums, go into a revolving fund which is used to pay all expenses, including salaries, associated with the program. This revolving fund also provides the funds needed to pay principal and interest on Title XI obligations in the event of default. The present balance in the revolving fund is approximately \$165 million, with the program only having experienced 12 corporate defaults since its inception.

Over the years, Title XI guaranteed financing has been approved for more than 400 companies involving more than 5,000 vessels, many of which could not have been financed without the aid of the program. The Title XI program provides for a full faith and credit guarantee by the United States Government of debt obligations issued by U.S. citizen shipowners for the purpose of financing or refinancing U.S. flag vessels constructed or reconstructed in U.S. shipyards.

Prior to the early 1970's, the program experienced only moderate growth, so that at the end of fiscal year 1970, there were nearly \$1 billion in Title XI contracts in force. During the 1970's, the program has experienced tremendous growth, and as of December 31, 1979, we had committed approximately \$6.7 billion of our \$10 billion authorization. I expect this growth not only to continue but to accelerate. For example, we have already received 35 applications during the first three months of this year, which is more than double the average level. This has resulted in a backlog of approximately 100 active pending applications, eight of which involve tankbarges. These eight applications involve 8 single-skin and 11 double-skin vessels and requested Title XI financing of approximately \$33 million.

The tremendous growth in the program can be attributed in part to the 1972 amendments to Title XI of the Merchant Marine Act of 1936. One of the primary changes in the new law increased the eligibility for Title XI financing for inland barges from 75 percent of their actual cost to 87.5 percent of their actual cost, thus making all

barges, both inland and oceangoing, eligible for 87.5 percent Title XI financing. Another important aspect of the 1972 amendments was that they altered the government's role in the financing by changing the basic concept from one of insuring a loan or mortgage related to a specific vessel to a direct government guarantee of the obligations. This change has added to the acceptability and marketability of the Title XI obligations, making them comparable to other government-agency issues.

Title XI financing is available for passenger vessels, cargo and combination passenger vessels, cargo-carrying vessels, tankers, towboats, barges including tankbarges, dredges, and floating dry docks. Eligible vessels can receive a Title XI guarantee of obligations up to 75 percent of their actual cost. However, Title XI guaranteed obligations can be issued in an amount up to 87.5 percent of actual cost for certain vessels.

The actual cost of a vessel for Title XI purposes is basically the vessel's construction costs and the nonequity construction period financing costs. Items or services of foreign origin or manufacture are generally excluded from a vessel's actual cost, as are items contracted for after delivery of the vessel. Additionally, expenses such as printing fees, legal fees, and accounting fees are not eligible for inclusion in actual cost.

Title XI financing is available for up to 25 years for many types of vessels. The Maritime Administration has limited the term of the financing for certain types of vessels because of economic and or financial conditions for which 25-year financing may not be prudent. As I will discuss in a few minutes, the term of the financing is one area that may be affected by the proposed tankbarge legislation. Repayment of the Title XI guaranteed debt is usually required on a straight-line principal basis with equal payments of principal being made on semiannual basis. However, depending on the particular circumstances, level debt amortization, which requires equal semiannual payments of principal and interest is permitted.

Prior to granting approval of an application, the Maritime Administration must make certain findings, including determinations that the applicant has adequate financial, managerial, and operating ability with respect to the vessel(s). Additionally, the project must be determined to be economically sound.

One noteworthy trend being experienced by the Title XI program has been the increasing use of outside equity sources to provide the necessary funding for Title XI transactions. In this regard, a significant amount of recent Title XI financings have involved the use of a leverage lease, limited partnership, or subcharter corporation to raise outside equity. These funding arrangements are another factor in the rapid expansion of the Title XI program.

Now that I've given you an overview of the program, I'd like to discuss the impact on the Title XI program of the proposed tankbarge regulations. In order to fully explain the impact of the proposed regulations, I've broken my analysis into three separate segments. The first deals with the impact on existing Title XI contracts; the second deals with pending and future Title XI applications; and the third deals with recommendations regarding the proposed regulations.

Impact of Proposed Regulations on Existing Title XI Contracts

The impact of the proposed regulations on existing Title XI contracts is twofold. First there is the direct impact on single-skin tankbarges which have been financed with Title XI guaranteed obligations. Secondly, there is an indirect impact resulting from either of the following two situations.

First, the proposed regulations may have a significant impact on companies that have financed both single-skin tankbarges and other equipment under Title XI. In these situations any negative financial impact of the proposed regulations may not only affect the operation of single-skin tankbarges, but may also affect the overall operations of the company, thereby potentially jeopardizing the company's ability to repay its total Title XI guaranteed debt.

Secondly, companies that own Title XI financed towboats which operate in conjunction with single-skin tankbarges owned by the other entities may experience certain employment difficulties as a result of the implementation of the proposed regulations. This situation could potentially expose Marad to the Title XI debt of these towboats. Due to the alternative employment possibilities, it would be quite difficult, if not impossible, to determine the amount of this indirect exposure. Therefore, I have not attempted to quantify this amount. However, I feel it is critical to be aware of the existence of this indirect exposure in evaluating the total impact of the proposed regulations.

In analyzing the direct impact on single-skin tankbarges I have made the following assumptions: (1) vessels to be included are tankbarges that are either currently engaged in or could be engaged in the carriage of petroleum products on U.S. waterways; (2) the vessels identified above are not exempt under the Minor Exceptions provisions of the proposed regulations; (3) the amortization of the Title XI obligations is being made over a 25-year period with equal payments of principal being made on a semiannual basis; and (4) each vessel's delivery date was on the date of execution of the Title XI documentation. Although these assumptions may result in a slight overstatement of the direct impact on the Title XI program, I believe they are reasonable and provide a useful estimate of Marad's exposure.

One additional point worth mentioning is that Title XI commitments issued subsequent to June 30, 1979, were not included in this analysis, as such contracts contained special provisions to limit Marad's exposure with respect to the proposed regulations. I will discuss the nature of these provisions in a few minutes.

With this in mind, as of December 31, 1979, there were Title XI guarantees outstanding on approximately 80 single-skin tankbarges and one outstanding Title XI letter commitment with respect to one single-skin tankbarge that could be affected by the proposed regulations. Marad's exposure on these vessels as of December 31, 1979, was approximately \$71.4 million.

If the proposed Coast Guard regulations were adopted, then at the time these single-skin tankbarges could not be employed in the carriage of petroleum products (a date I'll term the "Effective Date"), Marad's exposure would be approximately \$18.1 million. Although these figures only represent a small percentage of the total Title XI exposure, they do represent a significant investment in the maritime industry. It should be remembered that these figures do not take into account the indirect exposure or any negative impact on the future marketing of Title XI obligations.

Next, I would like to discuss the impact of the proposed regulations on pending and future Title XI applications that involve single-skin tankbarges.

Effect of Proposed Legislation on Pending and Future Title XI Applications

Marad realized that it would be necessary for all pending and future Title XI transactions to reflect the potential effects of the proposed regulations. In developing a method for accomplishing this, Marad wanted to minimize the risk to the Title XI program without discouraging its use by owners of single-skin tankbarges. To this end, Marad developed two basic alternatives to be incorporated into the Title XI documents.

The first and most obvious alternative is to limit the term of the Title XI mortgage so that it will coincide with the legal operating period for single-skin tankbarges. However, most owners felt that such a limitation would, in effect, eliminate one of the major and most important benefits of the Title XI program. Therefore, we developed a second alternative that would not directly affect the term of the Title XI mortgage.

The second alternative provides that at the Effective Date there will be sufficient funds available to retire the then-outstanding Title XI debt on the single-skin tankbarges. An example of this second alternative is to require the shipowner to make periodic

deposits into a Reserve Fund that will build up to an amount sufficient to totally repay the Title XI debt on the Effective Date. I should point out that any such deposits are in addition to and not in lieu of the normal Reserve Fund deposit requirements of the Title XI documents.

I believe that both of these alternatives should significantly reduce Marad's potential exposure on future Title XI transactions involving single-skin tankbarges. However, the total risk to Marad is not totally eliminated, as these single-skin tankbarges must generate sufficient revenues to either (a) amortize the debt over the shorter financing term indicated in the first alternative or (b) build up adequate reserves as indicated in the second alternative. Of course, once specific regulations are enacted, Marad will be able to develop a more effective method for processing single-skin tankbarge applications.

This leads me to my final area of discussion, in which I would like to present my recommendations and views of the future effects of the proposed regulations.

Recommendations and Views on the Future

The most important recommendation I can make is that issuance of final regulations be held in abeyance until there is some sort of consensus on the overall effect of the regulations. Seminars such as this do provide an excellent forum for eliciting varying viewpoints on the subject and should prove quite helpful in formulating the final regulations.

In formulating these final regulations, I would recommend that consideration be given to the following topics. First, the effects of the proposed regulations on the Title XI program. Second, the continued use of single-skin tankbarges, provided they continued to meet the required Coast Guard standards. Third, the development of construction designs for single-skin tankbarges that may be able to achieve the pollution controls that are envisioned by the use of double-skin vessels. And finally, the development of improved training programs that may reduce accidents caused by human error.

As far as the future is concerned, the effects on the Title XI program will obviously be a reflection of the maritime industry's response to the regulations. As such, there should be an increasing number of double-hull tankbarges financed under the Title XI program. There should also be a greater amount of Title XI guaranteed bonds issued as a result of higher construction costs associated with double-skin tankbarges and the possible phasing out of single-skin tankbarges. Additionally, any future Title XI financings of single-skin vessels would most probably be more restrictive than past financings. Any such restrictions could affect the economic viability

of such projects, thereby limiting the availability of Title XI financing for such transactions.

TANKBARGE POLLUTION COMPARED TO POLLUTION FROM TANK VESSELS

Sharron Stewart

Member

National Advisory Committee on Oceans and Atmosphere

Introduction

This year marks the sixth consecutive year in which Congress has considered comprehensive oil-spill liability and compensation legislation, the first bill having been introduced by the Ford Administration in the 94th Congress. As the various "Superfund" proposals have been shaped over those years, several areas of disagreement have developed.

One such area is the question of whether inland tankbarges carrying oil as cargo should be afforded a lower limit of liability than ocean-certificated tankbarges and tank vessels. The bill currently being considered by the House of Representatives, H.R. 85, would subject inland oil barges to a minimum liability of \$150,000 or \$150 per gross ton, whichever is greater [see Section 104 (b)(2)]. Ocean-certificated barges and self-propelled tank vessels would be subject to a minimum liability of \$250,000, or \$300 per gross ton (up to a maximum of \$30 million), whichever is greater [see Section 104 (b)(3)]. In the last oil-spill liability bill considered by the Senate, S. 2083 (95th Congress, 2nd session), no distinction was made between inland oil barges and ocean-certificated barges and tank vessels.

The National Advisory Committee on Oceans and Atmosphere (NACOA) considered the differences between the House and Senate positions during the 95th Congress and has consistently opposed the House provision as giving an undue advantage to the owners and operators of inland oil barges. We have prepared this paper to explain the rationale underlying our position.

The Exclusivity Holdings Under Section 311

The law that currently governs oil-spill liability, Section 311 of the Federal Water Pollution Control Act, as amended, was interpreted by the courts in 1977 [Complaint of Steuart Trans. Co., 435 F. Supp. 798 (E.D. Va. 1977), aff'd, 596 F.2d 609 (4th Cir. 1979)] to be the exclusive remedy of the United States in recovering its cleanup costs from a spiller of oil or hazardous substances. Because H.R. 85, as well as the bills considered by the Senate in the past two Congresses, would, as written, be the exclusive remedy of the United States, the

recovery of cleanup costs under Section 311 gives an accurate picture of the way in which these costs would be recovered under H.R. 85.

Table 1 lists the six cases that have been decided in federal courts, including Steuart, supra, showing the cleanup costs expended by the United States as compared to the liability limits of the dischargers. As of this date, the United States has been able to recover only 13 percent of the nearly \$12.5 million it spent in these six incidents. The difference of more than \$10.7 million has been paid directly by the taxpayers from the Section 311(k) "revolving" fund.

NACOA emphasizes that, of the six incidents listed in Table 1, only one of the barges was an ocean-certificated barge. That was the NEPCO 140 barge, whose discharge of 300,000 gallons in the Saint Lawrence River cost \$9 million to clean up. Even if NEPCO 140 were subjected to the higher liability limits of ocean-certificated barges, as in H.R. 85, her liability would have been only \$1.6 million, or 18 percent of the total cleanup costs. NACOA also emphasizes that there have been no similar cases involving self-propelled tank vessels.

We submit, therefore, that barges are clearly not paying their share of the pollution costs that they are causing. Even doubling the liability limits of the spillers in Table 1 would produce inadequate recovery in every case. If any case can be made for a variation in liability limits between inland oil barges and ocean-certificated barges and self-propelled vessels, that case can only be made for making inland oil barges subject to higher liability limits than the other barges and vessels.

Table 1
Cleanup Costs Recoverable by the United States in Barge Spills

<u>Incident</u>	<u>Cleanup Costs Incurred</u>	<u>Liability Limit of Spiller</u>	<u>Percentage Recoverable</u>
	-----Dollars-----		<u>Percent</u>
1976 Chesapeake Bay	480,705	122,300	25
1978 Chesapeake Bay	600,000	190,000	32
1974 Dixie Carriers	954,404	121,600	13
1975 Valley Towing	1,098,670	357,600	33
1976 NEPCO 140	9,000,000	847,800	9
1975 BIG SAM	278,648	15,500	6
Totals	<u>12,412,427</u>	<u>1,654,800</u>	<u>13</u>

Deficit: \$10,757,627

Percentage of Oil Spilled from Tankbarges

There is a widespread misconception to the effect that barges spill less oil than do tank vessels. U.S. Coast Guard statistics do not divide barge spills into spills from inland oil barges and spills from ocean-certificated barges, but, with that caveat in mind, NACOA would like to present the following comparison. In 1976, U.S. Coast Guard statistics for oil spills in and around U.S. waters showed a large aberration owing to the inclusion of 7.5 million gallons spilled from the Argo Merchant. Although we do not discount the Argo Merchant spill, we point out that the United States settled that incident with TOVALOP for about \$1.2 million.

Table 2 presents the U.S. Coast Guard's statistics on volume spilled from vessels and breaks it down into tank-vessel and tankbarge spills for 1971 through 1978. For 1976, we have presented two sets of figures, the second one excluding the volume spilled from the Argo Merchant. With the exception of the Argo Merchant's volume, barges have been responsible for 40 percent more oil spilled from 1971 to 1978 than was spilled by tank vessels. Even if one were to include the volume spilled from the Argo Merchant in this comparison, tank vessels and tankbarges would be responsible for nearly equal amounts of oil pollution during that period. NACOA wishes to emphasize that the perception put forth by many members of the oil transportation industry, to the effect that barges only have small spills, is not an accurate reflection of the actual situation.

Table 2
Oil Spills from Tank Vessels and Barges Compared

<u>Year</u>	<u>Volume spilled from all vessels</u>	<u>Volume spilled from tank vessels</u>		<u>Volume spilled from tankbarges</u>	
	-----Gallons-----	Percent	Gallons	Percent	
1971	3,902,265	1,665,264	42.7	1,197,819	30.7
1972	6,503,298	2,583,952	39.7	3,739,144	57.5
1973	7,919,439	4,494,254	56.7	1,572,059	19.9
1974	4,286,438	1,434,168	33.5	2,468,724	57.6
1975	6,671,639	1,769,333	26.5	3,497,337	52.4
(1976)	(10,600,407)	(8,924,675)	(84.2)	(1,370,909)	(12.9)
1976	3,100,407	1,424,675	45.6	1,370,909	44.2
1977	2,431,798	207,429	8.5	1,844,059	75.8
1978	4,461,993	329,017	7.4	3,634,897	81.5
<u>Totals</u>	<u>39,277,277</u>	<u>13,908,092</u>	<u>35.4</u>	<u>19,324,948</u>	<u>49.2</u>

Conclusions and Recommendations

NACOA concluded, from its analysis of the U.S. Coast Guard statistics from 1971 through 1978, that tankbarges are at least as great a source of pollution as are tank vessels, and are an even greater source of oil pollution in the confined waters of the United States where inland barges operate. From the Section 311 exclusivity cases, NACOA believes that it is clear that oil spills from tankbarges in confined internal waters result in greater cleanup costs being expended per gallon of oil discharged than do spills in coastal and open marine waters.

Recognizing this, we conclude that the beneficial treatment accorded inland oil barges in H.R. 85 cannot be supported. In fact, even if the higher liability limit of \$300 per gross ton were applied to the six incidents in Table 1, the United States would still be unable to recover all of its cleanup costs in five of the six incidents. In testimony before the House of Representatives, NACOA has stated its conclusion that there is no rational basis for making the distinction benefiting inland oil-barge owners and operators that is made in H.R. 85. We submit to the participants in this workshop that the facts support our position. We hope that you will emphasize in your recommendations that barge-related spills are indeed at least as serious a problem as are spills from tank vessels, if not more so.

THE EFFECT OF POLLUTION INSURANCE,
LIABILITY, AND PENALTIES
ON TANKBARGE CONSTRUCTION

Richard M. Willis
Engineering Computer Optecnomics, Inc.

The relevance of a discussion of the incentive/disincentive impacts of pollution insurance, liability, and penalty factors on pollution prevention as regards tankbarge construction is contingent on the relationship of those factors to the allocation of the actual costs of pollution.

The extent to which a system of liabilities and penalties rewards superior performance--in this case, the nonpollution of our waters--is an economic question. "If it is less expensive to spill than to prevent, then the investment in prevention is not economically sound."

It is the contention of this paper that our present system rewards spilling to a greater extent than it rewards prevention. That this contention is a simplistic view is readily admitted, and it is not intended to infer that our transportation-system owners want to pollute--obviously, the costs of pollution are great. Rather it is an expression that our system of penalties, liabilities, and insurance for liability does not reward the nonpolluter and does not fully tax the polluter, thus developing an irrational economic system. The development of a rational system will, however, be required in order for the marine-transportation industry to respond to future changes and events that appear to be just over the horizon, both politically and economically.

The Present System

Limits of Liability

The Federal Water Pollution Control Act, [P.L. 95-217] (FWPCA), as amended, mandates minimum and maximum liability limits based on the gross tonnage of the vessel. These liability limits do not reflect the actual costs of potential pollution, as they are a compromise arrived at because of the inability of the transportation industry to obtain stipulated financial guarantees at a competitive figure for higher liability. Thus, the cost of pollution, the potential of pollution, the traffic pattern, construction characteristics, and previous experience or size of the potential polluter were not real determinants in the establishment of the limitation schedules. Rather, a factor unrelated to the costs of pollution--the ability/capacity of the insurance industry to guarantee the financial

limits of the liability--was a major determinant in the establishment of liability limits.

Insurance Costs

The insurance industry provides the financial guarantee where the individual company is unable or unwilling to establish itself as a self-insurer.

It is difficult to relate the pollution-insurance cost to the issue of pollution abatement through improved construction standards, as it is based on a fictitious liability limit not related to clean-up and damage costs of pollution. In addition, that insurance cost uses as a rating base for basic coverage the gross registered tonnage of the vessel and, for additional coverage, the cost of the vessel. The relationship of the gross tonnage of the vessel to its potential pollution cost--outside of the fact that a larger vessel has a larger amount of product to spill--seems to the writer to have little relevance, given that:

- Most spill events incur small amounts of spillage.
- Such factors as pattern of trade, location, etc., are not taken into account.

Moreover, the use of vessel cost as a rating base for pollution insurance, although traditional and direct, does not have any merit other than ease of developing a premium value.

Penalties

The intent of penalties is to provide a deterrent. In the case of penalties for pollution, penalties do not appear to be a deterring factor for the following reasons:

- The penalty is probably not assessed on the actual instigator of the spill--rather, it is charged to the company that the instigator may work for.
- The penalty in theory has no relationship to the severity of the spill.
- In too many cases, the amount of the penalty may be insignificant.
- There is no cumulative effect of multiple penalties.

Comments on the Existing System

The above comments direct the writer to the conclusion that issues of insurance, liability limits, and penalties provide no incentive to improve construction standards to prevent pollution; perhaps, in reality, they provide a disincentive. Clearly, that is the case where pollution-insurance coverage is based on cost of vessel.

Potential Changes to the System

The Effects of Future National Public Policy

At some future date, the increasing political pressures to control pollution and to provide protection from the effects of pollution will result in the establishment of a national public policy. It would be difficult to envision that such a public policy, which for want of better nomenclature will be referred to as a "superfund," would not dramatically increase the out-of-pocket costs per polluting incident. The costs for which a spiller or the superfund is liable would have a broader definition than the present FWPCA. These costs would presumably be similar to those of the Outer Continental Shelf Act [P.L. 95-372] and would include:

- Removal costs.
- Damage to real or personal property.
- Damage to natural resources.
- Loss of earnings resulting from injury to real or personal property or natural resources, without regard to ownership.
- Loss of use of real or personal property or natural resources.

To the extent that they are pertinent, these costs are already being borne by the nation as a whole. However, many of them are not being funded, but rather are being absorbed by the damaged party, whose recourse currently is through litigation.

Recent court cases have allowed damage claims for losses to birds and trees. In the Stewart case presented in the Coast Guard's EIS (1), the stated value of the waterfowl killed was as great as the total clean-up costs. It is interesting to see that the lawsuits in the state of Texas arising from the the IXTOC I blowout amount to some \$365 million and that a Texas Congressman has filed to have those claims considered under any future superfund to be established.

The point being made is that clean-up costs will be only a small portion of the future pollution costs to be borne by the nation. As those actual dollar costs rise, the pressure on the polluting

industry--in this case marine transportation--to cease polluting will soar dramatically.

In addition, liability-limitation levels will face substantial pressures to relate more realistically to potential pollution-damage costs. Whether financial-responsibility levels will also increase with higher limits of liability is conjecture, as the economic impact of that financial responsibility has not yet been addressed in a national manner. Also, the categories and extent of liabilities may be modified; i.e., some proposals provide for no limit on the liability for clean-up costs, and others discuss strict and absolute liability interpretations.

In sum, future public policy will increase both national costs of pollution and the marine-transportation industry's cost of pollution prevention and asset protection.

The Pollution Insurance Industry

There are a number of factors which should tend to change the character and functioning of the pollution-insurance industry. They are, in part, the following:

- An increase in the industry's capacity, which has resulted, worldwide, in increased competition.
- Tremendous losses, which, when coupled with the above, have put great pressure on the profits of the marine insurer.
- The changing pollution-liability laws and patterns.
- The development of data depicting the incidence and magnitude of pollution events and costs over an increasing period of time.

Each of these factors will contribute to the insurance industry's ability and need to devise new bases and techniques for developing insurance rates and bounds. Loss prevention, in this writer's opinion, will become a strong factor in the development of insurance rates and costs. Even more importantly, those companies whose loss experience is above average (i.e., lower spill record) will be aggressively marketed, and the offender will find difficulty in finding protection at any cost. Recent front-page articles in major newspapers have focused on the changing attitude of the insurance market to repetitive offenders, with the Greek independent ship owners becoming convenient examples. It is increasingly apparent that the value of a vessel and/or its cargo are not, in themselves, a viable/profitable gauge of the insurance risk to the potential investor. The information is available, or can be made available, to make more rational and thereby more profitable decisions.

Other Factors

There are a multitude of events that could dramatically change all the assumptions under which this conference is being conducted--from a devastating catastrophic accident to an economic depression of unknown extent--and no paper should be willing to discuss them all. It suffices to conclude, however, that, in the future, pollution of our waters will not be accepted at present levels or even a fraction of present levels. We who are involved in marine transportation must and can do something about this problem. It is not enough to say it is an inherent risk in supplying energy to the nation--inventive and exhaustive action will be required.

The Alternatives of Double-Hulled Barges

If it is accepted that the previous discussion portrays a reasonable assumption of the future, and there should be little disagreement that at least costs and liability limits will increase and that the insurance industry should act more rationally, then it must be accepted that the status quo is untenable. There is no question that we must pollute less; the question is "can we pollute less, economically?" And "economically" must be viewed in the larger sense--not only in terms of direct transportation costs.

One of the difficulties and frustrations that exist in any confrontation situation--in which we are involved--is that the opposing partners present data that reinforce their positions without regard for gray areas and even without evidence of common purpose. Unfortunately, this writer cannot term himself an independent observer or a third party either, for I find it hard to accept that we cannot prevent two large vessels from colliding with each other but can land a man on the moon. (Human error exists in each case, but in the latter event we have provided for it.)

The studies and responses to the proposed regulations show a deep interest in the ability of the barge industry to continue to serve the nation as it has in the past. One conclusion from the responses is very apparent--it will cost more to utilize double hulls. The additional costs do vary, depending on the assumptions that are developed. An additional conclusion is also apparent--double-hull barges pollute less and the numbers have wide variations--extreme would be a modest adjective.

The Frankel study (2) suggests a very straightforward analysis and develops a conclusion that double-hull vessels would pollute at a rate of 80 percent of that of single-hull vessels, while the Coast Guard studies indicate a rate far below that. All these studies have involved a great deal of work and original thought and must be viewed as increasing the knowledge of accident statistics. However, each of these studies has required an independent appraisal of an accident

involving a single-hulled vessel and a qualitative evaluation of the preventability of the accident.

In this writer's opinion, the more direct method of analysis would be to compare the quantitative pollution rate of the double-hulled barge to that of the single-hulled barge. Fortunately, that information is readily available in the Coast Guard Environmental Impact Statement (EIS) (1):

- For accidents resulting in an oil spill of more than 500 gallons for the years 1973 to 1977 from identifiable barges, four barges were of double-hull or double-side construction spilling approximately 3500 barrels and 143 were of single-hull construction spilling approximately 175,000 barrels.

With an average of 690 double-hulled or partially double-hulled vessels in this time frame and approximately 2,800 single-hulled, it is pertinent to develop the following polluting accident characteristics in a very straightforward, simplistic manner for spills larger than 500 gallons:

- For each double-hulled barge, you can expect one spill every 1000 vessel/years.
- For each single-hulled barge, you can expect 10 spills every 1000 vessel/years.
- Single-hulled barges can be expected to pollute at a rate 10 times that of double-hulled barges.

On the above basis it is possible to construct a graph depicting the reduction in pollution that would occur under the proposed regulations (Figure 1). The Booz-Allen & Hamilton figures (3) for number of towboats were used for number of barges in any one year and a formula similar to that of the Frankel study was used for outflow per barge, albeit with different outflow assumptions.

A vast reduction in pollution can be readily seen in Figure 1. However, an even more impelling discussion in the responses to the Coast Guard's EIS (other than differences of opinion on the ability of double-hulled barges to prevent pollution) concerns the ability of the barge-transportation industry to finance the mandated replacement barges adequately and profitably.

The point expressed by the financial institutions (4) that tell of widespread inability of individual firms to conform to the new standards is well taken. Therefore, it is imperative that the proposed regulations more fully recognize the total economic impact of the new standards. There are methods that will achieve our goal of

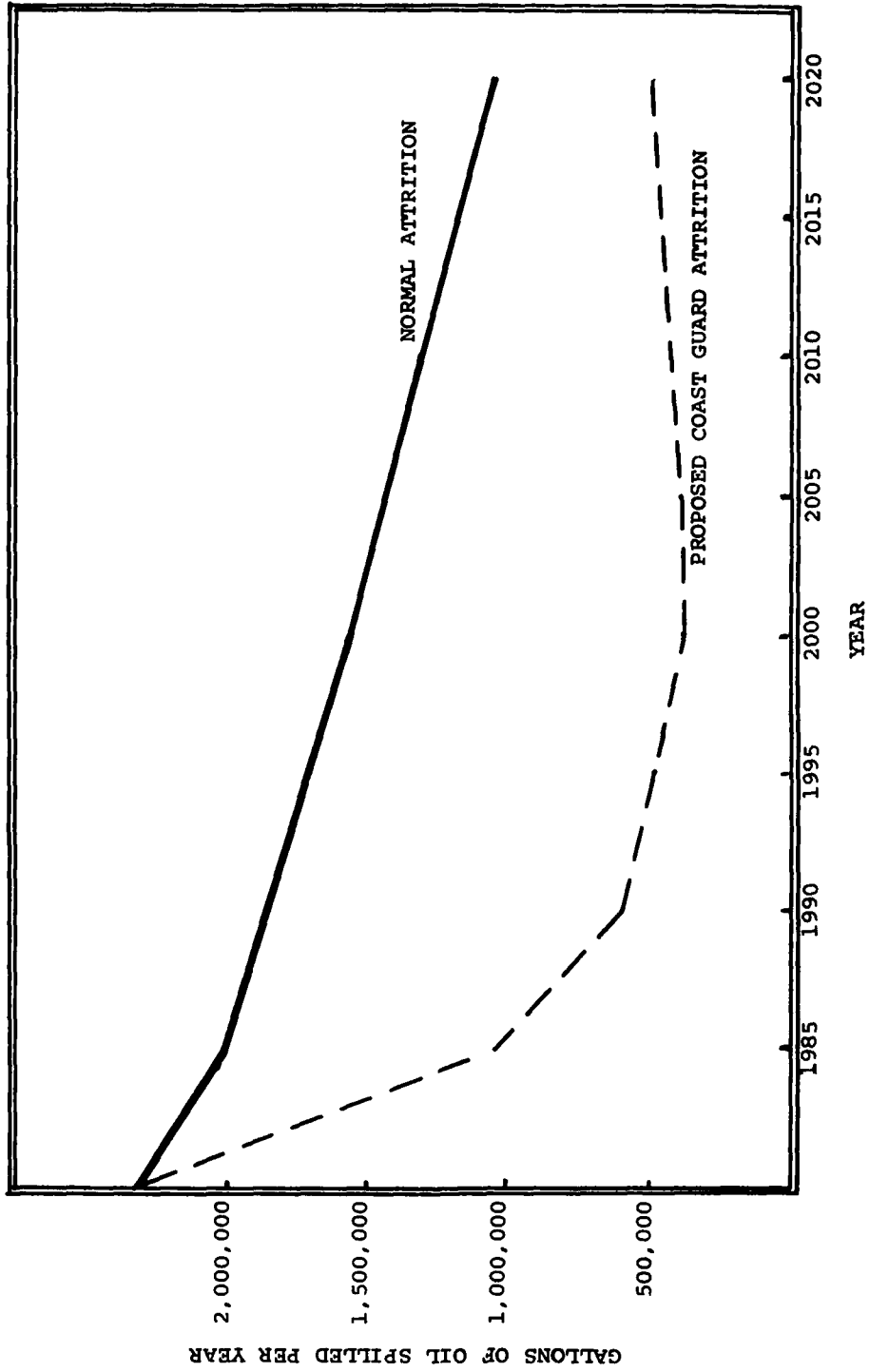


FIGURE 1: GALLONS OF OIL SPILLED BY TANK BARGES PER YEAR
 NORMAL AND PROPOSED ATTRITION OF SINGLE HULL BARGES

reducing pollution and still be economically rational. Some of these methods, not meant to be inclusive, are:

- A reevaluation of the 20-year life of single-hulled barges. Figure 2 modifies the proposed and existing attrition using present scrapping levels with no single-hull tankbarges being built after 1979 and normal attrition, and affords a significant gain in pollution prevention. Other schemes can be equally justifiable.
- Different liability limitations for single- and double-hull barges serving the same trade. Not only construction characteristics, but operating procedures could be involved in this category.
- Recognition in the regulations of different trading patterns and different risks developed in those patterns that may affect the cost of pollution reduction. For instance, new offshore/coastal tankbarges may be more economically constructed and operated with the use of double bottoms rather than full double hulls, given their accident pattern.
- Insurance premiums can be related to loss-prevention standards, decreasing costs to the non-polluter.
- Penalties can be more directly related to the polluter, the severity, and the multiple offender, increasing the penalty for the low achiever.

Conclusion

The marine petroleum-transportation industry cannot take the position that it is being unjustifiably criticized for its pollution record. It must recognize that it does pollute and endeavor to decrease that pollution. A corollary to that statement is that it is impossible, economically, to stop that pollution immediately.

Double-hull barges do significantly decrease oil pollution resulting from barge transportation of petroleum and also decrease the costs associated with that pollution. The mandate of this meeting, to the writer, is how best to achieve the orderly, economic transition to a fleet of fully double-hulled/double-bottom tankbarges.

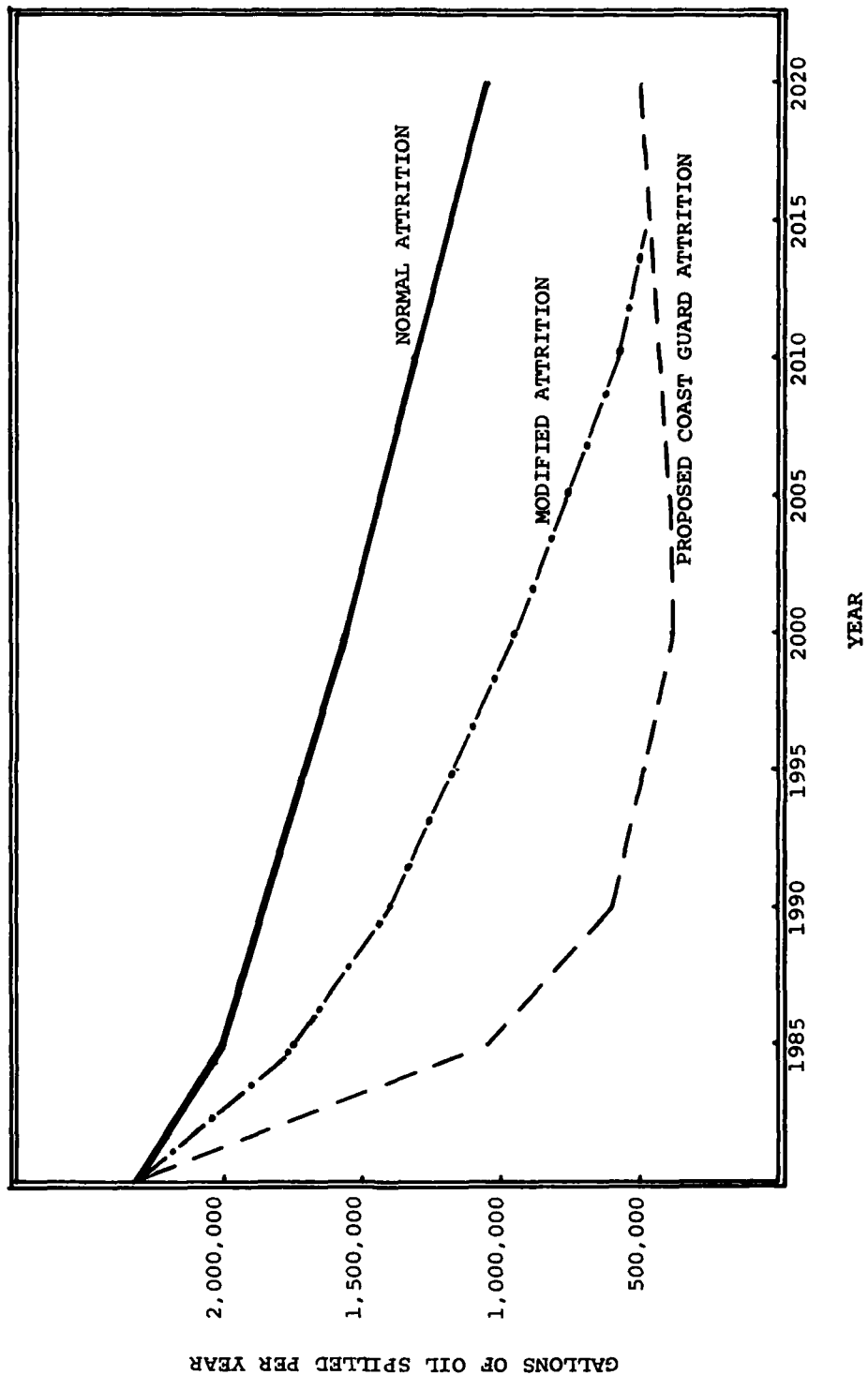


FIGURE 2: GALLONS OF OIL SPILLED BY TANK BARGES PER YEAR SHOWING "MODIFIED" ATTRITION OF SINGLE HULL BARGES

References

1. Draft Regulatory Analysis and Environment Impact Statement, U.S. Coast Guard, May 1979.
2. "Evaluation of United States Coast Guard Draft Regulatory Analysis Design Standards for Tank Barges - Structural and Statistical Assessment", E.G. Frankel, Inc., Boston, Massachusetts
3. "Economic Impact of Tank Barge Standards." Booz, Allen and Hamilton, Inc., Bethesda, Maryland, September 1979.
4. United States Coast Guard Dockets 75-083 and 75-0839.

CLOSING PLENARY SESSION

Dr. Eric Schenker, Chairman, presiding

DR. SCHENKER: We will have five reports -- and we definitely will adjourn by 4:30. We do not plan to have any discussion. If any individual feels that his or her views were not represented, or additional information should be provided for the committee, I urge you to send reviews in writing to Mr. Everett Lunsford at the Academy. The deadline will be May 16. The committee will meet May 20 and 21. At that time we will review the proceedings.

We will start with Dr. Michaels' report on Congressional mandates.

DR. MICHAELS: This will be a report of the workshop on Congressional mandates. Let me start by saying that the focus of our workshop has been or review and an analysis of the legislative acts underlying and guiding executive action relative to the effects of oil tankbarge operations in the marine environment.

Any review of the mandates and intent of the Congress demonstrates a full range from very specific to very general. Further, it is clear that a multiplicity of legislative and executive actions are operative and that must be considered in the implementation of any one act.

Within this context, however, the workshop concludes that the Port and Tanker Safety Act of 1978 -- that is, Public Law 95-474 -- is the fundamental legislation which underlies the U. S. Coast Guard's regulatory action. The workshop has focused mainly, then, on the act, its mandates, and its implications for the regulatory, technical, and administrative activities relative to tankbarge pollution.

Now, review has led to a series of findings which may be defined as both the exploration of the Congressional mandate and Congressional intent, and these may be listed as follows:

First, the Congress, in the Port and Tanker Safety Act of 1978, explicitly states that the current status of oil pollution due to tank vessels is not acceptable. It further requires that timely action be taken to reduce oil pollution from tank vessels.

Second, under Public Law 95-474, the Coast Guard has the authority and responsibility to investigate and, if necessary, to promulgate regulations regarding tank-vessel construction standards.

Third, the Congress, under that Act, did not mandate that the United States Coast Guard require double hulls or any other specific construction standards on new construction or the existing tankbarge fleet.

Fourth, the Coast Guard has been delegated the authority to promulgate construction standards under this Act. It has not been delegated construction-standard authority under the Clean Water Act. The full extent of construction authority, in fact, under the Clean Water Act, Section 1321-J, has not been determined.

In promulgating regulations under the 1978 Act, the Port and Tanker Safety act, the Coast Guard may wish to examine the Clean Water Act in order to determine that its own regulations are not inconsistent. However, undue weight should not be given to the Clean Water Act, inasmuch as the Port and Tanker Safety Act represents the specific delegating authority to the Coast Guard relative to construction standards.

Fifth, in promulgating regulations under paragraph 6 of the Port and Tanker Safety Act, the Coast Guard should not use paragraph 101 (a) (1) and paragraph 311 (b) of the Clean Water Act as an independent basis for imposing standards more stringent than those which would otherwise be justified under the provisions of the Port and Tanker Safety Act and other applicable provisions of the law.

Sixth, in evaluating alternatives to construction features for tankbarges, cognizance must be taken of the various other laws that the Coast Guard administers for the protection of the marine environment and vessel safety. There include, among other things, aids to navigation, vessel traffic services, and personnel requirements.

Seven, there is a clear mandate in the Port and Tanker Safety Act to the Coast Guard to improve the consultative process. It is believed that the existing consultative process has not been sufficient to many of the interested parties. Consequently, an improved process should be established that is clearly understood by all interested parties.

Eighth, the Congress did mandate that the standards developed through regulation shall incorporate the best available technology, and these shall be required unless clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation, vessel safety, or the protection of the marine environment.

Ninth, the intent of Congress is clearly to require an integrated process involving consultation, technical analysis, and regulation. Such a process is a continuous and an iterative one that allows (a) complete identification of all alternatives, including no action, for achieving the goals of the legislation; (b) full analysis of the economic, environmental, and social costs and benefits of the alternative as may be within the state of the art; and (c) that there be a full review of these analyses by all interested parties.

From our review, the workshop concludes that there is a clear mandate by the Congress to reduce the oil pollution due to tankbarges.

Further, the Congress has provided the Coast Guard with direct authority to establish standards for achieving that objective. In addition, the legislation defines and requires a consultative process and a technical evaluation of alternatives.

Many members of the workshop feel that the processes employed up to this point have not fully met the intent of the Port and Tanker Safety Act of 1978, and the Coast Guard needs to examine its current procedures to be sure that the Congressional intent for this process is being met in the most effective manner.

DR. SCHENKER: Panel II, Technical Options and Problems, was moderated by Mr. Donald Courtsal.

MR. COURTSAL: We had a rather large group, somewhere between 50 and 60 people most of the time. Because of that, we really did not make any effort to achieve consensus, although, reflecting on how we left things this morning, I felt that there was general agreement with the suggestions that we made as alternatives to the proposed rulemaking.

There may be a few exceptions to that, and those people, I think, will submit separate documents on their feelings, where they were not exactly represented by the suggestions I have here. These are not offered in order of importance, but rather as they came up.

First, where identification is possible, perhaps the lead barges should receive special consideration for grounding hazards. That, of course, would be an alternative to double-hull construction.

For inland barges, products that did not have high pollution hazard, such as asphalt, tallow, fish oil, and so forth, could be handled in single-skin barges.

Number three, the great difference in cost estimates for double-skin and single-skin barges needs to be resolved. A firmer data base, eliminating inflation, market conditions, yard preference, needs to be established. We found its very disconcerting that such a wide range of cost forecasts were made by so many groups.

Next, the greater scantling requirements for single-skin barges may be an alternative to double-hull construction. Bill McNeal's paper, which will be included in the proceedings, has a number of suggestions in this area, and previous suggestions have already been included in the record from the Coast Guard hearings.

I also have here a list that Mr. Gillies from American Bureau of Shipping (ABS) put together, and I will just run down that quickly. Things to consider, scantling changes or detail modifications to consider, would be such things as minimum deck-plate thickness; minimum truck thickness; minimum side-shell thickness; minimum gunwale connection radius -- perhaps that should be larger; minimum bilge

radius, providing a rolled angle at the gunwales rather than a bent plate, and at the bilge also; additional rub bars with backup, some kind of framing backup; increased scantlings for longitudinals, transverses, and trusses; permitting only longitudinal framing to check the buckling characteristics of decks; delete serrations in framing; reinforce lead barges -- we mentioned that one already -- eliminate hard spots; incline headers inboard--that is not a structural change so much as detail change; provide 12-inch ullage openings; provide walkways; limit tank sizes -- the reason, of course, is to reduce the size of spill by having smaller tanks; having greater dry-docking intervals for double-skin tank barges, and I will mention that again, later; perhaps a change in gauging requirements for older barges in the amount of deterioration that would be acceptable; improving inspection requirements and also improving perhaps the quality of inspection -- that is a question that we mention a little later.

The next item--it was noted that the retirement of perfectly good equipment -- and we are referring now to single-skin barges -- seems very wasteful. Maintenance of barges to be retired would certainly fall off as they neared their retirement age, and that perhaps could result in greater pollution than we might be saving by going double-hull. If retirement were not mandated, would single-skin barges ever be retired? How should this be dealt with? Accelerated depreciation schedules or other economic incentives might help to accelerate retirement without actually mandating it.

Further research may be appropriate before taking further action on regulation -- such things as structural research, as Dr. Frankel's paper covered, gas hazards in voids -- just how big a hazard is it, how should we deal with it? -- technology for controlling and cleaning up spills, and we are referring here to both damage-control techniques--ways of limiting the spill from the damage--and also the cleanup; the economic impact of any of these changes, particularly a cost-benefit analysis, which needs to be more accurate than what we have seen so far; reinstitute the industry advisory committees so that the Coast Guard can have a better understanding of industry's need before getting as far down the road as we are here, before the issue of rulemaking, perhaps.

Single-unit operations, manned barges, or other special applications might be reason for permitting single-skin operation. Tank rearrangement, a greater number of tanks -- we mentioned this earlier but I will do it again -- could be an alternative to double-hull construction, thus limiting at least the size of the spill.

Rules in the various subchapters need to be consistent. We are referring here specifically to one that was noted where the existing subchapter requires a different double-bottom depth than the double-bottom depth that was in the suggested rulemaking, and we show our reasons for that. It is a minor detail, really, but the point was brought up.

The Coast Guard should be in charge of spill cleanup on the rivers rather than EPA. There is apparently the feeling that EPA is not as responsive and it is hard to get hold of them sometimes when there is a spill.

Slower attrition rate, longer retirement period, might be a better solution to upgrading the fleet, and of course, that goes all the way down to no retirement.

Extended periods between required dry-dockings of double-skin tankbarges might be an incentive for moving from single-skin to double-skin barges.

We need to know more about the percentage of oil moved in single-skin and double-skin barges. The point was made that it is really very difficult to think about the amount of pollution prevention and that sort of thing when we do not really know how much oil is moved in single-skin and how much is moved in double-skin.

We need to make more accurate evaluation of deadweight carrying capacity of single-skin and double-skin tankbarges. There was a lot of discussion in our group about whether there is in truth a loss of deadweight or not. That needs to be dealt with. Loss of volume -- and this is not loss of volumetric but a loss of deadweight.

If double-hull construction is not required for oceangoing ships, it should not be required, perhaps, for oceangoing barges.

Consider higher-technology solutions to retain spills after an accident has occurred, such as elastomers and other things rather than double-hull construction. Dr. Frankel is going to include a list of suggestions that he had, and that will be included with the proceedings.

There should be a breakdown of service areas when considering solutions to the spill problem. In other words, the general suggestion of double-hull construction for all barges perhaps is a bit too general. The ocean coastal service has a little different requirement from the river service, which is again different from intercoastal service, which probably is again different for a Great Lakes situation. So to make it the overall general approach may be a bit gross.

Increase inspections and improved effectiveness of inspections may be an alternative to double-skin barges.

Consider improved fendering systems on locks in lieu of double-skin construction.

Does the Coast Guard need to improve its data base used in accident analysis? Industry needs to furnish better data to the Coast Guard. The data base need to be improved so that the location of the accidents

can be accessed. Apparently, in the present Coast Guard data base, that cannot be done.

Should we investigate the cost of single-skin modifications in making evaluations? In other words, when we are evaluating single-skin versus double-skin, we should consider scantling and design changes to single-skin, but, has that been put in the evaluation, the economic evaluation? It needs to be, was the feeling of our group.

To what extent are minimum structural requirements already being exceeded by the industry? I think the point was made that, generally, all of the barges being built today exceed minimum standards of both Coast Guard and ABS with really very few exceptions, and those are probably limited-service barges, and just how great is that excess, and how much does that influence what we are talking about?

Is some modification in design standards or in welding standards appropriate?

DR. SCHENKER: I am sure we all realize that your group worked hard and came up with some excellent recommendations.

The third panel discussed personnel standards, training, and enforcement, and the moderator was Hazel Brown.

MS. BROWN: In the personnel standards, training, and enforcement area, we had good participation, a lot of discussion, and I will try to put it into some kind of consensus of opinion.

We are pretty much in agreement on most of these points. The industry has recognized the need for dealing with personnel and training issues, and since the early 1970's, there has been a trend to develop and utilize training of personnel as a means of reducing pollution incidents. The existing programs are showing positive results, although the data and the statistics needed to indicate the impact that training has on our industry and on pollution prevention need to be collected in a more efficient way to provide more up-to-date statistics and a data base to show that training is having an impact.

