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REDUCING TANKBARGE POLLUTION

Report of the
Committee on Reducing
Tankbarge Pollution

Maritime Transportation Research Board
Commission on Sociotechnical Systems
National Research Council

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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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PREFACE

As the result of controversy over its proposed regulation requiring double-hull tankbarges for oil transport, the U.S. Coast Guard asked the Maritime Transportation Research Board (MTRB) of the National Academy of Sciences to study ways of reducing tankbarge pollution. Subsequently, MTRB created the Committee on Reducing Tankbarge Pollution to conduct the study.

The Committee on Reducing Tankbarge Pollution examined the tankbarge question and identified issues and problems of national concern that resulted from the proposed regulation requiring double-hull tankbarges for oil transport. A workshop was held in April 1980 to gather information and ideas for the Committee's consideration and to provide a 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. The workshop proceedings were published in September 1980. It should be understood that the Committee's report was not limited to the material, conclusions, and recommendations from the workshop. The workshop provided information, but the Committee considered other material and formed its own conclusions and recommendations.

The Committee attempted to place the problem of reducing tankbarge pollution in proper perspective. It recognized the necessity to develop a coherent policy by which the nation's waterborne commerce is moved efficiently, effectively, and economically. It also recognized that environmental and economic considerations can and must be balanced for this purpose.

The Committee conducted its work as part of the Maritime Transportation Research Board's program to provide guidance toward improving the flow of waterborne commerce within the United States and with the rest of the world. Committee members served as individuals contributing their personal knowledge and judgment. Liaison representatives, on the other hand, are designated by their agencies, at the request of the National Research Council, to participate in Committee discussions and to share information and the views of their respective organizations with the Committee members. Liaison representatives do not have a vote during the Committee's deliberations. All members and liaison representatives gave generously of their time, both in attendance at meetings and in writing the report. All are to be commended for their interest, commitment, and contribution to the Committee's effort.

Eric Schenker

Eric Schenker, Chairman
Committee on Reducing Tankbarge Pollution

January 1981

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CHAPTER 1

INTRODUCTION AND SUMMARY

In mid-1979 the U.S. Coast Guard published in the Federal Register a proposal intended to reduce oil pollution from tankbarges. The Coast Guard proposed that after December 31, 1979, newly constructed tankbarges operating in U.S. inland or coastal waters would be required to have double hulls. In other words, tankbarges (with certain exceptions) would be required by regulation to have an outer hull that would be separated from an inner hull (i.e., the cargo tanks) by a void of at least 24 inches.

The rationale for this rule was that the outer hull would provide additional protection against spills from the inner hull cargo tanks in the event of accidents. This conclusion was based on a 1974 study conducted jointly by the Coast Guard and the U.S. Maritime Administration, using limited 1972 pollution data. Some spills from tankbarge accidents, it was acknowledged, would not be prevented by double hulls because serious accidents, resulting in penetration of the inner hull and the release of cargo, would occasionally occur.

At the same time that it published notice of this proposed rule, the Coast Guard also published an advance notice of proposed rulemaking intended to accelerate the phasing-out of single-hull tankbarges. The advance notice proposed that single-hull tankbarges that were more than 20 years old (with certain exceptions) would not be certificated to carry oil after 1985. The Coast Guard estimated that this rule would require the retirement or reconstruction by 1985 of about 1,000 of the 2,130 single-hull barges in oil service at that time.

The Coast Guard's proposals aroused considerable opposition from most tankbarge firms. Among other things, they criticized the proposals on grounds that they would impose substantial new costs on the companies but would be of relatively little help in achieving the goal of minimizing oil pollution from tankbarges.

As a result of these objections, the Coast Guard suspended the effective date of its proposals and asked the National Academy of Sciences to carry out a study primarily devoted to examining the issues involved and evaluating alternative methods of reducing oil pollution from tankbarges. Subsequently, the Academy's Maritime Transportation Research Board created the Committee on Reducing Tankbarge Pollution to conduct the study. The Committee, whose members are listed elsewhere in this report, was aided in its work by liaison representatives from the Coast Guard and the Maritime Administration.