In order to make everyone aware of the type of training that is now in existence, we had presentations by representatives of the various types of programs that do exist for our industry today. We had a report on the National River Academy, which is sponsored by management and operated by management.

We had a presentation by the Lundeberg School, which is sponsored by management and labor jointly. We has a strictly single-management program explained by Chotin. This company had an in-house program for training of personnel.

We feel -- this committee -- that it is unrealistic goal to expect zero pollution and/or to build the perfect barge. The human element is always going to exist, and it has to continue to be dealt with.

There should be greater enforcement of the existing regulations with greater emphasis on the personnel involved. We got down to talking about the people who cause the pollution incidents. It was felt that a more rigorous and equal enforcement of penalties for improper performance by the operators and the tankermen should be continued and encouraged. It was requested that this include utilization by the Coast Guard of the administrative law judge procedures and less use of just warnings. We discussed the problem that can occur when just a slap on the wrist is the only way of enforcing a regulation, and what this does in a disincentive way to the whole industry.

The industry will continue to cooperate with the Coast Guard in the enforcement of the existing regulations. Some concern was indicated about the Coast Guard's ability in this regard, especially in the productivity area. It was brought out in much discussion that this could be because of some inadequate training programs that perhaps exist within the Coast Guard and the present rotation system that is practiced by the Coast Guard.

Regulations regarding personnel appear to be adequate. The proposed tankerman regulations are eagerly awaited, and the industry feels these regulations could be a tool for training and the establishment of minimum competency standards for which the industry can strive.

With regard to these forthcoming tankerman regulations, it was the group's suggestion that perhaps a format such as a seminar could be used to solicit additional comments and questions through dialogue to clarify and facilitate speedy implementation of these long-awaited regulations. Everyone was saying, make haste; we are eager; we want to see what is coming.

The technological advances which are available within the maritime industry and other industries to vessel operators need to be utilized by the towing industry, especially in the area of communication. Adequate training in the use of this communication technology is essential.

More enforcement in radiocommunications circuit discipline is necessary.

The Coast Guard should reinstitute the open-book pollution exercise for renewal of all licenses. There was discussion and agreement that the renewal and recertification of licenses is adequate as now required in regulations, and that it would be of interest that the open-book

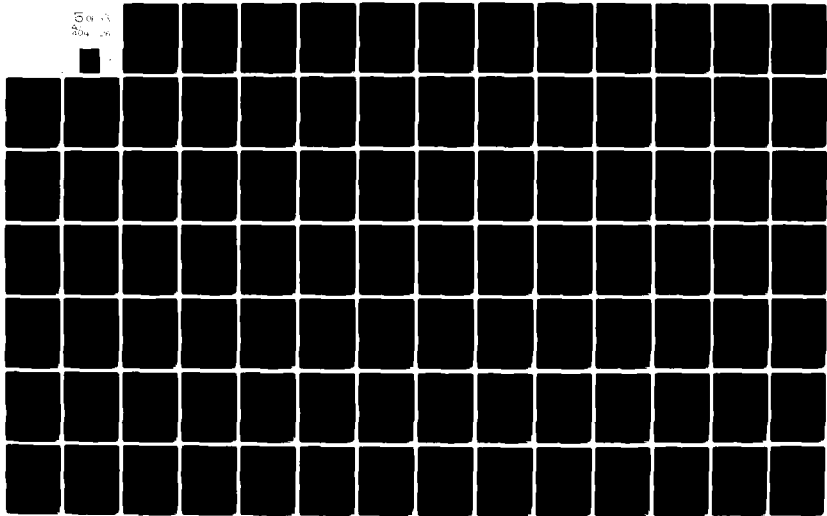
AD-A096 126

NATIONAL RESEARCH COUNCIL WASHINGTON D C MARITIME TRA--ETC F/G 13/2
WORKSHOP ON REDUCING TANKBARGE POLLUTION. APRIL 15-16, 1980.(U)
AUG 80 N00014-75-C-0711

NL

UNCLASSIFIED

500 11
804 26



exercise on pollution be continued. We just learned it was being discontinued.

The incentives not to pollute seem to be adequate if equally and properly implemented. "Equally" and "properly" seem to be the key words.

There was support for the reinstatement of the Towing Industry Advisory Committee, to be used as a tool for liaison between the Coast Guard, industry, labor, and the general public.

There is a recommendation for a study to be done to provide the necessary statistics and data to show the impact that training and existing regulations have already made in improving the pollution problem.

Through training, management, supervision, and enforcement, the human error factor which has been quoted in the studies as a major cause of pollution will continue to show a decided decline. We feel that we are on the right track; we just need some more time, and when we need to be able to show how much improvement we have made through proper training.

We strongly believe that the enforcement of the existing regulations with regard to personnel and equipment will reduce pollution without the implementation and the financial burden of double-hull construction.

DR. SCHENKER: The fourth panel discussed operating environment, and George Brazier of the Corps of Engineers was moderator.

MR. BRAZIER: Of the general topics considered by this conference, we believe that ours, the tankbarge operating environment, is particularly important because of the operational nature of many tankbarge pollution incidents.

I would like to start by saying that the bottom line of our discussion is that the best way to reduce pollution from barges is to reduce accidents.

The primary topics we addressed were: one, tankbarge relationship to pollution of the waterways; two, finding of measures to reduce tankbarge pollution potentials; three, aids to navigation; four, communication of and use of navigational information; five, port safety and vessel-traffic management; six, industry operational decisionmaking; seven, ice operations and domestic icebreaking; eight, initial and maintenance dredging; nine, general operating environment improvements.

Dr. Charles Bates gave a presentation on the relationship of tankbarge operations to marine pollution. While a case can be made

that barge spills can be extremely harmful to the aquatic environment, Dr. Bates presented a strong argument that barge spills actually constitute only a small part of the overall marine-pollution problem and that benefit/cost analyses should recognize this fact. Dr. Bates further suggested that the petroleum industry should not be treated disproportionately in comparison to other users and potential polluters of the marine environment when the costs of meeting national marine environmental protection objectives are assessed. Dr. Bates also suggested that particular attention should be given to options which penalize actual violators of antipollution laws, rather than focusing on options which require expensive across-the-board protective measures by an entire industry.

He found barge spills to account for less pollution than evidenced in Coast Guard estimates. He attributes this finding to the Coast Guard's use of a data base which includes total petroleum hydrocarbons in river outflows rather than relying solely on pollution-incident reports.

The options developed during discussion of Dr. Bates' presentation did not result in consensus. These options, however, include a: change in the method of pollution response. Where waters are still, contain spills. Where adequate mixing will occur, apply dispersants to the maximum, making use of Mother Nature's demonstrated ability to tolerate significant threshold levels. Also, speed up cleanup response, including mass mobilization of the populace, as practiced in some other countries.

Two, regionalize rulemaking to give adequate consideration to those areas where industry has maintained good safety records and has already committed itself to reduction of pollution potentials or has established an industry-sponsored cleanup capability.

Three, establish a system whereby a polluter must replace biota that have been harmed. He identified this subject; however, it was recognized by everybody present that this is a hard recommendation to administer and even to define.

Four, establish detector systems to alert a towboat operator that he has a pollution problem. This option is considered more appropriate for ocean and coastal operations. In river operations, problems generally are more readily apparent to the operators concerned, if for no other reason than they are looking right at their tows, ahead of them, for the most part.

Five, equip vessels with sophisticated navigation equipment. Make it redundant where appropriate, especially for radar and radios.

We generally agreed that the present trend of industry responsiveness to pollution concerns is good and should continue.

We had no scheduled speaker for the topic of funding measures to reduce pollution potential, or who should pay the bill. However, we recognize that both government and industry resources are limited, and we must make the best use of limited funds. We did not arrive at specific alternatives, but did raise some issues that warrant further consideration.

These were, one, if more goods are to be transported by land to reduce marine pollution, the impact on the highway system may be severe and should be looked at. Two, adverse economic impacts could result if some firms go out of business because of double-hull requirements. Discussion from the floor indicated that about 10 percent of the marginal operators have already gone out of business because of the increasing costs of spills and the high value of cargo being carried. Three, the economic impacts of explosion hazards associated with double hulls may not have been adequately addressed by the Coast Guard. It was recognized that the second hull has the capability for entrapping gases that would explode and provide more problems than you would like to have.

Captain Charter began our consideration of port safety and vessel-traffic management with an overview of the Coast Guard's Vessel Traffic Service (VTS) program. Of particular interest is that operations of the Coast Guard's New Orleans VTS may be suspended soon as an austerity measure. However, a study of that system is underway and will be completed. Its results will be used to restructure the New Orleans VTS to better serve its users if or when service continues.

We achieved a consensus that vessel-traffic management is an effective option for reducing tankbarge pollution potential. We agreed that industry should be brought into VTS planning for consultation at early stages of VTS development. We also agreed that efforts to establish an advisory committee for the New Orleans VTS should continue.

The following specific options were also discussed, although consensus was not reached on all: One, civilianization of Vessel Traffic Services should be encouraged to enhance the expertise of watch personnel. The Coast Guard is considering an industry recommendation to try this at the New Orleans VTS. This subject came up several times, essentially in the context that the frequent rotation of uniformed personnel does not give time for those people to really learn the area or their jobs as those jobs related to the area.

Two, electronic retransmission of position data at VTS's would reduce cumbersome communications requirements on vessel personnel. Research is nearing completion on a prototype system of this type, and regulatory implementation is expected for the Prince William Sound VTS.

Three, VTS's are not designed to correct in extremis situations, but TV installation at critical locations could assist in early VTS

recognition of potentials for extremis situations. They are designed to prevent an extremis situation from occurring.

Four, good communications are a key to vessel safety. Communications should be enhanced wherever possible.

Five, where VTS's are not available, channel monitoring by the Coast Guard could help clear unnecessary traffic from navigation-communication frequencies.

Six, centralize management authority, or provide a central point of contact so that VTS and captain-of-the-port directions are provided from a single source to users. It was indicated that there are conflicts sometimes that are difficult for the mariners to adjust to.

Seven, where VTS participation is mandatory, provide watchstanders more direct authority for space management. This option was not received with enthusiasm by all participants, however.

The topic of ice operations and domestic icebreaking was addressed as an open-discussion topic. Commander Hewell provided an overview of Coast Guard icebreaking policy and capabilities. Generally, industry would like to see an expansion in Coast Guard icebreaking capabilities. However, such an expansion is unlikely, we understand, because of probable unfavorable economic analyses.

We did not achieve a consensus on all aspects of this topic, but some of the options we discussed are as follows. One, industry might provide its own icebreaking tugs and barges. Two, develop new techniques to facilitate barge transit in ice, including installing bubble systems. Three, do better testing of air-cushion-vehicle icebreaking capabilities in river systems.

It was generally acknowledged that the Coast Guard does excellent work in icebreaking in open waters, the sea, etc. There was some feeling, however, that more attention should be paid to the inland waters of the United States, the rivers.

Four, increase ice surveillance capabilities and transmit to users.

Five, expand ice-modeling research and development programs. It was noted that the Corps of Engineers is already doing some of this. The Coast Guard is involved with the Corps in some of this effort.

Six, use surplus hot water from electrical generating plants to keep key ice-infested areas open.

Seven, although in the Department of Energy's realm, expand land-storage-tank capacities in areas where heavy ice may preclude cargo delivery. This would reduce the need for tankbarge operations in the winter when ice problems are heavy.

Another open-discussion topic was industry operational decision making. It was suggested that pressures of competition, for example, could result in the taking of unnecessary risks. We generally agreed, and AWO concurred, such risks are unacceptable. However, we agreed that there will always be someone, somewhere, who will take unnecessary risks and thereby increase the pollution possibility.

We also generally agreed that strict enforcement of existing standards would reduce the attractiveness of taking risks. AWO members were most supportive of this position, and this echoes the comments previously made. It seems that people outside of the Coast Guard were at least as supportive as the Coast Guard on this issue. They believe that when people goof, they should be slapped and held accountable for their actions.

One of the specific options we considered was enhanced Coast Guard investigator knowledge of commercial towing. We thought that sometimes the Coast Guard official investigating accidents and problems does not really know enough about the business of commercial towing.

Two, enhance industry standards through self-regulation. Three, industry must face up to tanker man turnover problems resulting from pay scales not being competitive.

In the general-improvements category, Crowley Maritime reported that stress seems to play a part in many casualty incidents. The firm has employed a consultant skilled in alcoholism and other personal-problem counseling to look into the problems to see if ways can be developed to reduce stress-related incidents. It was acknowledged that sometimes you bring from home to the job the carryover from some situations that can adversely affect how you do your job.

Also as a general topic, we addressed Coast Guardsmen's ability to communicate via radio. There was a strong feeling that too many unnecessary questions often are asked during emergency situations in which the industry is fighting a problem. The thought was expressed, that many times there are so many questions from the Coast Guard to the people actually doing the fighting that it is hard for them to do their jobs.

The problem is believed to be simply a lack of understanding of commercial towboat operations. Although the Coast Guard has made advances in providing this kind of understanding, particularly through the vessel-traffic program, it may be beneficial from a safety standpoint to broaden the scope of this effort. Also, industry would like to see Coast Guardsmen's tour lengths extended. This is a very strong issue among industry people and an issue which needs much more indepth examination by the Coast Guard, we feel.

The working group is of the consensus that aids to navigation offer a wide variety of options for reducing tankbarge pollution. It is the working group's general opinion that the Coast Guard's aids-to-navigation program represents a sound, reasonable approach to navigational needs, when considered in the light of other Coast Guard mission priorities and funding availability. Particularly, it was noted that insufficient funding priority has apparently been given to this important subject.

However, there is a difference of opinion as to whether or not all important navigational needs are being met under the existing program. Our consideration of this topic opened with a presentation of the Coast Guard's program by Captain Leonard Garrett. We note that the Coast Guard has various initiatives underway which will improve the program.

Industry was represented by Captain Harold Muth, of the American Waterways Operators. According to Captain Muth, commercial operators believe that certain aids would significantly reduce the potential for barge spills through the increased safety margins that they would provide. Operators contend that adequate marine environmental protection at reduced cost would be provided by such improvements in combination with other options, including some upgrading of tankbarge construction standards.

Some of the options we discussed were: one, develop a reliable buoy to mark ends of rock dikes in the Mississippi River system. It was remarked that maybe the Corps of Engineers could design its dikes to aid in buoy setting.

Two, mark the center of bridge navigation spans by the use of transponders.

Three, require adequate bridge protection and fendering works and give the Coast Guard authority to ensure that these works are properly maintained.

Four, expedite modifications or replacement of antiquated bridges under the Truman-Hobbs Act.

Five, enhance the capabilities of existing aids in major oil spills. This is needed due to the problem of background lights which tend to obscure lighted aids. Shielding of background lights should be undertaken where possible.

Six, increase the number of aids-to-navigation ranges in both coastal and inland river areas.

Seven, increase the number of buoys marking channels. Buoys are sometimes so far apart that vessels low in the water have difficulty identifying them.

Eight, establish precision navigation systems and/or use radar transponders to enhance positioning during low-visibility operation. The Coast Guard is already looking at fixed- versus swept-frequency racons.

Nine, provide better navigation and weather information to dispatchers and operators.

Ten, establish a better dialogue between the Coast Guard and users. Some initiative are underway, and we agree that more are needed, particularly to provide user feedback. Some of the industry people acknowledged that some of the problems they have had in the past have been at least partially overcome by the increased effort of the Coast Guard to talk to them. This came out as a very important issue. Industry would like the efforts of the Coast Guard to continue so that there could be dialogue going back and forth freely at all times.

Eleven, Coast Guard and AWO could look at low-cost doppler systems to aid in determination of vessel slippage, particularly on curves.

Twelve, TV presentations of bridge centerlines may be useful to operators.

Bill Murden of the Corps of Engineers provided a detailed view of our national dredging program. The options we developed include improved channel designs and the use of electronic surveying and positioning techniques to assist in the positioning of navigational aids.

While these options may prove useful, a more pressing problem was put before us: timely maintenance dredging itself is in jeopardy, in part because of budgetary austerity and stiff environmental requirements at both the federal and state levels. Not only have these latter requirements made it increasingly difficult to initiate maintenance dredging, but it is also becoming increasingly difficult to secure acceptable disposal sites for dredge material. These problems are aggravated when maintenance dredging involves contaminated bottom sediments.

It seems to the working group that options to maintain existing federal navigation projects at acceptable depths and widths are more appropriate than promoting options such as new channel configurations. One option that was proposed was a relaxation of marine environmental protection standards to the extent necessary to allow adequate maintenance of existing navigation projects. Industry generally favors this approach. Of course, it was also pointed out that what is done concerning the environment is in compliance with the laws, and as long as the laws are there, somebody is going to have to obey them.

Although environmentalists were not well represented during our session, it is fair to say that a relaxation of marine environmental

standards would likely be strongly opposed because of potentially significant harm to the aquatic environment.

DR. SCHENKER: The fifth panel discussed insurance, liability, and penalties, and Mr. Lagattolla was the moderator.

MR. LAGATTOLLA: There was a lot of controversy. Our group concentrated on insurance, liability, and penalties, and of necessity, a lot of time was spent on discussion of the statistics in the Coast Guard reports, the statistics provided by the insurance industry, and some of the statistics that the AWO had available.

I must say that there was discrepancy. But there was also agreement that we have a great many small spills which do not account for a great percentage of the total oil spilled, and we have a very small number of very serious spills that account for a great part of the total oil that was spilled.

A specific question to which we directed ourselves were what are the incentives and disincentives of insurance, and what is the effect of insurance-rating systems on pollution reduction? The specific answer that the committee came up with was that pollution-liability insurance cannot be relied on as a primary disincentive to pollution from tankbarges.

The next question that we discussed was what is the insurance experience with double-hull barges. On the basis of information presented to this group, it concluded that at the present time, the insurance industry has not made a distinction in premium rates for pollution insurance between single- and double-hull tankbarges.

The next question we considered was do current penalties work and who should pay them. The group agonized quite long on that particular subject. Some members of the group thought that some reasonable or meaningful penalty, monetary penalty, should be imposed on the individual, as for example the tankerman who caused the spill. But from a legal point of view, it was decided that that was not particularly viable at this time. In any event, the group concluded that while civil and criminal penalties and suspension and revocation proceedings do work to a certain point, they cannot be relied on as a primary disincentive to pollution from tankbarges.

Along the same lines, the next question that was discussed was, does licence insurance provide a disincentive for pollution reduction? The committee decided that the availability of license insurance does not encourage pollution.

Going back to who should pay a penalty, the wording that we came up with was that in choosing among a number of statutorily enumerated parties who may be subject to a particular penalty, discretion should be exercised in a manner which will best serve the purposes of the

law. That sounds a little convoluted, but what it means is simply that under the law, the owner-operator or person in charge can be penalized, and it is a question of each one pointing to the other and deciding on just who should be penalized.

As far as any recommendations that the group had, we discussed certain situations that could arise where delay in response in cleaning up a spill could aggravate the situation. That involves the situation under the Clean Water Act where the spiller can limit his liability only in respect of the government's claim for cleanup costs. This means that if the spiller voluntarily engages a cleanup contractor, he can incur costs in the direct engagement of the contractor far in excess of what his liability would be if the Coast Guard were to do the cleanup.

The committee was informed that, in some cases, while the spiller is deciding whether he should or should not voluntarily carry out the cleanup, the spill situation is aggravated. As a result, the committee has recommended that legislation be introduced to amend Section 311 of the Clean Water Act to permit an owner or operator to offset against total liability that sum expended by him within the limits of his statutory liability.

The committee also agreed that any legislation or regulatory action should retain the principles of reasonably defined limits of liability and adequate defenses in order to be assured of the continued availability of pollution-liability insurance.

DR. SCHENKER: Again, let me repeat, if some of you have additional information you can provide to the committee, I welcome your remarks in writing. Please send them to Everett Lunsford.

Thank you for coming.

COMMENTARY SUBMITTED BY PARTICIPANTS



Ashland Petroleum Company

DIVISION OF ASHLAND OIL, INC.

P. O. BOX 391 • ASHLAND, KENTUCKY 41101 • (606) 329 3333

WORKSHOP ON REDUCING TANKBARGE POLLUTION

National Academy of Sciences
April 15 & 16, 1980
Personnel Standards Training and Enforcement

THE FOLLOWING COMMENTS ARE OFFERED BY ASHLAND PETROLEUM COMPANY - AN INDEPENDENT REFINER, AND TRANSPORTER OF PETROLEUM PRODUCTS FOR THE PAST 55 YEARS.

WE ARE ENGAGED IN TERMINALING AND TRANSPORTING PETROLEUM AND PETROCHEMICAL PRODUCTS ON THE RIVERS AND THE GREAT LAKES. ASHLAND NOW OPERATES A FLEET OF 3 GREAT LAKES TANKERS, 1 GREAT LAKES TUG/BARGE, 20 RIVER TOWBOATS, AND A FLEET OF 216 TANK BARGES. OF THESE 216 BARGES, 174 ARE OWNED, 26 ARE LONG-TERM CHARTER, AND THE BALANCE (16) ON SHORT-TERM CHARTER. THESE VESSELS SERVE SOME 37 COMPANY-OWNED OR LEASED TERMINALS, AS WELL AS MANY OTHER DOCKS OF CUSTOMERS AND VENDORS, IN TRANSPORTING MILLIONS OF BARRELS MONTHLY TO SERVE THE ENERGY NEEDS OF THE UNITED STATES.

ALL CARGO TRANSFERS ARE UNDER THE SUPERVISION OF CERTIFICATED TANKERMAN.

OVER A 4 YEAR PERIOD (1975 THROUGH 1978), ASHLAND RECORDED 49 POLLUTION INCIDENTS INVOLVING TANK BARGES AVERAGING 27 BARRELS PER SPILL. IN 1979 WE HAD 13 SPILLS; 6 HULL FRACTURES FOR 67 BARRELS, AND 7 SPILLS DUE TO HUMAN ERROR OF 4 BARRELS, FOR AN AVERAGE SPILL OF LESS THAN 6 BARRELS. IN THE SAME 12 MONTHS, ASHLAND LOADED, TRANSPORTED AND DISCHARGED 75 MILLION BARRELS. ASSUMING THE TOTAL QUANTITY SPILLED FOR THE 5 YEAR PERIOD OCCURRED IN 1979, THIS WOULD REPRESENT LESS THAN 1/1000 OF 1% OF THE TOTAL QUANTITY TRANSPORTED IN ONE YEAR.

ASHLAND'S ON-GOING PROGRAM FOR THE ESTABLISHMENT OF PERSONNEL STANDARDS, TRAINING, AND ENFORCEMENT ARE SIMILIAR TO MANY OF THE COMPANIES ENGAGED IN TRANSPORTATION OF LIQUID PRODUCTS.

THE APPLICANT IS AS CAREFULLY SCREENED AS PRESENT EMPLOYMENT GUIDELINES WILL PERMIT. EACH IS INTERVIEWED AT LEAST TWICE BEFORE SELECTION IS MADE. DURING HIS INTERVIEW, HE HAS VIEWED OUR TRAINING FILM "WELCOME ABOARD" WHICH GRAPHICALLY DESCRIBES HIS NEW WORKING ENVIRONMENT, "DO'S AND DON'T'S" OF SAFE WORK PERFORMANCE, INCLUDING A WARNING RELATIVE TO OIL POLLUTION (AT THIS POINT IT IS NOT DESIRABLE TO EXPOUND ON POLLUTION PREVENTION UNTIL HE IS ON BOARD AND THE SIGNIFICANCE OF HIS WORKING ENVIRONMENT IS APPARENT).

AFTER ARRIVING ABOARD AND BEFORE HIS FIRST DUTY ASSIGNMENT ON THE BOAT, HE MUST REVIEW AND UNDERSTAND THE SAFETY REQUIREMENTS OF HIS JOB AND SIGN OFF ON THE SAFETY REVIEW CHECK-OFF LIST. (EXHIBIT A)

AFTER COMPLETION OF HIS SAFETY CHECK LIST HE IS SHOWN HIS DUTIES ABOARD THE BOAT AND IS GIVEN A TOUR OF THE BARGES. AS THE DAYS GO BY AND HE DEVELOPS PROFICIENCY IN HIS JOB, HE WILL ASSIST A CERTIFICATED TANKSMAN IN CARGO TRANSFER OPERATIONS - INSTRUCTED IN THE IMPORTANCE OF EVERY ACTION AS VERIFIED BY THE DECLARATION OF INSPECTION (DOI) USED IN EVERY TRANSFER. (EXHIBIT B)

AFTER APPROXIMATELY THREE MONTHS EMPLOYMENT, HE RECEIVES AN OUTLINE FOR STUDY AND THE FOLLOWING TRAINING MANUALS. (EXHIBIT C)

1. OIL POLLUTION CONTROL FOR TANKERMAN - CG-480 DATED JUNE 1975.
2. RULES AND REGULATIONS FOR TANK VESSELS - CG-123 DATED AUGUST 1, 1977.
3. FIRE FIGHTING MANUAL FOR TANK VESSELS - CG-329 DATED JANUARY 1, 1974.
4. A MANUAL FOR THE SAFE HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUID AND OTHER HAZADOUS PRODUCTS - CG-174 DATED SEPTEMBER 1, 1976.

WE ALSO USE A TANKERMAN TRAINING FILM DEVELOPED UNDER THE AUSPICES OF THE AMERICAN PETROLEUM INSTITUTE, DOCK OPERATORS, AND BARGE LINES.

EACH EMPLOYEE IS EXPECTED TO PASS THE TANKERMAN'S EXAMINATION TO OBTAIN HIS CERTIFICATE. UPON CERTIFICATION HE RECEIVES AN INCREASE IN PAY, BUT IF HE DOES NOT GET HIS CERTIFICATE, HIS FUTURE RAISES ARE MAINTAINED AT THE SIX MONTH LEVEL.

AS THE EMPLOYEE PROGRESSES, HE IS SUBJECTED TO ORAL EXAMINATIONS BY HIS SUPERVISORS, AND WHEN FOUND SUFFICIENTLY PROFICIENT AFTER SIX MONTHS OR MORE ON-THE-JOB EXPERIENCE, A COMPANY LETTER OF RECOMMENDATION, REQUIRED BY THE COAST GUARD, IS PREPARED INDICATING HIS LENGTH OF SERVICE AND PREPAREDNESS FOR THE EXAMINATION.

IT IS A REASONABLE EXAM, HOWEVER NOT OVER 50% PASS IT THE FIRST TIME. FAILED - THEY ARE REQUIRED TO WAIT UP TO TWO WEEKS BEFORE RE-EXAMINATION.

IN ADDITION, EACH EMPLOYEE IS TRAINED IN AN APPROVED RED CROSS FIRST AID COURSE. WE HAVE ALSO DEVELOPED AN 8 HOUR FIRE-FIGHTING PROGRAM CONSISTING OF 4 HOURS CLASS ROOM WORK AND 4 HOURS OF ON-HANDS FIRE-FIGHTING EXPERIENCE. (EXHIBIT D)

IT SHOULD BE NOTED WITH THE EFFORT TO SELECT ONLY THOSE INTERESTED IN THE JOB, PHYSICALLY QUALIFIED TO DO THE WORK, AND REWARDED FOR THEIR EFFORTS TO QUALIFY FOR THE TANKERMAN'S ROLE - WE STILL HAVE 100% TURNOVER ANNUALLY IN OUR TOWBOAT TANKERMEN.

TURNING NOW TO THE TERMINAL FACILITIES, WE FEEL WE HAVE MORE SURVEILLANCE THAN NECESSARY. WITH THE REPORTING PROCEDURES REQUIRED OF EACH SHORE FACILITY PRIOR TO CARGO TRANSFER, AND THE FREQUENT VISITS OF THE PORT SECURITY TEAM BOARDING OUR TANKBARGES WHETHER AT TRANSFER OR MOORED. IT IS NOT UNUSUAL TO HAVE TWO DIFFERENT PORT SECURITY TEAMS VISIT ONE OF OUR DOCKS IN THE SAME DAY.

WITH REGARD TO SUPERVISION OF THE DOCK FACILITIES, THERE IS AN ANNUAL FORMAL INSPECTION MADE BY THE COAST GUARD AND THE FIRE MARSHALL OF ALL ASPECTS OF THE OPERATION. WE ALSO HAVE AN INFORMAL COAST GUARD INSPECTION MADE EACH TIME THE COTP TEAM VISITS THE CARGO TRANSFER TAKING PLACE AT THE DOCK.

WITH RESPECT TO ADEQUACY OF THE REGULATORY PROCEDURES WE FEEL THE ABOVE DESCRIBED ACTIVITIES ARE MORE THAN ADEQUATE. HOWEVER, INDUSTRY INCLUDING MANAGEMENT AND LABOR REPRESENTATIVES, TOGETHER WITH THE COAST GUARD TACKLED A REVIEW OF THE TANKERMAN REGULATIONS IN 1974. THIS EFFORT STARTED UNDER THE GUIDANCE OF THE TOWING INDUSTRY ADVISORY COMMITTEE TO THE COAST GUARD AND CONTINUED THROUGH NUMEROUS DRAFTS, RE-DRAFTS, ON-SITE VISITS, AND A FINAL PROPOSAL SUBMITTED FOR EDITING AND ACCEPTANCE IN 1977 BUT STILL NOT ADOPTED. WE FAIL TO UNDERSTAND WHY IT TAKES SO LONG TO COMPLETE RULE MAKING, WHEN THE COAST GUARD ALSO RECOGNIZES THAT 85% OF THE SPILLS ARE ATTRIBUTED TO PERSONNEL ERROR.

WE, THE INDUSTRY, FEEL WE HAVE MORE REGULATIONS THAN NECESSARY. WE FEEL THERE HAS BEEN A MARKED IMPROVEMENT IN SPILL EXPERIENCE, CERTAINLY THERE HAS BEEN IN OUR OPERATIONS; AND FOR THESE REASONS WE FAIL TO SEE HOW EXPANSION OF TRAINING REQUIREMENTS OR ADDITIONAL REGULATIONS WILL HELP IN THIS EFFORT.

WE DO FEEL THE COAST GUARD HAS FAILED TO TAKE ACTION AGAINST THE TANKERMAN PREFERING TO TAKE ACTION AGAINST THE VESSEL OWNER/OPERATOR WHEN IT IS CLEARLY A FAULT IN JUDGEMENT.

WE URGE CAREFUL CONSIDERATION OF AN OVER REGULATED INDUSTRY IN YOUR RECOMMENDATIONS AND REPORT TO THE U.S. COAST GUARD.

EXHIBIT A

INSTRUCTIONS: TO BE COMPLETED BY MATE AND NEW EMPLOYEE
SIGNED, AND GIVEN TO THE CAPTAIN.

SAFETY RULES REVIEW 3333

USE BALL POINT PEN ONLY

INITIALS
NEW HIRE MATE

1. I will always wear my Life Jacket properly while on the tow, on the bow of the boat, and at any other time when I am in danger of falling overboard.
2. I will wear proper clothing, especially leather palm gloves and safety toe shoes.
3. I will wear goggles when chipping, burning, grinding, painting, or at any other time danger of self injury exists.
4. I will when working around machinery or shafting that is in operation, check clothing for loose ends or a loose wiping rag to avoid being caught.
5. I will not smoke: (a) in bed, (b) on decks of oil barges, (c) in paint lockers, (d) at oil docks, (e) in unauthorized areas.
6. I will keep my hands and feet from between the barges in tow and from between towknees and the barges. I will keep my fingers from between timberheads and wires when handling face wires.
7. I will not lean over the edge of the boat or barge to grab a line or to use a pike pole.
8. I will place rachets in the rigging so that they must be tightened inboard.
9. I will always lift loads properly, that is by bending knees and keeping my back straight. If the load is too heavy, I will ask for help.
10. I will report faulty equipment or tools to my supervisor.
11. I will, when walking on the barges in tow, walk nearer the middle whenever possible and avoid any open spaces between the barges. If it is necessary to walk along the outside, I will carry any rigging load on the outside shoulder.
12. I will not work around the edge of the boat or barge with my back to the river.
13. I will always step over-NOT ON- manhole covers.
14. I will advise the pilot before going alone on tow at night and keep my flashlight lit so that the pilot will know my whereabouts on the tow.
15. I will keep alert when maneuvering barges in a lock, and not lean against the lock wall, another barge, cell, or any other structure.
16. I will "Watch the Bump," brace myself when a bump is coming, and pass the word, "Watch the Bump."
17. I will not stand or step in a loop of line at any time.
18. I will stand clear of lines or wires when they have a strain on them, and when handling a line on a timberhead or capstan, stand off to the side.
19. I will not swim off the boat, barges, or docks. This is prohibited.
20. I will not run on the barges, jump from barge to barge, or jump over timberheads.
21. I will not wrestle or horseplay on the boat or barges.
22. I will report all injuries immediately and fill out an injury report.
23. I will know the location of ALL fire extinguishers and fire stations, also the location of the General Alarm Stations.
24. I have read and understand my duties described on the Station Bill.
25. I will obey Company Policy, which 1) does not permit alcoholic beverages to be brought aboard by towboat personnel or to be used aboard the boat, 2) does not permit the use, sale, or possession of non-prescribed or illegal drugs on company premises, and 3) forbids employees to bring firearms of any kind on company property.

I HAVE READ AND UNDERSTAND THE ABOVE		I HAVE REVIEWED THESE RULES WITH NEW EMPLOYEE		CAPTAIN	
NEW EMPLOYEE SIGNATURE		MATE'S SIGNATURE		M/V	
DATE	DATE	DATE	DATE	DATE	DATE

DISTRIBUTION WHITE AND CANARY TO MARINE SERVICES. PINK TO BOAT FILE.

RULES AND REGULATIONS

EXHIBIT B

156.120 Requirements for oil transfer.
No person may transfer oil to or from a vessel unless—

- (a) The vessel's moorings are strong enough to hold in all expected conditions of surge, current, and weather and are long enough to allow adjustment for changes in draft, drift, and tide during the transfer operation;
- (b) Oil transfer hoses or loading arms are long enough to allow the vessel to move to the limits of its moorings without placing strain on the hose, loading arm, or transfer piping system;
- (c) Each hose is supported in a manner that prevents strain on its coupling;
- (d) Each part of the transfer system necessary to allow the flow of oil is lined up for the transfer;
- (e) Each part of the transfer system not necessary for the transfer operation is securely blanked or shut off;
- (f) The transfer system is connected to a fixed piping system on the receiving vessel or facility except that when receiving fuel for the vessel an automatic back pressure shutoff nozzle may be used;

(g) Except when used to receive or discharge ballast, each overboard discharge or sea suction valve that is connected to the vessel's oil transfer, ballast, or cargo tank systems is sealed, lashed, or locked in the closed position

(h) Each oil transfer hose has no loose covers, kinks, bulges, soft spots, and no gouges, cuts, or slashes that penetrate the hose reinforcement;

(i) Each coupling meets the requirement of 156.130;

(j) The discharge containment required by 154.530, 155.310, and 155.320 of this chapter, as appropriate, is in place;

(k) Each scupper or drain in a discharge containment system is closed;

(l) Any continuing loss of oil from any transfer component is at a rate that will not exceed the capacity of the containment system;

(m) The communications required by 154.560 of this chapter are operable for the transfer operation;

(n) The emergency means of shutdown required by 154.550 and 155.780 of this chapter, as appropriate, is in position and operable;

(o) The designated personnel are on duty to conduct the transfer operations in accordance with the facility operations manual and vessel oil transfer procedures that apply to the transfer operation;

(p) At least one person is present who fluently speaks the language spoken by each person in charge;

(q) The person in charge of oil transfer operations on the transferring vessel or facility and the person in charge of oil transfer operations on the receiving vessel or facility have held a conference, to assure that each person in charge understands the following details of the transfer operations—

- (1) The identity of the product to be transferred;
- (2) The sequence of transfer operations;
- (3) The transfer rate;
- (4) The name or title and location of each person participating in the transfer operation;
- (5) Particulars of the transferring

- and receiving systems.
- (6) Critical stages of the transfer operation.
- (7) Federal, State, and local rules that apply to the transfer of oil.
- (8) Emergency procedures.
- (9) Discharge containment procedures.
- (10) Discharge reporting procedures.
- (11) Watch or shift arrangements.
- (12) Transfer shutdown procedures.

(r) The person in charge of oil transfer operations on the transferring vessel or facility and the person in charge of oil transfer operations on the receiving vessel or facility agree to begin the transfer operation;

(s) Each person in charge required by this part is present;

(t) Between sunset and sunrise the lighting required by 154.570 and 155.790 of this chapter is provided; and

(u) For vessel to vessel transfer operations involving a tank barge between sunset and sunrise, lighting of the intensity specified in 155.790 of this chapter is provided on the barge.

156.130 Connections.

(a) Each person who makes a connection for oil transfer operations shall—

- (1) Use suitable material in joints and couplings to make a tight seal;
- (2) Use a bolt in at least every other hole and in no case less than four bolts in each temporary connection utilizing an American National Standards Institute (ANSI) standard flange coupling;
- (3) Use a bolt in each hole of couplings other than ANSI standard flange coupling;
- (4) Use a bolt in each hole of each permanently connected flange coupling;
- (5) Use bolts of the same size in each bolted coupling; and
- (6) Tighten each bolt and nut uniformly to distribute the load.

(b) No person who makes a connection for oil transfer operations may use any bolt that shows signs of strain or is elongated or deteriorated.

(c) No person may use a connection for oil transfer operations unless it is—

- (1) A bolted or full threaded connection; or
- (2) A quick-connect coupling approved by the Commandant; or
- (3) An automatic back pressure shutoff nozzle used to fuel the vessel.

156.150 Declaration of inspection.

(a) No person may transfer oil to or from a vessel unless each person in charge, designated under 154.710 and 155.700 of this chapter, has signed the declaration of inspection form prescribed in paragraph (c) of this section.

(b) No person in charge may sign the declaration of inspection unless he or the other person in charge has determined by inspection that the facility and vessel meets the requirements in 156.120.

(c) The declaration of inspection required to be signed in paragraph (a) of this section may be in any form but must contain at least—

- (1) The name or other identification of the transferring vessel or facility and the receiving vessel or facility;
- (2) The address of the facility or location of the transfer operation if not at a facility;
- (3) The date the transfer operation is started;
- (4) A list of the requirements in 156.120 of this chapter with spaces on the form following each requirement for the person in charge of the vessel or facility to indicate whether the requirement is met for the transfer operation; and

(5) A space for the date, time of signing, signature, and title of each person in charge during oil transfer operations on the transferring vessel or facility and a space for the date, time of signing, signature, and title of each person in charge during the oil transfer operations on the receiving facility or vessel.

(d) The form for the declaration of inspection required in paragraph (a) of this section may incorporate the declaration-of-inspection requirements of 46 CFR 35.35-30.

(e) The operator of each facility shall retain for at least 1 month from the date of signature, a signed copy of each declaration of inspection required for that facility.

(f) The operator of each vessel engaged in vessel-to-vessel transfers shall retain for at least 1 month from the date of signature a signed copy of each declaration of inspection for such vessel-to-vessel transfers.

156.160 Supervision by person in charge.

(a) No person may connect, top off, disconnect, or engage in any other critical oil transfer operation unless the person in charge, designated under 154.710 or 155.700 of this chapter, personally supervises the operation.

(b) No person may start the flow of oil to or from a vessel unless instructed to do so by the person in charge.

(c) No person may transfer oil to or from a vessel unless the person in charge is in the immediate vicinity of the transfer operation and immediately available to the oil transfer personnel.

35.35-30 "Declaration of Inspection" for tankships - TALL.

After completing the inspection required by Section 35.35-20 and prior to giving his approval to start the cargo transfer operation, the master or senior deck officer on duty shall fill in the following Declaration of Inspection in duplicate. The original of the Declaration of Inspection shall be kept aboard for the information of authorized persons. The duplicate, where required, shall be handed to the terminal superintendent or his representative, who shall on demand be given the opportunity to satisfy himself that the condition of the vessel is as stated in the Declaration of Inspection.

DECLARATION OF INSPECTION PRIOR TO BULK CARGO TRANSFER

Date _____
S _____ Port of _____

I, _____, being the master or senior deck officer in charge of the transfer of bulk flammable and combustible cargo about to be undertaken, do certify that I have personally inspected this vessel with reference to the following requirements set forth in Section 35.35-20 and that opposite each of them I have indicated that the regulations have been complied with.

- (1) Are warnings displayed as required?
- (2) Is there any repair work in way of cargo spaces being carried on for which permission has not been given?
- (3) Have cargo connections been properly made and are cargo valves properly set?
- (4) Have all cargo connections for loading Grades A, B, and C cargoes been made to vessel's pipelines?
- (5) Are there any fires or open flames present on the deck or in any compartment which is located on, facing, open and adjacent to the main deck of the vessel on which the cargo connections have been made?

INFORMATION FOR TANKERMAN APPLICANTS - From U. S. Coast Guard Office

Certification as a Tankerman by the U. S. Coast Guard satisfies a legal requirement that persons loading, offloading or having in tow bulk flammable or combustible liquids be so certified.

An applicant for such certification is requested to bring his birth certificate, Social Security Card and a letter certifying his experience with Flammable and/or Combustible liquids, his general character and for what Coast Guard grade (s) application is being made (we prefer this letter from the applicant's employer).

Tankerman certification at this port is pointed toward unmanned barge operations and is normally given in the following categories dependent on the man's experience and the needs of the employer:

Grade D and lower	LFG Products by specific name(s)
Grade B and lower	
Grade A and lower (good for products up to 40# RVP)	

In addition to the qualifying experience required, a 50 question multiple choice type of examination is given. Questions cover cargo handling, safety, fire fighting, first aid, Tank Vessel Regulations, gas freeing, cargo piping, and venting.

For reference, examination questions are drawn from the following publications and as they refer to unmanned barges are found in this port:

"A Manual for the Safe Handling of Flammable and Combustible Liquids" (CG-174)
Chapters 1, 2, 4, 5, 7, 8, 9, 11, 12, 14, 15, and 17

"Fire Fighting Manual for Tank Vessels" (CG-329)

"Rules and Regulations for Tank Vessels" (CG-123) Subparts:

30.01-10	30.20-10	31.05-15	32.50 (All)	35.01-40
30.10-13	30.20-15	31.10-17	32.55 (All)	35.01-50
30.10-15	31.01-1	31.10-18	32.60-35	35.30 (All)
30.10-22	31.01-10	31.10-22	34.50-5	35.35 (All except
30.10-25	31.05-1	31.10-35	34.50-10	35.35-30)
30.10-55	31.05-5	31.15-5	35.01-1	35.05-15
30.10-63	31.05-10	32.45	35.01-10	

Applicants for LFG endorsements should study Chapter 6 in CG-174, and Part 38 "Tank Vessel Regulations" (CG-123), also Parts 39 and 40 if applicable and pertinent parts of the Fire Fighting Manual. LFG applicants should be prepared to answer questions regarding dangers, special characteristics and hazards associated with the specific LFG product for which they are applying for certification.

"Rules and Regulations for Tank Vessels" (CG-123) Subparts:

30.10-13	32.45	35.30-1	35.35-40	38.10-1	38.20-5
30.10-39	34.50-5	35.30-5	38.01-1	38.10-15	
30.20-10	35.01-1	35.30-30	38.01-5	38.10-20	
31.05-5	35.01-50	35.35-1	38.05-5	38.15-1	
32.05-1	35.01-55	35.35-5	38.05-10	38.15-5	

A non-expired Coast Guard license as Master, Mate, Pilot or Engineer automatically qualifies the individual holder as a Tankerman.

34.50-10(a) footnote 12 does not appear in the 5/1/69 edition of CG-123. The revised text of footnote 12 is as follows:

¹²(Fire extinguishers) "Not required on unmanned barges except during transfer of cargo or operation of barge machinery or boilers (See 35.35-1(c))."

35.35-1(c): "The certificated tankerman in charge of an unmanned barge shall insure that the approved portable (fire) extinguishers required by Table 35.50-10(a) are on board and are readily available."

33 CFR 126.16(b): "Warning Alarms. Warning alarms shall be installed at the waterside of such facility (of particular hazard such as Acrylonitrile, Butadiene, Anhydrous, Ammonia, Chlorine, Ethyl Ether, Phenol, Propane, Sulfuric Acid, Vinyl Chloride, etc.) to warn approaching or transiting water traffic of immediate danger in the event of fire or cargo release. Warning alarms shall be of the siren type, or the emergency rotating flashing light type, and be of sufficient intensity to be heard, or seen, a distance of one (01) mile during normal facility working conditions. The alarm signal shall not conflict with local municipal prescription. (In this area a flashing amber light is used sometime in conjunction with a siren.)"

Marine Fire-Fighting

COURSE OUTLINE

Orientation

1. General Welcome
2. Ashland Marine Fire-Fighting Course History
(our record as relating to fires).
3. Purpose of the Course
 - a. To provide Ashland Tankermen with the knowledge and expertise to competently handle fires on barges and docks.
 - b. To develop fire prevention and suppression know-how.
 - c. A tankerman must understand that fire fighting requires courage, knowledge, training, and team-work.
 - d. As a fire fighter, he must understand what fire is and why it behaves as it does.
 - e. This course will not make you a professional fire fighter.
 - f. This course will make you a better fire fighter and enable you to handle emergencies in the event of a fire.
4. Where the Course Will be Conducted
 - a. Portions of your training will be conducted on board the boat.
 - b. Training in emergency procedures. Training for your particular boat fire-fighting equipment will be conducted on board.
 - c. Training on inspections and maintenance, location of all fire equipment on board barges and boats will normally be done on board each boat or at the terminal location.
 - d. The training will be documented to show proof of training for application to fire-fighting course.
 - e. Some training may be conducted in a classroom-type situation using films, slides and lectures by the instructor.
 - f. The field training exercise will be held at the Ashland Oil Refinery fire-fighting training ground.

SOURCES OF FIRE AND FIRE PREVENTION

A. Housekeeping

1. General

- a. Fires that do not start are ones that do no damage and kill no people.
- b. Job of fire prevention is a job for all.
- c. Cleanliness and carefulness is a team that can prevent most fires.
- d. When situations or conditions exist that are unsafe, it is your duty to correct it or report it.
- e. The fire you prevent may save your life.
- f. Highest risk is at the dock product handling.
- g. Repairs and maintenance.
- h. Visitors and shoreside personnel.
- i. Minimum tankerman activities.

2. Boat Personnel - People Working and Living On Board Boat

- a. Berthing compartment, including guest quarters.
- b. Galley
 1. Greasy vent hoods
 2. Spilled grease
- c. Deck lockers and storage compartments (paint lockers).
- d. Engine room bilage.

3. Barges

- a. Drip pans
 1. Watch for leaks, open valves.
 2. Make sure they are empty and clean.
 3. Be sure they are big enough to hold the product.

b. Barge Decks

1. Wipe up all spills.
2. Keep all equipment and rigging stored in proper place.

c. Barge Engine

1. Keep oil and grease wiped off.
2. Don't let Class A materials collect around pump and engine.

B. Preventive Maintenance

1. Boat

a. Main Engines, Machinery and Pump Room

1. Cause of most boat fires - broken fuel line.
2. Many accidents happen because something in the engine room did not work (steering rudders, loss of air, problems in fuel systems).

b. Electrical Equipment

1. Because of vibration, electrical fixtures tend to wear more quickly. All electrical equipment needs inspection regularly.

c. Alarms

1. Regular testing to make sure they work.
2. The hazard of becoming used to an alarm.
3. Make sure your people know what the alarm means.

d. Fire-Fighting Equipment

1. All fire systems checked each month.
2. Inspect all fire hose and nozzle for wear and servicability.
3. Pump seals and motor maintenance.
4. Electric foam valve.

e. Water-tight Doors

1. Make sure no one has damaged or painted over the gaskets that would prevent these doors from sealing.

2. Barges

- a. Pump engine, look for excess oil leakage - check fuel tank and fuel lines for leaks.
- b. Barge Pump
 1. Check all valves for leaks.
 2. Check pump packing or mechanical seal for leakage. If pump has stripping line or drain plug, make sure they are tight.
- c. Emergency Shut Down - remote control valves. If the pump has more than one, check all.
- d. Product Hose
 1. Check hose for damage or evidence of past leakage.
 2. Look for inspection dates. Hose should have been inspected and tested within the last twelve months.
 3. Make sure the hose was designed for the product you have - asphalt, oil service, or chemical.
 4. Relief valve and pump pressure gauge. Any time the pressure gauge reads more than the relief setting, shut down and check the system.

C. Safe Work Procedures and Performance

1. Do the Job the Safe Way
 - a. If the job calls for a fire watch, have one.
 - b. Do not take shortcuts. Always blind off hoses and cargo lines as soon as they are disconnected.
 - c. Always close main cargo hatches when not standing by. Keep flame screens in.
 - d. No horse-play.
2. Clothing and Equipment
 - a. Flash fire story.
 - b. Shoes, shirts, and pants.
 - c. Matches and cigarette lighters.

D. Fire-Fighting Orientation - Training and Drills for all Boat Employees

1. New Employees

- a. Boat - It is Ashland's policy to acquaint new employees with all fire-fighting equipment at the earliest possible time after he or she has come on board.
- b. Even though the new employee probably will not be a tankerman, he will be called upon to assist the tankerman in case of an emergency. He must know all fire-fighting procedures and equipment.

2. Fire Drills and Man Overboard Drills

- a. Go over monthly fire drill report (make sure everyone understands the importance of the report).

E. Smoking and Non-Smoking Areas

General

The warning on a package of cigarettes that smoking may be hazardous to your health is especially true if you attempt to smoke in a flammable atmosphere.

1. On the boat, list no smoking area.
2. No smoking on the barges - period.
3. No smoking on docks and floats.
4. Cigarette lighters and matches.
 - a. We ask that you leave your matches and lighters on the boat.

F. Spill Prevention and Clean Up

1. Most common causes of spills.
 - a. Inattention to loading.
 - b. Equipment failure, hose, valve.
 - c. Misalignment of valves for cargo transfer, pumping or loading against a closed valve or an open valve that no one knows is open.
 - d. Go over typical barge piping schematic. (Show schematic on overhead projector).
2. How spill relates to fire hazards.

G. Flame Screens and PV Valves

1. Use of flame screen, how it works, and importance of keeping them clean.
 - a. Oily screen will burn up.
 - b. Screen must be in good repair, no holes or torn places, and fit snugly in hatch.
2. PV Valves
 - a. Explain how they work.
 - b. Disassemble one (show that if one part is damaged or dirty, no part of the valve will work.
 - c. Explain the importance of keeping them clean.
 - d. Why the vents have flame screens.
 - e. Design pressure for opening and closing.

H. Static Electricity

1. Slides that show and explain what static electricity is and how it works.
2. Bonding and grounding.
3. Hose and pipeline continuity.
4. Cathodic Protection
 - a. Explain problems with induced current.
 - b. Show diagram of bonding and grounding at marine wharfs on overhead projector.

I. Emergency Shut Downs

1. Make sure they are operational. If you are using barge pump, make sure you know where it is and if it will work.
2. How they work.
 - a. Ask the question, "What does the emergency cable do to the engine?"
3. If you are using shoreside equipment, make sure you know where their emergency shutdowns are.

J. Film A,B,C, & D of Hand Fire Extinguishers

1. Understanding the basic characteristics of Fire

- a. fire pyramid
- b. fire triangle

2. Flashpoint and auto ignition temperature

- a. different flash points of gasoline and other fuels and chemicals
- b. auto ignition temperature

3. Portable extinguisher

- a. What type fire they can be used on (size)
- b. portable water extinguisher
- c. portable CO² - what type fire
- d. operation application of Ansul dry chemical hand portable extinguishers.
 - 1) how to check extinguishers
 - 2) hydrostatic test
 - 3) distance and length of time

4. Portable dry chemical extinguisher

- a. type fire they can be used on
- b. different types of powder
- c. disassemble or explain the different parts
- d. hydrostatic testing requirements
- e. length of time and distance

K. Fires That Are Too Big for Hand Portable Extinguishers

1. Foam

- a. how foam works
- b. protein foam

2. Foam application

- a. play pipe
- b. eductors

3. Water fog

- a. how fog works
- b. what it takes to make fog
 - 1) pump pressure
 - 2) fog nozzle

4. Fire hose

- a. hose lays
- b. hose care
- c. hose testing

408

5. Test

FIELD ORIENTATION

1. Smoking regulations
2. Break up into teams

Project #1 - Ground Spill - Petroleum Fire (100 sq. feet)

Product gas
Extinguishing agent - dry chemical - hand

Project #2 - Drip Pan Fire (9 sq. feet)

Hand extinguisher - dry chemical and CO²

Project #3 - Flange and Pump Packing Fire

Hand extinguisher - dry chemical

Project #4 - Dome and Compartment Fire

Use of flame screen

Project #5 - Large Pit Fire (300 sq. feet)

Use water fog and foam

Project #6 - Tank Fire - Petroleum

Water fog and foam (200 sq. feet)

EVALUATION OF THE SAFETY OF SHIP NAVIGATION IN HARBORS

Paper Presented at SNAME 1980 Spring Meeting

CAORF Research Staff

National Maritime Research Center

March 1980

INTRODUCTION

The advent of large ships carrying cargo harmful to the environment, and the economic advantage of accommodating oversized vessels in existing ports has focused the attention of the public, port authorities, ship operators, and government agencies on the need for improvements in the safety of navigation in U.S. port waterways. To date, navigational safety in U.S. port waterways has been maintained at a relatively high level by virtue of an evolutionary process. Ship size increased at a slow enough pace that channel requirements, and ship maneuverability requirements could be determined on a trial and error basis. Given a number of near misses and an occasional accident, port and ship designs were improved to acceptable levels of safety. As one port showed its capacity to accommodate particular vessels, another port sought the same type of traffic by improving its own design to be equivalent to the first. Out of this experience and limited research, rules of thumb and empirically derived design criteria evolved for channel dimensions, aids to navigation, and ship design. Our difficulty today arises from the rapid escalation in ship size and the potential outdating of the available design criteria. An analysis of shipping traffic in U.S. port waterways would show that by many existing design policies and standards present waterways cannot safely accommodate many of the large ships using the waterway today, much less larger vessels in the future. Are present operations of oversized vessels safe or are we in a time bomb situation? What is the present margin of safety for navigating large ships in existing channels? What economical improvements can be made to increase the margin of safety? Clearly, analytical techniques need to be developed to quantitatively evaluate navigational safety of large ships in narrow waterways. The evolutionary process is too slow to provide the criteria in a timely fashion and the environmental economic and social consequences of a major marine accident are too high to risk.

STATEMENT OF THE PROBLEM

Research conducted in the area of navigation of ships in narrow waterways was for many years focused on hydraulic channel testing and simulation of ships' hydrodynamic response in analog or digital computer models. These methods were used to evaluate a single transit of a channel by a ship. Typically autopilot rudder and propulsion control algorithms were utilized to control the model or the simulation. The advantage of such research methods was repeatability and the ability to isolate and study unique hydrodynamic response. These research methods provided valuable data with regard to the vessel's physical response in the waterway. The extent to which these vessels could safely transit the waterway, however, could not be ascertained since these methods failed to account for the variability the pilot and helmsman introduce in the real world. Recognizing this deficiency during the past decade, several research institutions around the world have integrated the human element in the research approach via the use of ship simulators. By considering the variability man's performance adds to the piloting process, we are truly considering the ultimate safety of the vessel in the waterway for a waterway can be said to be safe to the extent that variability of ship tracks in the waterway can be contained within the boundaries of the waterway under stated environmental conditions.

The goal of the methodology for evaluating safety of navigation in the narrow waterways is to account for the variability the pilot and helmsman population introduces to the ship tracks in the waterway. The variability of interest is that normally resultant from differences in perceptual and cognitive behavior between different pilots and helmsmen and differences in behavior over time or for unique ships or channels for single pilots or helmsmen. Research in this area must be conducted to assure a representative sample of subjects has been analyzed in order to achieve a level of statistical significance transferrable to the real world. The methodology of research and examples presented in this paper appears to achieve these goals.

METHODOLOGY

The process for determining the requirements for safe navigation in restricted waterways was developed to address the following critical design and operational questions facing ship operations, port authorities, and regulatory agencies.

Which environmental conditions preclude safe navigation in the waterways?

Which operational procedures for specific ship types enhance their safe navigation in the waterway? What level of safe navigation is provided by the aid to navigation system in the

waterway or what is the affect of alternate aids to navigation?

What maneuvering characteristics are required for proposed ships to safely navigate the waterway?

Is an acceptable level of safe navigation present for a proposed ship type in a given waterway or what changes in the waterway dimensions are required to ensure acceptable safety levels?

All of these questions must be addressed using methods which recognize that it is performance of a human pilot exercising his capabilities in navigation that must be analyzed. Safely navigating a ship which is large for the channel is relatively routine for an experienced pilot if the ship is maneuverable and directionally stable, and there is no wind, current, or other perturbing influences such as banks or traffic ships present. Determination of safety, given a adverse environment with allowance for the variability in response by the pilot, is the objective.

The basic methodology consists of the following steps:

- I. Define the characteristics of the harbor and its environment.
- II. Define the operational characteristics of the ship.
- III. Explore the interaction of the ship and the harbor in presence of limiting environmental conditions under control by the human operator during simulated harbor transits.
- IV. Analyze the results of that interaction through appropriate measures of safe navigation performance.

The elements of these four steps are discussed below.

STEP I. DEFINE CHARACTERISTICS OR THE HARBOR AND ITS ENVIRONMENT

There are many categories of information required to describe a port sufficiently for a comprehensive study of safe navigation. The sources of required data, however, are few and consist of (1) navigation charts, light lists and current direction and velocity data for the harbor published by the National Ocean Survey and (2) weather information and statistics for the area published by the National Weather Service. Information collected from these sources should be compared with and enhanced by interviews with mariners and weather observers with extensive local knowledge. The categories of data required for a port study include the following:

- Waterway configuration
 - Channel widths and depths
 - Turn types and angles
 - Bank and shoal locations
 - Type and location of hazards
- Environmental statistics
 - Wind direction and velocity
 - Current direction and velocity
 - Visibility range
 - Unique current conditions
- Aids to navigation system
 - Types of aids
 - Characteristics and patterns (day and night)
 - Locations
- Operational policies and conditions
 - Traffic rules and congestion
 - Tug available and size
 - Limits on operations
 - Types of vessels currently accommodated

The foremost limiting condition to large ships has generally been channel width and depth. To assess the general limitations of U.S. ports and waterways, the authors have developed a data base resident in a computer file which contains data on the physical channel characteristics of 32 major ports of the United States. Each straight channel leg and each turn in these harbors has been examined and data on depth, width, aids to navigation, turn angle, etc., recorded. To assist naval architects contemplating design of future vessels, summary tables which characterize ports of the United States have been assembled from this data. These tables and the list of ports used are provided in Appendix A.

STEP II. DEFINE OPERATIONAL CHARACTERISTICS OF THE SHIP

Each question of safe navigation in a waterway implies a potential ship or family of ships. Normally, the problem involves the extension of the operating limits of the channel to a larger ship or a ship of specific characteristics. It may involve maintaining existing ships through a channel which has been impacted by channel side construction, or extension of port operational environmental limits to increase possible port use. In each case, a required component in the study is a mathematical hydrodynamic model of ship motion with the proper set of response coefficients for the ship's propulsion and control forces. Mathematical models of ship's motion have progressed to a stage in which there are a number of ship types available as models. Additionally, hydraulic model tests can produce good estimates for

models coefficients given the ship's physical characteristics. Today's mathematical models include factors such as bank influence, shallow water effects, bow thruster and tug boat forces, passing ship effects, and wind and current effects.

STEP III. SIMULATION OF TRANSITS IN THE WATERWAYS UNDER OPERATOR CONTROL

The objective of the simulation is to determine how consistently, given the environment, ship characteristics, channel design, aids to navigation and possibly external help from tugs, a pilot operating with a helmsman can navigate the ship through the channel safely. An appropriate simulator facility which can address this problem is the full scale ship simulator. The ship simulator normally consists of a full scale ship's bridge with all normal equipment. Typically, there is a method for representing the visual outside world, the radar image of the world, and the progress of the ship through that world. The motion of the ship through the world is driven by the computer using the hydrodynamic model which is in turn driven by signals from the steering stand and throttle on the bridge. The technology of ship simulators has been most advanced in the Computer Aided Operations Research Facility (CAORF) which is located at the Kings Point Merchant Marine Academy and is sponsored by the National Maritime Research Center of the Maritime Administration. At CAORF, a 125-foot cylindrical screen extending for 120 degrees to each side of the bridge portrays a computer-generated visual scene containing ships, shorelines, navigational aids, bridges and buildings realistically shown and moving in real-time response to the ship's movement. The visual scene can realistically simulate any level of visibility (fog) under night or day conditions. The visual scene is projected on the screen by special television projectors. The radar image is generated by a computerized radar signal synthesizer and is programmed to coincide with the visual scene. Pilots and masters navigating the ship experience the equivalent sensations, and use the same information from the visual scene, the radar, and from the instruments as when navigating in the real world. CAORF has proven to be a valid, valuable tool for studying navigation performance with man-in-the-loop. CAORF has been used to study many port design problems including Valdez, Alaska (1), Puget Sound (2), Point Conception California (3), Galveston (4), Pascagoula (5), and the Santa Barbara Channel (6). A multiyear research program has been maintained to systematically address a study of safe navigation in restricted waterways.

STEP IV. ANALYSIS OF SIMULATION RESULTS AND MEASURES OF SAFETY

To obtain the benefits sought in the methodology, performance measures must be defined which relate simulation results to safety. The objective of navigation in restricted waterways is primarily to

maintain the position of the ship in the proper location relative to the channel boundaries or the channel centerline (i.e., establishing proper crosstrack position). In the absence of traffic ships, the normal crosstrack position in straight channel legs is near the centerline. When meeting other ships this position will shift toward the starboard boundary of the channel. The performance to be measured is the consistency with which pilots passing through the channel can determine and control their crosstrack position recognizing the necessity for tighter consistency near the channel boundaries than near the centerline. As will be discussed, measures of safety are principally descriptive of crosstrack variation.

Alongtrack position in restricted waterways is of minor importance except in two instances. The first instance is the determination of the position to begin a turn, after which negotiation of the turn again becomes primarily a cross-track and turn rate control problem. The second instance is to bring the ship to a stop at some location.

Measures of navigation performance in restricted waterways are therefore directed toward measuring consistency of crosstrack position for repeated transits of the channel by many pilots under the same condition. Changes in safety of navigation are defined by determining differences in the measures for changed conditions. Three principal measures have been derived and effectively applied across various experimental conditions.

1. The mean track location across the channel of the:
 - Ship's center of gravity (CG)
 - Port and starboard extreme points of the ship's hull
2. Statistical limits descriptive of the variability about the mean track:
 - Standard deviation of across track location at points along the track
 - Location of the 95-percent limit of the track envelope of the CG
3. Combined index

Measures 1 and 2 may be easily understood by considering the plot of these data long a sample channel. Figure 1 shows these data plotted at 600-foot increments along a channel. The dashed lines indicate the channel edges, and solid lines indicate the mean tracks of the ship's CG and the port and starboard extreme points. The asterick symbols show the CG standard deviation doubled on either side of the CG mean point. If the distributions of crosstrack variance are assumed to be normal, this envelope would contain 95 percent of all transits.

Measure 3 is called the combined index because it combines the mean ship position in the channel and the variation of the transits about that mean position. This combination has desirable features for

predicting navigational safety in restricted channels. Neither the mean ship position across channel or transit path variability alone gives a complete description of safety. When combined on one index, however, the index can discriminate between tolerance for higher patch variability when the mean track is far from the channel edge and the requirement for low track variability when the mean track is near the channel edge or when passing another ship and assign both conditions a favorable value.

The index computation is shown graphically in Figure 2. A normal distribution based on the standard deviation of the center of gravity point is centered on the mean crosstrack position of the CG point. The index value is the integrated area under the distribution curve which lies beyond the channel edge. The values of the combined index are plotted on the right side of Figure 1.

The two curves are for the values relative to the port boundary (P) and starboard boundary (S). Presently, insufficient data are available to test if the assumption of normality is correct. In fact, it is suspected that a truncated distribution may be more characteristic of the crosstrack variance as the edge is approached. The assumption of normality, however, is conservative and is sensitive to changes in pilots' performance. Since it is not necessarily the proper distribution, the index should not be interpreted as probability of grounding.

The values for this combined index included in this paper have been calculated relative to the mean ship center of gravity location. The process can easily be applied to calculate values relative to the mean port and starboard extreme point locations at along-channel locations. The index values for the starboard extreme point would be relative to the starboard channel boundary only, and the values for the port extreme point index would be relative to the port channel boundary only. The resulting index would reflect mean channel position, track variance, and heading error.

APPLICATION OF THE METHODOLOGY TO PORT DESIGN PROBLEMS: AN OVERVIEW OF FINDINGS

The Maritime Administration has conducted a series of experiments on their CAORF facility to evaluate the performance of navigation in restricted waterways. These experiments have investigated those areas of performance wherein the master's, the pilot's, or the docking master's variability is likely to cause the ship to exceed safe operating conditions. The experiments have provided an initial understanding of the complex and interdependent relationships of harbor design parameters. They have uncovered a number of mitigating measures which can be applied in specific problem areas to achieve satisfactory performance in heretofore marginal situations.

Principally, six harbor design issues have been addressed at CAORF. These are: channel dimensions, environmental limits, operating procedures, tug requirements, aid to navigation requirements, and ship maneuvering requirements. Each of these areas is discussed briefly below with regard to their impact on master, pilot or docking master variability. Specific data are not quoted in this section due to the large number of experiments from which conclusions were derived and the difficulty of comparing findings between specific experiments. Examples of performance measure in several of the areas are presented separately in a later section.

Channel Dimensions

The adequacy of channel dimensions has been addressed in several harbor design experiments. Most recently, studies have been concluded on the Galveston ship channel, the Restricted Waterway Experiments IIIA (8), and IIIB (9), and the Pascagoula ship channel. Experiments in channel dimensions generally addressed channel width and/or turn configuration. Typically, worst case wind and current combinations were selected to represent conditions below which profitable operations could be maintained. Experimental conditions tested whether subject pilots could safely maneuver in the proposed channel under the selected conditions.

As a result of the wind and current variability and the requirement for the pilot to maintain a high drift angle against the wind and current, the ship's tracks displayed a high level of variability in crosstrack position both within runs and between runs. While this variability does not show a large dependence on channel width, the channel width must contain it and allow for an additional margin of safety.

Depending on the turn design (effective maneuvering radius allowed) the crosstrack variance in some cases was significantly affected when exiting the turn; the smaller the required turning radius, the higher the crosstrack variance during and exiting the turn. Analysis of performance in turns has indicated pilot control actions are initiated in 'anticipation' of the turn. For small radius and narrow turns, the pilot's anticipated actions must be accurate in magnitude and precisely timed. For large radius turns, there is more room for error in the anticipatory actions, and for making correcting actions during the turn. Proper turn design has been shown to effectively reduce crosstrack variation in a narrow waterway.

Environmental Limits

The selection of appropriate wind, current, and even visibility conditions is an important issue in any harbor design study. Typically a ship operator or port authority species limits below which

he requires 100 percent operation. Limits are defined considering the frequency distribution of local weather conditions and the economic consequences of occasional delays in delivery or shipment. In studies where the port is to be open to many operators (e.g., Galveston), environmental conditions are selected to provide (for example) 90 to 95 percent harbor availability based on weather and current statistics.

The effect of environmental conditions on the ship and pilot are twofold. First, the ship must 'crab' along the channel with a specific draft angle to maintain a ship's course equivalent to the channel course. Secondly, due to the presence of high drift angles, the pilot's perception of his position and therefore the accuracy of corrective orders is degraded. Draft angle increases the 'swept width' of the ship's path, thus occupying a wider portion of the channel. The effect of the degradation of the pilot's control process is to increase the crosstrack variability. The net effect of environmental conditions is thus seen to be a reduction in safety, placing the extreme points of the ship closer to the channel edge and increasing the crosstrack variability of those points.

Current and wind combinations may also degrade performance in turns. Typically, the most severe effect evolves from a following current where the ship's ground speed appears high while the water speed is low, impairing maneuverability. Excessive windage can contribute to difficulties in turning depending on the topsides and superstructure configuration. In cases where environmental conditions degraded turn performance, crosstrack variation exiting the turn was high and the only solution appeared to be widening of the channel following the turn.

Operating Procedures

Many design studies involve handling ships in new harbors or modified waterways. Until recently, there was little experience in the United States with oversized vessels (e.g., 150,000 dwt tankers and above). Most harbor design studies of today, however, involve accommodating such vessels in U.S. ports.

With increased environmental pressures, authorities must consider establishing operational limits, be they environment (wind strength, current cycle, etc.) or procedural (specified routes, speed traffic conditions, etc.). Procedures need to be established which could act as mitigating measures to ship system failures. Several port studies at CAORF have addressed these issues: the Valdez tanker study, Puget Sound speed limit study, and Point Conception LNG study.

The issue of many procedural studies is to determine the safest approach and departure routes to a harbor across the environmental conditions. In Valdez, the departure route proved to be the design point. By reducing turn angle along the route, crosstrack variance passing by middle rock was reduced. For the Point Conception

operations, the evaluation of the approach route concluded that crossing an oncoming traffic lane would present little hazard.

Findings of several port related studies have indicated that safety may be inversely dependent on ship's speed over a limited range. The first impression is that slow ship speeds will be inherently safer. Data indicate, however, that with reduced speed comes a reduction of maneuverability and an increase in crosstrack variability. Increased speed not only increases maneuverability, but also significantly reduces the required drift angle for adverse wind and current conditions.

Tug Assistance

Harbors planned for accommodation of oversized vessels often assume the use of larger shiphandling tugs than are generally available in U.S. ports today. Several port design experiments at CAORF have addressed the use and size of tugs for oversized vessel operations. Notable are the Point Conception Study, the Galveston Channel Study and the Pascagoula Channel Study.

Tug use for slowing vessels via long lines astern, and as rudders are tactics widely used in Europe and Japan for oversized vessels, but have not yet received much interest in the United States. The interdependence of tug power and ship type/size versus environmental conditions is important but is yet largely unknown. A high fidelity simulation of tug forces has been recently added to CAORF and will be applied in a number of experiments in the near future.

Aids to Navigation

Visual aids to navigation appear to serve as a mitigating factor to some of the perturbing environmental and channel design variables. Providing extra aids in a channel has resulted in lower crosstrack variance and improved performance in difficult turns. Experimental conditions with fewer aids resulted in higher variance and unacceptable performance in channels of equivalent design and environmental conditions. Deficiencies in some harbor waterways might thus be overcome with additional aids to navigation.

Evaluation of precise radio aid navigating systems has been undertaken to evaluate potential performance gains achievable through a highly accurate positioning system. Data indicate excellent trackkeeping performance to date. Like visual aids to navigation, advanced radio aid systems maybe employed to overcome marginal operating conditions in ports in place of port modifications such as widening channels.

Ship Performance

The impact of ship controllability on variability of trackkeeping has suggested that newly constructed ships might be custom designed for a specific port or type of waterway. LNG operations are particularly suitable for this type of investigation due to this ship's commitment to certain terminals.

An experiment conducted at CAORF indicated that track variability increased with a reduction in the turning response of a large tanker. Improvements in maneuverability of large vessels using advanced design concepts may prove highly beneficial to safe navigation in restricted waters. Of interest is rudder size, number of rudders, number of propellers and perhaps hull form. If higher turning moment could be produced at lower speed (e.g., twin screws), perhaps safe operations could be conducted at very lower speeds. This area of performance is still at the basic research level, but the gains to be achieved are promising.

EXAMPLES OF ANALYSIS OF RELATIVE NAVIGATIONAL SAFETY IN NARROW WATERWAYS

Specific comparisons of navigation performance evaluation under alternate conditions of ship characteristics, channel design, and aids to navigation have been drawn from two recent experiments at CAORF. During these experiments, Restricted Waterways Experiment Phase IIIA and IIIB, trained pilots navigated an 80,000 dwt tanker along a 500 foot wide channel containing three turns connected by straight channel segments. This channel configuration is shown in Figure 3. Five pilots made transits through the channel for each condition providing a statistical basis for evaluating the relative effect of the condition on safe navigation. Results for these experiments have been reported in references 8 and 9. For this paper, several experimental conditions have been selected to illustrate the value of analysis of navigation safety using the measures previously described.

Ship Maneuverability

The amount of control force required to enable ships to negotiate waterways is one factor to be considered in the design of a new ship. There has been a feeling among mariners that given enough training and experience, man is sufficiently adaptable to overcome difficulties with slow responding ships. The purpose of this comparison was to determine, in relatively severe environmental conditions, what actual effect a reduction of maneuverability would have on safe navigation of a ship in restricted waterways. Would the pilots compensate for the slow response or would their overall safety be reduced?

For this experiment the ship was modeled with two alternate rudders. One rudder was the standard rudder used for an 80,000 dwt tanker. The alternate rudder had only one-half the effective area of a standard rudder. The results should be of interest to naval architects as well as port authorities and ship operators.

The channel transits through the first leg, first turn, and second leg of the channel shown in Figure 3 were compared. The first leg required compensation for a crosscurrent, while the second leg had a following current. Graphic presentation of the results is shown in Figures 4, 5, and 6.

The results show that the pilot was not able to fully compensate for the reduced maneuverability. Transits with the less maneuverable ship resulted in greater variability in track position in the straight legs and turns as illustrated by the crosstrack standard deviations. The mean track line is more sinuous on both straight legs for the less maneuverable ship and the mean extreme point violates the channel boundaries in the first leg as illustrated in Figures 4 and 6. The combined index values averaged along each segment are given in Table I. In all instances the more highly maneuverable ship allowed smaller combined index numbers. There is clear indication that with less maneuverable ships, pilots require more channel width for safe navigation.

Turn Configuration

Turns in channels of the United States are generally of two types, noncutoff turns and cutoff turns. The basic difference in the two types is that the vertex of the channel boundaries on the inside of the turn has been cut back on the cutoff type turn while it has been left intact on the noncutoff turn, Figure 7. Turns and cutoff turns occur with nearly equal frequency.

Navigation through 30-degree cutoff and noncutoff turns was investigated during the CAORF experiments. Graphic display of the results for turns is shown in Figure 8. Experienced pilots navigated cutoff type turns more smoothly and safely than the noncutoff type. Their mean cross channel position through cutoff turns was close to ideal while the combined index values are uniformly negligible. On noncutoff turns the pilots entered the turns and exited the turns wider with greater variance in track line position. There is a focal point on noncutoff turns at the turn apex at which the track variance is very low. The pilots apparently must pass through this point on the turn regardless of their position entering the turn and without regard for the effect on turn recovery. This effect is not apparent on cutoff turns where the pilots can establish a smooth curve through the turn and continue the line through recovery entering the next channel with a low crosstrack standard deviation. A rather dramatic

reduction in the average combined index for the cutoff turn may be noted in Table II.

Additional Channel Markings

Many channels consist of a series of relatively short (1.5 to 1.7 nm) straight legs separated by turns. The turns must be marked so their position is known. It has not been clear, however, that the addition of buoys along the straight legs away from the turns is cost-effective with regard to increased safety. During the CAORF experiments, the second leg of the channel provided an excellent comparison of the effect of turn markings only versus the addition of a gated pair of buoys midway along the leg. The two configurations are shown in Figure 9. Graphic presentation of the results are shown in Figure 10. The average combined index values are shown in Table III.

Conclusions from this comparison are that the additional buoys clearly caused the mean track line to shift toward the center of the channel away from the edges and reduced the variance between transits. The combination of improved mean track line position and lower track line variance reduced the combined index values to essentially zero. As shown in Figure 10, these results clearly illustrate the potential use of aids to navigation to reduced crosstrack variance in certain channels and to increase the relative safety margin by holding the mean track near the channel centerline.

CONCLUSIONS

Performance data gathered on the ship simulation at CAORF have shown that a number of port design parameters directly affect piloting variability and navigation safety in narrow channels. The safe operational configuration of any port can be seen to be an appropriate combination of channel dimensions, operating procedures, limiting environmental conditions, ship maneuvering characteristics and aids to navigation. Such combinations must yield a variability in trackkeeping performance that will fall safely within the defined channel for multiple ship transits. In this context, the design of any particular port is seen to be unique, each providing specific limitations on the design parameters. As a generality, the evolving experimental data base in port design from CAORF is increasing our understanding of the complex relation of piloting variability to safety and port design parameters. Through the methodology and experimental analysis at CAORF, we are now able, in many cases, to apply mitigation solutions to identified problems which are cost-effective and may have a low environmental impact.

The effectiveness of the present methodology is demonstrated by the ability to sense changes in all critical port design parameters.

The formulated performance measures are effective in addressing the following requirements:

- Summarize alongtrack performance
- Identify specific problem locations and reflect changes required to solve them
- Provide numerical indices for comparison of relative safety

The final requirements of these measures will be to provide absolute indication of safety relative to actual behavior at sea. Measures indicative of the actual probability of grounding per transit will be sought over the next several years through extended experimentation at CAORF and at-sea data collection.

REFERENCES

1. McIlroy, W., A Review of Valdez Experiment First CAORF Symposium, National Maritime Reserch Center, June 1977.
2. Riek, J., Tenenbaum, S., McIlroy, W., An Investigation into Safety of Passage of Large Tankers in the Puget Sound Area, Report to the U.S. Coast Guard, October 1978.
3. Reese, W. Phillip, Maritime Risk Assessment Applied to California LNG Import Terminals, Proceedings, Second CAORF Symposium, National Maritime Research Center, 1978.
4. Tenenbaum, S., Investigation of Navigation into the Port of Galveston, Proceedings, Third CAORF Symposium, National Maritime Research Center, 1979.
5. Cook, R., Investigation of Limiting Channel Conditions for LNG Transit into the Port of Pascagoula, Mississippi, National Maritime Research Center Report, October 1979.
6. Mara, T., Keyes, P.R., and Pulgisi, J., Impact of an All-Weather Precision Navigation System for Channel Navigation Performance and Ship Control, Vol. 3, Proceedings, Fifth Ship Control Systems Symposium, David W. Taylor Naval Ship Research and Development Center, Annapolis, November, 1973.
7. Bertsche, W.R., Pesch, A.J., Maskasky, J., Clark, J.G., and Atkins, D.A., Study of the Performance of Aids to Navigation Systems - Phase I, An Empirical Model Approach, Report to the U.S. Coast Guard No. GC-D-36-78, July 1978.
8. Atkins, D.A. and Bertschel, W.R., Restricted Waterways Experiment, IIIA, Data Analysis and Findings, National Maritime Research Center Report No. CAORF-24-7802-01, October 1978.
9. Atkins, D.A., Bertsche, W.R., and Cooper, R.A., Restricted Waterways Experiment IIIB, Results and Findings, National Research Center Report, May 1978.

Appendix

THE PHYSICAL CHARACTERISTICS OF WATERWAYS IN 32 MAJOR PORTS

Information covering physical characteristics and present aids to navigation of 32 major U.S. ports has been collected and entered into a computer data file. The ports selected and their regions are listed in Table IV.

Using the most recent USCG navigation charts, data descriptive of the physical dimensions of channel segments in each port were documented for each of the following four categories:

- Straight channels. Defined as the space between turns or larger areas of water. Delineated by dashed lines on navigation charts.
- Turns. Defined as a change in direction coming out of one straight channel and going into another.
- Bays. Defined as an open area of water with no dredged area or delineation of channels. Boundaries are land masses.
- Rivers. Defined as a river on chart. Boundaries are the river banks.

TABLE IV. COASTAL REGIONS AND PORTS EVALUATION IN THE DATA BASE

<u>East Coast</u>	<u>West Coast</u>
Portland (ME)	Long Beach
Boston	Los Angeles
Providence	San Francisco
New London	Portland (ORE)
New Haven	Seattle
New York	Juneau
Albany	Valdez
Philadelphia	Honolulu
Baltimore	Coos Bay
Chesapeake Bay	
Norfolk	<u>Gulf Coast</u>
Wilmington (NC)	Tampa
Charleston (SC)	New Orleans
Savannah	Port Arthur
Jacksonville	Houston/Galveston
Miami	
<u>Great Lakes</u>	
Duluth	

The physical data compiled were channel width, depth, length, turn angle, and turn type (dredged configuration). The remaining data were code numbers and chart numbers which allowed retrieval of data from the computer data base and cross-reference to charts.

When necessary, averaged widths of the rivers and bays were entered and generally speaking, where there were different depths, the shallowest was chosen. Dash marks delimiting the channels on the charts were used as a basis for measurement. Depth is either taken off the chart tabulation table or directly off the channel. Only channels with depths of 29 feet or deeper were considered for this analysis.

In total, there were entries for 835 channel segments of which 47 percent were straight channels and 46 percent were turns. The remaining 7 percent were rivers and bends. Only the two larger groups by occurrence (straight channels and turns) have been tabulated.

STRAIGHT CHANNELS

Straight channel depth and width for each port is given in Table V.

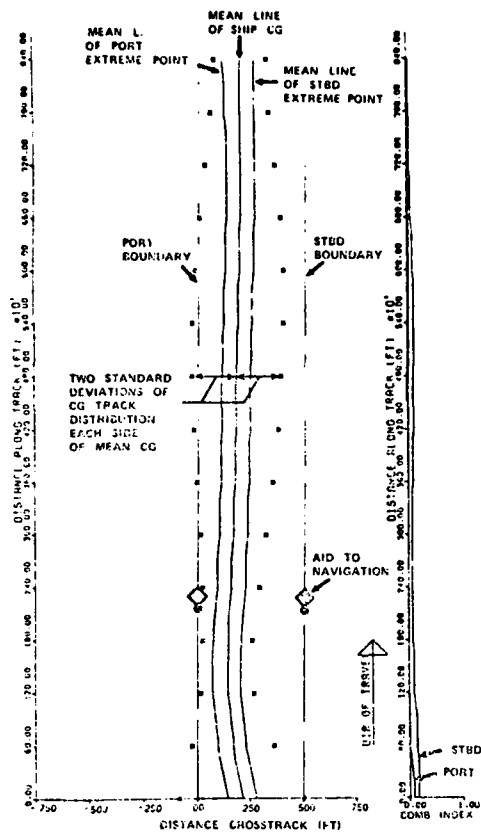


Fig. 1. Measure of Performance Plot

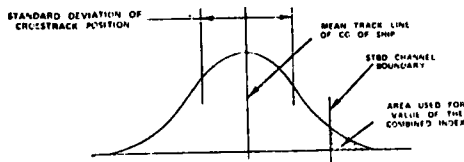


Fig. 2. Combined Index

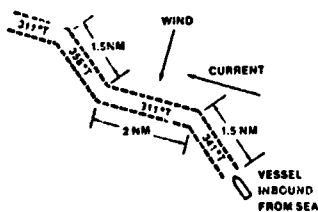
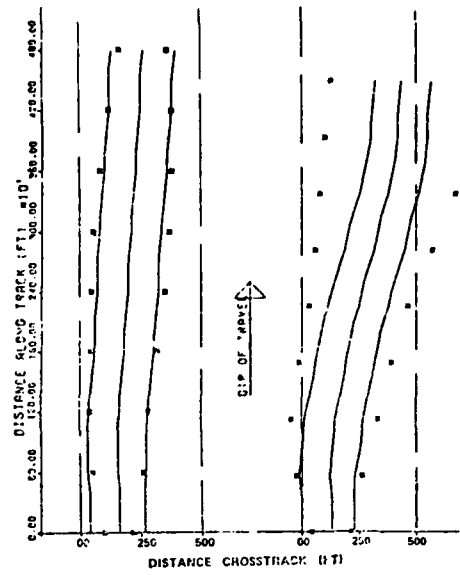


Fig. 2. Combined Index



Normal Rudder Leg 1 Small Rudder Leg 1
Fig. 4. Effect (of Rudder Size) in Leg 1

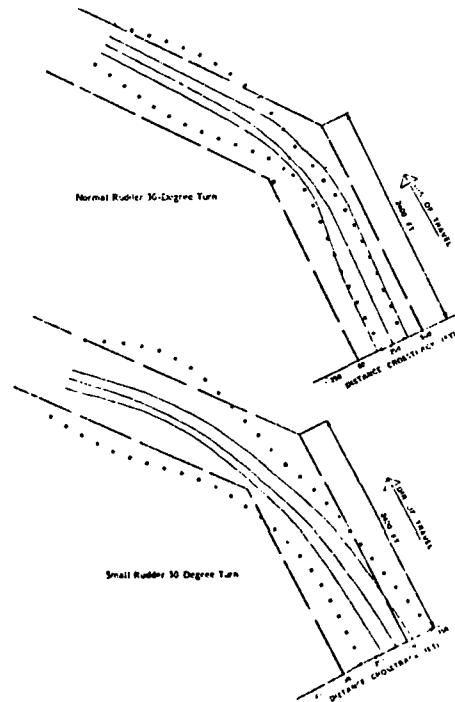


Fig. 5. Effect (of Rudder Size) in Turn

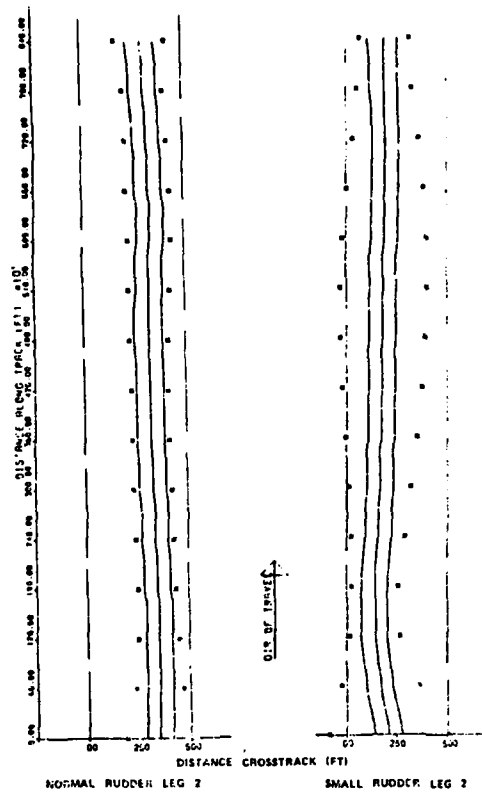


Fig. 6. Effect (of Rudder Size) In Leg 2

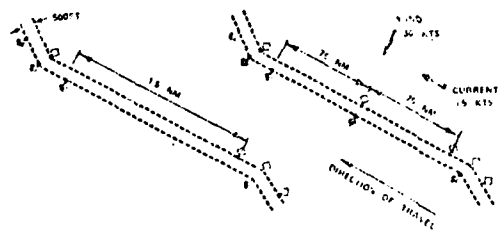


Fig 9. Experimental Channels With and Without Midleg Buoys

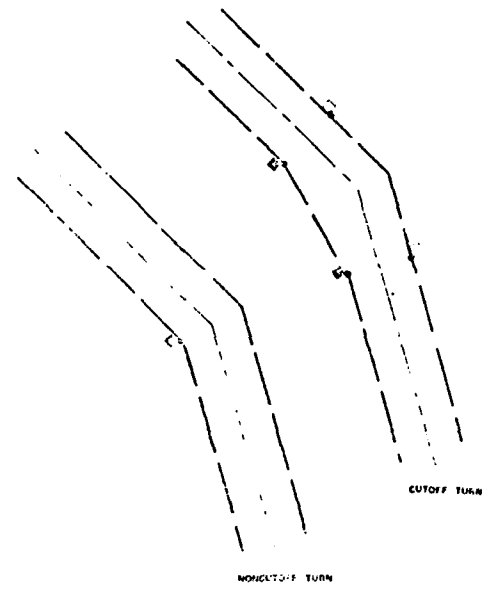


Fig. 7. Cutoff and Noncutoff Turns

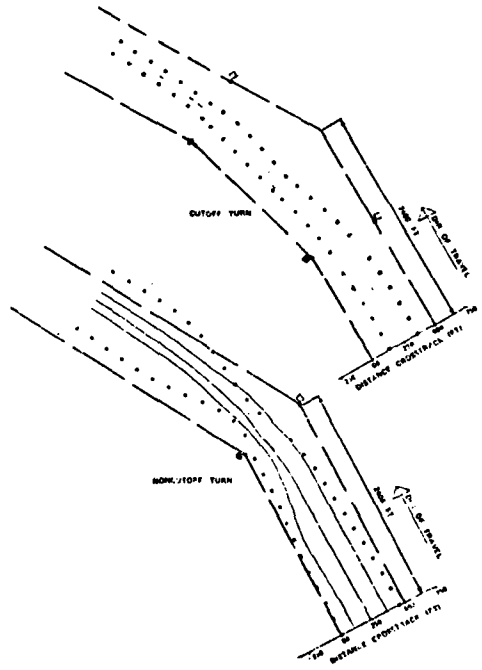


Fig. 8. Effect of Turn Type

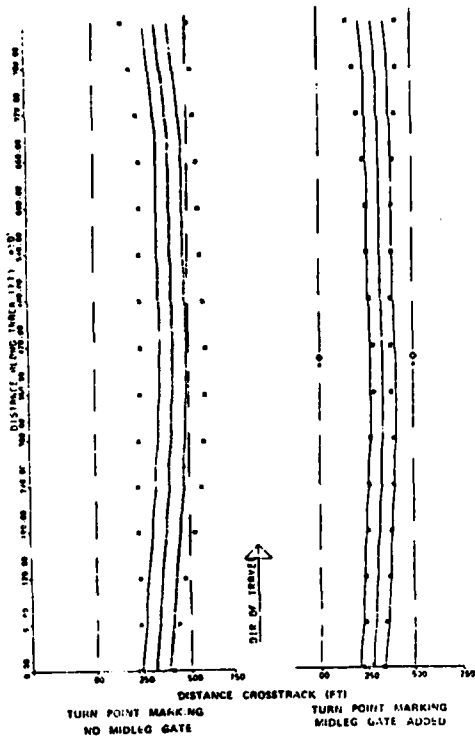


Fig. 10. Effect of Adding Midleg Buoys on Straight Channel Legs

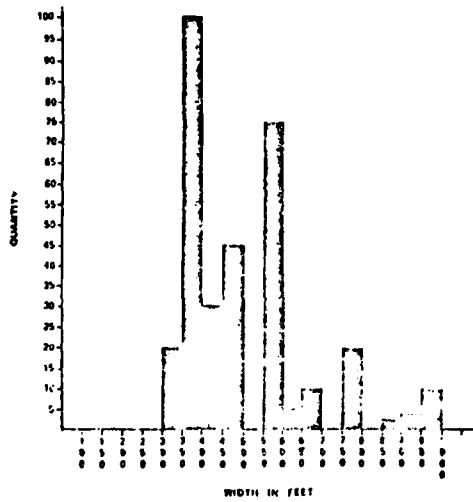


Fig. 11. Distribution of Straight Channels by Channel Width

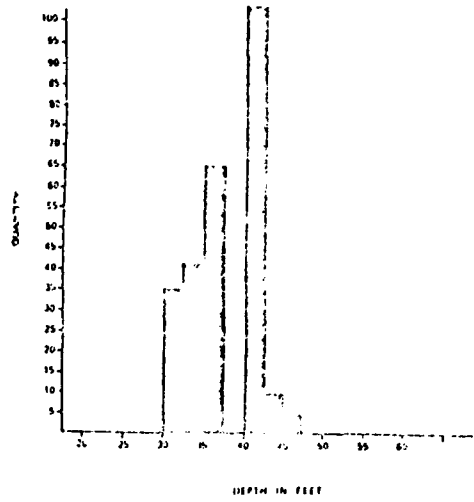


Fig. 12. Distribution of Straight Channels by Channel Depth

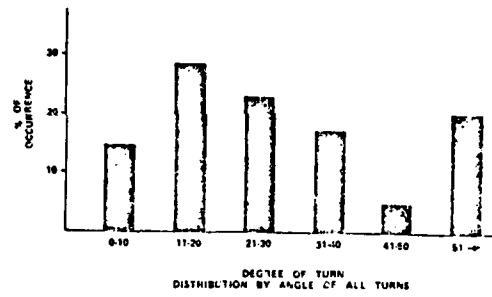


Fig. 13. Distribution of Turn Angles

TABLE 1. AVERAGE COMBINED INDEX COMPARISON FOR NORMAL AND SMALL RUDDER SHIP

	Average Combined Index					
	Leg One Cross Current		Turn		Leg Two Following Current	
	Part	STUD	Part	STUD	Part	STUD
Normal Rudder	.171	.014	.083	.009	.029	.021
Small Rudder	.243	.260	.114	.276	.083	.011

TABLE II. EFFECT OF TURN CONFIGURATION ON COMBINED INDEX

Turn Condition	Average Combined Index	
	Port	Starboard
Noncutoff Turn with Corner Buoys (Small Radius)	0.015	0.032
Cutoff Turn with Gate Buoys (Larger Radius)	0.003	0.001

TABLE III. EFFECT OF ADDING MIDDLE BUOY

	AVERAGE COMBINED INDEX			
	WITHOUT GATE		WITH ADDITIONAL GATE	
	PORT	STARBOARD	PORT	STARBOARD
Without Traffic	0.022	0.026	0.022	0.026

TABLE V. SUMMARY OF STRAIGHT CHANNEL DEPTH AND WIDTH FOR EACH MAJOR U.S. PORT (DEPTH IN FEET)

HARBORS	WIDTH				
	350-400	400-500	500-600	600-800	800-1000
Portland					35
Boston	32				35
Providence	35		40		
New London			33		
New Haven	35	35			
New York	35	35	35	35	
Philadelphia		40		40	40
Albany	32	32	31		
Charapeake		35		42, 37	41, 40
Baltimore	27			42	35
Charleston	35, 33	35	35	35	35
Norfolk				42, 40, 45	45
Wilmington	38	40			
Savannah	38	40, 38	40		
Jacksonville	30	38, 39	34	42, 38	
Miami		38, 35			
Tampa	34, 32	36	36		
Mobile	40	40	42, 40	40	
New Orleans		36, 33	40, 30, 33		
Port Arthur	40	40			
Corpus Christi		45	47, 47		
Houston	40, 35			42, 40	40
Los Angeles		47			
Long Beach				60	
San Francisco	30	45, 30, 35	35, 30		
Portland		40	40	40	
Cook Bay	30				
Seattle					55
Juneau					30
Honolulu	35	40			
Paltoth					

CENTER
FOR
LAW
AND
SOCIAL
POLICY

1751 N STREET N W WASHINGTON D C 20036 202 872 0670

May 16, 1980

Everett P. Lunsford, Jr.
Project Manager
Committee on Reducing Tankbarge
Pollution
Maritime Transportation Research
Board
National Academy of Sciences
2101 Constitution Avenue NW, Rm. 538
Washington, DC 20418

RE: Comments Concerning MTRB Tankbarge
Pollution Workshop

Dear Mr. Lunsford:

During the April 15-16, 1980 Workshop on Reducing Tankbarge
Pollution, you advised the participants that further comments
could be submitted on or before May 16, 1980 for consideration
by the steering committee and the Academy as it prepares a
report and recommendations concerning solutions to the tankbarge
pollution problem. We are submitting these comments on behalf
of sixteen (16) environmental organizations--American Littoral
Society, Center for Environmental Education, Clean Water Action
Project, Coast Alliance, Defenders of Wildlife, Environmental Defense
Fund, Environmental Policy Center, Friends of the Earth, Fund for
Animals, National Parks and Conservation Association, National
Wildlife Federation, Natural Resources Defense Council, Oceanic
Society, Sierra Club, Society for Animal Protective Legislation
and Wilderness Society (collectively referred to as the

James N. Barnes
Nancy Duff Campbell
Deborah C. Costlow
Clifton E. Curtis
Roger S. Foster
L. Thomas Galloway
Marcia D. Greenberger
Margaret A. Kohn
J. David McAteer*
Leonard C. Meeker
Sanford A. Newman*
Carol Oppenheimer
Marilyn G. Rose
Andrew Jay Schwartzman
Heidi P. Sanchez
Herbert Semmel
Richard L. Webb
Attorneys At Law
*Not admitted in D.C.