BACKGROUND

Since 1970 it has been the policy of the federal government, as stated in the Federal Water Pollution Control Act, to eliminate discharges of oil from vessels or land facilities into the inland and coastal waters of the United States. So far, however, efforts to achieve this goal have not been completely successful. Although the nation has made progress in reducing oil spills into its streams, rivers, lakes, and coastal waters, more work remains to be done.

Between 1974 and 1978, the most recent 5-year period for which figures are available from the Coast Guard's Pollution Incident Reporting System (PIRS), there were more than 13,000 reported spills of oil from marine transportation sources, an average of 2600 per year. These sources include tankships, cargo ships, tankbarges, marine ports and terminals, and offshore pipelines. The reported amount of oil released from these sources during that period was close to 49 million gallons.

In addition, more than 38 million gallons of oil were reported spilled into the country's waters from offshore production facilities and land-based sources--e.g., oil refineries, electric power plants, tank trucks, factories--during the same 5-year period. Still more oil finds its way into the waterways undetected and unreported--at least as much as that reported and probably more, as indicated by the National Academy of Sciences report, "Petroleum in the Marine Environment" (Ocean Affairs Board, Commission on Natural Resources, 1975).

Well over half of the amount reported spilled from marine transportation sources during that period consisted of oil entering the water from tankships. At the other extreme were ocean-going cargo ships and offshore pipelines, each of which accounted for less than 1 percent of the oil released. Marine ports and terminals were responsible for slightly more than 18 percent of the oil released.

Tankbarges--the subject of this report--were the other source of oil pollution from marine transportation sources during the period in question, accounting for 24 percent, or approximately 2 million gallons annually. Most of this oil was spilled into rivers, harbors, and other inland waterways. It should also be noted that, although tankbarges accounted for slightly less than a quarter of the volume of oil spilled from marine transportation sources during that period, the number of spills from tankbarges was higher than for any other marine transportation source. In short, there were many small spills and a relatively small number of large spills from tankbarges.

While the amount spilled by tankbarges is certainly not insignificant, it is very small in comparison to the amount transported safely over long distances by tankbarges.

The accuracy of the preceding spill figures, it should be noted, is not thought to be perfect. It does seem clear, however, that the Coast Guard's PIRS figures are a sufficiently accurate indicator of the relative amounts of oil spilled, and the relative numbers of spills, from all marine transportation sources of oil pollution.

THE SCOPE AND STRUCTURE OF THIS REPORT

The Committee's principal task was to analyze and evaluate the Coast Guard's proposals and any other actions that could be taken to reduce oil pollution from tankbarges and to prepare a report discussing the options for reducing pollution from tankbarges and their advantages and disadvantages. The Committee was also given instructions to draw conclusions and make recommendations as to what actions should be taken for the purpose of reducing oil pollution from tankbarges. The Committee's conclusions and recommendations are contained in Chapter 8.

Chapter 2 of this report has two main parts. In the first part, the Committee outlines the recent history of federal legislative acts and presidential executive orders directed at the problem of water pollution, particularly through releases of oil, and the history of the Coast Guard's efforts to implement those laws and executive orders. In the second part of Chapter 2 the Committee finds that the Coast Guard, in the regulations proposed in 1979, did not include in its consideration other national objectives, some of which, it would appear, are in conflict with the goal of phasing out single-hull tankbarges and replacing them with double-hull barges. It is pointed out, among other things, that the Coast Guard's proposals would appear to be inflationary and result in reduced industry productivity.