Mr. Everett P. Lunsford, Jr.
May 16, 1980
Page Two

environmental organizations").^{1/} Representatives from several of these organizations participated in the April 15-16 Workshop.

The environmental organizations listed above have long recognized the problem of oil pollution in our inland and coastal waters. We have participated in the recent Coast Guard attempts to address the problem of tankbarge pollution by submitting comments on September 28, 1979 on the draft double hull regulatory analysis. This letter summarizes the results of the workshop from the perspective of the environmental organizations and sets forth our views and concerns as to the most efficient and effective ways to alleviate the problem.

The workshop discussed many facets of the tank barge issue. The working group on Congressional Mandates concluded that the Coast Guard has the legislative authority to require structural design and other changes. The Technical Group discussions provided evidence of the practicality of requiring double hulls on tank barges for certain parts of our waterways and provided insights into the benefits to be gained by applying modified structural design changes to other segments of the tank barge industry. With respect to the other working groups, the extensive discussions on possible alternatives to structural design requirements and modifications demonstrated that some measures would be valuable complements in preventing pollution. However, those work group participants failed to show that such measures can be adequate as substitutes for structural design changes.

^{1/} Attached as Appendix A is a description of these organizations.

Mr. Everett P. Lunsford, Jr.
May 16, 1980
Page Three

We recognize the sizable costs involved in reducing tank barge pollution--industry, Coast Guard and the public all must bear part of these costs. We have thus attempted to reach a solution that achieves the most pollution prevention for the least cost by combining the most efficient preventative measures. The implementation of both structural design changes, as advanced in these comments, and the adoption of certain complementary alternative measures proposed in the workshop, could provide such a solution.

Nature of the Problem ^{2/}

Pollution of the marine environment is a well-recognized problem. Most notorious is, of course, the seagoing tanker, but tank barge pollution is also extremely significant. During the NAS workshop, some participants attempted to minimize this threat, due to our uncertain state of knowledge. We feel such an effort is misplaced and inappropriate. Neither the workshop in general nor any working group in particular focused on the impacts of oil or chemical pollution in the marine environment. This is hardly the proper forum in which to attempt to review

^{2/}This section is only a brief summary of the effects of oil pollution on the marine environment, as taken from a vast body of scientific literature. For additional literature references and the analyses of the problem, see the collections of studies in Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. D. A. Wolfe, Ed. Pergamon Press, Oxford.; Proceedings of 1979 (1977) (1975) (1973) Joint Conference on Prevention and Control of Oil Spills, New Orleans, La., sponsored by API, EPA, USCG, published by API; The Proceedings of the Conference on Assessment of Ecological Impacts of Oil Spills, 14-17 June 1978, Keystone, Colorado, sponsored by the American Institute of Biological Sciences.

Mr. Everett P. Lunsford
May 16, 1980
Page Four

or rebut the wealth of studies done on the short-term and long-term effects of petroleum or chemicals on coastal, intertidal and estuarine ecosystems. Obviously, much remains to be known about the fate and effects of oils and chemicals, but from what is known the steering committee and the Academy should have little difficulty finding that pollution of the marine environment is a serious problem. Moreover, the Congressional determination that the problem does exist, as discussed below, should serve as a persuasive call for action on the issue at hand. In this context, the impact of oils and chemicals in the marine environment and the contribution of tank barges to that problem can not be underestimated.

Information on the effects of oil spills is extensive if not definitive.^{3/} Much less is known about the chronic and catastrophic effects of chemical spills, though the devastation to the James River due to kepone contamination gives ample reason by itself for being very concerned. Marine environments, whether they be inland or coastal, react differently to pollution. Marine organisms are affected in different ways, though there are some general effects.

^{3/} Much has been learned from studies that have been done, such as those involving: the Santa Barbara well blowout in 1969; the NEPCO 140 barge spill in the St. Lawrence river in 1976; the Argo Merchant spill of 170,000 barrels of No. 6 fuel oil into the northwest Atlantic in 1976; the Zoe Colotroni spill off the southwestern coast of Puerto Rico in 1973; the Amoco Cadiz spill off the Brittany coast in March, 1978; and the Ixtoc I spill in the Gulf of Mexico's Bay of Campeche in June, 1979.

Mr. Everett P. Lunsford
May 16, 1980
Page Five

The lethal effects of petroleum on marine life are well-documented. Despite the acknowledged uncertainties, a number of disturbing facts appear to have been demonstrated by research work to date. Petroleum can kill marine life by: (1) coating and asphyxiation, (2) poisoning through direct contact or ingestion, (3) exposure to water-soluble toxic petroleum components, (4) destruction of more sensitive juvenile forms and (5) disruption of body insulation of warm-blooded animals.^{4/} Some of these problems, as we will discuss below, are particularly serious in the inland and coastal waters that tank barges pollute.

Petroleum also has myriad sublethal effects on marine life. The most dangerous and far-reaching is probably the effect on chemoreception, which may occur after only slight exposure to petroleum hydrocarbons. The problem can be summarized as follows:

The detection of food, feeding impulses, escape from predators, territory definition, homing of migratory species, and other biological processes that are critical to the survival of the species are regulated by very low concentrations of substances in sea water. Natural chemical signals . . . that trigger the responses may be masked or mimicked by the presence of low concentrations of pollutants.^{5/}

Thus, low levels of pollution can severely retard basic functions of marine organisms.

^{4/}Boesch, Donald, Karl H. Hirschner, and Jerome H. Milgram. Oil Spills and the Marine Environment. Ballinger, Cambridge, 1974, p. 35.

^{5/}Todd, J. H., J. Atema, and D. B. Boylan, "Chemical Communication in the Sea," Mar. Technol. Soc. J., 6: 54-6, 1972.

Mr. Everett P. Lunsford
May 16, 1980
Page Six

Petroleum, as well as chemicals discharged into the inland and coastal waters, can act as a mutagen and carcinogen^{6/} Furthermore, exposure to petroleum has been shown to adversely affect reproductive potential.^{7/}

According to the U.S. Coast Guard's draft Regulatory Analysis and Draft EIS ("Coast Guard DEIS") presented to the NAS workshop, roughly 2.1 million gallons of oil enter inland and coastal waters each year from tank barge pollution. This pollution tends to be concentrated in areas of great ecological vulnerability--shorelines, estuaries and enclosed inland waterways. As a result, even small spills have exaggerated ecological effects in comparison with larger spills in more open waters.

Studies of specific spills have documented the severe harm done to these habitats. The small spill at West Falmouth, Mass., killed 95% of the animals collected after the accident.^{8/} A similar EPA study of Casco Bay, Maine found severe pollution effects of the intertidal ecosystem,^{9/} while the EPA study at

^{6/} See Zobell, C. E., Sources and Biodegradation of Carcinogenic Hydrocarbons, in Proceedings of the 1971 Joint Conference on Prevention and Control of Oil Spills, March 1971, New Orleans, La., sponsored by API, EPA, USCG, published by API.

^{7/} National Academy of Sciences, "Petroleum in the Marine Environment," May 21-25, 1973, NAS, Washington, D.C. at 85.

^{8/} U.S. Environmental Protection Agency, "A Small Oil Spill at West Falmouth," (EPA 600/9-79-007) March 1979, Office of Research and Development, EPA, Washington, D.C. 20460

^{9/} U.S. Environmental Protection Agency, "Tamano Oil Spill in Casco Bay: Environmental Effects and Cleanup Operations," (EPA 430/9-75-018) December 1975, Office of Water Program Operations, EPA, Washington, D.C. 20460

Mr. Everett P. Lunsford
May 16, 1980
Page Seven

Bahia Sucio, Puerto Rico, found severe effects on the marsh, benthic and beach communities.^{10/} Dow reported that three and one-half years after a spill, the oil trapped in the sandy beach had killed 85% of the 50 million marketable clams in the area^{11/} and that the oil was killing successive year classes as late as five years after the spill.^{12/} Bender, et al., found oil to cause "significant ecological effects" when introduced into estuaries.^{13/}

These consequences reflect a number of aspects of the areas most affected by barge spills. Intertidal and benthic organisms, unlike fish at sea, are highly immobile and cannot escape inundation by oil spills. Estuaries are sensitive for several reasons: they are shallow, confined, and their turbidity causes absorption in the sediment and consequent long-term effects, including the effects on life on shore and the possible reentry into the near-shore area. As the National Academy of Sciences said, "because they combine biological productivity with the most severe exposure

^{10/}U.S. Environmental Protection Agency, "Oil Spill Bahia Sucio, Puerto Rico, Environmental Effects," (EPA 430/9-79-014) March 1973, Office of Water Programs Operations, EPA, Washington, D.C. 20460.

^{11/}Dow, R. G. and J. W. Hurst, Jr., 1975. The Ecological, Chemical, and Histopathological Evaluation of Oil Spill Site. Part I. Ecological Studies. Mar. Poll. Bull., 6: 164-66.

^{12/}Dow, R. G., 1978. Size-selective Mortalities of Classes in an Oil Spill Site. Mar. Poll. Bull., 9(2): 45-48.

^{13/} Bender, M. E., E. A. Shearls, R. P. Ayres, C. H. Hershner and R. J. Huggett. Ecological Effects of Experimental Oil Spills on Eastern Coastal Plain Estuarine Ecosystems, in Proceedings of 1977 Joint Conference on Prevention and Control of Oil Spills, March 1977, New Orleans, La., sponsored by API, EPA, USCG, published by API.

Mr. Everett P. Lunsford
May 16, 1980
Page Eight

to wastes, estuaries are most vulnerable to the serious effects of chronic oil pollution." ^{14/}

We know from past experience "that in spite of the precautions taken by most companies, corporations, and individuals, oil has been spilled in many areas, causing damage to the environment and surrounding properties."^{15/} While there are innumerable pollutant sources that contribute to this problem, the Coast Guard DEIS that was issued last year concerning tank barges makes clear that transfer and transport incidents involving barges represent an identifiable source of significant pollution to inland waters, harbors and coastal waters. While the total pollution from tankships is considerably larger than for tank barges (Coast Guard DEIS, Table I), absent two catastrophic tankship spills during 1971-77, the volume of oil spilled for these two types of vessels during that time period was between 300,000-400,000 barrels. Table I also indicates that the problem of tank barge pollution is not decreasing. That pollution took the form of about 1,000 spills per year, the bulk of which we can assume were in the fragile coastal and inland waters. Regardless of the amount and sources of other pollution, the site-concentrated tank barge pollution is a serious and substantial threat to the marine environment that must be remedied.

^{14/}NAS, supra note 4 at 86.

^{15/}U.S. Environmental Protection Agency, "Inland Spills," EPA Region VII, Kansas City, Mo., 1973.

Mr. Everett P. Lunsford
May 16, 1980
Page Nine

Congressional Mandates

The working group on Congressional Mandates concluded that Congress, in the Port and Tanker Safety Act of 1978, has given the Coast Guard a mandate to take action to reduce tanker and tank barge pollution. Congress provided in §5 of the Act (46 U.S.C. §391(a)(1)(B)):

That existing standards for the design, construction, alteration, repair, maintenance, operation, equipping, personnel qualification, and manning of all such vessels which use any port or place subject to the jurisdiction of the United States or which operate in the navigable waters of the United States must be more stringent and comprehensive for the mitigation of the hazards to life, property, and the marine environment.

With this mandate to act, the important remaining issue was the power of the Coast Guard to require double hulls. Group 2 concluded that although double hulls were not required under the Act, the Coast Guard indeed had the authority to issue regulations requiring double hulls. This is in accord with Senator Magnuson's statement that there can be no doubt "that the [double hulls] standards . . . are within the range of standards that Congress foresaw as resulting from the legislative mandate."

The Port and Tanker Safety Act also addresses the weight to be given the existing Coast Guard proposal. Section 5 of the Act states (46 U.S.C. §391(a)(1)(D)):

That standards developed through regulations shall incorporate the best available technology and shall be required unless clearly shown to create an undue economic impact which is not outweighed by the benefits to navigation and vessel safety or protection to the marine environment.

Mr. Everett P. Lunsford
May 16, 1980
Page Ten

Pursuant to this statutory directive, the burden is on the industry to show an undue economic impact and an absence of sufficient benefit from a regulation that would incorporate, as directed, the "best available technology." Of course there will always exist some questions about the benefits and costs of a regulatory proposal, but the mere existence of questions is insufficient to overrule the Coast Guard's proposal. The industry has an affirmative burden to prove its unreasonableness.

This interpretation also accords with Senator Magnuson's statement that since the industry has been given a Coast Guard proposal,

it is incumbent on industry that it clearly demonstrate to the Coast Guard why the Coast Guard has erred [T]his showing must be more than one of simply demonstrating increased costs. Similarly, it is incumbent that the industry clearly demonstrate why the benefits to navigation, vessel safety, or protection of the marine environment that the Coast Guard states will accrue, or why these benefits are clearly outweighed by an undue economic impact.

Thus unless industry can meet this burden, the Coast Guard's proposal for structural design changes should stand.

Group 2 also concluded that the Coast Guard has failed to meet its duty to engage in thorough consultations before issuing any final order. The workshop itself is evidence that the Coast Guard is taking steps to comply with this important requirement. Continued consultations should be encouraged.^{16/}

^{16/}We question the appropriateness, however, of creating an advisory group such as the previously existing Towing Industry Advisory Council, absent guarantees that there would be adequate representation and input from societal sectors such as the states, local communities, environmental and consumer groups.

Mr. Everett P. Lunsford
May 16, 1980
Page Eleven

The Congressional Mandate group made it clear that Congress intended the Coast Guard to take appropriate action to stem the pollution problem. It is evident from the workshop that a reasonable program now exists that will carry out the legislative objectives. This program demonstrates that the Coast Guard is correct in relying primarily on structural design changes with other measures implemented only as complements.

Double Hull and Other Structural Design Requirements for Tank Barges

The adoption of more stringent structural design requirements on tank barges would primarily contribute to a reduction in transport polluting incidents, since it is those incidents where serious hull damage occurs. The environmental organizations supported the U.S. Coast Guard's June 14, 1979 proposed regulations to require double hull construction for all new tank barges and the thrust of the proposed regulatory action for existing tank barges. These organizations believe that double hull requirements represent a long overdue step towards reducing pollution risks by tank barges.

The studies upon which the Coast Guard relied in its June 14, 1979 proposed rulemaking support the need for double hulls on barges. As updated and revised in the oil spill analysis that was presented to the NAS workshop by Lt. Comm. Alan Spackman, double hulls could be expected to prevent 95% of the cargo tank penetrations, with a resultant 47% (minimum) reduction in volume spilled due to transport-related incidents involving hull damage,

Mr. Everett P. Lunsford
May 16, 1980
Page Twelve

and a 44% reduction in the total volume spilled. Richard Willis' analysis is also instructive in its finding that "single hulled barges can be expected to pollute at a rate 12.5 times that of a double hulled barge." (at p. 11)

While those statistical figures do not distinguish inland barges from coastal/ocean barges, some industry representatives have presented information which would indicate that the trade and operating environment differ significantly. A much greater majority of the collisions or accidents within our nation's inland river system that result in pollution of the marine environment are caused by low-energy impact incidents. Those polluting incidents could be significantly reduced by the adoption of double hull requirements. As C. van Mook's paper indicates, "river navigation is beset by the many continuously present hazards of shallow water, restricted channels, ever-changing bottom contours, current, wind, man-made vessels, and other vessels." (at p. 5) Within the inland river systems, given the economic burdens associated with building doubled hulled vessels, it would seem advisable to focus initially on the midcontinent river system, using that regulatory implementation over a twelve-to twenty-four month period as a source of added information leading to similar or modified actions encompassing other geographical areas.

The requirement of double hulls on midcontinent inland river tank barges should be pursued without further delay. The environmental organizations believe that promulgation of regulations

Mr. Everett P. Lunsford
May 16, 1980
Page Thirteen

should take into consideration the difference between new and existing inland and coastal barges in the following manner:

- (1) The Coast Guard should require that all new barges in the midcontinent river system be constructed with double hulls. Those rivers are the most heavily trafficked by barges. There is already a significant industrial trend towards double hulled barges. According to the statistics presented by W. A. Creelman, there are currently 1407 single hull barges and 1352 double hull barges in operation within that geographical area. The operating environments and the nature of the trade--a much greater percentage of chemical and residual fuel-carrying barges--makes the midcontinent river system much more conducive as the logical point of departure for initiating double hull requirements.^{17/}
- (2) As for existing vessels in the midcontinental river system, there should be a phase-out period that takes into consideration the economic impact of more rigid standards. Richard Willis' paper describes and graphically depicts the significant pollution savings that would result from modified

^{17/}A subcategory would be to exempt certain "new" midcontinent river system barges in particular trades from the double hull requirement. Barges carrying products that solidify at ambient river or air temperature should be given special consideration. Products such as asphalt might only require double sides, since asphalt has heating requirements that might preclude double hulls due to heat expansion problems. In general, viscous or solid products, such as polymerized styrene, coaltar, or cold asphalt could be very difficult to remove from a double hulled barge. As van Mook's paper indicated a "double-side wall, single bottom tank barge, with the forward bottom of a lead unit especially reinforced against grounding, may be sufficient for any such products." [p. 10]

Mr. Everett P. Lunsford
May 16, 1980
Page Fourteen

attrition standards that assume that new barges will be constructed with double hulls and that the average retirement/scrapping age of existing barges (28.2 yrs.) will continue (at p. 13, and Figure 2). Until existing single hulled barges have been retired, those vessels should be required to make certain design modifications within a reasonable time period following implementation of the rule-making. For example, all existing midcontinent river system vessels should be required, by retrofitting, if necessary, to have:

- (a) increased inspections;^{18/}
- (b) end void spaces;
- (c) side and bottom rub bars (plates);
- (d) side and bottom minimum plate thickness of 1/2" if those sections of the barge are ever replaced;
- (e) the round knuckle replacements should have a minimum radius of 6"; and
- (f) cargo compartments should be subdivided into compartments not exceeding 6,000 barrel cubic capacity.

^{18/} Consistent with the towing industry's recommendation that increased inspection should be required for single hulled barges (Creelman's paper, Exh. A, p. 2), we would recommend (1) bi-annual drydock inspections of single hulled barges until they have been in service 20 years, (2) annual drydock inspections for single hulled barges over 20 years of age, (3) certified semi-annual owner inspections meeting specified standards, and (4) regular unannounced visual inspections of single hulled barges in loaded condition, including compliance with sheen test standards.

Mr. Everett P. Lunsford
May 16, 1980
Page Fifteen

- (3) New river barges outside the midcontinent river system might be exempted from the double hull requirement for the present. Their trade is generally much more seasonal, in rivers like the Columbia and the Snake, and the nature of their cargo trade differs from that found in the midcontinent system. The added costs of double hulls could be prohibitive. Also, certain small operators serving stripper wells might find the double hull requirement economically prohibitive. Decisions should be made on a case-by-case basis, but there is evidence that imposition of double hulls might drive some of these operators out of business.
- (4) Existing river barges outside of the midcontinent system should be required to adopt the requirements set out in subpara (2), above, although the Coast Guard should be given considerable discretion in granting some exemptions where appropriate--where the economic burden outweighs the benefits to the environment and to navigation safety.
- (5) Coastal/ocean/Great Lakes barges' accident patterns suggest that the greatest number of oil outflow incidents are caused by groundings. Consistent with the recommendations presented in Mr. Willis' paper (at 15),

Mr. Everett P. Lunsford
May 16, 1980
Page Sixteen

serious consideration should be given to requiring coastal barges to have double bottoms. Coastal barges have different trading patterns and different risks, yet benefits of the type referred to in Kent Woodward's paper involving asphalt cargo trade (at p. 3), serve as examples of situations where double hulls are advantageous, irrespective of their pollution reduction benefits in grounding accidents. A double bottom provides an immediate benefit in most grounding situations: there is no outflow of oil or chemicals. Studies have shown the value of double bottoms for tankers, and the same reasoning is applicable to barges. In a study of thirty groundings performed by (then Lt.) Cmdr. James Card between 1969 and 1973, outflow from tankers would have been prevented in twenty-seven cases by a double bottom whose height was one-fifteenth the beam,^{19/} A height of two meters, commonly used for tankers, would have prevented outflow in twenty-nine cases. Card's study was not selective--every grounding in U.S. waters was considered. And his findings have never been controverted.

- (7) Existing coastal barges should be required--subject to Coast Guard determinations based on such factors as the cargo trade and differences in coastal areas to adopt some or all of the retrofit and increased inspection requirements set forth in subpara (2), above.

^{19/}Card, Effectiveness of Double Bottoms in Preventing Oil Outflow from Tanker Bottom Damage Incidents (1973).

Mr. Everett Lunsford
May 16, 1980
Page Seventeen

ADDITIONAL NON-STRUCTURAL PROTECTIVE MEASURES

Three of the working groups discussed various measures other than structural design changes that might be implemented to reduce tank barge pollution. Some were shown to provide worthwhile benefits and others to provide only minimal benefits, if any. Many were shown to be impractical because of the Coast Guard's budgetary constraints and other priorities. The implementation of many of these measures would be a positive step toward reducing pollution, but the workshops demonstrated that, at best, they will be complements, and not alternatives to structural design changes.

(a) Operational Environment

Of the many proposals discussed in Group 4, three were dismissed as having only marginal benefits or chances of implementation. These three were (1) improved detectors of leakage, (2) greater use of dispersants, and (3) expanded Coast Guard icebreaking operations.

It was suggested that equipping vessels with devices that would quickly alert vessel operators of any leak would reduce pollution by decreasing the lag time between initial leakage and initial reaction. Yet industry representatives felt this was an insignificant step towards reducing pollution. Inland operators would not benefit because most spills in the inland waters are easily observable, and coastal operators felt that

Mr. Everett Lunsford
May 16, 1980
Page Eighteen

being made aware of a leak was not a major problem. Moreover, this measure is only a response measure and does nothing to correct the actual causes of tank barge pollution.

The same can be said for the use of dispersants, particularly with regards to inland use. The working group realized that dispersants are also expensive, have adverse side effects and are to a degree controlled by the EPA, which has reservations about their use in large quantities. All these factors prevent the extensive use of dispersants from being a practical or even a desirable pollution-preventing measure. Clearly dispersants do not provide an answer to the pollution problem.

The extension of ice-breaking operations also was found not to be of great significance, primarily because it was unlikely to occur. Capt. Uithol of the Coast Guard stated that ice-breaking should only be done where it appears to be cost-effective and that the Coast Guard currently clears most of the waterways it feels will meet that test. He also said the Coast Guard wants to maintain its current system so that it will be predictable and that funds for extended ice-breaking operations are unlikely to be appropriated. Ice-breaking is expensive, provides only regional and seasonal aid, and is not even primarily administered as an aid to commerce. Thus several factors indicate that extended ice-breaking operations are unlikely and of limited potential.

Mr. Everett Lunsford
May 16, 1980
Page Nineteen

Two topics of discussion did reveal greater potential: the Vessel Traffic System (VTS); and aids to navigation. There are undoubtedly improvements to be made in these areas, yet several factors show them to be inadequate as alternatives to structural design changes.

According to Capt. Charter of the Coast Guard, a VTS works well in an area which is limited geographically, so that a watch officer can see the entire area, or in an area where traffic density is low. Where such ideal conditions do not exist, the advantages of a VTS are far less certain. If the VTS is expanded beyond visual range, a display must be used, adding greatly to costs. The Coast Guard estimates that the various possible VTS display systems can have an initial installation cost as high as \$1.5 million (television system) and annual operating costs as high as \$660,000 (traffic center with computers) for each VTS. As with many of the measures discussed in Group 4, this measure calls for sizable expenditures by the Coast Guard, yet the Coast Guard clearly has limited resources. The adaptability of VTS to different types of waterways also casts doubt on the viability of VTS as an adequate alternative. As Capt. Charter pointed out, it is very difficult for the Coast Guard to analyze inland waterways for purposes of VTS applicability. The Coast Guard has found 22 areas to be suitable for a VTS but those 22 areas cover little of the country's inland waters. Thus, the fact remains that VTS is a geographically limited and costly solution.

Mr. Everett Lunsford
May 16, 1980
Page Twenty

In addition, the effectiveness of the VTS is limited. The VTS in New Orleans, the port the Coast Guard rates second in terms of the level of VTS needed, has been closed for ineffectiveness. The VTS in New York, the top-rated port, has yet to be activated and will not be for at least another year. It is recognized by all that VTS is ineffective in the in extremis situations that characterize many tank barge accidents. Of course bad weather cripples the effectiveness of the sight VTS's.

We recognize that VTS can help prevent tank barge pollution and we hope it can be implemented in more areas. But, as Group 4 recognized, improvements are needed to make the VTS a truly effective system for the small area it services. (See transcript of Plenary Session, 23-24.) Changes such as "civilianization" of some vessel traffic services, electronic retransmission of position data and centralization of management authority may improve the VTS. On the other hand, some of these measures will add further costs to the system. Thus, although it is a desirable system, we think the geographical, efficiency and cost limitations prevent VTS from being a viable alternative to structural design changes.

A similar conclusion must be drawn with regard to aids to navigation, although for a different set of reasons. Aids to navigation clearly can reduce the incidence of tank barge acci-

Mr. Everett Lunsford
May 16, 1980
Page Twenty-one

dents and should be improved and expanded as much as possible. But, as the Coast Guard made clear at the workshop, it is not possible for aids to navigation to grow into a full solution.

The primary reason is again cost. Industry papers and representatives provided a wealth of suggestions on how the Coast Guard can improve navigation, (See transcript of Plenary Session, 29-30.) yet the Coast Guard has limited resources. In addition, many aids are now being maintained and increases in effectiveness become more and more expensive at the margin.

The second obstacle is Coast Guard priorities. In his summary before Group 4, Capt. Garrett pointed out that expenditures on aids challenge existing Coast Guard priorities, priorities that will not likely be reordered in favor of aids for commercial transport. Only a congressional or presidential directive would change this situation.

The Coast Guard has created an internal Office of Navigation to direct resources spent on aids to the most efficient areas but without receiving more resources to spend. It is hoped that this will improve overall efficiency, but even if a comprehensive effort in the area might substantially solve the pollution problem, the Coast Guard has neither the directive nor the resources to make such an effort.

As it is, such an effort could not in fact replace structural design changes as the best method of reducing tank barge

Mr. Everett Lunsford
May 16, 1980
Page Twenty-two

pollution. It has been estimated that 85% of all tank barge accidents are caused by human error, an element that will exist in great measure even after aids to navigation are improved. Group 4 briefly discussed the human error problem and considered that the industry could regulate itself in the area but its conclusions must defer to those of the Personnel Group.

The final item discussed in Group 4 was the status of dredging operations in the U.S. It appears that the Corps of Engineers and the Congress have taken steps to improve the dredging capabilities, yet no one suggested this as a feasible alternative for reducing tank barge pollution, which is caused by myriad other factors. Much of the discussion focussed instead on the costs of dredging under various circumstances. Like most operations, dredging will only be done when it is cost effective. The working group felt that the most acceptable path was to maintain existing federal navigation projects at acceptable depths and widths.

The working group on Operational Environment did a thorough job of analyzing numerous pollution preventing measures, some of which should indeed prove beneficial. Nevertheless, the common denominator involved the Coast Guard's spending more resources on each of the measures, and this is not possible. Combined with the geographical and efficiency limitations of various

Mr. Everett Lunsford
May 16, 1980
Page Twenty-three

proposals, the cost limitation shows that the changes in the operating environment, to the extent they can be implemented, can function only as part of an overall prevention program, not as an alternative.

(b) Personnel, Standards and Enforcement

The principal item discussed in Group 3 was the emergence of personnel training programs and their effect on tank barge pollution.^{20/} There appears to be a great deal being done to train tankermen and thereby reduce the amount of spills they cause. Presentations by representatives of the National River Academy and the Harry Lundeberg School demonstrated the increased efficiency the industry should realize in cargo transfer operations. License renewal procedures and the Coast Guard's forthcoming tankermen regulations should also help decrease the frequency of operational spills. The major short-coming in the application of personnel training programs is that they primarily address operational or transfer spills, not vessel casualty or transport spills.

Although operational accidents account for roughly 80% of the number of tank barge oil spill accidents, they only pro-

^{20/} There was also discussion in the structural design working group concerning alternatives to double hulls (e.g., William McNeil's paper, at p.3). We have recommended that some of these features be adopted as retrofit requirements for existing single hull barges. Other measures that would improve the operating environment for personnel include, among others: standards for access to cargo holds; walkways; requirements that ullage openings be a minimum of twelve inches; and improved laddering between tug and barge in coastal waters.

Mr. Everett Lunsford
May 16, 1980
Page Twenty-four

vide about 15% of the volume of oil spilled by tank barges. (Coast Guard EIS, 10) The numerically fewer vessel casualty spills are far more damaging than the numerous operational spills. For example, an incident last April 16 on the Mississippi River, involving the tug National Venture spilled 155,000 gallons of No. 6 fuel oil and caused severe damage. (Oil Spill Intelligence Report, Vol. 3, No. 18, May 2, 1980) It is very misleading to apply the limited benefits of personnel training programs to the entire tank bargesetting.

The need for operator training programs was recently acknowledged by the Maritime Transportation Research Board. (Proceedings: Symposium on Piloting and VTS Systems, MTRB, National Academy of Sciences, Washington, D.C., 1980.) Although some training programs for operators do exist, far too little emphasis is presently placed on transport training. Coast Guard licensing of operators of uninspected towing vessels, as explained by Commander James R. Norman, involves little more than one examination. Since Group 3 felt renewal and recertification of licenses as now required is adequate, there is no reason to expect improvement from this process.

The lack of operator training programs may demonstrate the irresolvable nature of the problem. According to John Gardinier of the Coast Guard, the barge operators responsible for most judgment errors have been in their forties, with an

Mr. Everett Lunsford
May 16, 1980
Page Twenty-five

average of about 17 years experience, reacting to exceptionally adverse circumstances. It is questionable whether a training program could serve better than 17 years experience for purposes of handling such a situation. These adverse circumstances will always arise and, while pipes, hoses, valves and the like can be controlled, many factors involved in transport cannot. Structural design changes, on the other hand, can more effectively cope with transport variables.

The group also discussed the possible effects of stricter enforcement of regulations and penalties and it was felt that while rigorous and equal enforcement of penalties for violations by operators and tankermen would be a disincentive to pollute, it would be a marginal one. According to Group 4, competition in the industry will always cause risk-taking and misjudgments, and penalties will not eliminate these. Enforcement of regulations is a part of any pollution prevention program but not a complete program in itself.

Some measures, such as better communications on the waters, improved Coast Guard inspections and open-book tests on Coast Guard oil spill regulations, were discussed in both Groups 3 and 4. These do not appear to have major effects on pollution. The Coast Guard stated that communications have continually been improving and it did not see communications as a significant problem. All parties realize further improvements can be made,

Mr. Everett Lunsford
May 16, 1980
Page Twenty-six

but they do not seem to be of the type that can have an appreciable remedial effect on the problem.

The working group on Personnel, Standards and Enforcement analyzed the human factor in tank barge pollution. The most profitable result seems to be recognizable decreases in operational discharges achievable through personnel training programs. Other measures may also inhibit certain polluting sources, but in light of the disproportionate impact of vessel casualty spills, these measures cannot replace structural design changes. Instead, as structural design changes primarily address vessel casualty spills, personnel and enforcement measures seem to be a perfect operational complement to structural design requirements as discussed above.

(c) Insurance, Liability and Penalties

The working group on insurance agreed that insurance does not provide a significant incentive to prevent pollution. It was pointed out in discussions that pollution liability insurance, compared to hull coverage, is a small fraction of overall coverage. Moreover, as Richard Willis pointed out, there is no rational relationship in the nature of pollution liability costs and the potential pollution of a barge. Rate-setting uses different, essentially irrelevant criteria.

In addition, the working group found that lower insurance costs are not given for double hulled barges, so insurance pro-

Mr. Everett Lunsford
May 16, 1980
Page Twenty-seven

vides no incentive to build double hulled vessels. Together, these factors showed that pollution insurance is neither an alternative to other measures and was not likely to be one in the future.

At the same time, improvements could be made to make insurance more of a deterrent. The scope of its coverage and the per ton limits of liability could be increased to ensure that the polluter paid for more of the costs he incurs. As the paper by Sharon Steward pointed out, the limitations on liability mean that the polluter/insurer at present pays only a fraction of the costs of a spill.

In addition, some expressed an interest in differentiating the treatment accorded single and double hull barges so as to provide an insurance incentive for the latter. Also, the costs incurred by a polluter in cleaning up a spill should be deducted from his overall liability to provide an incentive to the polluter to undertake rapid clean up action in the event of a spill.

With regard to penalties it was also agreed that these provided little if any incentive to prevent pollution, especially since they usually fall on the company, who can easily absorb them. It was suggested that penalties be scaled according to the record of the violator or even to the environmental significance of the area where the offense occurred. Finally, many felt that putting small penalties directly on the individual

Mr. Everett Lunsford
May 16, 1980
Page Twenty-eight

violator or of assessing much larger penalties on the company could be an effective improvement.

Though these minor changes may be beneficial, it was the clear consensus of the group that insurance and penalties do not provide a viable alternative for reducing tank barge pollution.

Conclusion

The environmental organizations favor the adoption of double hull design requirements for tank barges, in general, with initial implementation directed towards barges serving the mid-continent river system. Although several other measures under consideration at the workshop may be also useful in reducing tank barge pollution, it is evident that they cannot replace tank barge redesign as the best approach. We believe that the pollution prevention program as outlined in these comments can contribute significantly to pollution reduction, without undue economic costs, with resulting

Mr. Everett Lunsford
May 16, 1980
Page Twenty-nine

substantial benefits to our nation's marine and coastal ecosystems,
and to personnel and vessel safety.

Respectfully submitted,



Clifton E. Curtis
Michael M'Gonigle
Daniel Wake*

On behalf of:

American Littoral Society
Center for Environmental Education
Clean Water Action Project
Coast Alliance
Defenders of Wildlife
Environmental Defense Fund
Environmental Policy Center
Friends of the Earth
Fund for Animals
National Parks and Conservation
Association
National Wildlife Federation
Natural Resources Defense Council
Oceanic Society
Sierra Club
Society for Animal Protective
Legislation
Wilderness Society

cc: Steering Committee Members
Agency Liaison Representatives
Admiral John B. Hayes
The Honorable Neil Goldschmidt
The Honorable Warren M. Magnuson
The Honorable Gerry Studds

APPENDIX "A"

AMERICAN LITTORAL SOCIETY is a non-membership organization located at Sandy Hook, Highlands, New Jersey, 07732. CENTER FOR ENVIRONMENTAL EDUCATION, whose principal office is 1925 K St., N.W., is a non-membership organization that publishes the Whale Report, which has 250,000 readers. CLEAN WATER ACTION PROJECT is a non-membership organization with offices at 1341 G St., N.W., Washington, D.C. 20009. COAST ALLIANCE is located at 1346 Connecticut Ave., N.W., Washington, D.C., 20036, and represents a coalition of environmental organizations concerned with the protection of coastal resources. DEFENDERS OF WILDLIFE has a membership of approximately 50,000 persons and offices at 1244 19th St., N.W., Washington, D.C. 20036. ENVIRONMENTAL DEFENSE FUND, whose principal place of business is 475 Park Avenue, New York, New York, 10016, has a membership of approximately 45,000 persons and a 700 member Scientist's Advisory Committee, including members residing in 18 foreign countries. ENVIRONMENTAL POLICY CENTER is located at 317 Pennsylvania Ave., S.E., Washington, D.C., 20003, and represents coalitions of citizens around the country on energy and natural resources issues. FRIENDS OF THE EARTH, whose principal place of business is 124 Spear St., San Francisco, CA, 94105, has a membership of 20,000 persons and is affiliated with "sister organizations" in 12 foreign countries. FUND FOR ANIMALS, whose principal place of business is 1765 P St., N.W., Washington, D.C., 20036 has a membership of approximately 200,000. NATIONAL PARKS AND CONSERVATION ASSOCIATION, whose principal place of business is 1701 18th St., N.W., Washington D.C., 20009, has a membership of approximately 35,000 to 40,000 persons. NATIONAL WILDLIFE FEDERATION has offices at 1416 16th St.,

N.W., Washington, D.C., 20036, and is composed of associate members and members of state affiliate organizations comprising over 200,000 persons. NATURAL RESOURCES DEFENSE COUNCIL, whose principal office is at 122 E. 42nd St., New York, New York, 10017, and which has additional offices in Washington, D.C. and Palo Alto, CA, has a membership of approximately 38,500 persons, including members residing in 21 foreign countries. OCEANIC SOCIETY, whose office is on Magee Avenue, Stamford, CN, 06902, has a membership of 60,000 persons. SIERRA CLUB, whose principal place of business is at 530 Bush St., San Francisco, CA, 94104, has a membership of approximately 180,000 persons, including persons residing in 67 foreign countries. SOCIETY FOR ANIMAL PROTECTIVE LEGISLATION, whose principal place of business is P.O. Box 3650, Washington, D.C., 20007, has a membership of approximately 22,000 persons. THE WILDERNESS SOCIETY, which has its principal office at 1901 Pennsylvania Ave., N.W., Washington, D.C., 20006, and a field office in Denver, CO, has a membership of approximately 70,000 persons.

MEMORANDUM OF TRANSMITTAL

TO: EVERETT P. LUNSFORD, JR. APRIL 10, 1980
PROJECT MANAGER
COMMITTEE ON REDUCING TANK BARGE POLLUTION

FROM: JAMES H. SANBORN
INTERSTATE AND OCEAN TRANSPORT COMPANY

SUBJ: NATIONAL ACADEMY OF SCIENCE MARITIME TRANSPORTATION
RESEARCH BOARD WORKSHOP ON REDUCING TANK BARGE POLLUTION.

ATTACHED HERETO IS MATERIAL WHICH WE AT INTERSTATE HAVE PREPARED WHICH WE SHOULD APPRECIATE YOUR INCORPORATING OR ADDING TO PRESENTATION OR PAPERS COMMENTING ON PROGRAM IV, OPERATING ENVIRONMENT RELATIVE TO AIDS TO NAVIGATION.

WE, AND INDEED THE ENTIRE MARITIME COMMUNITY, UTILIZING THE DELAWARE BAY AND RIVER, WERE PARTICULARLY CONCERNED APPROXIMATELY ONE YEAR AGO WHEN IN EFFECT AIDS TO NAVIGATION EFFICACY WAS REDUCED UNILATERALLY BY THE COAST GUARD. THE PHILADELPHIA MARITIME ADVISORY COMMITTEE CONSISTING OF PRIMARILY MASTER MARINERS AND EXPERIENCED RIVER AND BAY PILOTS, UNDERTOOK TO REVERSE THIS SITUATION. A DETAILED STUDY OF THE EXISTING AIDS TO NAVIGATION IN THE DELAWARE RIVER WAS CONDUCTED. FOLLOWING THAT AND DISCUSSION THEREOF, RECOMMENDATIONS WERE MADE AND COST ESTIMATES WERE MADE, ALL OF WHICH WERE INCORPORATED IN A RATHER DETAILED REPORT PREPARED BY ONE OF THE EXPERIENCED DELAWARE RIVER AND BAY LICENSED PILOTS, CAPT. JOSEPH F. BRADLEY. THIS REPORT WAS WELL RECEIVED BY MEMBERS OF CONGRESS, THE UNITED STATES COAST GUARD, AND BY THE INDUSTRY UTILIZING THE DELAWARE RIVER AND BAY PORT AREA.

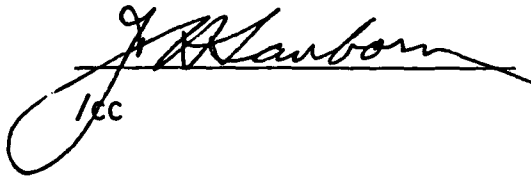
IT HAS BEEN OUR EXPERIENCE AND INDEED IS OUR FIRM CONVICTION THAT SAFETY OF LIFE, PROPERTY, AND VESSELS CAN BE ENHANCED BY PROVIDING THE MARINER AND THE PILOT WITH THE BEST THAT TECHNOLOGY OF THE 1980'S HAS TO OFFER IN AIDS TO NAVIGATION. IF WE PROVIDE THE MARINER WITH AIDS WHICH PERMIT HIM TO AT ALL TIMES PINPOINT HIS EXACT LOCATION, THEN WE DO A GREAT DEAL TO ELIMINATE SUCH THINGS AS GROUNDINGS AND STRANDINGS. SUCH INCIDENTS ARE FREQUENTLY ACCOMPANIED BY OIL SPILLS AND RESULTANT ENVIRONMENTAL POLLUTION.

PHILADELPHIA IS ONE OF THE LARGEST PORTS AND ONE OF THE BUSIEST PORTS IN THE UNITED STATES. MUCH OF ITS COMMERCE IS THE TRANSPORTATION OF PETROLEUM; BOTH CRUDE OIL AND SOME PRODUCTS IN-BOUND AND REFINED, AND RESIDUAL PETROLEUM PRODUCTS OUT-BOUND. THE DELAWARE RIVER AND BAY ENCOMPASSES THE SECOND LARGEST REFINING AREA IN THE UNITED STATES. THEREFORE, AS AN ENERGY IMPORTANT PORT, IT'S STATUS IS OBVIOUS.

OUR CONTENTION, WHICH WE BELIEVE IS SHARED BY MANY, IS THAT THE STATE-OF-THE-ART AND THE STRUCTURES IN BEING OF UNITED STATES AIDS TO NAVIGATION ARE WOEFULLY LACKING. THE APPROACH WHICH WE TOOK IN ORDER TO BEST ILLUSTRATE THIS FACT, GIVEN THAT GOOD AIDS TO NAVIGATION ENHANCE SAFE NAVIGATION AND HENCE REDUCE ACCIDENTS, WAS TO UNDERTAKE TO COMPARE THE AIDS TO NAVIGATION WHICH THE MARINER AND THE PILOT HAS FOR HIS USE IN THE DELAWARE BAY AND RIVER WHICH IS A TYPICAL, BUSY, IMPORTANT MAJOR U.S. PORT WITH THOSE OF A PORT OF EQUAL IMPORTANCE IN ANOTHER PART OF THE HIGHLY INDUSTRIALIZED WESTERN WORLD. WE SELECTED ROTTERDAM AS A SAMPLE PORT. THE PORT IS SIMILARLY ONE OF THE MAJOR PETROLEUM PORTS IN THE WORLD AND SERVES THE HIGHLY INDUSTRIALIZED WESTERN EUROPEAN MARKET.

THE AIDS TO NAVIGATION AVAILABLE IN THE PORT OF ROTTERDAM AND ITS APPROACHES COULD BE BEST EVALUATED AND COMPARED WITH THOSE OF THE DELAWARE BAY AND RIVER BY ONE WHO USES THESE AIDS AS PART OF HIS NORMAL OCCUPATION. WE THEREFORE APPROACHED CAPT. BRADLEY AND SECURED HIS AGREEMENT TO TRAVEL TO ROTTERDAM AND TO MEET WITH HIS DUTCH PILOT COLLEAGUES AS WELL AS THOSE IN CHARGE OF AIDS TO NAVIGATION IN THE PORT OF ROTTERDAM IN ORDER TO ASSEMBLE DATA, EVALUATE SYSTEMS, AND TO COMPARE THE AIDS AND THEIR STATE-OF-THE-ART IN THE PORT OF ROTTERDAM WITH THOSE WHICH HE AND HIS EXPERIENCED DELAWARE RIVER PILOT COLLEAGUES USE DAILY.

THE REPORT WHICH FOLLOWS HAS BEEN PREPARED BY CAPT. BRADLEY. WE TRUST YOU WILL FIND THAT IT VIVIDLY ILLUSTRATES OUR CONTENTION THAT MUCH IS TO BE GAINED IN PROMOTING SAFE NAVIGATION AND THEREFORE REDUCING POLLUTION FROM GROUNDINGS BY THE LONG NEGLECTED AND CRYING NEED TO IMPROVE EVEN THE VERY BASIC AIDS TO NAVIGATION IN THE UNITED STATES.


icc

A REVIEW OF THE AIDS TO NAVIGATION AVAILABLE TO THE NAVIGATOR CALLING ON THE PORT OF ROTTERDAM, AND A COMPARISON WITH AIDS TO NAVIGATION IN THE UNITED STATES.

PREPARED BY CAPT. JOSEPH F. BRADLEY, DELAWARE RIVER PILOTS ASSOCIATION ON BEHALF OF INTERSTATE AND OCEAN TRANSPORT COMPANY.

FOR SUBMISSION TO PANEL IV, OPERATING ENVIRONMENT, OF THE NATIONAL ACADEMY OF SCIENCE MARITIME TRANSPORTATION RESEARCH BOARD WORKSHOP ON REDUCING TANK/BARGE POLLUTION.

INTRODUCTION

IT BECOMES APPARENT AS ONE READS ABOUT THEIR LIGHTS THAT THE DUTCH GOVERNMENT REPRESENTED BY THE PILOTAGE SERVICE CONSIDERS VISUAL AIDS TO NAVIGATION A HIGH PRIORITY ITEM. CONSIDER IF YOU WILL THE MILLIONS OF DUTCH FLORIN SPENT WITHIN THE LAST 10 YEARS TO CONSTRUCT THE LIGHTHOUSE AT MAASVLAKTE, THE SIX LEADING LIGHT STRUCTURES IN THE HARBOR ENTRANCE, AND TWO HARBOR LIGHTS BUILT AT THE EXTREMITIES OF THE TWO ENTRANCE MOLES. CONSIDER THE SIX LEADING LIGHT STRUCTURES AND THEIR ATTENDANT LIGHT SOURCES WHICH HAVE ABILITY TO CHANGE THE INTENSITY OF THE LIGHTS FROM 90 PERCENT BRIGHTNESS DURING THE DAY TO 30 PERCENT BRIGHTNESS DURING HOURS OF DARKNESS, WITH LEADING LIGHTS 116 DEGREES HAVING AN EVEN HIGHER INTENSITY CONTROL FOR PERIODS OF POOR VISIBILITY.

CONSIDER THE REDUNDANCY OF THEIR FAIL SAFE SYSTEMS AIMED AT PREVENTING OUTAGES FOR EVEN MINUTE PERIODS OF TIME. COMMERCIAL POWER SUPPLIES, BACKED UP BY DIESEL GENERATORS, BACKED UP AGAIN BY BATTERY BANKS WITH AN AUTOMATIC ALARM SYSTEM OVERLOOK ALL COMPONENTS. INNOVATIVE USE OF NEW OPTICS SUCH AS REPRESENTED HERE ILLUSTRATES A KEEN AWARENESS BY THE DUTCH AUTHORITIES OF THE NAVIGATION NEEDS OF THE USERS OF THE WATERWAY.

THE EFFECT HAS BEEN A SAFETY RECORD OF WHICH ALL PORTS SHOULD BE ENVIOUS: WITH TRAFFIC HARDLY EVER SHUT DOWN BECAUSE OF LACK OF VISIBILITY, THE LAST ACCIDENT OCCURRED THREE TO FOUR YEARS AGO.

I. THE AIDS TO NAVIGATION AT THE PORT OF ROTTERDAM

A. ELECTRONIC AIDS

ROTTERDAM, THE LEADING PORT OF EUROPE, IS SITUATED AT THE MOUTH OF THE RIVER RHINE. ITS WATERWAYS ACCOMMODATE MORE THAN 90,000 SHIP MOVEMENTS A YEAR. ADDITIONALLY, CLOSE TO 300,000 BARGE TRANSITS OCCUR ANNUALLY. BECAUSE THIS HIGH AMOUNT OF SHIPPING OCCURS WITHIN A RATHER CONFINED AREA, IT STANDS TO REASON THAT A 'COMPREHENSIVE AIDS TO NAVIGATION SYSTEM WOULD BE NEEDED.

RADAR PLAYS A MAJOR ROLE IN THIS SYSTEM. SHORTLY AFTER THE SECOND WORLD WAR, RADAR CAME TO BE RECOGNIZED AS A MAJOR AID, NOT ONLY TO PREVENT COLLISIONS, BUT ALSO TO FACILITATE SAFE NAVIGATION. IT WAS QUICKLY REALIZED THAT RADAR COULD BE OF INESTIMABLE VALUE FOR SHIPS ENTERING PORT, ESPECIALLY WHEN VISIBILITY WAS BAD, AND THIS LED TO THE BIRTH OF SHORE BASED, OR HARBOR RADAR.

THE FIRST DUTCH PORT TO BENEFIT WAS IJMUIDEN WHICH, IN 1951 OPENED A PORT RADAR STATION TO "TALK" TO SEA-GOING VESSELS INTO OR OUT OF PORT. PILOTS WERE EQUIPPED WITH WALKIE-TALKIES TO COMMUNICATE WITH THE RADAR OPERATORS WHO KEPT THEM INFORMED OF THE MOVEMENTS OF OTHER VESSELS IN THEIR VICINITY. ROTTERDAM FOLLOWED SUIT IN 1956. A CHAIN OF SEVEN SHORE-BASED RADAR STATIONS WAS BUILT ALONG THE NEW WATERWAY, REACHING FROM THE SEASHORE INTO THE HEART OF THE CITY. ON COMPLETION IT WAS KNOWN AS THE MOST UP TO DATE SYSTEM IN THE WORLD.

THE MAIN OBJECTIVE OF THE DESIGNERS HAD BEEN TO RENDER ASSISTANCE TO SHIPPING ON THE RIVER WHEN VISIBILITY WAS BAD. THE SYSTEM IS DIVIDED INTO BLOCKS, AND VESSELS UNDER OBSERVATION ARE HANDED OVER FROM ONE BLOCK TO THE NEXT. AT THE END OF THE 1960'S THE SERVICE WAS EXTENDED TO 24 HOURS PER DAY TO SUPPLY SHIPPING WITH ALL NECESSARY INFORMATION REGARDLESS OF THE VISIBILITY. A LIMITED VESSEL MANAGEMENT SYSTEM STARTED IN THIS WAY, THOUGH ORIGINALLY THIS WAS NOT THE OBJECTIVE.

THE NATIONAL GOVERNMENT AND THE CITY OF ROTTERDAM COOPERATE CLOSELY WITHIN A PROJECT ORGANIZATION. THE NATIONAL GOVERNMENT IS RESPONSIBLE FOR THE ADMINISTRATION OF THE WATERWAY VIA THE STATE (FEDERAL) WATERWAYS DEPARTMENT AND FOR NAVIGATIONAL ASSISTANCE TO SHIPPING VIA THE STATE (FEDERAL) PILOTAGE AUTHORITY.

SHORE BASED RADAR PLAYS A MAJOR PART IN THE PORT ORGANIZATION IN ROTTERDAM, BUT IT REMAINS AN INSTRUMENT WITHIN A LARGER WHOLE. WHEN THE PROJECT BUREAU BEGAN WORK IN 1975, TO PLAN A MODERNIZATION OF THE SYSTEM, IT ENVISIONED TWO GOALS:

1. PROMOTING THE SAFETY OF THE POPULATION AND OF SHIPPING.
2. PROMOTING EFFICIENCY IN THE PORT.

THE STARTING POINT WAS TO KEEP THE ADVANTAGES OF THE EXISTING TRAFFIC INFORMATION SYSTEM AS IT HAD GROWN IN PRACTICE, WHILE ELIMINATING OR MENDING ITS WEAKER POINTS. THE RESULT WAS TO BE A WHOLLY MODERN AND RELIABLE TRAFFIC MANAGEMENT SYSTEM CENTERED ROUND A PERFECT INFORMATION PROCESSING. ONE OF THE CHIEF TASKS OF THE NEW SYSTEM WILL BE TO CHANNEL THE HUGH AMOUNTS OF INFORMATION GENERATED BY WATERBORNE COMMERCE IN AND AROUND ROTTERDAM TO THE RIGHT PLACE AT THE RIGHT TIME.

THE COLLECTION AND TRANSMISSION OF THIS INFORMATION INVOLVES MANY GROUPS, SOME OF WHICH ARE PILOTS, HARBOR MASTERS, PATROL CRAFT CREWS, TRAFFIC MANAGERS, AND ALL THE PEOPLE INVOLVED IN THE OPERATION OF WHAT IS CALLED THE HARBOR COORDINATION CENTER. THIS CENTER HAS THE TASK OF COORDINATING ALL THE GOVERNMENT DEPARTMENTS WITH VITAL TASKS AS REGARDS SHIPPING MOVEMENTS.

THE PEOPLE WORKING WITHIN THIS SYSTEM ARE PARA-PROFESSIONALS WHO, IN MOST CASES, SPEND MANY YEARS IN ONE JOB CLASSIFICATION. A GOOD CASE IN POINT WOULD BE THE OPERATORS OF THE SEVEN RADAR INSTALLATIONS. MANY OF THESE ARE DUTCH NAVY PERSONNEL WHO BRING YEARS OF PRIOR NAVAL EXPERIENCE TO THE JOB.

IT IS THE OPINION OF MOST MARINERS THAT THE BEST AND ONLY WAY TO OPERATE A VESSEL TRAFFIC INFORMATION SERVICE IS TO HAVE IT STAFFED WITH PERMANENT TYPE PERSONNEL WHO HAVE NAUTICAL BACKGROUNDS.

THIS VITAL SYSTEM EXISTS NOT WITHOUT ITS PROBLEMS. SOME DUTCH GOVERNMENT AUTHORITIES FEEL THAT WHEN THE ENTIRE MODERNIZED SERVICE IS FUNCTIONAL ABOUT 1985, THAT IT SHOULD BE POSSIBLE TO MAKE VESSELS ACCEPT GUIDANCE AND SAILING DIRECTIONS WHEN TRAFFIC DENSITY OR OTHER CIRCUMSTANCES REQUIRE. IT IS NOT AS UNCOMPLICATED AS IT SOUNDS. LEGAL QUESTIONS ARISE AS TO WHETHER MASTERS AND PILOTS SHOULD BE PREPARED TO FOLLOW ADVICE AND DIRECTIONS FROM TRAFFIC MANAGERS. LEGAL RESPONSIBILITIES UNDER THESE CIRCUMSTANCES HAVE NOT YET BEEN TESTED.

THESE QUESTIONS WILL NOT GO AWAY AND IT IS EXPECTED IN THE END THAT VESSEL TRAFFIC INFORMATION SERVICES WILL REMAIN JUST THAT, INFORMATION SERVICES, LEAVING THE RESPONSIBILITY FOR THE SAFE PASSAGE OF THE VESSEL IN THE HANDS OF THE SHIPS MASTER AND HIS ADVISOR, THE PILOT.

THE AREA TO BE COVERED BY THE NEW SYSTEM WILL BE THE EURO CHANNEL AND THE HOOK OF HOLLAND ROADSTEAD, THE ROTTERDAM WATERWAY, AND NIEUWEMAAS RIVER UP TO FIVE KMS UPSTREAM FROM THE VAN BRIERENOORD BRIDGE, KONINGSHAVEN, THE OUDE MAAS RIVER UP TO FIVE KMS UPSTREAM FROM THE SPIJKENISSE BRIDGE, THE BEER CANAL, CALAND CANAL AND THE HARTEL CANAL, INCLUDING THE DOCK BASINS BORDERING ON THESE WATERWAYS.

THE IMPROVED VESSEL TRAFFIC INFORMATION SYSTEM IS EXPECTED TO COMPRISE THE HARBOR COORDINATION CENTER, THREE REGIONAL TRAFFIC CENTERS, AND UP TO 20 UNMANNED RADAR STATIONS. THE HARBOR COORDINATION CENTER WILL BE IN OVERALL CHARGE OF THE INFORMATION SERVICE. ITS DUTIES WILL INCLUDE PREPARING THE OUTWARD AND INWARD CLEARANCE OF SEA-GOING VESSELS, DIRECTING OPERATIONS IN CASE OF CATASTROPHIES, AND SUPERVISING TRANSPORT OF DANGEROUS GOODS. THE THREE REGIONAL CENTERS, WHICH WILL BE LOCATED AT THE HOOK OF HOLLAND, THE BOTLEK AREA, AND NEAR WAALHAVEN, WILL COLLECT INFORMATION SUPPLIED BY ANY OF THE 20 UNMANNED RADAR STATIONS. EACH REGIONAL CENTER WILL THEN BE ABLE TO CARRY OUT ITS TRAFFIC INFORMATION ACTIVITIES LOCALLY.

THE PROJECTED COST OF THIS MODERNIZATION PROGRAM IS ESTIMATED TO BE MEASURED IN THE HUNDREDS OF MILLIONS OF DOLLARS. AN IMPORTANT QUESTION TO BE ANSWERED IS, IS THIS AN ACCEPTABLE PRICE TO PAY FOR A SYSTEM WITH SO MUCH BUILT-IN SAFETY AS TO BE UNIQUE AMONG ALL THE WORLD'S PORTS? THE ANSWER FOR HOLLAND IS AN OBVIOUS YES.

IN ADDITION TO RADAR, ANOTHER ELECTRONIC INSTRUMENT IS NOW BEING USED TO ASSIST VLCC'S USING THE APPROACH AND ACCESS CHANNELS INTO EUROPORT. THIS POSITION FINDING SYSTEM HAS BEEN GIVEN THE NAME "HOLLAND CHAIN". IT USES PORTABLE, ON BOARD SHIP EQUIPMENT WHICH IS REFERRED TO AS "THE BROWN BOX". (SEE F-2) THIS DECCA SYSTEM USES PHASE COMPARISON FOR DETERMINING THE DISTANCE FROM THE TOWERS TRANSMITTING IN THE 70-130 KH₂ BAND. HOLLAND HAS SET UP ITS OWN MINI THREE-STATION CHAIN. IT IS FROM THIS THAT THE "BROWN BOXES" DRAW THEIR HIGHLY ACCURATE POSITION FIXING INFORMATION. (SEE FIG.1)

WHEN A VLCC APPROACHES EURO #1 BUOY AT THE ENTRANCE TO EURO CHANNEL, IT IS MET BY A HELICOPTER BEARING THE PILOT AND A PORTABLE DECCA "BROWN BOX". ONLY VLCC'S WITH DRAFTS UP TO A MAXIMUM OF 68' ARE GRANTED THE USE OF THIS INSTRUMENT. THE TOTAL WEIGHT OF THE CONTAINER PLUS THE INSTRUMENT IS ABOUT 40 POUNDS.

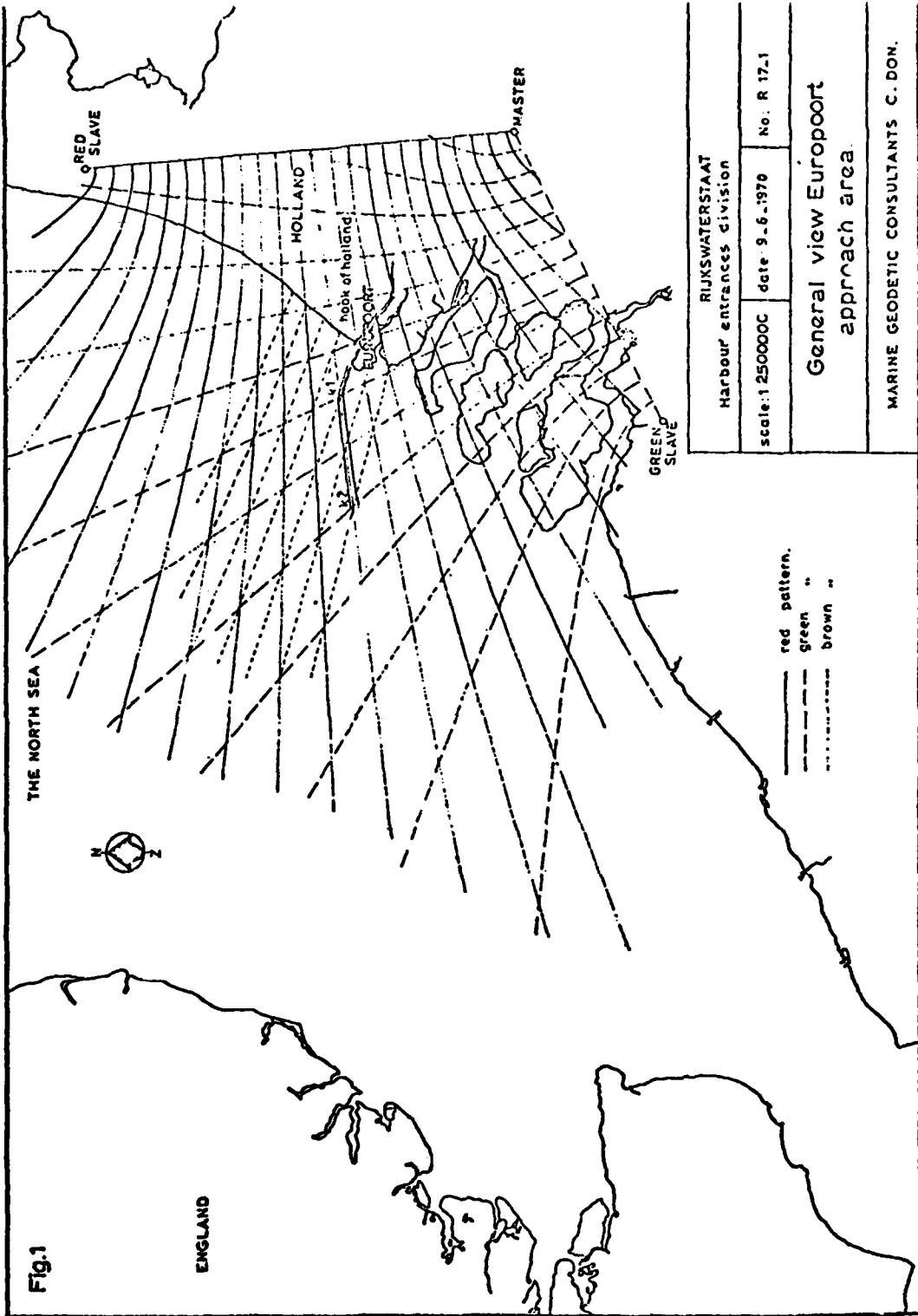
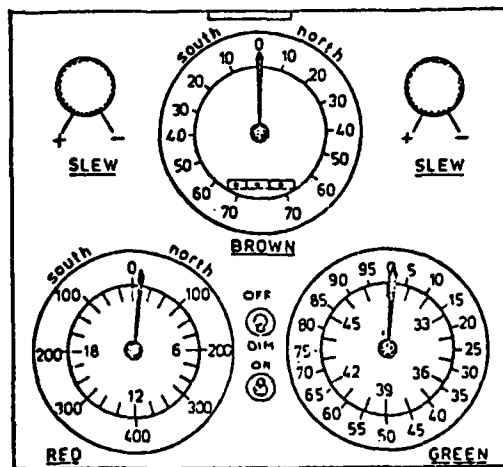
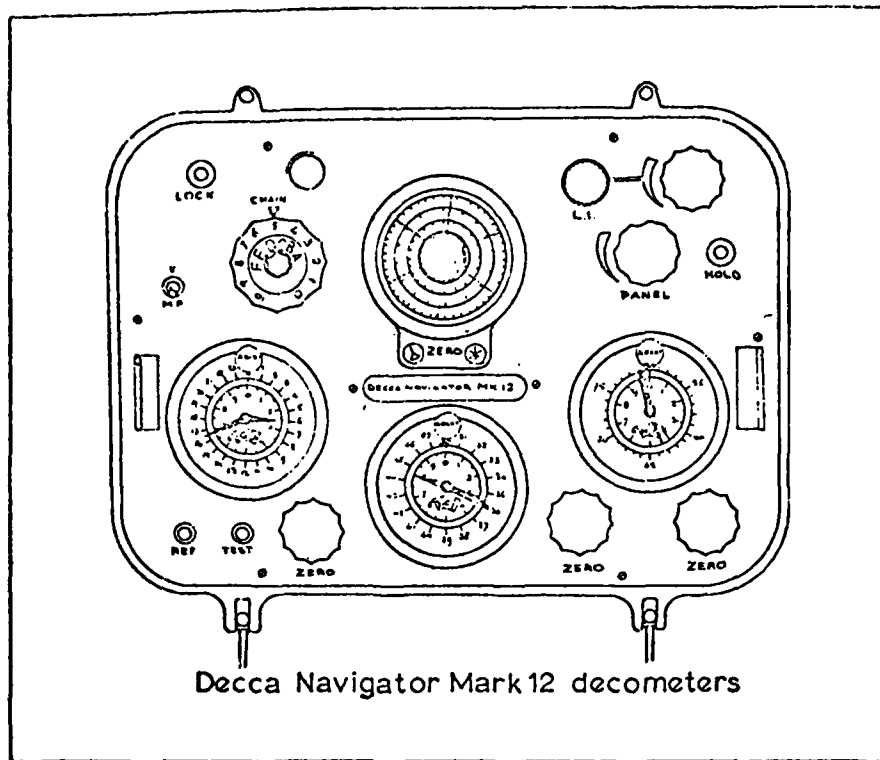


Fig.1



B. VISUAL AIDS TO NAVIGATION

AS IMPORTANT AS ELECTRONIC NAVIGATION AIDS ARE THERE REMAINS TO BE MENTIONED - BUOYS, LIGHTED AND UNLIGHTED BEACONS, RANGE LIGHTS AND LIGHTHOUSES. THESE AIDS TO NAVIGATION CONTRIBUTE AS MUCH AS, AND POSSIBLY MORE TO THE SAFETY OF SHIPPING IN AND AROUND ROTTERDAM.

THE GOVERNMENT PILOTAGE AUTHORITY HAS THE RESPONSIBILITY FOR SERVICING AND POSITIONING ABOUT 550 LIGHTBUOYS AND 2500 OTHER BUOYS AND FLOATING BEACONS. CLOSE COOPERATION WITH THE PILOT SERVICE IS A FEATURE OF THE DUTCH AIDS TO NAVIGATION SYSTEM. FOR EXAMPLE, WHEN IN THE PILOT'S OPINION A CHANGE IN DEPTH OF A FAIRWAY NECESSITATES SHIFTING A BUOY OR ADDING A NEW ONE TO INHANCE SAFE PASSAGE, A MEETING IS HELD BETWEEN THE PROPER AUTHORITIES. IF IT IS CONFIRMED TO BE IN THE BEST INTEREST OF SAFETY A DECISION WILL BE MADE TO IMPLEMENT THE REQUEST.

NEW MATERIALS AND NEW LIGHTING TECHNIQUES ARE CONTINUALLY BEING DEVELOPED AND PUT TO THE TEST OF PRACTICAL EXPERIENCE. TECHNICAL RESEARCH AND DEVELOPMENT IS CARRIED OUT BY THE TECHNICAL LIGHTHOUSE SERVICE WHICH ALSO TAKES CARE OF MAINTENANCE OF ELECTRIC AND ELECTRONIC DEVICES USED BY THE GOVERNMENT PILOTAGE AUTHORITY.

INTERNATIONAL EXCHANGE OF DATA CONCERNING BUOYAGE SYSTEMS AND LIGHTING TECHNIQUES TAKES PLACE IN THE INTERNATIONAL ASSOCIATION OF LIGHTHOUSES AUTHORITIES OF WHICH THE GOVERNMENT PILOTAGE AUTHORITY IS A MEMBER.

RECOMMENDATIONS MADE BY THIS INTERNATIONAL ORGANIZATION RESULTED IN 1977 AND 1978, IN THE INTRODUCTION OF A UNIFORM BUOYAGE SYSTEM BY A LARGE NUMBER OF COUNTRIES. THIS IS KNOWN AS BUOYAGE SYSTEM "A", COMBINED CARDINAL AND LATERAL SYSTEM (RED TO PORT).

FOR PURPOSES OF ILLUSTRATION OF THE QUALITY AND QUANTITY OF AIDS TO NAVIGATION ON THE APPROACHES TO, AND INSIDE THE RIVER ENTRANCE THEY HAVE BEEN LISTED AND DESCRIBED IN EXHIBIT A ^{1/} AND FURTHER ILLUSTRATED BY FIGS. 3,4, & 5 WHICH FOLLOW ON SUCCEEDING PAGES HERE. EXHIBIT B IS ATTACHED FOR FURTHER DESCRIPTION OF THE ROTTERDAM APPROACH AIDS.

SOME ADDITIONAL SECONDARY AIDS ARE NOT MENTIONED. FOR EXAMPLE, THE INDIRECT ILLUMINATION OF THE CENTER DAM BETWEEN ROTTERDAM WATERWAY AND CALAND CANAL (EUROPOORT). THIS SYSTEM CONSISTS OF 54 LANTERN POSTS, 2-1/2 TO 3 M HIGH, WITH LANTERNS AND 220 V 40 W LAMPS. THE LAMPS ARE SWITCHED ON BY A DAY AND NIGHT SWITCH. THE EFFECT IS THAT THE DAM CAN BE SEEN UNDER DARK CIRCUMSTANCES.

ALSO NOT MENTIONED IS ONE LIGHT PLATFORM SIMILAR IN STRUCTURE TO AMBROSE LIGHT TOWER CALLED THE GOEREE LIGHT PLATFORM SHOWING A G_pFL (4) 20s 32M 28M HORN (4) RC RACON WHICH SITS ON THE SITE OF THE OLD GOEREE LIGHTSHIP. FURTHER THERE ARE TWO LIGHTSHIPS, 20 LARGE LIGHTHOUSES AND 300 LIGHT STANDARDS.

^{1/} THIS MATERIAL WAS OBTAINED IN ROTTERDAM BY J. BRADLEY FROM PILOTAGE AUTHORITIES.

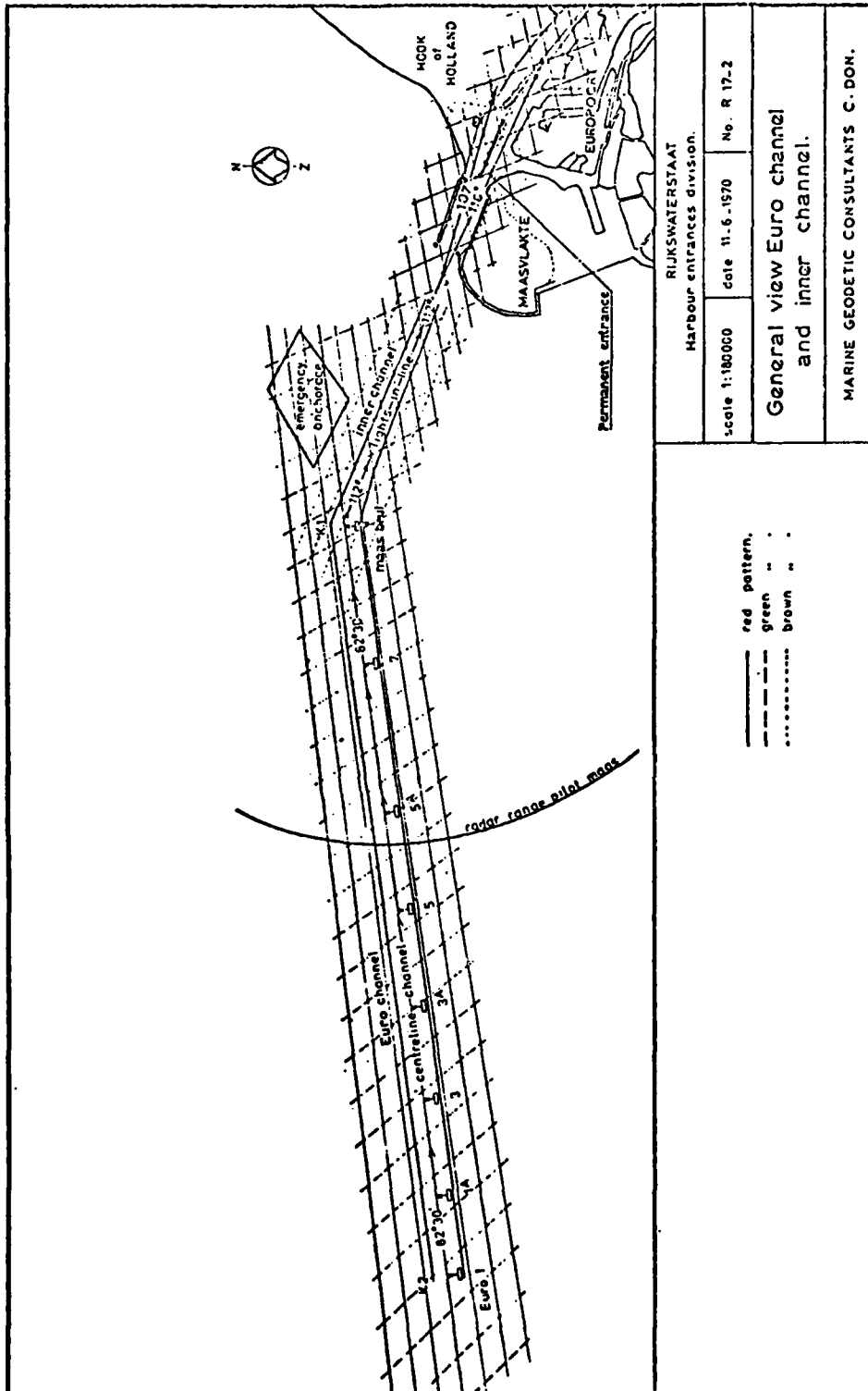
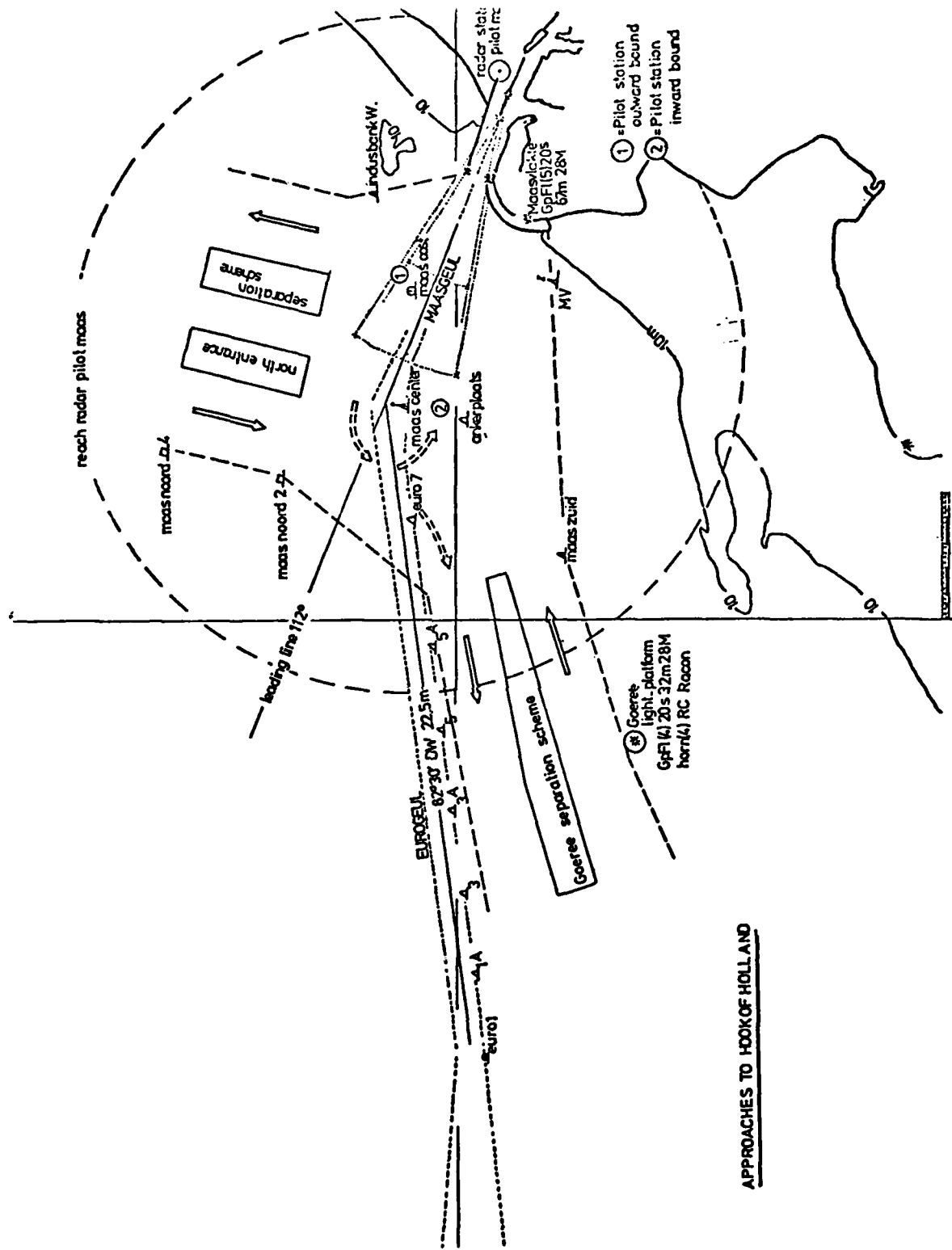


FIG. 3



APPROACHES TO HOOK OF HOLLAND

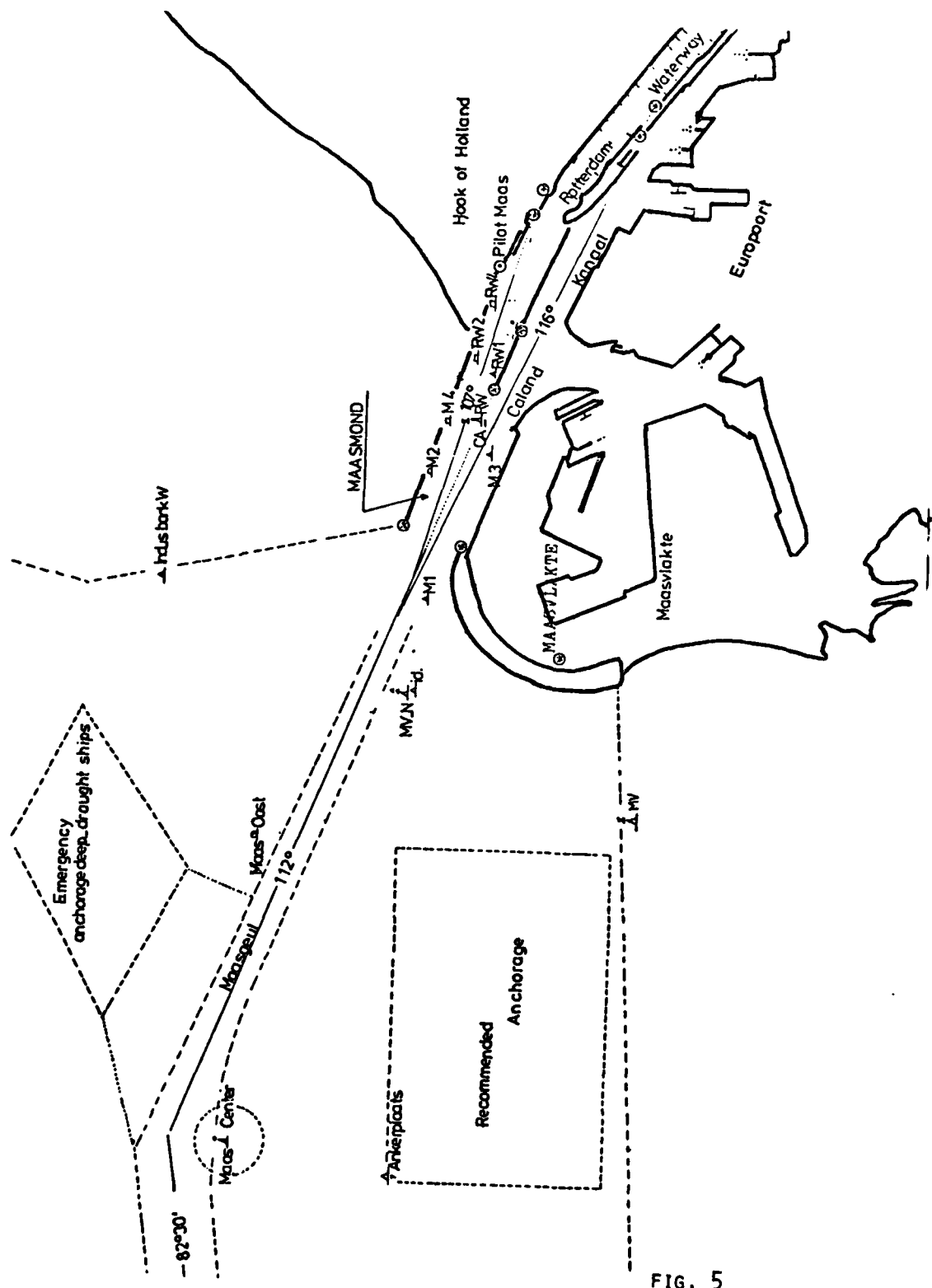


FIG. 5

II. A COMPARISON OF ROTTERDAM'S AIDS TO NAVIGATION WITH
THOSE IN THE UNITED STATES.

THE TOTAL DUTCH AIDS TO NAVIGATION SYSTEM, BOTH ELECTRONIC AND VISUAL, BESPEAKS AN OVERRIDING CONCERN FOR SAFETY FOR THE RESIDENTS AND FOR PROPERTY IN THE AREA. THE COST OF CONSTRUCTION AND MAINTENANCE SEEMS TO HAVE BECOME A SECONDARY CONSIDERATION.

TO TRY TO COMPARE AIDS TO NAVIGATION IN THE UNITED STATES WITH THOSE IN HOLLAND IS FOR THIS USER A FRUSTRATING BUSINESS.

ECONOMY SEEMS TO BE THE DRIVING FORCE BEHIND THE ADMINISTRATION OF THE AIDS TO NAVIGATION SYSTEM IN THE UNITED STATES. IT HAS BEEN SAID AND IS WORTH REPEATING THAT "EXAGGERATING THE DEMANDS OF ECONOMY CAN DEFEAT THE WHOLE PURPOSE OF THE SYSTEM THAT IS MEANT TO BENEFIT FROM IT".

PRESENTLY EQUIPMENT INVENTORIES ARE SADLY LACKING IN VARIETY.

HARDWARE SUITABLE FOR MOST RANGE LIGHT APPLICATIONS CONTINUES TO BE MISSING FROM THE SERVICING ORGANIZATIONS SHELVES. THERE IS A TINY ARRAY OF EQUIPMENT AVAILABLE WHICH IS DESIGNATED AS MINOR AIDS TO NAVIGATION HARDWARE, MOST OF WHICH HAS LITTLE APPLICATION ON THE BANKS OF OUR MODERN DAY WATERWAYS. INCREASED RESIDENTIAL AND INDUSTRIAL DEVELOPMENT ALONG THE SHORE LINE HAS CAUSED BACKGROUND LIGHTING OF HIGH INTENSITIES WITH WHICH THE MANUFACTURERS OF THE LIGHTS NEVER INTENDED HIS EQUIPMENT TO COMPETE, WHEN DESIGNED GENERATIONS AGO. IT CAN BE ASKED WHY IS THERE A TREND TOWARD MINIMAL

AD-A096 126

NATIONAL RESEARCH COUNCIL WASHINGTON D C MARITIME TRA--ETC F/6 13/2
WORKSHOP ON REDUCING TANKBARGE POLLUTION. APRIL 15-16, 1980.(U)
AUG 80 N00014-75-C-0711

UNCLASSIFIED

NL

6 19 11
209 11

UNCLASSIFIED

END
DATE
4 1981
DTIC

HARDWARE INVENTORIES? THE ANSWER IS THAT THERE ARE TRAINING AND SERVICING REQUIREMENTS BOTH OF WHICH ARE A FUNCTION OF THE DRIVE FOR ECONOMY.

IN OUR COUNTRY MANY MAJOR LIGHT STRUCTURES, LIGHTHOUSES INCLUDED, HAVE BEEN ALLOWED TO DETERIORATE TO AN ALARMING DEGREE; SO MUCH SO THAT A FEW ARE IN AN EMINENT STATE OF COLLAPSE. THE ACRONYM FOR THE CAUSITIVE FACTOR IN THIS CASE IS LAMP, WHICH STANDS FOR LIGHTHOUSE AUTOMATION PROJECT. WHEN PERMANENT ON-SITE PERSONNEL WERE REPLACED BY DIESELS OR BATTERIES, THE MAINTENANCE OF THESE STRUCTURES, IN MOST CASES CEASED. MAINTENANCE OF THESE SITES HAS NOW BECOME A MAJOR PROBLEM. COST FACTORS AGAIN PLAY A MAJOR ROLE.

HISTORICALLY, MANAGEMENT OF THE R/N PROGRAM HAS CONCENTRATED ON MANAGEMENT OF SERVICING AND MAINTENANCE RATHER THAN ON MANAGEMENT OF AIDS AS A SERVICE TO MARINERS. THE TREND IN RECENT YEARS CONTINUES TO BE TOWARD REDUCTION OF THE COST OF SERVICING AIDS.

IF THERE WAS ANY DEVELOPMENT IN THE PAST TEN YEARS THAT COULD BE CATEGORIZED AS THE PARAMOUNT CAUSITIVE FACTOR IN THE DETERIORATION OF THE AIDS PROGRAM, IT HAS TO BE THE CONCEPT OF ZERO BASED BUDGETING. THIS CAUSES THE SERVICING ORGANIZATION TO BE UNRESPONSIVE TO THE NEED OF THE USERS BY DENYING THE ADMINISTRATORS FUNDS WITH WHICH TO RESPOND IN A TIMELY FASHION TO REQUESTS FOR IMPROVEMENTS.

A STUDY OF THE SHORT RANGE AND RADIO NAVIGATION AID TO NAVIGATION RESEARCH AND DEVELOPMENT EFFORTS FOR THE PAST FIVE OR SIX YEARS IN THE UNITED STATES SHOWS IT TO BE HEAVILY

WEIGHTED TO ELECTRONIC EQUIPMENT RESEARCH, WHILE THIS IS TO BE EXPECTED GIVEN THE PRESENT STATE-OF-THE-ART, SOME BASIC RESEARCH INVOLVING OPTICS MIGHT REAP HUGE BENEFITS FOR USERS NOW PLEADING FOR BETTER LIGHT INTENSITIES.

VESSEL TRAFFIC SERVICES AS USED IN THIS COUNTRY HAVE HAD MIXED RESULTS. IN AREAS LIKE ROTTERDAM WHERE HARBOR AND DOCKING AREAS EXTEND PERPENDICULARLY FROM THE MAIN SHIP CHANNEL, VESSEL TRAFFIC SERVICES ARE EXTREMELY VALUABLE TO THE MARINER. THEY ALLOW THE INBOUND OR OUTBOUND VESSEL TO BE AWARE OF ANOTHER VESSEL'S PRESENCE WHEN THEY CANNOT BE SITED VISUALLY. IT HAS BEEN STATED ABOVE THEY ARE MANNED BY EXPERIENCED PERSONNEL AND MOST IMPORTANT THEY ENJOY THE COMPLETE CONFIDENCE OF THE USERS OF THAT WATERWAY.

MOST MARINERS WILL AGREE THAT IN SOME AREAS A SHORE BASED RADAR AND TRAFFIC CENTER MAY ASSIST THE NAVIGATOR BY PROVIDING HIM WITH IMPORTANT INFORMATION THAT HE CANNOT DEVELOP ON HIS OWN. THESE PORT AREAS ARE BY DEFINITION, NARROW, CONFINED, AND CONGESTED. FOR THE MOST PART, THIS DESCRIBES THE AREAS WHERE VESSEL TRAFFIC SERVICES HAVE BEEN INSTALLED. THE FLY IN THE OINTMENT SO TO SPEAK IS THAT THESE SHORE BASED CENTERS ARE MANNED BY RELATIVELY INEXPERIENCED ENLISTED PERSONNEL AND JUNIOR OFFICERS, WITH THE FORCE OF LAW BEHIND THEM, IF THEY SHOULD CHOOSE TO COUNTER A DECISION THE NAVIGATOR HAS MADE. THESE PEOPLE HAVE LITTLE OR NO EXPERIENCE IN SHIP-HANDLING ON VESSELS OF THE SIZE AND HORSEPOWER OF MERCHANT VESSELS OF THE PRESENT.

THE INFORMATION PASSED FROM THE CENTERS TO VESSELS TENDS TO BE AMBIGUOUS IN THAT IT CAN BE INTERPRETED AS INFORMATION, ADVISORY INSTRUCTIONS OR IMPERATIVE COMMANDS TO BE FOLLOWED REGARDLESS OF THE CONSEQUENCES. CONFUSION OVER WHO IS ULTIMATELY RESPONSIBLE FOR DECISIONS MADE CAN ONLY REDUCE THE INTENDED EFFECTIVENESS OF THE SERVICE.

WE BELIEVE THAT INSTALLATION OF SOPHISTICATED RADAR AND CLOSED CIRCUIT T.V. GEAR CAN ONLY BE MARGINALLY COST EFFECTIVE, AND ONLY WHEN USED IN CONFINED AND CONGESTED AREAS. THE MARINER AND TAXPAYER WOULD BE MUCH BETTER SERVED AND AT MUCH LESS COST IF THE AGED AND DECAYING VISUAL AIDS NOW BEING USED WERE UPGRADED TO THE STATE-OF-THE-ART OF THE EIGHTIES.

IN SUMMARY, THE SYSTEM OF VISUAL AIDS TO NAVIGATION IN THE UNITED STATES IS SUFFERING FROM BENIGN NEGLECT. THE CAUSES ARE MANY. FOREMOST AMONG THEM IS A BUDGETING SQUEEZE IMPOSED BY TOO MANY PRESIDENTIAL AND CONGRESSIONAL INITIATIVES AND MUCH TOO LITTLE IN THE WAY OF APPROPRIATION TO ACCOMPANY THEM.

ELECTRONIC AIDS TO NAVIGATION RESEARCH IS JUST NOW BEGINNING TO SHOW SOME INTERESTING RESULTS. AN EXAMPLE IS THE CREATION OF A PORTABLE MINI-LORAN RECEIVER CAPABLE OF GIVING THE MARINER, ON THE BRIDGE, DIGITAL READOUTS IN FEET TO THE RIGHT OR LEFT OF THE CENTER OF THE CHANNEL. THIS WILL HOPEFULLY PROVE IN THE NEAR FUTURE TO BE AS GREAT AN AID AS RADAR AND THE VHF RADIO.

THE UNITED STATES, AS CONCERNED AS WE ARE TO GUARD AGAINST ACCIDENTS WHICH CAUSE DAMAGE TO OUR ENVIRONMENT, NOT TO MENTION PRESERVATION OF LIFE, HAS A VERY LONG WAY TO GO TO FACILITATE SAFE NAVIGATION OF ITS WATERS BY A SYSTEM SO SIMPLE, BASIC AND EFFECTIVE AS AIDS TO NAVIGATION.

EXHIBIT A
VISUAL AIDS TO NAVIGATION
APPROACHES TO & INSIDE THE
RIVER AT THE PORT OF ROTTERDAM

I. AIDS TO NAVIGATION ON THE APPROACHES TO AND INSIDE THE RIVER

ENTRANCE 1/

Maasvlakte Lighthouse

Leading Lights Maasmond 112° (white)

" " Calandkanaal 116° (green)

" " Rotterdam Waterway 107° (red)

In addition to the above named lights the following buoys have been laid:

a. Maas Centre: A Safe Water mark, the centre of a round-about of which outbound vessels are advised to pass North-ward and in bound vessels South-ward. Pilots embark South of this position.

b. Ankerplaats: South of this Special Mark is the recommended anchorage area.

c. Maasvlakte Noord: A North Cardinal buoy marking the Western mole of the Maasvlakte. For radar identification a blind buoy has been placed near this position.

d. Maas Oost: A Safe Water mark. Near this position pilots of outbound vessels disembard.

e. Maas 1, 2, 3, 4 are lateral marks in the Maasmond marking the Northern mole and the South bank. In the entrance of Maasmond two harbour light-platforms have been placed.

f. CA - RW: The bifurcation of Rotterdam Waterway and Caland Kanaal is marked by this West Cardinal buoy.

g. RW 1, RW 2, RW 4: These buoys are lateral marks in the entrance of Rotterdam Waterway.

1/ Refer also to figures 4,5, & 6 in the body of the report.

From Hook of Holland up to Vlaardingen the Rotterdam Waterway is marked by dolphins which have been placed on the ends of submerged moles and are equipped on the Northern side with square and on the Southern side with round daymarks. Most of the dolphins are equipped with a light.

II. THE CHARACTERISTICS OF THESE VISUAL AIDS

Name	Position	Colour	Height	Visible nominal x 1000	Candels	Character	Colour
Maasvlakte	51-58 04-01	N YBHS E	67 m	27 nm	3,500	Gp Fl (5)	20s w.
Harbourlight North	51-59,5 04-03	N YBHS E	31 m	10 nm	1,5 1.000	Fixed r: Alt. rw	6 s
Harbourlight South	51-59 04-02	N YBHS E	31 m	10 nm	1,5 1.000	Fixed gr. Alt. gr w	6 s Nautophone
107° Low	51-58,5 04-07,5	N RWHS E	30 m	18 nm	day 320 night 32	ISO r	6 s
High	450 m off low	RWHS	44 m	18 nm	d. 320 n. 32	ISO r	6 s
112° Low	51-59 04-05	N BWHS E	30 m	21 nm	d. 1.900 n. 190	ISO w	4 s
High	1135 m off low	BWHS	47,5 m	21 nm	d. 1.900 190	ISO w	4 s
116° Low	51-57,5 04-08,5	N RWHS E	30 m	16 nm	d. 300 n. 30 1.600	ISO gr	6 s (foglights)
High	550 m off low	RWHS	44 m	16 nm	d. 300 n. 30 1.600	ISO gr	6 s (foglights)
Maas Center	52°01'11" N 03°53'33" E	Pillar RWVS	Iso	4 s	W	Spherical	yes
Maas Oost	52 01 01 03 58 09	Sphere RWVS	Iso	8 s	W	--	"
Ankerplaats	51 59 42 03 53 00	Cone Y	Fl.	10 s	Y	--	"

MV-Noord	51 59 39 04 00 18	Pillar BY	VQF	N-card.	"
MV-N id.	51 59 35 04 00 22	Cone Y	--	--	"
Maas 1	51 59 30 04 01 45	Cone G	Iso 4 s G	--	"
Maas 3	51 58 57 04 03 56	Cone G	Iso 8 s G	--	"
Maas 2	51 59 30 04 03 40	Can R	Iso 4 s R	--	"
Maas 4	51 59 20 04 04 27	Can R	Iso 8 s R	--	"
CA 4 RW	51 59 03 04 04 29	Pillar YBY	QF (9) 15 s W	N-Card.	"
RW 1	51 58 58 04 05 07	Cone G	Iso 4 s G	--	"
RW 2	51 59 10 04 05 14	Can R	Iso 4 s R	--	"
RW 4	51 59 01 04 06 00	Can R	Iso 8 s R	--	"

Colours

RWVS = Red White Vertical Striped

Y = Yellow

BY = Black Yellow

G = Green

R = Red

YBY = Yellow Black Yellow

System : Buoyagesystem "A", combined Cardinal and Lateral system
(red to port).