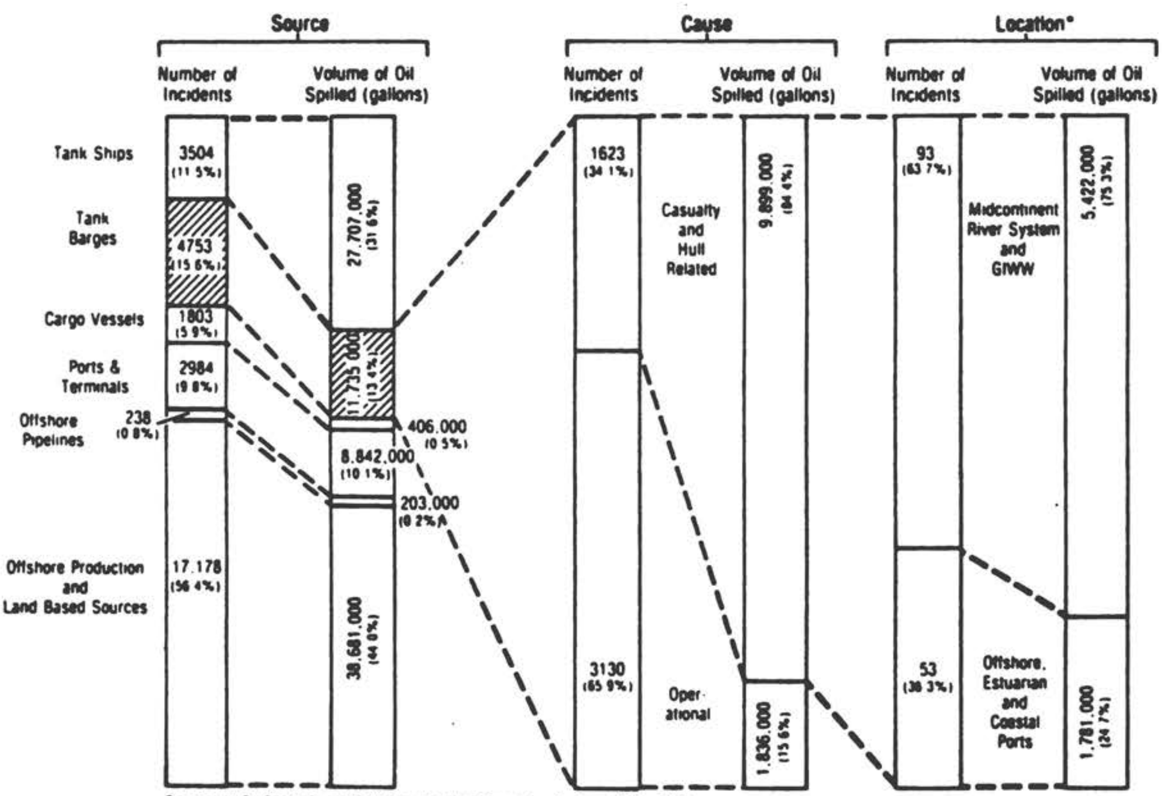
Chapter 2 then outlines a method for evaluating various alternative means of reducing oil pollution from tankbarges by measuring, in subjective terms, their impact on other national goals, such as environmental quality and economic growth. In short, the Committee suggests that the Coast Guard try to determine whether other methods of reducing oil pollution from tankbarges would have a greater, or a lesser, effect on other national goals.

Chapter 3 presents the oil spill data used in this report. The data base is the Coast Guard's Pollution Incident Reporting System (PIRS), the same as that used by the Coast Guard in substantiating its proposals (but for the period 1974-1978 rather than 1973-1977 because the later 1978 data are now available). Following a brief discussion of statistics showing the improved quality of the nation's rivers, this chapter provides data on what percentage of the number and volume of oil spills involve tankbarges, what percentage of the volume spilled is the result of accidents (collisions, rammings, and groundings), and where tankbarge spills occur.

Subsequently, in a comparison of the spills from ocean-going tankships (self-propelled) and tankbarges, Chapter 3 explains why tankbarge spills are more frequent. Unlike ocean-going tankships, tankbarges move in narrow channels, often in close proximity to other barges and shoreline facilities. Despite these hazards, the chapter notes, tankbarges have a better record than ocean-going tankships in terms of the amount of oil spilled in relation to the amount of oil handled.