III. Engineering descriptions of individual aids in the approaches to Rotterdam and Europort/Maasvlakte.

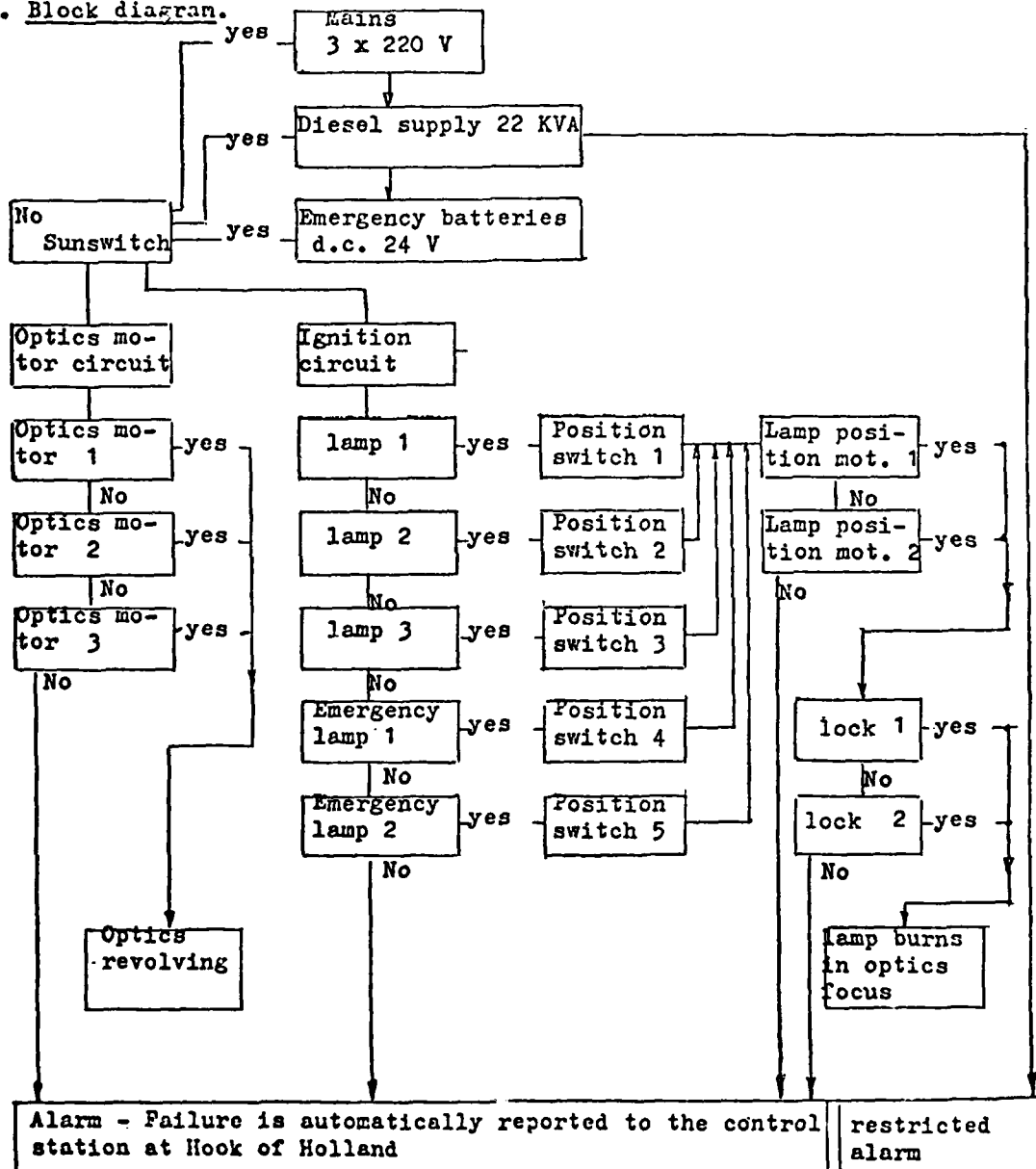
The replacement cost is estimated at f.1,000,000 for Maasvlakte lighthouse.

A. The coastal light Maasvlakte.

1. Design. See article "Landmarks near the entrance to Rotterdam/

Europort" in IALA bulletin no. 67 1976-3 (Annex 1)

2. Block diagram.



The Lighthouse is maintained by a mobile maintenance team of two men stationed at Hook of Holland. All preventative maintenance is performed on the spot.

3. Remote control of Maasvlakte Lighthouse, leading lights 107^o, 112^o and 116^o

Lighthouse Maasvlakte

If a discrepancy occurs in the installation of the lighthouse automatically a telephone call is made by means of a tape recorder. When the message has been received at the control station a telephone call to the lighthouse is made in order to stop the tape recorder.

B. Leading Lights

1. Description

- a. Leading Lights 107^o: The towers of the leading line 107^o were built in the same way as Maasvlakte lighthouse.
- b. Leading Lights 112^o: See article "Landmarks near the entrance to Rotterdam Europoort" in IALA Bulletin nr. 67 1976-3 (Annex 1).
- c. Leading Lights 116^o: The towers of the leading line 116^o were built in the same way as those of the leading line 112^o.
- d. All towers are equipped with an obstruction light and the higher light of the 112^o leading line has 4 extra obstruction lights half way.

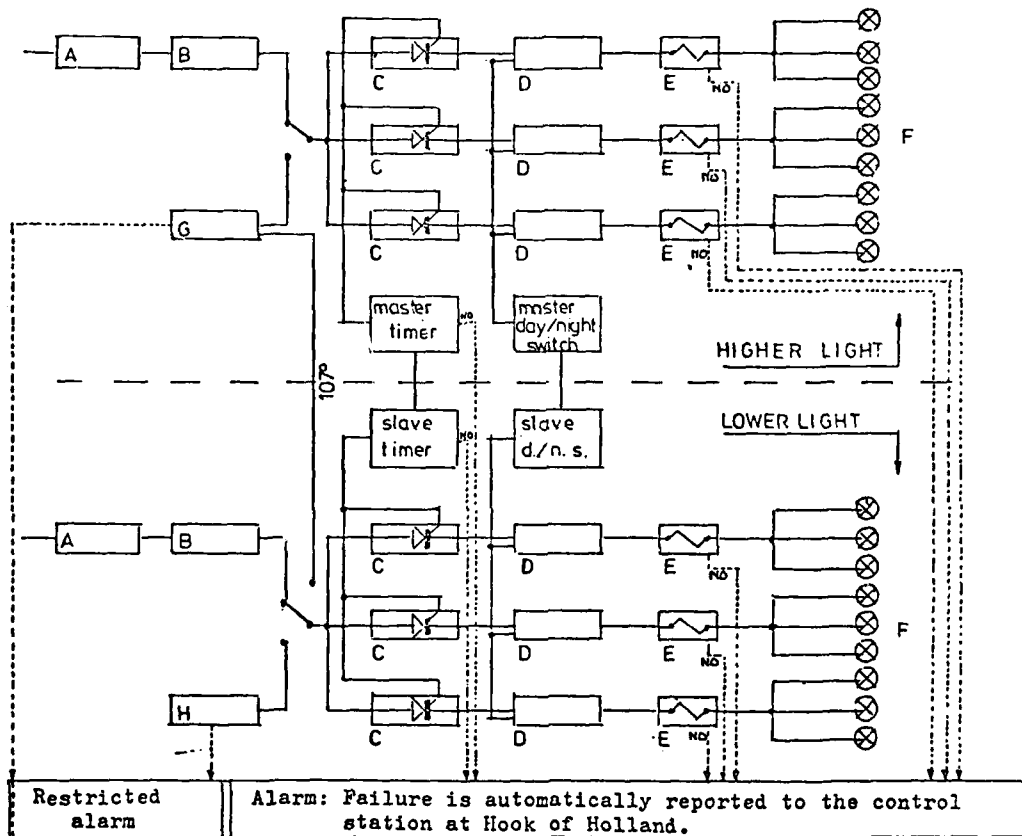
The lower light of the leading line 112^o is equipped with 4 flood lights for bird migration and in reduced visibility conditions the 4 windows at 1/3 of the height of the tower are illuminated by high pressure natrium vapor lamps.

If necessary, the direction of the leading line 116^o can be altered by moving the lower light. This light can be moved over 6 meters.

2. Block diagram of the lights of the leading lines 107°, 112° and 116°.

a. Lights of the leading lines 107° and 112°.

The leading line 112° has two diesels and the leading line 107° has one diesel as secondary power supply.



- A = High voltage station 10.000 V \rightarrow 380 V a.c.
- B = Voltage control
- C = Thyristor switch
- D = Intensity control
- E = Lamp signal control.
- F = Lamps (In daytime 90% and in reduced visibility conditions -
by night 30%)
- G = Diesel for the lower and the higher light 107°, Diesel for the higher light 112°
- H = Diesel for the lower light 112°

b. Lights of the leading line 110 degrees

A = High voltage station 10.000 V \rightarrow 320 V

B = Voltage control

C = Thyristor switch

D = Intensity control

E = Lamp signal control

F = Lamps (in daytime 90% and in reduced visibility conditions -
by night 30%)

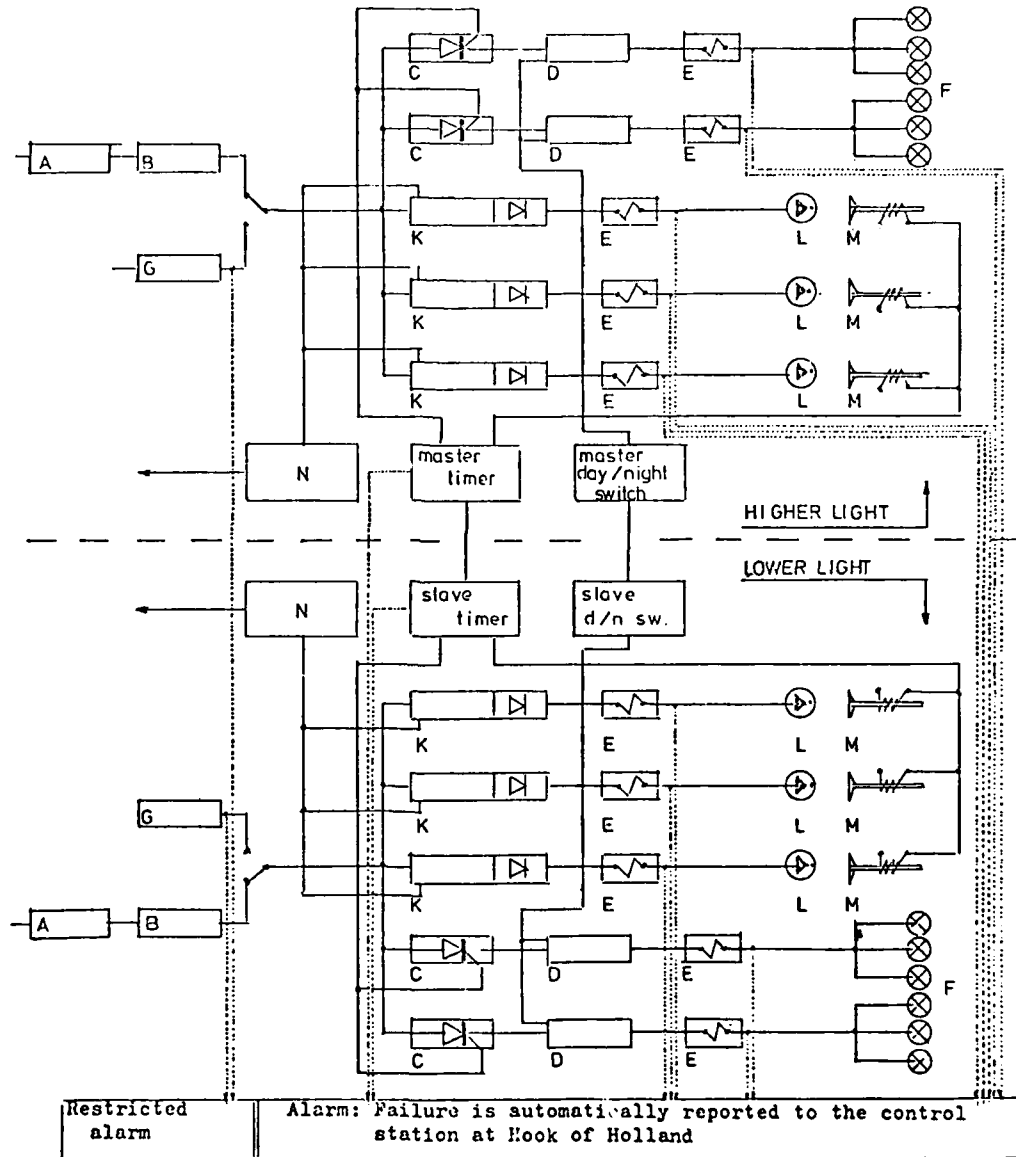
G = Diesel 22 KVA

K = By transducer controlled rectifier

L = Xenon lamp 1600 W (20V-80A)

M = Mechanical lamp signal control

N = Remote intensity control (normally 50%, on request 75 or 100%)



For all leading lights: When the master timer and/or the master day/night switch fail(s) the slave(s) take(s) over command.

3. Initial Investment Cost. In 1974 the cost of the towers of the leading line 107° was f. 650.000.- and of the leading 112° and 116° together f 4.500.000.-

4. Annual Energy Consumption and Costs.

Leading Lights 107°	24.000 KW	f. 12.000,-
Leading Lights 112° + 116°	261.000 KW	f. 130.500,-

5. Maintenance. The leading lights are maintained by a mobile team of two men stationed at Hook of Holland. The towers of the leading line 112° can be reached by tender in half an hour, the towers of the leading line 116° either by road, 3/4 hr, or by tender, 1/2 hr. and those of the leading line 107° are situated near the station at Hook of Holland.

All preventative maintenance is performed on the spot.

6. Repair. Small repairs are made on the spot by the maintenance team and more complicated repairs are made by the Technical Department of Lighthouse Service at Scheveningen.

7. Cause of failures. The cause of failures is mostly due to a breakdown in switches. Several times the lights of the dam-illumination were struck by lightning which caused a disturbance in the 112° leading line installation. During the operational period, however, the lights of the leading lines were never extinguished but burned fixed or were non synchronous.

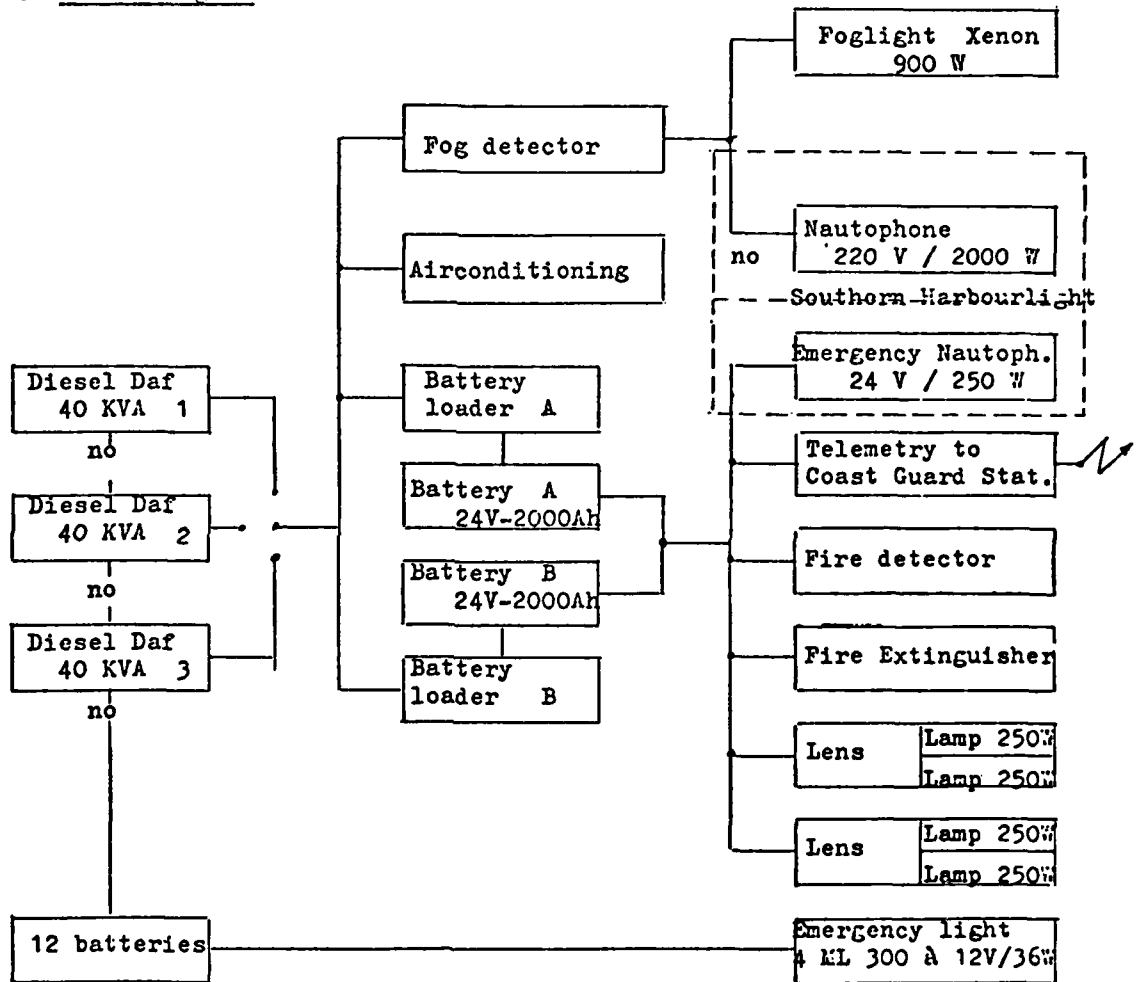
8. Leading Lights 112° and 116°. A similar system is used for these lights but it does not function properly due to damages to the telephone cable. A study is being made on a new system which will be more reliable.

c. Harbourlights.

1. Design.

See article " Landmarks near the entrance to Rotterdam Europoort." in IALA Bulletin nr. 67 1976-3 (Annex 1).

2. Block diagram.



All units are remote controlled at the Coast Guard Station at Hook of Holland.

Alarm is given: a) When one of the Diesels, the fogdetector, the foglight, the airconditioner, Batteryloader A or B does not function.
b) When the harbourlight is extinguished.

3. Initial Investment Cost.

The investment cost of each harbourlight was f 5 .000.000.- in 1974.

4. Annual Maintenance Cost.

The annual maintenance cost including fuel = f 222.000,- (1978).

The cost is rather high due to the rent of a helicopter by which the maintenance crew is transported to the harbourlights.

5. Maintenance and Repair.

The maintenance and repair is performed on the spot by a private company 10x/year. The maintenance crew consists of 12 men.

6. Harbourlights.

The control is performed by means of UHF 405 MHz wave-band

(See block diagram Fig A-1).

7. Failure.

If a failure occurs in the automatic apparatus then the various nautical functions of the harbourlights can be controlled by the crew of the control station. If the nautophone alarm works the nautophone can be switched on by pressing the reset button for about 6 sec.

8. Repair.

Repairs of discrepancies to the dolphins are the responsibility of the Ministry of Transport and Waterways. Repairs are made on the spot.

Semaphore Remote control Harbourslights Southern harbourlight

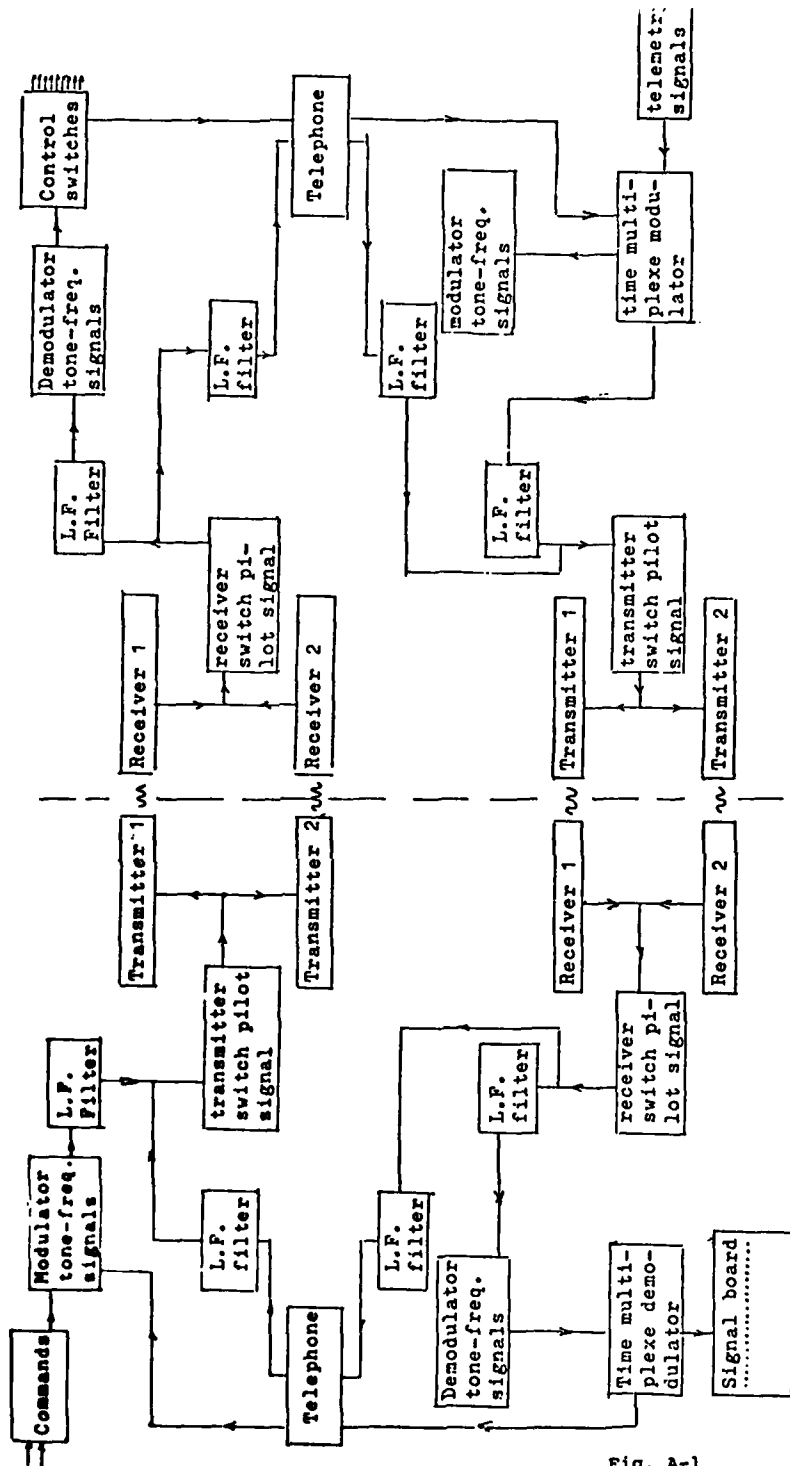


Fig. A-1

Transmitting power 5 W E.R.P.

D. Lightbuoys

1. Design. The most common type of a lighted buoy is a 10 m³ cylindrical steel lightbuoy. The buoys are moored to a 32 mm chain with a length of 3 x the water depth and a 3000 Kgs. weighing concrete sinker. The chain is attached to the buoy by a bridle consisting of 6 m 32 mm chain.

The lighting apparatus on these buoys are either 200 mm gas lanterns or 140 mm electric lanterns with 0,92 A lamps. The gas lanterns are supplied by propane and are AGA or Pintsch Bamag lanterns.

The electric lanterns are supplied by 6 x 1,2 V - 2000 Ah dry Carbone batteries. The housing is made by the Technical Department of the Lighthouse Service and the electrical device is made by Tideland.

(See Fig. A-2).

All buoys are equipped with radar reflectors. Lateral buoys have 600 mm radar reflectors and cardinal buoys have topmarks with built in radar reflectors.

All buoys, except Maas Centre Buoy, are provided with lateral cardinal or safe-water daymarks.

Maas Centre Buoy is a 18 m³ light-whistle buoy. Particulars of this buoy are: Length 15,6 m; draft 7,5 m; diameter of the body 3,03 m; weight 12,6 tons; two gas tanks each containing 429 Kgs propane and a lantern placed on top of the superstructure. Particulars of the 10 m³ cylindrical steel light buoys with a tail skirt are: Length 6,05 m; draft 1,7 m; diameter of the body 2,96 m; weight 5,8 tons; a gas tank containing 250 Kgs propane or a battery case containing 6 x 1,2V-2000 Ah batteries.

2. Consumption. Gas consumption is 180 Kgs./buoy and battery consumption 9 to 12 batteries/buoy yearly.

3. Maintenance. The buoys are maintained by the sea-going buoy tender "Delfshaven" based at Rotterdam. The vessels crew consists of 2 officers and 9 seamen. The responsibility of this vessel is maintenance of the buoys at sea between 51°52'N and 52°20'N on the Netherlands' Part of the Continental Shelf, the inlets to the Brouwerhavense Dam, Haringvliet Dam and the approaches to Rotterdam/Europoort and Scheveningen.

Most maintenance is done on station. The aids are regularly inspected. After 12 to 18 months on station, the buoys are replaced by reconditioned buoys. Reconditioning is done at Hellevoetsluis. A depot for buoyage materials is near Hook of Holland. The transport from and to Hellevoetsluis is mostly done by a smaller buoy tender.

4. Repair. Most repairs are made on station, if necessary damaged buoys are replaced.

5. Failures. The majority of failures were caused by collisions.

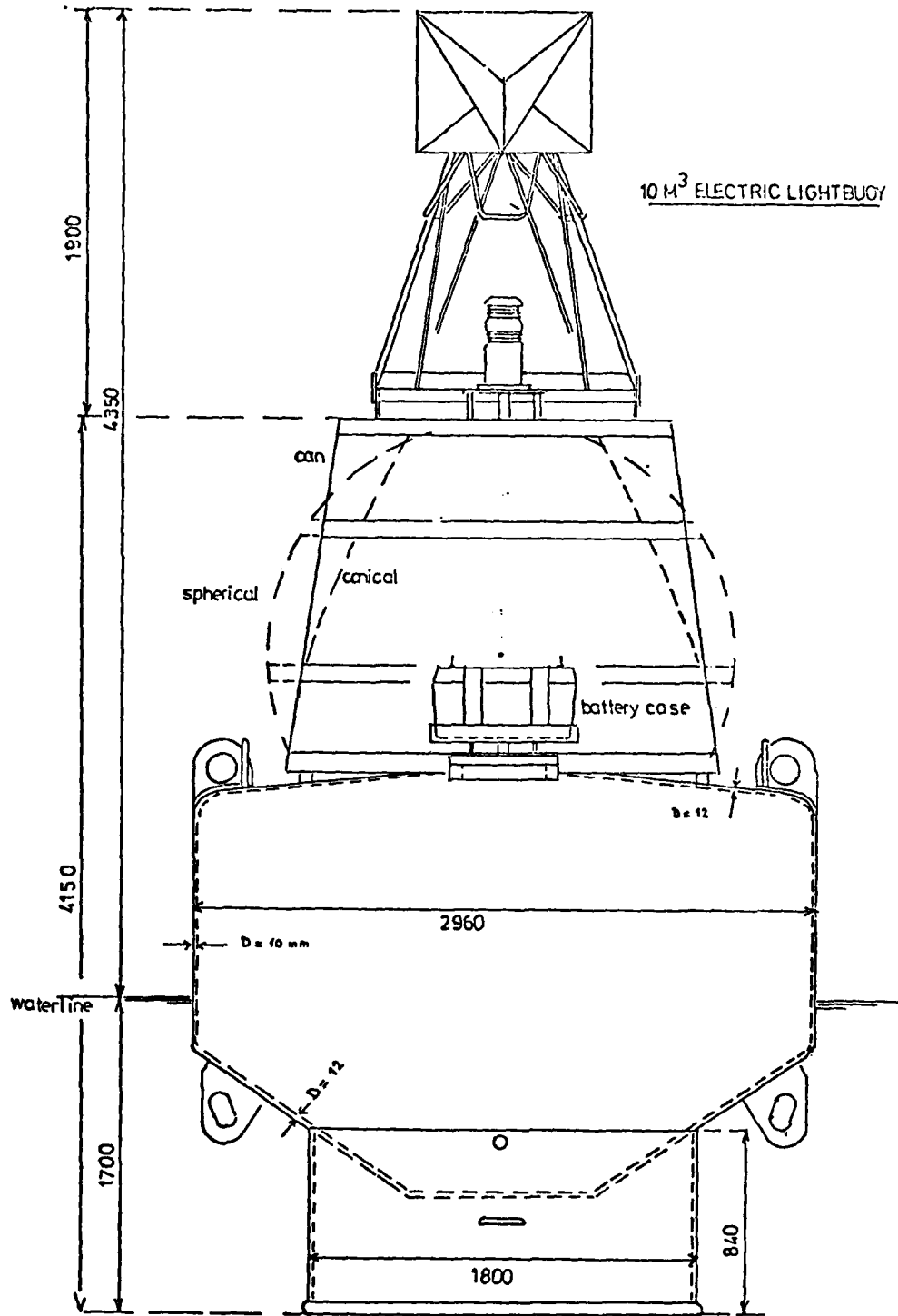


Fig. A-2

F. Dolphins

The northern side of Rotterdam Waterway is marked by red lights and the southern side by green lights interrupted by 5 white lights, which are placed on top of the dolphins. Characters and color are in conformity to the Maritime Buoyage System "A".

1. Design.

The dolphin consists of a steel pipe with a length of 16 to 20 meters, a gas tank, a lantern platform and a lantern. The gas tank contains 600 ltrs. propane and the lantern is a Pintsch Bamag PE 200 lantern. The steel pipes are driven into the ground and the gas tank, light platform and lantern are placed afterwards-

2. Initial Investment.

The replacement cost of a dolphin is f 30.565,- (1976)

Replacement cost of hardware is:

PE 200 gas powered lantern f 10.300,-

Gas tank f 9.850,-

3. Annual Energy Consumption.

The annual gas consumption is about 16117 Kgs. and the cost is about f 8.059,-

4. Maintenance.

The dolphins are property and the responsibility of the Ministry of Transport and Waterways.

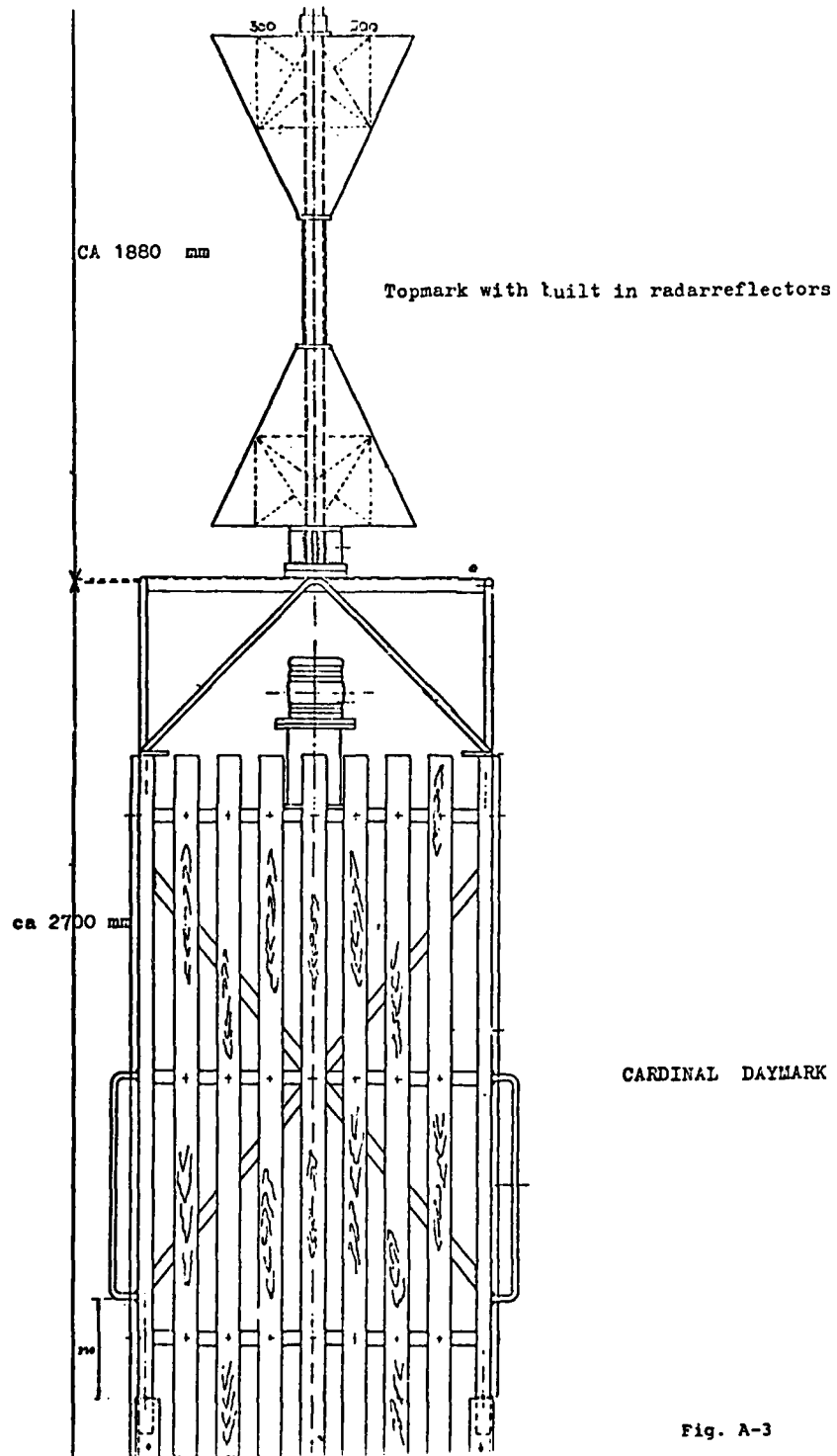


EXHIBIT B

ENGEL & VREESWIJK, LANDMARKS NEAR THE
ENTRANCE TO ROTTERDAM EUROPOORT,
BULLETIN DE L'A.I.S.M./I.A.L.A., 1976-3

Landmarks near the entrance to Rotterdam Europoort

Marques d'atterrissage aux abords du port de Rotterdam (Europoort)

by Ir. H. O. ENGEL and J. K. VREESWIJK
Directorate General of Pilotage and Aids to Navigation, The Hague

SUMMARY

This paper describes the new aid-to-navigation lights comprising one lighthouse, three lighted leading lines and two harbour lights which, in addition to a shore-based radar and a Decca navigation system, mark the entrance to the port of Rotterdam.

The Maasvlakte lighthouse is an octagonal tower 65 m high which carries a revolving flashing light with an intensity of 3,500,000 cd and a geographical range of 21 nautical miles, completely automated and normally powered from the mains (Fig. 1). A detailed description of the tower is given in the Annex.

The three lighted day and night leading lines are also powered from the mains and comprise:

- a 116° leading line consisting of two green lights marking the access to Europoort,
- a 112° leading line consisting of two white lights marking the western part of the approach channel from the Maas-centre buoy (the paper gives a detailed description of the construction of the towers),
- a 107° leading line consisting of two red lights marking the access to Rotterdam.

The two harbour lights, placed at the ends of each new mole (a red light on the North mole and a green light on the South mole) are caisson lighthouses powered by generating stations and pro-

vided with landing platforms for helicopters to facilitate servicing. These lights have an intensity of 1,500 cd and a geographical range of 16 nautical miles. A detailed description of the construction of the towers is given in the paper.

RÉSUMÉ

Cet article décrit la nouvelle signalisation lumineuse du port de Rotterdam composée d'un phare, de trois alignements de feux et de deux feux de port qui, en plus du radar de surveillance et du système Decca, marquent l'accès du port.

Le phare de Maasvlakte est une tour octogonale de 65 m de hauteur portant un feu à éclats tournants de 3 500 000 cd et de 21 milles de portée, entièrement automatique et alimenté normalement sur le réseau de distribution (Fig. 1). Une description détaillée de la tour est donnée en Annexe.

Les trois alignements de feux, également alimentés sur le réseau de distribution, se composent:

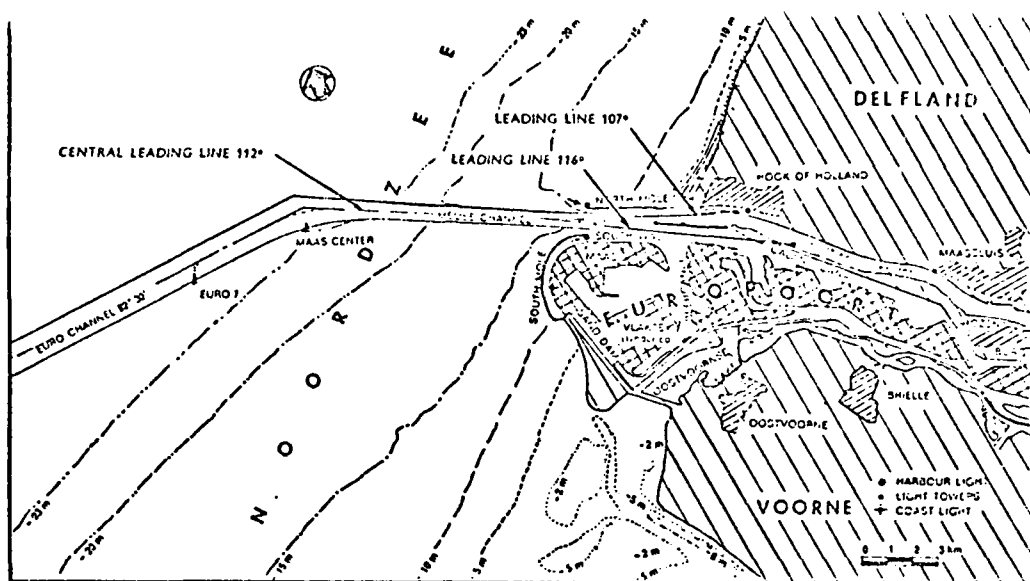
- d'un alignement à 116°, constitué de deux feux verts, balisant l'accès à Europoort,
- d'un alignement central à 112°, constitué de deux feux blancs, balisant la partie ouest du chenal d'approche depuis la bouée Maas-centre (l'article donne une description détaillée de la construction des deux tours),

— d'un alignement à 107°, constitué de deux feux rouges, balisant l'accès au port de Rotterdam.

Les deux feux de port, placés à l'extrémité de chacune des deux digues (un feu rouge sur la digue nord et un feu vert sur la digue sud) sont des phares sur caisson alimentés par des groupes électrogènes et munis de plates-formes d'atterrissage pour hélicoptères pour faciliter leur entretien. Ces feux ont une intensité de 1 500 cd et ont une portée de 16 milles marins. L'article contient une description détaillée de la construction de ces tours.

In addition to a shore-based radar and a Decca navigation system, the following lighthouses were designed and built by the Hydraulics and Public Works Section of the Ministry of Transport and Waterways as part of the nautical equipment of the reconstructed entrance of the seaway to Rotterdam Europoort designed and installed by the Directorate General of Pilotage and Aids to Navigation:

1. The coastal light "Maasvlakte".
2. Three leading lines for the approaches to the Rotterdam harbour area:
 - 2.1 Two towers for the central leading line (112°) of the Maas channel,



- 2.2 Two towers for the leading line to and from Europoort (116°),
- 2.3 Two towers for the leading line to and from the Rotterdam Waterway (107°).
- 3. Two lighthouses at the ends of the new moles at Hook of Holland.

1. THE COASTAL LIGHT "MAASVLAKTE" (Fig. 1)

This completely automated light is placed on top of a 65 m high tower. The shape of the tower, a detailed description of which appears at the Annex (p. 16), is octagonal. It is painted with yellow and black horizontal stripes. The exterior has been treated with pressure-grout. Because of bird migration, the tower is floodlighted. It is fitted with a revolving optic and a lampchanger carrying three 2000W high pressure mercury vapor lamps and two 250 W incandescent lamps. Both the optic and the lampchanger are activated by an a.c. electric generator with a d.c. motor in reserve. With this installation, the intensity of the light is

3,500,000 cd with a geographical range of 21 nautical miles. The power is normally drawn from the mains. In emergency situations, a motor generator serves as an alternative source of power supply and a battery with 24 hour capacity is installed as extra safeguard. When a failure occurs, the Hook of Holland Coast Guard station is automatically alarmed. The alarm unit makes use of the public telephone system.

2. THE LEADING LINES

Shipping navigating the western part of the approach channel aligned to 82°30 is guided from the Maas-centre buoy to the entrance by the central white lighted leading line (112°). From the entrance, Europoort bound shipping follows the green 116° lighted leading line, while the red 107° lighted leading line indicates the way to Rotterdam. The six towers of the three leading lines are of octagonal shape, the resulting shadow effects increasing the conspicuity. Their characteristics are as follows:

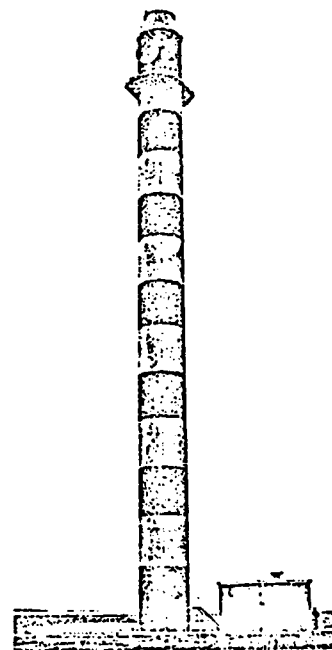


Fig. 1 — Maasvlakte lighthouse

Leading line	107°	112°	116°
Height of the lower light	30 m above O.D.	30 m above O.D.	30 m above O.D.
Height of the higher light	44 m above O.D.	47.50 m above O.D.	44 m above O.D.
Distance between the towers	450 m	1 135 m	550 m
Range	7 km	10 km	10 km
Light character	Fl: 3 s, Eclipse: 3 s	Fl: 2 s, Eclipse: 2 s	Fl: 4 s, Eclipse: 2 s
Light colour	Red	White	Green
Tower colouring	Reddish brown and white horizontal bands	Black and white horizontal bands	Reddish brown and white horizontal bands
Light intensity at night	32,000 cd	190,000 cd	30,000 cd
Light intensity in day-time	320,000 cd	1,900,000 cd	300,000 cd and 16,000,000 cd with the xenonlight (in reduced visibility)
Light source	9 floodlights	9 floodlights	6 floodlights, 3 xenonlights
Power supply :			
— normal	Electric mains	Electric mains	Electric mains
— in case of power failure	2 diesels 22 kVA in parallel	3 diesels 22 kVA in parallel	1 diesel 22 kVA per tower
Failure reporting	By electric cable to coast-guard station	By electric cable to coast-guard station	By electric cable to coast-guard station
Geographical range of the higher light tower	17 nm	18.5 nm	17 nm
Geographical range of the lower light tower	15.5 nm	15.5 nm	15.5 nm
Sector width of the lights	15°	22°	6° with the floodlights 10° with the xenonlight

CONSTRUCTION OF THE TOWERS OF THE 112° CENTRAL LIGHTED LEADING LINE (*)

The two lighthouses of the 112° lighted leading line are situated in the open sea, the western one being particularly exposed to heavy buffeting from the waves. Tests in the hydraulics laboratory at Delft showed that the towers could be subject to a quasi-static wave load of 750 tf and to breaking waves reaching a height of 12 m above mean sea level.

The towers had to be designed with due regard to the difficulties to be encountered at the site since at the time of their construction the protective moles

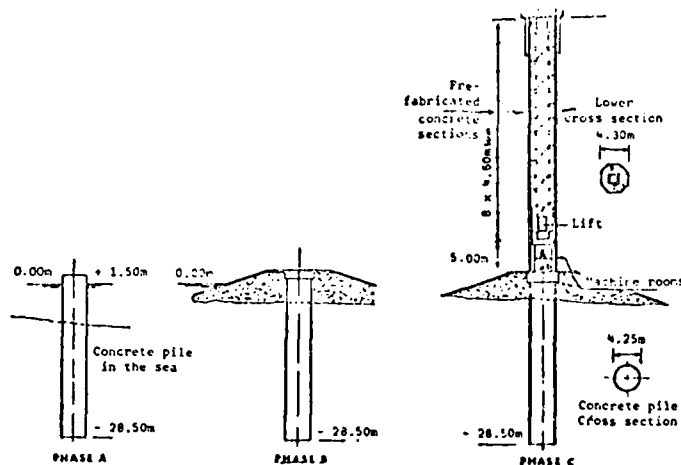
(*) These data were taken from the introduction of the paper "Hydraulic engineering works for the benefit of navigation in the new Rotterdam harbours", by Ir. J. F. Agema and Ir. J. C. Slagter of the Ministry of Transport and Waterways submitted at the Symposium on Concrete Sea Structures, 1972, in USSR.

had not yet been completed. The wave attack might therefore be greater than it would be later.

The mid-stream dam was also unfinished. In view of this, the work of erecting the towers was highly sensitive to changes in weather conditions and ultra-rapid construction methods had to be used. This was achieved by pre-constructing large components elsewhere in such a way that they could be put together with the least possible delay.

Since any formwork erected on the site would have been washed away, the foundation of each tower was a hollow prestressed concrete pile with an external diameter of 4.25 m and 0.30 m walls to bear the heavy load. Similar piles had been used for the foundations of the Zeeland bridge. They could be sunk into position in about 10 hours (Fig. 2, phase A). The mid-stream dam in which the towers are incorporated was completed when the foundation piles were in position (Fig. 2, phase B). The towers themselves were erected when the dam was completed and was

accessible in good weather (Fig. 2, phase C). To carry out the construction as rapidly and safely as possible, the structures were built of prefabricated elements 4.60 m high. The surfaces of the fillets to be joined together were morticed. The fillets could be joined separately either to each other or to the foundation pile. The great advantage of this was that in the event of a sudden storm, the construction work could be interrupted without endangering the whole project. The concrete elements weighed about 50 tons each and were delivered complete with such vital elements as stairs, platforms, ventilation and lift shafts, and lamp sockets. A 165 ton mobile crane was used to hoist the sections into place. The joining surfaces were brought into line by matching trapeziform joints. Before being eased into their final position, the joining surfaces of both sections were covered with adhesive epoxy resin. The last element to be filled was the concrete platform carrying the lantern. It took only two days to build one tower.