The chapter reports that tankbarges spilled a total of 11,735,000 gallons of oil between 1974 and 1978, and that the total number of spills was 4,753. In terms of volume, 84.4 percent of the oil lost in spills during the period resulted from tankbarge casualties (groundings, rammings, etc.); only 15.6 percent of the total volume spilled was operational (Figure 1-1).

Chapter 3 also reports that of the 146 spills of more than 500 gallons that occurred between 1974 and 1978, 93 were on the



Source: U.S. Coast Guard Pollution Incident Reporting System 1974-1978

*Figures shown for "Location" do not sum to those shown for "Cause" because only spills over 500 gallons arising from casualties are included

FIGURE 1-1 Tankbarge oil pollution in and around waters of the United States (1974-1978).

Midcontinent river system or the Gulf Intracoastal Waterway. These 93 spills accounted for 63.7 percent of the accidents and 75.3 percent of the volume--more than 5.4 million gallons--spilled in incidents involving the loss of more than 500 gallons. The other 53 incidents, which accounted for 25 percent of the volume--some 1.78 million gallons--spilled in incidents involving the loss of more than 500 gallons, occurred offshore or in estuarian or coastal ports (Figure 1-1).

Chapter 3 then analyzes tankbarge oil spills by location and finds that 86 percent of the collisions, rammings, and groundings that occurred from 1972 through 1976 took place on only four waterways--the Mississippi, the Ohio, the Illinois Waterway, and the Gulf Intracoastal Waterway West. The chapter notes that 38 ten-mile segments of waterway have been identified as locations where 10 or more accidents occurred during the period in question.

The chapter concludes with an analysis of the effectiveness of double-hull tankbarges in preventing oil spills. In all, the chapter says, double-hull barges could reduce the amount of oil spilled by 690,000 gallons a year, out of the average total amount spilled of approximately 2 million gallons. Some 280,000 gallons could be saved in barge collisions and rammings, another 210,000 gallons in barge groundings, and more than 200,000 gallons could be saved that would otherwise be lost from hull ruptures and leaks.

Chapter 4 of this report deals with design and structural alternatives to the requirement for double hulls and the phasing out of single-hull tankbarges. These alternatives are divided into structural and nonstructural alternatives.

In essence, the section on structural alternatives suggests greater selectivity in the application of the proposals and improvements in the design and structure of single-hull tankbarges, such as thicker plating, heavier frame scantlings, the elimination of serrated frames, and reductions in the size of oil-carrying compartments. This chapter also expresses doubts about the wisdom of the Coast Guard's proposal for early retirement of single-hulled tankbarges because of the financial burden that would be imposed on tankbarge firms.

Nonstructural alternatives proposed in Chapter 4 include improved inspection and repair standards for single-hull tankbarges and broader investigation of novel technological methods for preventing leaks--e.g., the use of internal sealing materials that would prevent oil leaks from small cracks or holes.

Also included in Chapter 4 are six questions on which, the committee believes, further investigation is necessary. These include further comparison of the construction costs of single- and double-hull barges, the definition of single-hull barge construction standards, the costs of improved single-hull construction, the matter of barge deadweight carrying capacity, the possibility of explosions due to the collection of gas fumes in the empty space between the inner and outer hulls of double-hull tankbarges, and a structural assessment of the resistance to damage of the two barge types.

Chapter 5 deals with tankbarge personnel and related matters. This chapter concerns itself primarily with various ways of improving the quality of the personnel responsible for operating tankbarges, chiefly towboat operators and tankermen.

One step that should be taken, the chapter states, is changing the examinations for operators' licenses and tankermen's endorsements. With respect to both, it is said, the examinations remain unchanged for so long that the training of persons wishing to take the examinations concentrates on teaching them the correct answers rather than teaching them concepts and general knowledge about barge operations.