3. THE LIGHTHOUSES AT THE ENDS OF THE TWO NEW MOLES

Two lighthouses were also built at the extremities of the two entrance moles,

the ends of which are below high water level.

Their characteristics are as follows :

<i>Height</i>	+ 31 m above O.D.
<i>Colour of the towers</i>	Yellow and black horizontal stripes
<i>Colour of harbour lights</i>	Northside: red Southside: green
<i>Colour of fog lights</i>	Northside: alternating red and white, Fl. 6 s Southside: alternating green and white, Fl. 8 s
<i>Intensity of harbour lights</i>	1500 cd
<i>Intensity of fog lights</i>	2,5 . 10 ⁹ cd
<i>Light source of harbour lights</i>	250 W / 24 V incandescent lamp
<i>Light source of fog lights</i>	900 W Xenon lamp
<i>Nautophone on southern mole</i>	1 blast every 10 s, 2000 W
<i>Power supply</i>	3 diesel generators of 30 kVA
<i>Secondary light</i>	4 lamps of 36 W
<i>Secondary nautophone</i>	600 W
<i>Secondary power supply</i>	2 x 2000 Ah
<i>Failure reference and control</i>	Telemetry
<i>Geographical range</i>	16 nautical miles

3.1 THE DESIGN (1)

The design of these harbour lights was strongly influenced by the surroundings where they had to be placed (in the stone dam) and by the working circumstances (deep water and considerable wash).

After an investigation conducted by the Hydraulics and Public Works Section of the Ministry of Transport and by the main contractors (a consortium called Combinatic Havenmond Hoek van Holland (CHJ), composed of Adriaan Volker, Bos & Kalis and van Hattum en Blankevoort) a construction process was chosen, whereby each harbour light was first made completely in working order after which it could be sunk at the site in one operation. Each structure is made of the following elements (Fig. 3):

a 12.50 m high twelve-sided caisson with a diameter of 25 m, made of reinforced concrete and in the centre, a circular pile shaft (diameter 4.25 m)

(1) These data were taken from a paper "Design and construction of the harbour lights", by Ir. L. E. den Ende, Project Engineer of the Harbour Entrances Department of the Hydraulics and Public Works Section of the Ministry of Transport and Waterways, published in *Rotterdam Europort Delta*, No. 1974/3.

the pile is a "crow's nest" containing a complete automatic generating station for electric supply. It is not possible to obtain the required electric supply via a cable from shore.

The harbour lights are also inaccessible via the stone dam for maintenance and inspection. This is why both harbour lights are provided with a six-sided steel helicopter platform measuring 24 m across. The helicopter platform is about 30 m above sea level.

Under the helicopter deck, there is the lantern with the powerful light source which is situated 25 m above water and visible in clear weather up to about 20 km. An additional powerful light is automatically switched on in foggy weather.

When positioning the harbour light, it might have happened that the caisson would not stand exactly horizontal, so

a jacking construction had been built in to adjust the harbour light vertically afterwards.

3.2 THE CONSTRUCTION

Approximately one year was available to build both harbour lights. In view of this rather short time for such a project and the specific form of the harbour lights, large scale prefabrication was made of the different parts incorporated in the harbour light. In this way, many parts could be worked on simultaneously.

Usually the construction of caissons takes place in a building basin. Examples of this building method in the Rotterdam area are the tunnel sections of the metro railway tunnel and the Benelux Tunnel.

It appeared desirable, however, both from financial and building time points

of view, to build the caissons on a pontoon and afterwards to launch them into the water by sinking the pontoon. This meant that the building place of the caissons could be chosen at will. The "Combinat Oosterschelde" situated in Kats, in Zeeland province, had a plant producing concrete and sufficiently trained staff to make a construction of this kind. Furthermore, two 300 ton overhang cranes were available there. These proved to be very useful since the pontoon on which the caissons were to be built was only available a few months later than was originally envisaged. This loss of time was compensated by constructing the shuttering with the reinforcement of the whole caisson ashore (total about 550 tons of steel), and placing it in its entirety on the pontoon, after which the pouring of concrete could commence almost immediately.

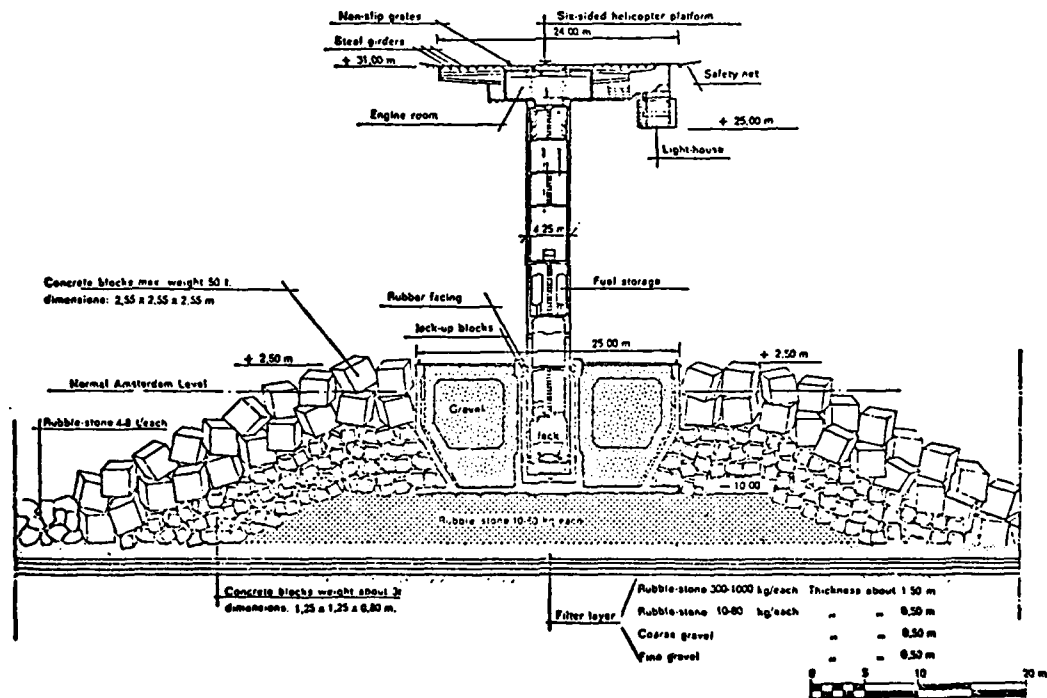


Fig. 3. — Harbour light vertical cross section

The other components made of concrete (the pile shafts and engine houses) were also made by the Combinatie Oosterschelde. The two helicopter platforms were built by the Staalconstructiebedrijf van Kloos-Kinderdijk N.V. near Rotterdam.

Installation of the necessary diesel sets and suchlike equipment in the engine houses took place almost entirely in Kats. Because of the size of the pontoon and the caissons it had to carry, transport from Kats to the Hook of Holland

had to take place "outside" via the Zeeland bridge, Oosterschelde, the North Sea and the new harbour entrance. The engine houses and the two pile shafts were transported "made" the coastline to the Hook of Holland via the Volkerak locks (Fig. 4). The two caissons were "unloaded" from the pontoon by sinking the pontoon near the Eur-O-Rama site, so that the caissons remained floating (Fig. 5). They were then towed to a previously prepared "home" close to the working site in the Beer Canal,

where the harbour lights were further assembled.

In the summer of 1973, the pile shaft, engine house and helicopter platform for each of the harbour lights were placed in position with the aid of the floating derrick "Ir J.G. Ship" (Fig. 6). After completion of the assembling operation, the electrical installations were tested for a period of two months in order to trace any possible defects. In January 1974 both harbour lights were standing ready in Europoort for sinking at their definitive positions at the heads of the North and South moles.

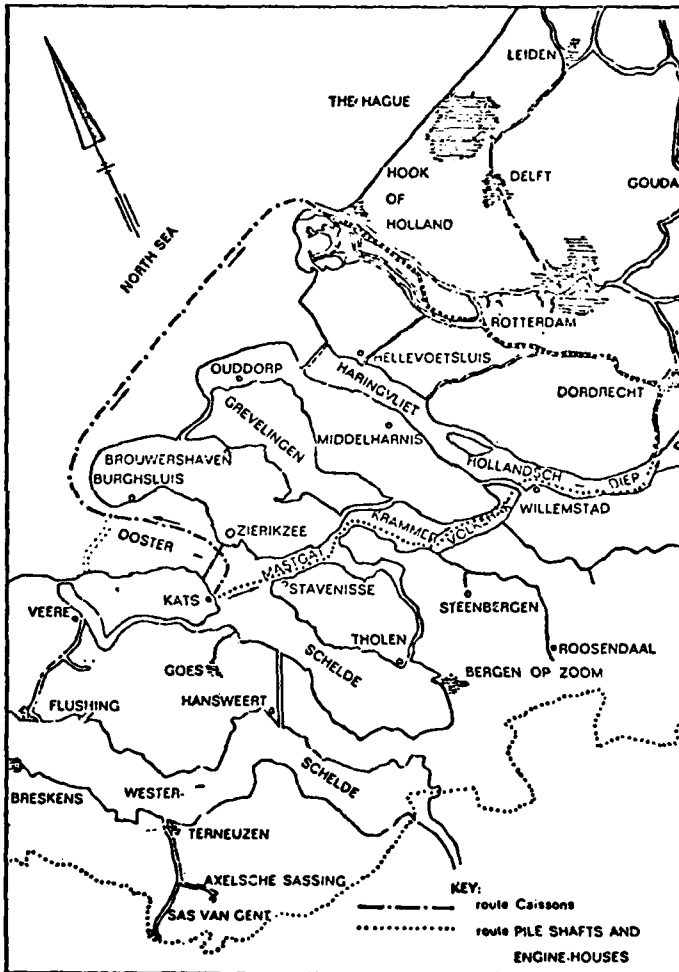


Fig. 4. — Transport routes from Kats to Hook of Holland

3.3 THE SINKING

The sinking of the two harbour lights required an enormous amount of preparation. Nothing was allowed to go wrong in the entrance channel leading to Rotterdam and Europoort.

A plan of operations for towing and sinking manoeuvres was drawn up in close co-operation between the contractors (CH3), the State and Municipal Harbour Services B.V., Nieuwe Rotterdamse Sleedienst and the Harbour Entrances Department of the Ministry of Transport (Figs 7 and 8). The plan was based on the currents occurring at the heads of the harbour moles, the tidal course and the waves or swell which were expected on the dates planned for positioning the harbour lights. In this respect, the mooring of the harbour light had a tidal aspect; the harbour lights had to be sunk as accurately as possible while the amount of variation in the direction of the light-house had to be very small. The whole operation was to be so critical that, for the first time since the beginning of the construction of the new harbour entrance (1966), shipping traffic had to be stopped for a short time.

Model scale tests of the mooring system adopted were made in the Delft Hydraulic Laboratory. This enabled to determine the hawser stress as well as the movements of the caissons in waves and swell. A long swell with periods greater than 12 s appeared to be the most dangerous. Reliable information on tide, wind and wave data was therefore of vital importance. In co-operation with the Royal Netherlands Meteorological

Fig. 5. — Unloading of the two caissons from the pontoon

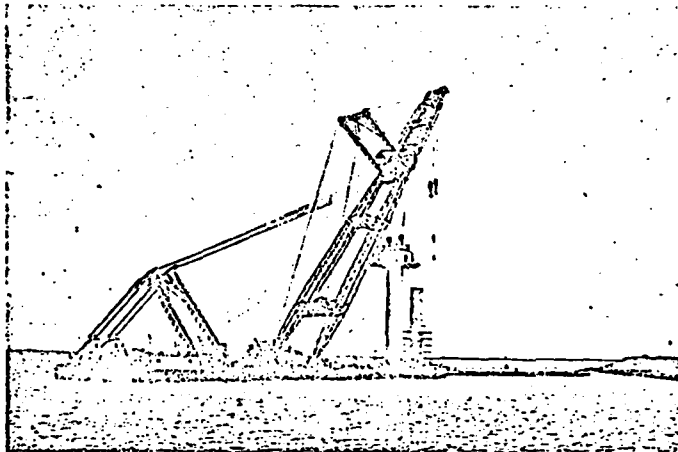
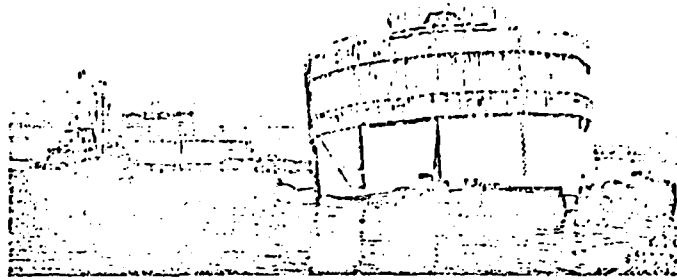


Fig. 6. — Positioning of engine houses

Institute (K.N.M.I.) in De Bilt, many months were spent collecting information, making forecast and holding two or three "trial" runs. A special measuring pole was positioned to obtain tide information. The foundations of the heads of the harbour piers were dumped on the filter layers using small dumpstone of 10 to 80 kg. These "mounds" were built up with the aid of stone dumpers especially built for the harbour entrance projects. Thanks to accurate position-finding and many soundings after dumping each layer of stone no dredging was necessary to level off the top of the mound at O.D. -10 m

Because the time to place the harbour lights was not exactly known and the weather conditions played a great role it was decided to have sufficient manned craft available on the spot for anchoring

the harbour lights during the sinking operation. These were the stone dumper vessels and the block dumper carriers used during the building of the dams which, after little adaptation, could replace special anchor pontoons.

Extra assistance was only given by four tugs and a few flat boats. The conditions required simultaneously to place the harbour lights included:

- (a) Calm weather on the day of the sinking operation and a few days thereafter (in order to fill the caisson with gravel and concrete, thus improving its stability);
- (b) A wave height or swell smaller than about 0.30 m of such small amplitude that the period would be less than 10 s;
- (c) Anchoring (clamping) and sinking had to be done in daylight;

(d) High tide was to reach a level of at least O.D. ± 0.60 m, because the draught of the caissons was 9.90 m and the top side of the mound was constructed at O.D. -10 m;

(e) Visibility had to be sufficient and not less than 1,500 m.

All these conditions were considered in the planning of operations and it was possible to see at a glance which days, as regards tides, light, etc., would not be suitable for placing the lights.

The harbour light at the head of the South mole was placed on February 26, 1974, and the harbour light at the head of the North mole on May 1974. In both cases the entire manoeuvre was carried out almost on schedule in accordance with the plan.

Due to the fact that the Geometrical

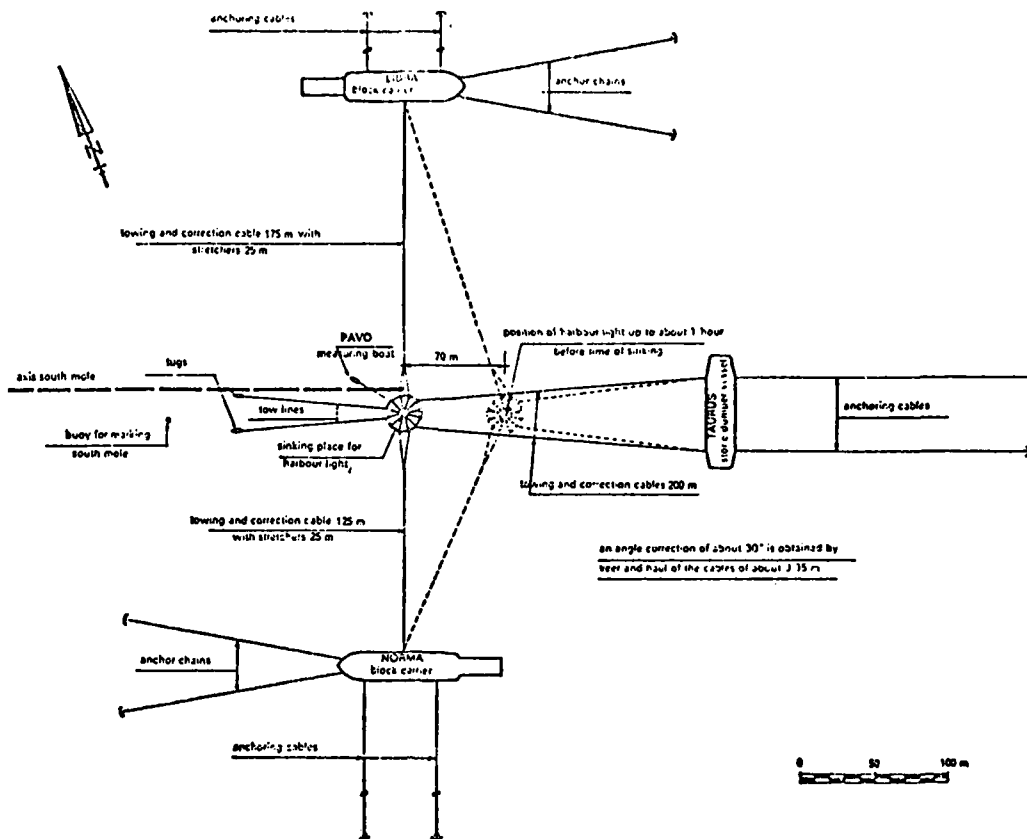


Fig. 7. — Sinking of South Mole harbour light

Service of the Hydraulics and Public Works section of the Ministry of Transport was able to ascertain the deviation from the desired site in different ways and to display the results via a computer within a few seconds, the caissons were manoeuvred extremely accurately.

Deviation sideways and lengthwise from the exact places were very small, i.e.:

— for the South mole:
sideways 0.12 m, lengthwise 0.03 m, rotation of the lighthouse 1°;

— for the North mole:
sideways 0.50 m, lengthwise 0.32 m, rotation of the lighthouse 3°.

The six valves in the walls of the caissons were opened when each caisson was over the position for sinking. After 3 to 4 min the harbour lights stood on the stone mounds. The horizontal deviation was also small, so that immediate readjustment of the pile shaft was

not necessary. Additional dumping of 50 ton blocks round the harbour lights took a few more months to complete.

The official inauguration of the harbour lights took place on September 13, 1974.

The transport and sinking of the two harbour lights can be considered as a pilot project for similar operations such as the siting of radar platforms or oil exploration rigs in the North Sea.

MORAN TOWING & TRANSPORTATION CO., INC.

ONE WORLD TRADE CENTER, SUITE 5335

NEW YORK, N. Y. 10048

ROBERT M. LOFTUS
VICE PRESIDENT
CONSTRUCTION & REPAIR DEPARTMENT

April 9, 1980

National Academy of Sciences
Maritime Transportation Research Board
2101 Constitution Avenue
Washington, D. C. 20418

Reference: Workshop on Reducing Tank Barge Pollution

Dear Sirs:

The Moran organization will be represented at the forthcoming workshop by Mr. Robert M. Loftus, Vice President. We wish, in addition, to present to the Maritime Transportation Research Board position papers on the various areas to be discussed at the workshop. These position papers are in the process of being prepared, and in the meantime we wish to submit this letter as a history of our organization in the oil transportation business and to present a summation of our position on the various areas to be discussed. Further, we wish to inform you that if we can be of further assistance during the period assigned for the Board's study of this problem, we shall be most happy to assist in whatever way possible.

The movement of petroleum has been an integral part of the Moran organization since the 1950's. During the years that followed, equipment has been replaced and upgraded. Today we operate a modern six barge fleet in the waters contiguous to New York Harbor as well as a large product carrier in the trans Gulf-Florida trade.

The majority of our trading involves the movement of products within the port of New York and nearby coastal waters. In the course of this trading, our barges lighter ships, bringing the product to nearby tank farms or directly to customers. Other movements involve the distribution of product from central terminals to various commercial customers as well as high volume movements to public utilities. Since 1975 over 5,000 transits have been made to service our customers, and in the course of completing these movements, petroleum products have been handled on and off barges in excess of 10,500 times. Further, in this five year period more than 1,750 movements of customer oil barges have been made by our tug division. In the

National Academy of Sciences

April 9, 1980

combined movements of oil barges and the concomitant transfer operations of our own barges, we have had seventeen incidents where oil was discharged upon the water. Forty-one percent of these incidents directly involved personnel error, thirty-six percent were related to towing problems, and in these, personnel judgments are again a factor. The remaining twenty-three percent are equipment failures. This is a record not uncommon to the prudent and responsible tug and barge operator.

A summary of our position is as follows: Transportation of petroleum products on the waters served by our organization will continue at present levels and may moderately expand. The barge fleets serving these areas will grow slightly, and present units will be augmented by larger, more economically sized barges. Based upon today's economy, the realities of the world oil situation, and the operational problems faced by a barge operator, we feel that the retrofitting of existing barges to any semblance of double hull construction or the construction of our new equipment with double hulls and/or double bottoms is not realistic.

The question of double hull and/or double bottoms versus single skin construction has been the subject of much discussion by tug and barge operators, IMCO proceedings, and the tanker industry in general. Throughout all of these discussions, the following factors emerge and must be considered:

While double bottoms in barges may be beneficial in minor groundings, they would offer no protection in the more serious incidents and could ensure that, in any grounding where the bottom is pierced, the barge will sink deeper into the water and thus impede salvage operations. Flooding of double bottoms or side void tanks could also cause serious heeling, further complicating an already complicated and serious problem. Double bottoms and/or sides further present many hazards in the day-to-day operations of a barge. Despite the most rigorous construction and maintenance procedures, cracks can occur in the internal structure of the vessel. With double bottoms placed below cargo tanks, there is always the possibility that some oil will leak into these spaces and produce toxic or explosive vapors representing a hazard to people and the barge. Cleaning procedures become an onerous task, practically and economically.

Regulatory bodies, American Bureau of Shipping and U. S. Coast Guard, however, should consider strengthening of sides and bottoms by brackets and/or reduction of frame spacings. This, coupled with more frequent internal inspection based

National Academy of Sciences

April 9, 1980

upon the age of the vessel and service, augmented by more frequent use of audiogagings, will serve to provide vessels that are sound, safe, and economically attractive to owners and eventually the consumer.

Since most of our incidents involve personnel error, we suggest higher standards in the certification of tankermen and more stringent investigation and enforcement of present laws. Consideration should also be given to a retraining or refresher-type course for tankermen to be given at specified intervals. These courses would expose the tankermen to current regulations, new technology, and in general refresh his qualifications.

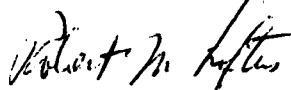
The operating environment with respect to navigation aid, etc. is considered adequate.

Lastly, in today's insurance market, premiums for pollution insurance are loss experience related, and if so administered, an incentive to keep claims to a minimum is self-imposed.

We hope the above will be of assistance to you in the preparation of recommendations to the United States Coast Guard for the solution to a problem that must be solved in a manner beneficial to all.

Very truly yours,

MORAN TOWING & TRANSPORTATION CO., INC.


Vice President

WILLIAM C. McNEAL
2519 BRISTOL PLACE
NEW ORLEANS, LA. 70114

April 30, 1980

Mr. Everett P. Lunsford, Jr., Project Manager
Committee on Reducing Tankbarge Pollution
Maritime Transportation Research Board
National Research Council
2101 Constitution Avenue
Washington, D. C. 20418

Dear Mr. Lunsford:

You will recall I was asked, at the April 15-16 Tankbarge Workshop, to comment on the recommendations I made for new tank barge construction as they may relate to repair of existing tank barges.

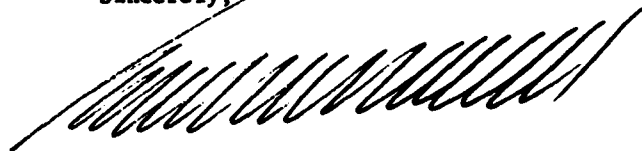
I suggested minimum plate thickness, minimum knuckle radii, continuous rub bars, elimination of serrated framing, greater compartmentation, redesign of the loading line, easier access to hatches by walkways and larger ullage openings.

It would be virtually impossible to effect changes in knuckle radii, rub bars, compartmentation, ullage openings and load lines. These are built into the barge during construction.

However plating and framing could be changed if and when repairs are made. Specifically, I suggest 3/8" plating be used as replacement for original 5/16" plating and that 1/2" plating be used to replace 3/8" original steel. Serrated frames could be eliminated as repaired and replaced. Walkways could always be installed.

I trust this responds to the request. If further data is needed, please let me know.

Sincerely,





Residuals Management Inc.

May 12, 1980

SUITE 519 OAKBROOK NORTH
1200 HARGER ROAD
OAK BROOK, ILLINOIS 60521
(312) 867-8150

Mr. Everett P. Lunsford, jr., Project Manager
Committee on Reducing Tankbarge Pollution
Maritime Transportation Research Board
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Dear Mr. Lunsford:

I was pleased to have the opportunity to participate in the NAS Workshop on Reducing Tankbarge Pollution. A number of my views are contained in the specific recommendations submitted by Group II concerning technical options and problems. I am writing this letter to offer several general observations for consideration by the Committee.

1. It is apparent that there is a trend toward the construction of double-skin tankbarges. While it has been noted that this trend has been influenced by the operational advantages of double-skin equipment for certain cargos, I have reason to believe that uncertainty regarding regulation against the use of single-skin equipment for petroleum service has exaggerated the apparent trend. Such uncertainty would cause a bargeline operator to either

- postpone construction of new barges, or
- elect to build double-skin equipment as a hedge against cargo restrictions.

In other words, I do not support a contention that the trend toward construction of double-skin vessels demonstrates the inherent superiority of this barge configuration over single-skin equipment for clean petroleum products.

2. There is substantial controversy over the statistics and analytical studies pertaining to

- the degree to which phasing out single-skin tankbarges for petroleum service will abate pollution of the waterways, and
- the impact of tankbarge regulation on the operational and economic viability of the towing industry.

Therefore, there are widely divergent cost/benefit estimates relating to the Coast Guard's proposed regulations. In view of this situation, I believe that the Committee should carefully examine the quality of fundamental data available for its independent study of the tankbarge issue. I strongly support Group II's recommendation to consider the need for additional research in the areas noted.

3. To my knowledge, an assessment of environmental damage stemming from petroleum spills attributable to tankbarge hull damage has not been made. I suspect that this lack of information is a major reason why there is so much resistance to the simplistic view that banning single-skin tankbarges from petroleum service will prove to be an effective measure against pollution. During the Workshop sessions, it was pointed out that there are basically two modal impacts which can be characterized as:

- low volume spills resulting from relatively slight hull damage. These events, which may be abated by using double-skin equipment, represent a small proportion of total oil products spilled. The events are widely distributed geographically, and they are more numerous than ...
- large spills resulting from high energy impact casualties. It is generally understood that double-skin barges do not provide substantially greater protection from pollution than single-skin equipment in these instances. Under circumstances where loss of buoyancy impairs damage control efforts, single-skin barges can offer less potential for pollution than double-skin vessels.

Clearly the benefits to be derived from restricting petroleum cargos to double-skin barges will be limited to spill events for which double-skin equipment affords significantly better protection against pollution. These benefits must be evaluated in terms of type-specific environmental damage which will be avoided through the use of double-skin vessels.

4. It is apparent that the avoidance of pollution arising from high energy impacts will be achieved effectively only by reducing the incidence of such casualties. Efforts toward this goal are certainly worthwhile, not only in terms of pollution, but also from the standpoints of personnel safety and property loss.

5. Based on presently available evidence, it can be argued that the contribution of single-skin tankbarges to overall pollution from all sources is very small. The Coast Guard estimates that tankbarge spills generally represent about 2% of pollution from all sources. Of this amount, Dr. E.G. Frankel has reasoned that restricting petroleum cargos to double-skin equipment will

decrease oil spills by approximately 20%. Thus, the potential for reducing waterway pollution by adopting single-skin tankbarge cargo restrictions could be less than 0.5%. Whether or not such restrictions can be justified in the face of the Nation's need for reliable, low-cost, energy efficient transportation of petroleum products now provided by the bargelines will depend on a hard look at the socio-economic issues involved.

6. The Group II participants recognized that:

- the single-skin tankbarge configuration has certain operational advantages over double-skin vessels for carriage of clean petroleum products.
- the superiority of double-skin barges over single-skin barges to abate pollution is perceived on the basis of traditional design considerations.
- the application of advanced technology to single-skin tankbarge design and/or construction techniques could result in cost effective ways to reduce the pollution risk potential of this equipment.

Therefore, if regulations prohibiting the use of existing single-skin vessels for petroleum service can be justified, the wording should not constitute a ban against the generic design configuration -- it should allow for improvements such that the implementation of these improvements will not require overturning the ponderous weight of regulation.

Thank you for considering these comments.

Very truly yours,



David F. Sampsell
Vice President

The Seafarers International Union

OF NORTH AMERICA • AFL-CIO

815 16th Street, N. W., Suite 510, Washington D. C. 20006

(202) 347-3504

PAUL HALL
President

May 15, 1980



Dr. Eric Schenker
Chairman
Committee on Reducing Tank Barge Pollution
National Academy of Sciences
2201 Constitution Avenue, NW
Washington, DC 20418

Dear Mr. Chairman:

The Seafarers International Union of North America, AFL-CIO, had the pleasure of participating in the National Academy of Sciences' workshop on Reducing Tank Barge Pollution held last April 15th and 16th. As the representative of thousands of workers on the inland waterways, the SIU was particularly interested in the workshop's discussions with respect to Personnel Standards, Training, and Enforcement. We believe very strongly that this may be the most promising area for achieving a significant reduction in tank barge pollution. Therefore, further to the input the Committee gathered at the April workshop, the SIU respectfully submits the following comments for your review and consideration.

It is our conclusion that proper recognition and enhancement of existing Coast Guard regulations pertaining to Personnel Standards, Training, and Enforcement would greatly add to the overall effort to reduce tank barge pollution. The SIU believes that industry, labor, and government must work together to achieve a meaningful reduction in the number of costly and environmentally damaging occurrences of pollution spillage. Numerous findings such as the Coast Guard's "Draft Regulatory Analysis and Environmental Impact Statement (May, 1979)," indicate that human error is the major cause of tank barge pollution. The Coast Guard's report concluded, among other things, that:

"The primary causes for both minor and major spills are related to personnel error. In the case of minor spills, personnel error usually involved mishandling of equipment and insufficient attention to regulations and operating procedures during cargo transfer operations. For major spills, misjudgements by barge

Dr. Eric Schenker
May 15, 1980
Page Two

pilots lead to collision or grounding incidents with subsequent hull damage and large oil spill volumes. Improved personnel performance could have been effective in preventing a large number of both minor and major oil spill incidents reviewed in this study."

We agree. The SIU has long maintained that one of the most effective means to reduce tank barge pollution lies in a recognition of the importance of properly trained personnel. The Coast Guard's conclusion is but one more example that improperly trained personnel are a significant factor in this problem. Since the appropriate training facilities and courses of instruction necessary to respond to this need already exist, the resolution of this problem becomes the function of more stringent and enforceable regulations regarding training and disbursement of personnel.

The key individual whose responsibilities lie in the proper handling of tank barge cargo transfers is the professional tankerman. This is the individual who possesses the knowledge and skills necessary to perform the delicate and critical function of cargo transfer. The role of a full-time, properly trained tankerman in reducing tank barge pollution cannot be overstated.

It is our belief that the task of a tankerman is critical to safe tank barge operations, so critical that it should be considered a full-time position. Current regulations do not require the presence of such a thoroughly-trained person, but rather allow this function to be carried out by a licensed Master, Mate, or Engineer. It is unreasonable and unrealistic to assume that tank barge cargo transfers can be safely conducted in such a casual fashion. Prompt attention must be given to a meaningful strengthening of Coast Guard tankerman regulations.

It is our sincere hope that the Committee will seriously evaluate the benefits to be derived from requiring highly-trained, full-time, professional tankermen aboard tank barges. The evidence overwhelmingly indicates that the adoption and adherence to strictly worded tankerman regulations would go a long way in significantly reducing the frequency and magnitude of tank barge pollution. To quote again from the aforementioned Coast Guard report, it is vital that we

"Continue the ongoing efforts to upgrade the performance capability of personnel involved in tank barge cargo transfer operations. Intensified training and qualification programs must be integrated into existing Coast Guard regulatory and operational system to ensure attainment of the desired improvement in performance."

Dr. Eric Schenker
May 15, 1980
Page Three

Mr. Chairman, this situation offers a unique opportunity for government, industry, and labor to work hand-in-hand to resolve a common problem. The SIU stands ready to assist in any manner deemed necessary to reach our shared objective -- tank barge pollution reduction.

We trust the full Committee will be given the opportunity to review our comments prior to the formulation of final recommendations. Thank you for this opportunity to express our views.

Sincerely,


Frank Drozak
Executive Vice President

PROPOSED COAST GUARD RULES

June 14, 1979

federal register

**Thursday
June 14, 1979**

Part VI

**Department of
Transportation**

Coast Guard

**New and Existing Tank Barges;
Proposals for Prevention of Oil Pollution**

DEPARTMENT OF TRANSPORTATION**Coast Guard****(46 CFR Parts 30, 32, and 35)****(CGD 75-083)****Proposed Design Standards for Tank Barges to Prevent Oil Pollution****AGENCY:** Coast Guard, DOT.**ACTION:** Proposed Rule; withdrawal of prior proposed rule.

SUMMARY: The Coast Guard proposes to amend the tank vessel regulations to require double hull construction for all new tank barges designed to carry oil in bulk on the navigable waters of the United States and to prohibit these barges from carrying oil in the void spaces of their double hulls. A study sponsored by the Coast Guard shows that approximately 80 percent of the oil pollution caused by tank barges could have been prevented if these barges had double hull construction. Double hull construction on new tank barges will reduce the number of accidental discharges of oil due to hull damage.

DATES: 1. Written comments must be received on or before September 30, 1979. 2. The public hearings will be held on August 2, 1979, August 15, 1979, August 23, 1979, and September 7, 1979.

ADDRESSES: Written comments should be submitted to Commandant (G-CMC/81) (CGD 75-083), U.S. Coast Guard, Washington, D.C. 20590.

Comments will be available for examination at the Marine Safety Council (G-CMC/81), Room 8117, Department of Transportation, Nassif Building, 400 Seventh Street, S.W., Washington, D.C. 20590. Studies referred to in this document are appendixes to the Regulatory Analysis and Environmental Impact Statement (Regulatory Analysis) summarized in this document. Copies of the Regulatory Analysis are available for examination at this address.

The Coast Guard will hold 4 public hearings concerning this proposal in conjunction with the public hearings on the advance notice of proposed rule making appearing elsewhere in this issue of the *Federal Register* (See table of contents for page number). The first will be held on August 2, 1979, beginning at 9:00 a.m., in Room 2230, 400 7th Street, S.W., Washington, DC 20590. The second will be held on August 15, 1979, beginning at 9:00 a.m., in the Olympic Hotel, Williamsburg Room, Fourth and Seneca Streets, Seattle, WA 98111. The third will be held on August 23, 1979,

beginning at 9:00 a.m., in the Holiday Inn Superdome Downtown, Russel B. Long Room, 1111 Gravier Street, New Orleans, LA 70122. The Fourth will be held on September 7, 1979, beginning at 9:00 a.m., in the Stouffers Riverfront Towers, Jefferson A and B Rooms, 200 South Fourth Street, St. Louis, MO 63102.

FOR FURTHER INFORMATION CONTACT: Lieutenant Commander Eugene K. Johnson, Merchant Marine Technical Division (G-MMT-1/82), U.S. Coast Guard, Nassif Building, 400 Seventh Street, S.W., Washington, D.C. 20590 (202-426-4431).

SUPPLEMENTARY INFORMATION: Interested persons are invited to participate in this rule making by submitting written views, data, or arguments. Each comment should include the name and address of the person submitting the comment, reference the docket number (CGD 75-083), identify the specific section of the proposal to which each comment applies, and include sufficient detail to indicate the basis on which each comment is made. All comments received before expiration of the comment period will be considered before final action is taken on this proposal. Interested persons are invited to attend the hearings and present oral or written statements on this proposal. It is requested that anyone desiring to make an oral statement notify Captain Philip J. Danahy, at the address listed under ADDRESSES, at least 10 days before the scheduled date of the public hearing and specify the approximate length of time needed for the presentation. Oral statements at the public hearing will normally be scheduled to be heard in the order that requests are received. It is urged that a written summary or copy of the oral statement be included with that request.

Drafting Information

The principal persons involved in drafting this proposed rule are Lieutenant Commander Eugene K. Johnson, Project Manager, Office of Merchant Marine Safety, and Mr. Stanley M. Colby, Project Attorney, Office of Chief Counsel.

Discussion**Background and Withdrawal of Prior Proposed Rule**

In the December 24, 1971 issue of the *Federal Register* (36 FR 24960), the Coast Guard published a notice of proposed rule making which, along with many other proposals, contained design standards to prevent pollution from tank barges on inland routes. One of these

proposals called for double walls on the sides and ends of tank barges but not for double bottoms. The inland barge industry entered strong objection to the proposed requirement for double wall construction. The basis of the objection was that the Coast Guard had not adequately investigated the cost nor had it established a case that double walls would significantly reduce oil pollution. Due to these comments, the proposed requirement for double walls on inland tank barges was not included in the final rules published on December 21, 1972 (37 FR 28250) and this document withdraws that proposal (proposed § 155.305).

The Coast Guard, in cooperation with the Maritime Administration, entered into a study of costs and alternatives available to reduce oil pollution caused by tank barge hull damage. The joint Maritime Administration/U.S. Coast Guard "TANK BARGE STUDY," NTIS # COM-75-10284/AS, was completed in October 1974. As a basis for this study, a survey of tank barges damaged in a one year period was conducted and a fleet profile of the sizes and types of construction used for existing barges was developed. Data from the Pollution Incident Reporting System, established by the Coast Guard in December 1971 to implement Section 311 of the Federal Water Pollution Control Act, was used to determine the amount of oil spilled by tank barges in the inland waters.

Various alternative designs for preventing oil pollution from tank barges were developed by the Coast Guard for several size categories. These alternatives were evaluated for both new tank barges and retrofitting of existing tank barges.

The effectiveness of the various alternatives was evaluated by two methods. As the first method, the damage survey from the study was compared against each alternative to determine if pollution would be prevented by that alternative. The conclusion reached by this method was that double hulls with a 24 inch separation of the inner and outer hulls would be 96 percent effective in preventing pollution due to hull damage. As the second method, field reports for tank barges in the Coast Guard Merchant Vessel Casualty File were analyzed for the same time period used in the first method. Only reports of damage with ensuing pollution were used. The conclusion reached by this method was that double hulls would be 95% effective in preventing pollution due to hull damage. The second method also showed that bottom damage is

important and has to be considered for effective design.

As a part of the 1974 Tank Barge Study, the life-cycle costs of the various alternatives were investigated by an outside contractor under a contract to the Maritime Administration. The Maritime Administration has updated these costs to 1978 levels and has calculated the additional costs for double hulls on ocean and coastwise tank barges.

Much of the information used in the joint study was supplied by the barge industry. Ample opportunity for comment on the results of the study was given by presenting most of the information in a paper, "Alternative Inland Tank Barge Designs for Pollution Avoidance", presented at the spring meeting of the Society of Naval Architects and Marine Engineers in May 1974 at Chicago, Illinois before the report was finished. Criticism of the study was that it used only a 1 year data base and that the pollution data was not good. The Pollution Incident Reporting System had been in operation only about 2 years at the time of the study. As with any new data system, problems occurred during implementation of the reporting procedures and early data in this system ranged from "not good" to "inadequate."

To identify the magnitude of oil pollution from tank barges and to determine the causes of that pollution, a contract was awarded by the Coast Guard to Automation Industries, Inc. on July 13, 1977. The final report, CG-M-2-78 "Tank Barge Oil Pollution Study," was submitted to the Coast Guard in February 1978. The following Coast Guard maintained data and file systems were used in the study: the Pollution Incident Reporting System (PIRS), Commercial Vessel Casualty Reporting System, Inspected Barge File, and District Penalty Files, for the years 1974 through 1978. The PIRS data was verified by sampling penalty files maintained in Coast Guard field offices and was found to be adequate, probably due to the maturity of the Pollution Incident Reporting System and the increased emphasis placed on pollution prevention in recent years.

For this 3 year period, the volume of oil spilled from tank barges was 173,971 barrels. This compares to a total of 288,704 barrels of oil spilled from tankships for the same period of which 178,571 barrels were spilled in a single incident, the ARGO MERCHANT. The oil spilled by tank barges occurred in the inland waters, harbors and near coastal waters of the U.S. These waters are ecologically very sensitive to oil

pollution and are highly visible to the public.

Of the oil spilled by barges, approximately 85% of the total volume was spilled in a relatively small number of incidents which occurred during the barge transport of oil and usually involved hull damage. Based on the 1974 study, approximately 80% of the volume of tank barge oil pollution can be eliminated by a double hull construction standard with a 24 inch separation of hulls. The analysis discussed in the following paragraph established that the effectiveness of double hulls may be as high as 89% in reducing the volume of oil pollution from tank barges.

For the years 1973 through 1977, an analysis of the Pollution Incident Reporting System data and the Commercial Vessel Casualty Reporting System data has been performed by the Coast Guard. Of 164 hull damage incidents having spills of 500 gallons or greater which have a total volume of 178,500 barrels, 94% of the total volume for the period, 91 casualty reports were identified. These reports were analyzed to determine if the routes for which tank barges are certificated has an impact on the pollution potential of tank barges, and the analysis disclosed that the route for which a tank barge is certificated does not appear to influence the pollution potential.

Proposed Regulations

The regulations proposed in this document would be codified in 46 CFR Subchapter D (Tank Vessels) in a new Subpart 32.64. While the proposed regulations are intended to prevent pollution and could have been placed in 33 CFR Part 157, the regulations are design standards and should be in Subchapter D. The proposed regulations would only apply to tank barges that carry oil. The definitions of oil and crude oil are included in the proposal for facilitation in applying the regulations, since these definitions are not now contained in Subchapter D.

The proposed regulations would apply to new tank barges, which are defined as those constructed or converted under a contract awarded after December 31, 1979, or in the absence of a contract, where the actual construction or conversion of the barge begins after December 31, 1979. The December 31, 1979, proposed date was selected by the Coast Guard based on the time frame anticipated for publishing this notice, holding hearings and receiving written comments, evaluating all the comments and publishing final rules. This date will be changed if substantial delays are encountered.

Since the analyses performed indicate that double hulls are necessary for all barges regardless of the route they are certificated for, the proposed regulations would apply to inland and seagoing barges. However, it is proposed to limit the application of the requirements to product carriers of less than 30,000 DWT and crude oil carriers of less than 20,000 DWT. Since the pollution prevention regulations for tank vessels (33 CFR Part 157) apply to both tank ships and tank barges, they are considered sufficient to meet the environmental mandate of Congress for any tank ships and tank barges larger than the proposed tonnage limits. Tank barges of this size are limited to the same areas of operation as tankships due to their size.

The proposed regulations would require that cargo tanks be located a minimum of 24 inches from the hull of the barge. This separation was chosen based on the expected effectiveness of this separation developed in the 1974 Tank Barge Study and the Coast Guard's opinion that this is the minimum separation that would permit inspection of the spaces between the cargo tanks and the hull. A review of representative plans for existing double hull barges has shown that most of these barges are now built with cargo tanks located 24 to 30 inches from the hull even though present regulations would allow 15 inches. However, the 15 inch minimum now allowed for double bottoms was originally established for independent cylindrical tanks and not for a full double bottom.

In the void spaces between the hull and cargo tanks the internal structures would have to be arranged so that the spaces can be inspected. Sounding devices to detect leakage into the spaces and a means of pumping out the spaces would be required. An access to enter the space would also be required. If vents are installed, even though not required under § 32.55-45(b), the proposed regulations would require flame screens in the vents. This is considered necessary for safety reasons because of the possibility of cargo leakage into the spaces.

The proposed regulations would require that the double hull tank barges meet a minimum stability standard. If the space between the cargo tanks and the hull is not subdivided properly, a barge could sink or capsize with only minor damage to the hull. The proposed standard would require that the subdivision of the space be arranged so that the barge will remain afloat and not capsize after holing the hull anywhere except on a transverse watertight bulkhead. 33 CFR Part 157 (Subpart B)

also contains stability requirements for certain seagoing tank barges.

The proposed regulations would prohibit the carriage of oil in the spaces between the cargo tanks and the hull of the barge. However, for larger barges where ballast may be needed in the unloaded condition, these spaces could be used for ballast water. This prohibition would only apply to new tank barges if this becomes a rule but a similar prohibition for existing tank barges is being considered in the advance notice appearing elsewhere in this separate Part VI in today's Federal Register (see table of contents for page number).

Section 30.01-5 of Subchapter D would be revised to require foreign tank barges operating on the navigable waters of the United States to meet the requirements of Subpart 32.64. There does not appear to be any significant trade at this time that would be affected should this become a rule. The change is considered necessary to prevent the development of a new trade to avoid these proposed regulations.

In addition to the proposal in this document, an Advance Notice of Proposed Rulemaking, appearing in this issue of the Federal Register, solicits ideas on how the existing single hull tank barges may be regulated to (1) reduce oil pollution due to hull damage while these barges are in service; and (2) hasten the retirement of single hull tank barges from the fleet so that transition to a double hull tank barge fleet can be accomplished in a timely manner.

This proposal has been reviewed under Department of Transportation's "Regulatory Policies and Procedures" (44 FR 11034, February 28, 1979). A Draft Evaluation has been prepared, and is included in the public docket.

Economic Impact

The major economic impact of a requirement for double hulls on new tank barges is the increase in cost for double hull construction over single hull construction. The costs have been calculated for inland and seagoing tank barges. A trend to double hull construction for inland tank barges exists; therefore, the total additional cost for double hull construction for inland tank barges that might otherwise have been single hull construction is approximately 2.3 million dollars for the period 1979 to 1983 in 1978 present value dollars. By 1983 it is assumed from current trends that all inland tank barges would have been built double hull regardless of these regulations.

Seagoing tank barges would not have been built to double hull standards

without these regulations. The cost per barge for a double hull ocean barge is considerably greater than for an inland tank barge. It is estimated that 7 single hull seagoing tank barges will be built in 1979. The estimated additional cost for double hulls on these 7 barges is about 7.1 million dollars. The total 1978 present value additional cost for double hulls on seagoing tank barges, to replace all existing single hull seagoing tank barges by 1980 is approximately 144.0 million dollars.

A detailed discussion of the costs is included as Chapter 4 of the Regulatory Analysis. The effects of the proposed regulations on the transport of oil and the reduction of oil pollution are also evaluated.

Summary of Regulatory Analysis

A single draft Regulatory Analysis and Environmental Impact Statement has been prepared for this notice of proposed rulemaking and the advance notice of proposed rulemaking for existing tank barges. This was done so that the scope of the Coast Guard's regulatory action to prevent oil pollution from barges is clearly presented and all applicable information is available to the public in a single document. All the major background studies are included as appendixes to the Regulatory Analysis.

The Regulatory Analysis establishes the need for regulations by carefully analyzing pollution and casualty data. The double hull design was selected based on effectiveness for preventing pollution due to hull damage which was established in the 1974 Tank Barge Study. The alternatives to double hull design are discussed and the reasons for the Coast Guard rejecting these alternatives are presented. Alternatives considered were:

- (a) Publish no additional standards. (No action)
- (b) Publish less stringent regulations than those proposed which included heavier scantlings either in selected areas or overall, double sides and ends, or tank size limits.
- (c) Publish regulations more stringent than those proposed by requiring the carriage of oil in Type I or Type II barge hulls as currently defined in Coast Guard regulations.
- (d) Reduce oil consumption or reduce the amount of oil transported by tank barges.
- (e) Use a different mode of transportation for the movement of oil.

In consideration of the foregoing, it is proposed to amend Subchapter D of Title 46, Code of Federal Regulations, as follows:

PART 30—GENERAL PROVISIONS

1. By revising § 30.01-5(e) to read as follows:

§ 30.01-5 Application of regulations—TB/ALL.

(e) This subchapter applies to each foreign flag vessel that carries combustible or flammable liquid cargoes on the navigable waters of the United States, except if the vessel has on board a current and valid Safety Equipment Certificate, issued under its Government that is signatory to the International Convention for the Safety of Life at Sea, 1980 (16 UST 185, TIAS 5780), or a current and valid certificate of inspection, issued under its Government having reciprocal vessel inspection arrangements with the United States and vessel inspection laws similar to the inspection laws of the United States, the vessel must only meet the following:

- (1) Subpart 32.64.
- (2) Sections 35.01-1 and 35.01-60.
- (3) If the vessel is involved in a marine casualty or accident when on the navigable waters of the United States, Subpart 35.15.
- (4) Subpart 35.30, except § 35.30-15.
- (5) Subpart 35.35.

PART 32—SPECIAL EQUIPMENT, MACHINERY, AND HULL REQUIREMENTS

2. By adding a new Subpart 32.64 to follow Subpart 32.63 and to read as follows:

Subpart 32.64—Hulls for New Tank Barges—B/ALL

Sec.

- 32.64-3 Definitions.
- 32.64-5 Applicability.
- 32.64-10 Hull structure.
- 32.64-15 Subdivision and stability.

Authority: R.S. 4417a (46 USC 391a, as amended by Pub. L. 95-474, Port and Tanker Safety Act of 1978); 46 CFR 1.46(n)(4)

§ 32.64-3 Definitions.

As used in this Subpart: "New tank barge" means a non-self-propelled vessel that carries oil in bulk and that is—

- (a) Constructed or undergoes a major conversion under a contract awarded after December 31, 1978; or
- (b) In the absence of a contract—
 - (i) Has the keel laid or is at a similar stage of construction after December 31, 1979; or
 - (ii) Major conversion is begun after December 31, 1979.

"Oil" includes oil of any kind or in any form, including, but not limited to,

petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

"Major conversion" means a conversion of an existing vessel which substantially alters the dimensions or carrying capacity of the vessel; or changes the type of vessel; or substantially prolongs its life; or which otherwise so alters the vessel that it is essentially a new vessel.

"Crude Oil" means any liquid hydrocarbon mixture occurring naturally in the earth, whether or not treated to render it suitable for transportation, and includes crude oil from which certain distillate fractions may have been removed, and crude oil to which certain distillate fractions may have been added.

§ 32.64-5 Applicability.

This subpart applies to new tank barges of less than 30,000 DWT except new tank barges of 20,000 DWT or more that carry only crude oil.

§ 32.64-10 Hull structure.

Each tank barge to which this subpart applies must be designed and constructed having—

(a) The outer boundary of each cargo tank at least 60 cm (24 inches) from the inner surface of the side, bottom, and fore and aft end hull plating; and

(b) In the spaces between the cargo tanks and the hull of the barge—

(1) Sufficient clearance between the internal structures to allow a person of average height and weight to inspect the hull;

(2) Sounding devices meeting § 56.50-90 of this chapter;

(3) Bilge pumps meeting § 56.50-55 of this chapter;

(4) An access of at least 38 cm. by 46 cm. (15" by 18") that may not be on a cargo tank boundary; and

(5) If vents are installed, flame screens, as defined in § 30.10-25 of this subchapter.

§ 32.64-15 Subdivision and stability.

The hull of each new tank barge under this subpart must be designed to retain, under any condition of loading, positive buoyancy and stability, 51 mm (2 inches) of positive metacentric height, after the bottom or side shell plating of the outer hull is holed anywhere on its girth except in way of a transverse watertight bulkhead.

Note.—There are additional requirements for seagoing tank barges in 33 CFR Part 157 (Subpart B).

PART 35—OPERATIONS

3. By adding a new § 35.01-60 to follow § 35.01-50 and to read as follows:

§ 35.01-60 Oil in void spaces of new tank barges—B/ALL.

A new tank barge under Subpart 32.64 of this subchapter may not carry oil as cargo in the void spaces between the hull and the cargo tanks.

(R. S. 4417a (46 USC 391a, as amended by Pub. L. 95-474, Port and Tanker Safety Act of 1978); 49 CFR 1.46(n)(4))

R. H. Scarborough,
Vice Admiral, U.S. Coast Guard, Acting
Commandant.

June 11, 1979.

[FR Doc. 79-1808 Filed 6-13-79; 8:45 am]

BILLING CODE 4910-14-M

[46 CFR Chapter I, Subchapter D and O]

[CGD 75-083a]

Proposal for Existing Tank Barges To Prevent Oil Pollution

AGENCY: Coast Guard, DOT.

ACTION: Advance Notice of Proposed Rulemaking.

SUMMARY: The Coast Guard is proposing to accelerate the normal attrition of certain single hull tank barges certificated to carry oil and to reduce the number of oil pollution incidents resulting from hull damage to these barges while they continue in operation. A study sponsored by the Coast Guard has shown that approximately 80 percent of the oil pollution caused by tank barges could have been prevented if these barges had complete double hull construction. Analysis of the tank barge fleet profile indicates that normal attrition of single hull tank barges from the operating fleet would delay the total realization of this dramatic reduction in oil pollution until some time beyond the year 2020. This advance notice is intended to complement proposed design standards for new tank barges to reduce oil pollution in the navigable waters of the United States.

DATES: 1. Written comments must be received on or before September 30, 1979.

2. The public hearings will be held on August 2, 1979, August 15, 1979, August 23, 1979 and September 7, 1979.

ADDRESSES: Written comments should be submitted to Commandant (G-CMC/81), (CG 75-083a), U.S. Coast Guard, Washington, D.C. 20590. Comments will be available for examination at the Marine Safety Council (G-CMC/81),

Room 8117, Department of Transportation, Nassif Building, 400 Seventh Street, S.W., Washington, D.C. 20590. Studies referred to in this document are appendices to the Regulatory Analysis and Environmental Impact Statement (Regulatory Analysis) summarized in this document. Copies of the Regulatory Analysis are available for examination at this address.

The Coast Guard will hold four public hearings on this advance notice of proposed rulemaking in conjunction with the public hearings on the notice of proposed rulemaking appearing elsewhere in this issue of the Federal Register. The first will be held on August 2, 1979 beginning at 9:00 AM, in Room 2230, 400 Seventh St., S.W., Washington, D.C. 20590. The second will be held on August 15, 1979 beginning at 9:00 AM, in the Olympic Hotel, Williamsburg Room, Fourth and Seneca Sts., Seattle, WA 98111. The third will be held on August 23, 1979 beginning at 9:00 AM, in the Holiday Inn Superdome Downtown, Russel B. Long Room, 1111 Gravier Street, New Orleans, LA 70122. The fourth will be held on September 7, 1979 beginning at 9:00 AM, in the Stouffers Riverfront Towers, Jefferson A and B Rooms, 200 South Fourth Street, St. Louis, MO 63102.

FOR FURTHER INFORMATION CONTACT: Lieutenant Commander Kenneth A. Rock, Merchant Vessel Inspection Division (G-MVI-2/83), U.S. Coast Guard, Nassif Building, 400 Seventh Street, SW., Washington, D.C. 20590, (202) 426-2190.

SUPPLEMENTARY INFORMATION: Interested persons are invited to participate in this rulemaking by submitting written views, data, or arguments. Each comment should include the name and address of the person submitting the comment, reference the docket number (CGD 75-083a), identify the specific section of the proposal to which each comment applies, and include sufficient detail to indicate the basis on which each comment is made. All comments received before expiration of the comment period will be considered before further action is taken on this proposal. Interested persons are invited to attend the hearings and present oral or written statements on this proposal. It is requested that anyone desiring to make an oral statement notify Captain Philip J. Danahy at the address listed under ADDRESSES at least ten days before the scheduled date of the public hearing and specify the approximate length of time needed for the presentation. Oral statements at the

public hearing will normally be scheduled to be heard in the order that requests are received. It is urged that a written summary or copy of the presentation be included with the request.

Draft Information

The principal persons involved in drafting this advanced notice are: Lieutenant Commander Theodore J. Sampson, Lieutenant Commander Kenneth A. Rock, Project Managers, Office of Merchant Marine Safety, and Mr. Stanley M. Colby, Project Attorney, Office of the Chief Counsel.

Background

Tank barges exist in a variety of configurations. Some are little more than compartmentized boxes having only a single layer of steel at any point on their hull. Others have end voids, full or partial double sides or bottoms, independent cargo tanks, or various combinations of these features. For the purpose of this advance notice, only a tank barge that has at least a complete double hull, including the end voids and double walls and bottoms, (but without a double deck) is considered a "double hull barge." All others are referred to as "single hull barges."

The current profile of the tank barge fleet shows that approximately 2130 single hull tank barges exist. Some are newly constructed while others were built in the early 1900's. Normal attrition of these tank barges from the fleet would find more than 50 percent still active in 1988, 25 percent still active in 2000, with total replacement not likely until after 2020. If the double hull tank barge construction requirements for new barges, proposed elsewhere in this issue of the *Federal Register* are to have a timely, appreciable effect on reducing the current volume of oil spilled by barges, it is clear that single hull tank barges will have to be removed from service at an accelerated pace.

In a notice of proposed rulemaking issued December 24, 1971, (36 FR 24860) this same problem was discussed. The accelerated phaseout of existing single hull barges would have been provided by a preclusion of the "rebuilding" of these vessels to original conditions, but allowing individual plate renewal or repair of damaged areas. As an alternate approach, the possibility of specifying a termination date for the use of single hull barges was proposed.

Numerous comments on the proposed approach and its alternatives were received. Comments from representatives of the barge operators, while supporting the intent of the

regulations to prevent pollution, decried effecting the phaseout by proscribing the "rebuilding" of single hull barges. The alternate approach of a termination date found equal opposition. It was argued that existing single hull vessels should be allowed to continue in operation until no longer serviceable due to the economic effects upon individual companies and the inability to move the required amount of petroleum products without a tank barge fleet of adequate size.

Two commenters suggested that a joint committee of local Coast Guard and industry representatives be established in each port to act as judges of when a vessel was to be considered no longer serviceable. Such a committee is not a viable approach in that it would not provide equitable treatment nationwide for the various operators involved. Further, such a committee would be dilution of the responsibility vested by the Port and Tanker Safety Act of 1973 (92 Stat. 14800, 46 U.S.C. 391a) in the Secretary of Transportation and subsequently delegated to the Coast Guard.

Unfortunately no comments were received which offered alternate approaches to the accelerated retirement of single hull barges.

The methods of handling single hull barges which were published in that notice of proposed rulemaking were not without support. The new construction standards and "rebuild" phaseout mechanism were regarded by numerous private citizens and commenters representing environmental organizations as long overdue. The input received from Coast Guard field offices unanimously supported the phaseout of single hull barges, preferring the use of a termination date.

The suppositions of the commenters that accelerated attrition of existing tank barges could not be effected without severe economic impact on the industry and its ability to transport the nation's oil had to be examined. Both of these questions have been addressed in the Regulatory Analysis.

Since that proposed rule was published in 1971, many studies have been conducted that addressed the problem of oil pollution from tank barges. These studies have clearly shown a need to accelerate the normal attrition of single hull tank barges to achieve a timely realization of the potential reduction in oil pollution that a double hull tank barge fleet would provide. These studies have also shown that the considerable amount of oil pollution resulting from minor hull damage incidents requires mitigating

action while awaiting the removal of single hull barges from service.

Discussion of the Proposals

This advance notice contains a comprehensive proposal affecting existing single hull tank barges. The Coast Guard is committed to reducing, in a timely fashion, the amount of oil pollution resulting from tank barges. However, the Coast Guard has made no firm commitment to the proposals advanced in this document. These proposals represent an initial effort to find a means to more rapidly realize the environmental benefits which will result from a double hull tank barge fleet, while not creating an undue burden upon the tank barge industry. Many assumptions and projections had to be made to evaluate the efficacy of this approach.

It is possible that some alternatives have been overlooked or that some assumptions are not valid. If these can be pointed out, this approach will then provide the starting point for improvement or refinement. If the comments received can identify an alternate method to achieve a total double hull tank barge fleet at an acceptable pace, and provide an equivalent reduction in oil pollution incidents from the single hull barges allowed to operate during the transition, this approach can be discarded in its entirety or the proposals herein can be modified accordingly. Comments are particularly requested with respect to benefits and feasibility of phasing out single hull barges within a time frame of less than twenty (20) years.

The first objective of this advance notice is to suggest a mechanism to accelerate the normal attrition of single hull tank barges from oil service. Single hull tank barges that are more than twenty years old would not be certificated for the carriage of oil after 1985. Exceptions would be made as follows:

1. Barges that have been constructed with end voids and double sides, or end voids and double bottoms, or independent cargo tanks would continue in normal, unrestricted operations until the vessel is no longer serviceable.
2. Barges converted to meet the construction provisions of paragraph 1, before the barge is twenty years old and before December 31, 1985, would be allowed the same privileges.
3. Existing single hull barges would be allowed to continue in operation without the conversion proposed in paragraph 2 until the vessel is no longer serviceable, provided the operator could

demonstrate to the satisfaction of the Commandant of the Coast Guard that:

a. The properties of the particular cargo or cargoes to be carried would preclude or significantly retard, at the ambient temperatures anticipated on the vessel's route, the outflow of the product if the hull was breached; and

b. The temperature of the product during transport would not exceed that critical for retaining the properties demonstrated in paragraph "a" above.

4. The Officer in Charge, Marine Inspection (OCMI) could grant exemptions to individual single hull barges for the carriage of oil if:

a. The vessel is a permanently moored barge; or

b. The vessel's operation is restricted to areas of little commercial vessel traffic where the vessel would not be exposed to any of the following rigors or hazards:

- (i) Locking operations;
- (ii) Fleeting operations;
- (iii) Midstream operations;
- (iv) Possible collision with a breakaway from an upstream barge fleeting operation or mooring area;
- (v) Any navigational hazard or condition where improper operation or loss of control of the tank barge could likely result in a casualty that would breach the hull.

For example: A vessel would not be certificated to operate in an area having a hard or rocky bottom where even low energy groundings would be expected to penetrate the hull. Or, a vessel would not be certificated to operate in an area having fast currents, where any loss of vessel control could be expected to result in high energy groundings or collisions.

The second objective of this advance notice is to suggest a means to reduce the number of oil pollution incidents that are expected to result from minor hull damage to single hull tank barges. Therefore, it is proposed that no existing tank barges would be permitted to carry oil in rake ends, corner voids, or double wall or bottom voids after December 31, 1980.

As an incentive for barge operators to more rapidly convert to double hull barge fleets, the requirements of Title 46 CFR Subchapter O would be changed to make internal inspections of double hull tank barges coincide with drydocking inspections. This would generally have the effect of lengthening the interval between internal inspections. Additionally, inspection of void spaces on externally structured integral tanks could be used by the OCMI as justification for extending the required interval of both drydocking and internal

inspections. This would eliminate the need for some gas-freeing operations currently required.

Considerations in Developing Regulations Proposed

Because the need to address tank barges as a significant source of pollution was questioned in 1971 when regulations were first proposed, valuable time has been lost to make a gradual transition to an environmentally safer tank barge fleet by 1985 (The Congressional target date for elimination of polluting discharges, mentioned in the Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 616, 33 U.S.C. 1251)). From a practical viewpoint, it is unacceptable to impose 1985 as the limit for use of all single hull barges. The impact on the nation's ability to transport oil and upon the economic viability of the many operators of single hull barges could not be justified by the expected environmental gains. The date of 1985 has therefore been used as the point after which the environmental benefits of a double hull barge fleet will be increasingly noticeable. To achieve this, single hull barges beyond twenty years of age should be barred from oil service.

The age of twenty years was chosen for several reasons. The transition to a double hull tank barge fleet can be 75 percent completed within a six year period which is not significantly beyond the Congressional target date for elimination of water pollution. The number of barges which would require replacement as a result of this age selection would not exceed the capabilities of today's shipbuilding industry. Approximately 1,000 vessels would be eliminated from service in 1985. But, sufficient time would be provided during the six years between the publication date of the regulations and 1985 to build all needed replacements.

The number of barges to be constructed as replacements for those retired from service in each year after 1985 could also be attained and the number of replacements needed should decrease gradually. Thus, the shipbuilding industry would not have to gear up for a short-lived massive barge production effort. Further, operators of single hull tank barge fleets would be given time to recover capital invested in recently acquired single hull tank barges. Finally, transport related pollution incidents could be reduced significantly by removing vessels from service when they reach the age where analysis of pollution data has shown the likelihood of their becoming involved in

a pollution incident is significantly greater than that of newer vessels.

Including the provisions to allow some vessels to continue in service, if they have double sides, double bottoms, or independent tanks would accommodate the 403 vessels so configured. The data analyzed from the Coast Guard Pollution Information Reporting System showed that these configurations, while not reducing the possibility of a transport pollution incident to a level acceptable for an entire tank barge fleet, do reduce the risk significantly when compared only with single hull tank barges.

A joint study by the Coast Guard and the Maritime Administration indicated that the cost of retrofitting vessels was not an economically feasible alternative for the entire single hull tank barge fleet. However, since that study was completed in 1974, there have been some vessels which have been retrofitted to provide double sides. Apparently this is, for some operators, an economically acceptable undertaking. Provision would be made, therefore, to allow this as an additional alternative to the proposed phase out.

It is recognized that there are some products, defined as oil, which have physical or chemical properties that make the probability of large spills occurring as a result of hull damage less likely. It appears that there may be an appreciable number of products which, with the proper precautions or operational procedures, could be safely transported in single hull barges. With adequate input from industry, it may be possible to generate a list of these products and then project the number of tank barges that are more than twenty years of age that could be used in such service. This could ease the economic impact by providing for barges more than twenty years old a value in excess of scrap value.

Similarly, an alternate use could be provided by allowing single hull vessels to be exempted by the OCMI if certificated for limited service. The low pollution incident ratios of some of the oldest barges indicate that some service may be allowed with little environmental risk when the vessels are restricted to certain limited operations.

The proposal prohibiting the carriage of oil in rake ends and void spaces would allow an early realization of the pollution prevention benefits that these empty spaces have been shown to provide. In view of the high incidence of damage to these areas that the various studies have shown, the carriage of oil in these spaces should be curtailed as soon as possible.

The revision of the internal inspection standards for double hull tank barges would ensure that the single hull tank barges (which have the greatest potential for becoming involved in a transport related oil pollution incident) would receive the most frequent examinations. This would also provide an economic incentive for more rapidly converting to a double hull fleet.

Economic Impact

The cost of the proposed regulations discussed in this document was basically computed by assessing the early replacement cost of single hull tank barges. A normal attrition curve was projected based upon recent retirement trends. The cost of barge replacement under normal conditions was compared with the cost of barge replacement under the imposed attrition of the proposal. Assumptions were made that should assure that the projected costs will be greater than actual costs.

These proposals are estimated to cost approximately \$222 million dollars, or a 31 percent increase over normal expenses for the tank barge industry. A detailed discussion of the costs, as well as the benefits, is included in chapter 4 of the Regulatory Analysis. The assessment of the benefits has been difficult to make in terms of a dollar figure that would offset the cost. Information concerning current costs to the tank barge industry incurred by response, recovery, and cleanup of tank barge oil spills is solicited. Likewise, comments concerning projection of the costs associated with the regulatory suggestions are welcome.

A single draft Regulatory Analysis and Environmental Impact Statement has been prepared for this advance notice of proposed rulemaking and the notice of proposed rulemaking for new tank barge construction appearing elsewhere in this issue of the Federal Register. This was done so that the scope of the Coast Guard's regulatory action to prevent oil pollution from barges is clearly presented and all applicable information is available to the public in a single document. All the major background studies are included as appendices to the Regulatory Analysis.

The Regulatory Analysis establishes the need for regulations by carefully analyzing pollution and casualty data. The double hull design was selected based on effectiveness for preventing pollution due to hull damage, which was established in the 1974 Tank Barge Study. The alternatives to double hull design are discussed and the reasons for the Coast Guard rejecting these

alternatives are presented. Alternatives and considerations in developing the proposals for existing single hull tank barges are also detailed.

The impacts of these rulemakings on the industries' economies, on the nation's environment, and the nation's ability to transport oil are also addressed.

(R.S. 4417a (46 U.S.C. 391a, amended by Pub. L. 95-674, Port and Tanker Safety Act of 1978) 49 CFR 1.46(n)(4))

Dated: June 11, 1979.

R. H. Scarborough,
Vice Admiral, U.S. Coast Guard, Acting
Commandant.

[FR Doc. 79-12826 Filed 6-13-79; 8:45 am]

BILLING CODE 4910-14-M

PARTICIPANTS

LIST OF PARTICIPANTS

WORKSHOP ON REDUCING TANKBARGE POLLUTION

Lecture Room
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, DC 20418

APRIL 15-16, 1980

Thomas Allegretti
Assistant Director
Department of Inland Waters &
Great Lakes Activities
Transportation Institute
923 15th Street, NW
Washington, DC 20005

William H. Anderson
Operations Manager
Reinauer Transportation Co.
19 Fulton Street
Newark, NJ 07102

Gordon Angell
Division of Inland Waterways
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW
Washington, DC 20230

Joseph Angelo
Mechanical Engineer
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

LT Brad Balch, USCG
Commandant (G-WEP-3)
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

Charles C. Bates
Consultant
P.O. Box 191
Green Valley, AZ 85614

Carl W. Bear, Jr.
President
Alabama River Towing Company
P.O. Box 488
Mobile, AL 36601

Lester C. Bedient
Crowley Maritime Corporation
Spear Street Tower
One Market Plaza
San Francisco, CA 94105

RADM Henry H. Bell
Chief, Office of Merchant Marine
Safety
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

J. George Betz
Vice President
Bouchard Transportation Co., Inc.
25 West Barclay Street
Hicksville, NY 11801

Jack R. Binion
President
Binion Marine Service, Inc.
10707 Corporate Drive - Suite 146
Stafford, TX 77477

John G. Blackburn
American Petroleum Institute
2101 L Street, NW
Washington, DC 20037

Leo J. Braun
Vice President
Rio Towing Company
P.O. Box 400
Pearland, TX 77581

George Brazier
Chief, Construction-Operations
Division
U.S. Army Corps of Engineers
DAEN-CWO - Pulaski Building
20 Massachusetts Ave., NW
Washington, DC 20314

Howard Brent
Vice President
Brent Towing Company, Inc.
P.O. Drawer 8
Greenville, MS 38701

Gerald L. Brown
Naval Architect Technician
Maritime Administration
U.S. Department of Commerce
2533 Iverson Street
Hillcrest Heights, MD 20031

Hazel Brown
President
Harry Lundeberg School of
Seamanship
Piney Point, MD 20674

Captain Richard L. Brown
Chief, Merchant Marine Technical
Division
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

W. T. Brown
Vice President
Brown Marine Service, Inc.
P.O. Box 1415
Pensacola, FL 31596

Gani Browsh
Assistant Vice President
Chotin Transportation, Inc.
P.O. Box 1460
Cincinnati, OH 45201

Charles E. Burrell
President
Domar Ocean Transportation, Ltd.
Division of Lee-Vac, Ltd.
P.O. Box 2528
Morgan City, LA 70380

Alan A. Butchman, Esq.
Houger, Garvey, Schubert,
Adams & Barer
1919 Pennsylvania Avenue, NW #850
Washington, DC 20006

John R. Butler, II
Vice President
Midland Marine Corporation
One Penn Plaza
New York, NY 10001

Rudolph V. Cassini
Staff Counsel, Subcommittee on
Coast Guard & Navigation
Committee on Merchant Marine &
Fisheries, U.S. House of
Representatives
Room 3573, House Annex 2
Washington, DC 20515

Captain Daniel Charter
Chief
Port Safety and Law Enforcement
Division
U.S. Coast Guard Headquarters
2100 2nd Street, SW
Washington, DC 20593

Stanley M. Colby
Attorney-Advisor
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

Sherrard Coleman
Marine Mammals Specialist
Defenders of Wildlife
1244 19th Street, NW
Washington, DC 20036

Michael D. Comens
Senior Naval Architect
Gulf Trading & Transportation Co.
Box 7880
Philadelphia, PA 19101

John J. Connolly
Vice President - Legislative
Relations
The American Waterways Operators, Inc.
1600 Wilson Blvd. - Suite 1101
Arlington, VA 22209

George W. Conrad
Marine Safety Specialist
National Transportation Safety Board
800 Independence Ave. SW
Washington, DC 20594

LCDR Richard M. Cool
U.S. Coast Guard
9030 Bowler Drive
Fairfax, VA 22031

Donald Courtsal
Vice President
Dravo Corporation
Engineering Works Division
Neville Island
Pittsburgh, PA 15225

William Creelman
President, Transport Division
National Marine Service, Inc.
1750 Brentwood Blvd.
St. Louis, MO 63144

John F. Curry
General Manager
Boston Fuel Transportation, Inc.
36 New Street
East Boston, MA 02128

Clifton E. Curtis
Attorney
Center for Law & Social Policy
1751 N Street, NW
Washington, DC 20036

Paul P. Daulerio, Jr.
Coordinator - Financial Analysis
Texaco, Inc.
2000 Westchester Avenue
White Plains, NY 10650

Joseph P. Dawley
Vice President-Operations
Allied Towing Corporation
P.O. Box 717
Norfolk, VA 23501

Cornelia Dean
Congressional Liaison
U.S. Department of Transportation
400 7th Street, SW, Room 10408
Washington, DC 20590

LCDR Steven J. Delaney
Attorney
U.S. Coast Guard Maritime &
International Law Division
2100 2nd Street, SW
Washington, DC 20593

E. G. Dietz
Manager Barge Transportation
Union Carbide Corporation
P.O. Box 4488
Charleston, WV 25304

James F. Dowd, III
Vice President
Inland Oil & Transport Company
2510 S. Brentwood Blvd.
St. Louis, MO 63144

W. Kenneth Elkins
Manager, Personnel and Safety
National Marine Service, Inc.
1750 Brentwood Boulevard
St. Louis, MO 63144

Eric Erdheim
Assistant General Counsel
National Oceanic & Atmospheric
Administration
6010 Executive Boulevard
Building 5 - Room 221
Rockville, MD 20852

Robert S. Faron
Attorney
LeBoeuf Lamb Leiby & MacRae
1333 New Hampshire Ave., NW
Washington, DC 20036

Lampros Fatsis
E.G. Frankel, Inc.
52 Bay State Road
Boston, MA 02144

George Fegert
Vice President & General Manager
Gretna Machinery & Iron Works
P.O. Box 215
Harvey, LA 70059

Constantine Foltis
Naval Architect
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW - Room 4059
Washington, DC 20230

Bernard Foote
Naval Architect
Marathon International Petroleum
(GB) Ltd.
174 Marylebone Road
London, NW1 5AT England

Clifford B. Foss
Manager, Barge Operations
Crowley Maritime Corporation
One Market Plaza - Suite 3200
San Francisco, CA 94105

Ernst G. Frankel
E. G. Frankel, Inc.
52 Bay State Road
Boston, MA 02144

John Gardenier
O.R. Analyst
Marine Safety Projects Branch
(G-DMT-1/54)
U.S. Coast Guard
Transpoint Bldg. - Room 4407
2100 2nd Street, SW
Washington, DC 20593

Captain L.W. Garret
Commandant, G-WAN
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

V. J. Gianelloni, III
Director
Louisiana Marine & Petroleum
Institute
P.O. Box 236
Chauvin, LA 70344

A. G. Gillies
Chief Surveyor, Technical Div.
American Bureau of Shipping
65 Broadway
New York, NY 10006

Thomas L. Gladders
President
Gladders Towing Co. Inc.
11 S. Meramec
St. Louis, MO 63105

Steve Golding
President
Ole Man River Towing, Inc.
P.O. Box 186
Vicksburg, MS 39180

James R. Goulden
Chief Financial Manager, Pollution
Liability Funds Management Div.
U.S. Coast Guard
Department of Transportation
630 Chestnut Avenue
Towson, MD 21204

George K. Gowans
Oceanographer
Science Applications, Inc.
8400 Westpark Drive
McLean, VA 22102

Charles W. Gower
Director of Engineering Services
Nashville Bridge Company
P.O. Box 239
Nashville, TN 37202

Bruce Graham
Scientist
IIT Research Institute
1825 K Street, NW - Room 310
Washington, DC 20006

Lawrence M. Grandy
Supervisor/Cargo Handling
Hannah Marine Corporation
Kinery Road at Archer Avenue
Lemont, IL 60439

Robert L. Gray
Manager, Marine Services
Ashland Petroleum Company
P.O. Box 391
Ashland, KY 41101

Andrew H. Greller
Operations Assistant - Sales
Marine Enterprises, Inc.
520 S. Front Street
Philadelphia, PA 19147

Ed Griffin
Executive Vice President
Coastal Towing, Inc.
7790 Braniff
Houston, TX 77061

Jesse B. Gunstream, Jr.
Vice President - Operations Manager
Higman Towing Company
Orange, TX 77630

James L. Guttman
Vice President
Mon River Towing, Inc.
Speers Road
Belle Vernon, PA 15012

Palmer C. Hamilton
Partner
Miller, Hamilton & Snider
Post Office Box 46
Mobile, AL 36601

Merle L. Harbourt
Vice President Southern Region
The American Waterways Operators,
Inc.
Whitney Bank Building, Suite 1027
New Orleans, LA 70130

John T. Hart
Vice President
Higman Towing Company
P.O. Box 908
Orange, TX 77630

CDR William Hewell, USCG
Chief, Ice Operations
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

L.E. Herring
Port Captain
Fuel Oil Supply and
Terminaling, Inc.
333 West Loop North, Suite 303
Houston, TX 77024

CDR Richard T. Hess
U.S. Coast Guard (G-MVP-TP/14)
2100 2nd Street, SW
Washington, DC 20593

G. G. Hicks
Marine Services-Port Facilities
Shell Oil Company
Two Shell Plaza
P.O. Box 2099
Houston, TX 77001

Ashley Hines
Claims Department
Brent Towing Company
P.O. Drawer 8
Greenville, MS 38701

Ralph W. Hooper
President
Interstate & Ocean Transport Co.
Three Parkway
Philadelphia, PA 19102

Ed Hopkins
Researcher
Clean Water Action Project
1341 G Street, NW
Washington, DC 20005

Robert Horowitz
Attorney-Advisor
U.S. Coast Guard (G-LMI/34)
2100 2nd Street, SW
Washington, DC 20593

CDR George Ireland
U.S. Coast Guard
Assistant Chief Merchant Marine
Technical Division, COMDT
2100 2nd Street, SW
Washington, DC 20593

Bob Isaac
General Counsel
Fuel Oil Supply and
Terminaling, Inc.
333 West Loop North, Suite 303
Houston, TX 77024

I. Bernard Jacobson
Senior Associate
Booz, Allen and Hamilton, Inc.
4330 East-West Highway
Bethesda, MD 20014

Clarence A. Johnson
Branch Manager
Exxon Company, U.S.A. -
Marine Department
P.O. Box 84
Linden, NJ 07036

LCDR Eugene K. Johnson
U.S. Coast Guard (G-MMT-1/13)
2100 2nd Street, SW
Washington, DC 20593

Paul C. Johnson
Insurance Examiner
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW
Washington, DC 20230

Elizabeth Kaplan
Friends of the Earth
530 7th Street, SE
Washington, DC 20003

Virgil F. Keith
Managing Principal
Engineering Computer Optecnomics,
Inc.
1036 Cape St. Claire Center
Annapolis, MD 21401

F. Michael Kien
Safety Engineer
U.S. Army Corps of Engineers
HQDA (DAEN-SOD)
Washington, DC 20314

Keith L. Kirkeide
Vice President, Bulk Petroleum
Services
Crowley Maritime Corporation
One Market Plaza, Suite 3200
San Francisco, CA 94105

Dennis A. Kirkonis
President
Arthur-Smith Corporation
3000 South Post Oak #1320
Houston, TX 77056

Christopher E. Krusa
Maritime Training Specialist
Office of Maritime Labor and
Training
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW - Room 3069
Washington, DC 20230

Anthony L. Kucera
President
The American Waterways Operators,
Inc.
1600 Wilson Blvd., Suite 1101
Arlington, VA 22209

Burt Kyle
Director, Office of Ship Operations
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW - Room 6616
Washington, DC 20230

Lee C. Lampton
Vice President
Magnolia Marine Transport Company
P.O. Box 1308
Jackson, MS 39205

Robert S. Lagattolla
President
Water Quality Insurance Syndicate
14 Wall Street
New York, NY 10005

Berdon Lawrence
President
Hollywood Marine, Inc.
P.O. Box 1343
Houston, TX 77001

Mitchell Lax
Office of Ship Financing Guarantees
Maritime Administration (M530)
U.S. Department of Commerce
14th & E Streets, NW
Washington, DC 20230

Fran Lipscomb
Research Assistant
Society for Animal Protective
Legislation
P.O. Box 3719
Washington, DC 20007

Tedi Levi
Comptroller
Ole Man River Towing, Inc.
P.O. Box 186
Vicksburg, MS 39180

Robert M. Loftus
Vice President
Moran Towing & Transportation Co., Inc.
1 World Trade Center - Suite 5335
New York, NY 10048

David G. Lunceford
Manager, Gulf Coast Branch Marine
Department
Exxon Company, U.S.A.
P.O. Box 411
Baton Rouge, LA 70821

Everett P. Lunsford, Jr.
Project Manager
Maritime Transportation Research
Board
National Academy of Sciences
2101 Constitution Ave., NW
Washington, DC 20418

Don A. Lyle
Manager, Inland Marine Division
Conoco Inc.
Rt. 1, Box 19A
Westlake, LA 70669

Edward M. MacCutcheon
Consultant
6405 Earlham Drive
Bethesda, MD 20034

Bruce McCartney
Channel Design Section
U.S. Army Corps of Engineers
20 Massachusetts Ave., NW
Washington, DC 20314

Brad McKenzie
Fuel Oil Supply & Terminaling, Inc.
333 West Loop North, Suite 303
Houston, TX 77024

CDR Neal Mahan
Executive Director, National
Boating/Safety Advisory Council
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

Francis Maloney
Supervisor, Chief Marine
Engineering
Department of Marine & Aviation
Bureau of Ferries
Staten Island, NY 10301

Al Mann
Planning Manager
Lee-Vac, Ltd.
P.O. Box 2607
Morgan City, LA 70380

Emmett Marston
Waxler Towing Company
P.O. Box 253
Memphis, TN 38101

R. J. Masiel
Manager, Facilities &
Transportation Administration
Chevron U.S.A. Inc.
575 Market Street - Room 3983
San Francisco, CA 94105

S. Masse
Chief, Deepwater Port Branch USCG
(MMT7/TP13)
2100 2nd Street, SW
Washington, DC 20593

George C. Mayes, III
Vice President
Barge Transport Company
1818 McKinney
Houston, TX 77003

Norman Meade
Coastal Zone Management
National Oceanic and Atmospheric
Administration
3300 Whitehaven Street
Washington, DC 20235

R. J. Meyers
Environmental Conservation
Coordinator
Exxon Company, U.S.A.
P.O. Box 1512
Houston, TX 77001

M'Gonigle R. Michael
Center for Law & Social Policy
1751 N Street, NW
Washington, DC 20036

Richard M. Michaels
University of Illinois-Chicago
Circle
Urban Systems Laboratory
College of Engineering
P.O. Box 4348
Chicago, IL 60680

Captain James Middleton
Marathon International Petroleum
(GB) Ltd.
P.O. Box A-C
Garyville, LA 70051

CDR J. T. Montonye
Chief, Short Range Aids to
Navigation Branch
U.S. Coast Guard
Commandant (G-WAN/&P14)
2100 2nd Street, SW
Washington, DC 20593

William P. Morelli
Staff Counsel
The Ohio River Company
P.O. Box 1460 - 1400 580 Bldg.
Cincinnati, OH 45201

T.A. Munson
Dow Chemical Company
Texas Division
Freeport, TX 77541

William Murden
Chief, Dredging Division
U.S. Army Corps of Engineers
Water Resources Support Center
Kingman Building
Fort Belvoir, VA 22060

Harold Muth
Vice President - Government
Relations
The American Waterways Operators,
Inc.
1600 Wilson Boulevard, Suite 1101
Arlington, VA 22209

John J. Nachtsheim
Assistant Administrator for Ship-
building & Ship Operations
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW - Room 6092
Washington, DC 20230

Charles Nalen
Director of Vocational Education
Harry Lundeborg School of
Seamanship
Piney Point, MD 20674

Captain Phillip Neal
Marine Safety Adviser
Mobil Oil Corporation
150 E. 42nd Street
New York, NY 10017

David S. Nieri
Program Manager
Mara-Time Marine Service
Park Circle
Centerport, NY 11721

CDR James R. Norman
U.S. Coast Guard
(G-MVP-TP/14)
2100 2nd Street, SW
Washington, DC 20593

Austin P. Olney, Esq.
LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Ave., NW #1100
Washington, DC 20036

Carl Oppenheimer
Consultant
300 White Street
Port Aransas, TX 78373

Harvey C. Paige
Executive Secretary
Maritime Transportation Research
National Academy of Sciences
2101 Constitution Ave., NW
Washington, DC 20418

Alex L. Parks
Secretary & Counsel
Columbia River Towboat Association
1200 Jackson Tower
Portland, OR 97205

Frank Pecquex
Legislative Representative
Seafarers International Union
815 16th Street - Suite 510
Washington, DC 20006

Capt. Charles R. Pillsbury
Chairman, Marine Cargo Operation
Department
Maritime Institute of Technology
and Graduate Studies
5700 Hammonds Ferry Road
Linthicum, MD 21090

Captain E.A. Poe
Port Captain
Nilo Barge Lines, Inc.
112 N. Fourth Street, Suite 1730
St. Louis, MO 63102

Joseph J. Puglisi
Managing Director, CAORF
National Maritime Research Center -
Computer Aided Operations Research
Facility
Kings Point, NY 11024

S. G. Putzke
Director of Operations (Marine)
Crowley Maritime Corporation
One Market Plaza
San Francisco, CA 94105

Robert M. Query
Engineer
U.S. Coast Guard (G-MHM-TP14)
2100 2nd Street, SW
Washington, DC 20593

H. A. Reinauer
President
Reinauer Transportation Company
19 Fulton Street
Newark, NJ 07102

LCDR Kenneth A. Rock
U.S. Coast Guard (G-MVI-2/TP24)
2100 2nd Street, SW
Washington, DC 20593

David F. Sampsell, PE
Vice President
Residuals Management Inc. (Ingram
Industries Inc.)
Suite 321, Oakbrook North
1200 Harger Road
Oak Brook, IL 60521

James H. Sanborn
Vice President - East Coast Group
Interstate and Ocean Transport Co.
Three Parkway- Suite 1400
Philadelphia, PA 19102

CDR J. A. Sanial
Branch Chief, Marine Safety
Technology Branch
U.S. Coast Guard (G-DMT-i/TP54)
2100 2nd Street, SW
Washington, DC 20593

Richard Saul
Director, Inland Waters & Great
Lakes Activities
Transportation Institute
923 15th Street, NW
Washington, DC 20005

Steve T. Scalzo
General Manager/Marine Operations
Foss Launch & Tug Company
660 West Ewing Street
Seattle, WA 98119

Vice Adm. R.H. Scarborough, USCG
Vice Commandant
U.S. Coast Guard Headquarters
2100 2nd Street, SW
Washington, DC 20593

Dr. Eric Schenker
Dean, School of Business
Administration
University of Wisconsin-Milwaukee
P.O. Box 413
Milwaukee, WI 53201

Alan L. Schneider
Chemical Engineer
USCG Cargo & Hazardous Materials
Division
U.S. Coast Guard
2100 2nd Street, SW
Washington, DC 20593

RADM Frederick P. Schubert, USCG
Maritime Advisor to the Secretary
of Transportation
U.S. Department of Transportation
(S-2)
400 7th Street, SW
Washington, DC 20590

Larry A. Seals
Vice President
Dixie Carriers, Inc.
P.O. Box 1537
Houston, TX 77001

Donald H. Seaman
Division of Environmental
Activities
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW
Washington, DC 20230

Paul F. Sleeper
Business Advisor
Exxon Company, U.S.A.
Marine Department
P.O. Box 1512
Houston, TX 77001

Duncan C. Smith, III
Minority Counsel
Coast Guard Subcommittee
Room 3580 - HOB Annex #2
Washington, DC 20515

Gene Solon
Consultant
Economic Associates, Inc.
1730 K Street, NW
Washington, DC 20006

Cesare Sorio
Coordinator, Marine Design &
Construction (MC4803)
AMOCO International Oil Co.
200 East Randolph
Chicago, IL 60601

LCDR Alan Spackman
U.S. Coast Guard (G-MMT-1/13)
2100 2nd Street, SW
Washington, DC 20593

William Stacey
Gulf Oil Corporation
P.O. Box 1524
Houston, TX 77001

Frank Stegbauer
Vice President
Southern Towing Company
P.O. Box 411
Memphis, TN 38101

Johnnie Stephens
Assistant Commander, Management
Naval Oceanography Command
NSTL Station
Bay St. Louis, MS 39529

David Streed
New Product Manager - Engineering
Systems
UNIROYAL, Inc. - 312 N. Hill St.
Mishawaka, IN 46544

Sharron Stewart
Member, National Advisory Committee
on Oceans and Atmosphere
3300 Whitehaven Street, NW
Washington, DC 20235

Donald Sullivan
Vice President Operations
Chotin Transportation Company
P.O. Box 3018
Baton Rouge, LA 70521

Douglas W. Svendsen, Esq.
Camp, Carmouche, Palmer, Barsh
& Hunter
2550 M Street, NW - Suite 695
Washington, DC 20037

E. A. Taylor
Assistant Marine Superintendent
Texaco Inc.
Avenue A & West First Street
Bayonne, NJ 07002

Leo E. Therrien
Senior Principle Engineer
Computer Sciences Corporation
6 John Clark Road
Middletown, RI 02840

Vincent D. Tibbetts
President
Boston Fuel Transportation Inc.
36 New Street
East Boston, MA 02128

Thomas Tooker
President
National River Academy
P.O. Box 827
Helena, AR 72342

Edward F. Tralka
Chief, Division Inland Waterways
Maritime Administration
U.S. Department of Commerce
14th & E Streets, NW
Washington, DC 20230

Henry Trutneff
Director, Human Resources
International Organization of
Masters, Mates, & Pilots
39 Broadway
New York, NY 10006

LCDR Richard S. Tweedie
U.S. Coast Guard (G-MMT1/13)
2100 2nd Street, SW
Washington, DC 20593

CDR James A. Umberger
USCG/EPA Liaison Officer
U.S. Environmental Protection Agency
Office of Environmental Review
(A-104)
401 M Street, SW
Washington, DC 20460

Stephen A. VanDyck
Executive Vice President
Interstate and Ocean Transport Co.
Three Parkway - Suite 1400
Philadelphia, PA 19102

Cornelias Van Mook
Chief Marine Engineer
Dravo Corporation
Engineering Works Division
Neville Island
Pittsburgh, PA 15225

Donald H. Voge
Manager, Tug/Barge Fleet
Sun Transport, Inc.
1200 Philadelphia Pike
Claymont, DE 19809

Mary Ellen Vollbrecht
Science Associate
National Audubon Society
1511 K Street, NW
Washington, DC 20005

Daniel F. Wake
Law Student
Center for Law and Social Policy
1751 N Street, NW
Washington, DC 20036

Jonathan Wales
Vice President
First National Bank of Boston
100 Federal Street
Boston, MA 02110

Kay Ward
Administrative Assistant
Hollywood Marine
P.O. Box 1343
Houston, TX 77001

Eddie Waxler
Vice President
Waxler Towing Co., Inc.
P.O. Box 253
Memphis, TN 38101

Robert R. Wells
Senior Scientist
Systems Control, Inc.
1901 N. Fort Myer Drive
Arlington, VA 22209

Paul T. Whiting
Senior Market Development Specialist
General Dynamics, Quincy
Shipbuilding Division
97 E. Howard Street
Quincy, MA 02169

Pamela Williams
Director of Production
Center for Environmental Education
1925 K Street - Suite 206
Washington, DC 20006

Richard Willis
Engineering Computer Optecnomics, Inc.
1036 Cape St. Claire Center
Annapolis, MD 21401

Dena L. Wilson
Director of Government Relations
The American Waterways Operators, Inc.
1600 Wilson Boulevard - Suite 1101
Arlington, VA 22209

Bart Withstandley
Manager, Marine Department
Swann Oil Inc.
130 Presidential Boulevard
Bala Cynwyd, PA 19004

Capt. Mat Wood
Chief, Marine Safety Division
Second Coast Guard District
U.S. Coast Guard
1430 Olive Street
St. Louis, MO 63103

Kent D. Woodward
Vice President - Gulf Coast Group
Interstate and Ocean Transport
Company
Three Parkway - Suite 1400
Philadelphia, PA 19102

Pat Yoder
Vice President - Public Affairs
The American Waterways Operators, Inc.
1600 Wilson Boulevard - Suite 1101
Arlington, VA 22209

LCDR Wayne Young, USCG
Construction-Operations Division
U.S. Army Corps of Engineers
DAEN-CWO - Pulaski Building
20 Massachusetts Ave., NW
Washington, DC 20314

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A096 726	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): PROCEEDINGS: WORKSHOP ON REDUCING TANKBARGE POLLUTION APRIL 15-16, 1980		5. TYPE OF REPORT & PERIOD COVERED Workshop Proceedings
7. AUTHOR(s) Paper Authors, Moderators, and Participants		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Maritime Transportation Research Board National Research Council 2101 Constitution Ave., NW Washington, DC 20418		8. CONTRACT OR GRANT NUMBER(s) N00014-75-C-0711
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research, Code 434 Department of the Navy Arlington, VA 22217		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS -----
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) -----		12. REPORT DATE August, 1980
		13. NUMBER OF PAGES xvi + 541
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Distribution of this report is unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) -----		
18. SUPPLEMENTARY NOTES Financial support is provided by the Department of Transportation		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Tankbarges Double Bottoms Oil Pollution Oil Spills - Operational Tankerman Oil Spills - Casualties Double-hull Barge Crew Training Single-hull Barge Regulatory Enforcement Wing Tanks Pollution Insurance (continued)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This workshop provided an information source for MTRB's Committee on Reducing Tankbarge Pollution and a forum for all interested parties to discuss the Coast Guard's proposals for reducing tankbarge pollution. The workshop was divided into five groups with the following topics: Congressional Mandates; Technical Options; Personnel; Operating environment; and Insurance, Liabilities, and Penalties. Each group was instructed to focus on the various ways on reducing tankbarge pollution and the problems and costs of each. The Congressional Mandates group was asked to look at all congressional (continued)		

DD FORM 1473 1 JAN 73

EDITION OF 1 NOV 68 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

19. Key Words (continued)

Liability Insurance
Licensing
Congressional Mandates
Environmental Effects
Chemical Barges

USCG Advisory Committees
Operating Environment
Aids to Navigation
Crew Licensing
Policy Conflicts

20. Abstract (continued)

mandates that interact with barge transportation, in addition to the environmental mandates. The papers in these Proceedings present a cross-section of the views, issues, and costs of reducing tankbarge pollution.

B

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