Another major problem with the towboat operators' examinations, in the Committee's view, is their lack of attention to radio communications, which in certain cases can be vital to avoiding tankbarge accidents. The chapter suggests that future examinations incorporate questions to test applicants' knowledge of such communications.

The Committee also states that the Coast Guard has some personnel problems that affect oil spills from tankbarges. Frequent rotations of Coast Guard personnel from one assignment to another, it is said by the Coast Guard, is beneficial in preventing conflicts of interest and assuring standardized practices, but it is detrimental to the development of specialized skills or complete knowledge of local parts of the waterways used by tankbarges. Mandatory retirement for some personnel after 20 years of service, and "up-or-out" promotion policies, while eliminating unsatisfactory personnel, also tend to reduce the level of experience, especially in such specialized areas as casualty investigation. The Committee recommends "civilianizing" the regulatory branch of the Coast Guard to help eliminate this problem.

In Chapter 6, "The Operating Environment of Tankbarges," the Committee discusses changes that might be made on waterways to help reduce spills. These include improved vessel traffic service (VTS) systems, improved communications, better aids to navigation, and greater attention to the design and protection of structures that cross or lie adjacent to waterways, such as locks, bridges and oil terminals.

This chapter devotes a large amount of attention to the matter of dredging to keep waterways deep enough to prevent tankbarges from going aground. It is pointed out in the course of this discussion that environmental protection groups, which are particularly distressed by oil spills, are also frequently opposed to dredging on grounds that it disturbs the ecosystem. The Committee notes, however, that when necessary dredging is prohibited, the chances of oil spills increase. Hence, the Committee suggests that some type of reasonable accommodation between the goals of reducing oil spills and preventing ecological damage from dredging should be sought.

In Chapter 6 the Committee also calls for more intensive study of the effects of oil spills on the environment, on grounds that less stringent measures for preventing spills may be appropriate where swift currents or other features of the aquatic environment may help to disperse oil spills quickly and with minimal damage. The Committee also suggests investigating improved clean-up methods and strategies.

Chapter 7 of the report addresses matters of insurance for tankbarge towing firms against damage claims for oil spills, the liability of tankbarge towing firms under the Federal Water Pollution Control Act when spills do occur, and the penalties that may be assessed under that act against the companies and against crew members.

One of the Committee's findings is that the cost of insurance is not great enough to serve as much of an incentive to barge towing companies to prevent oil spills. A second important finding in this chapter is that companies involved in insuring tankbarges against claims resulting from oil spills are unimpressed by the argument that double-hull tankbarges would greatly reduce spills. On the basis of recent statistics, it is the insurers' view that double hulls are just as likely to leak large amounts of oil in catastrophic accidents, which account for the largest volume of oil lost by tankbarges. For this reason, insurers do not give more favorable premium rates for double-hull barges.

While generally concluding that the FWPCA does not impose excessive liability on barge towing firms for oil spills, the Committee does recommend that the law be amended to allow the firms to deduct their own costs of cleaning up oil spills from their statutory liability. The Committee asserts that barge towing firms themselves conduct their own clean-ups in more than 90 percent of the reported oil spills.

Chapters 2 through 7 of this report were prepared by subcommittees composed of members of the Committee and liaison representatives of the Maritime Administration and the Coast Guard. These chapters are based on the discussions of the 187 persons who attended a Workshop on Reducing Tankbarge Pollution held in Washington on April 15-16, 1980, and on the many papers and supplementary papers submitted for the workshop. The workshop's proceedings were published in September 1980 and are available from the Maritime Transportation Research Board.

In broad terms, both the chapters themselves, and the conclusions and recommendations, state that the Coast Guard's proposals are too broad and all-encompassing and that the Coast Guard should conduct additional investigations into various alternative measures for reducing oil pollution from tankbarges, particularly improved construction details for single-hull tankbarges, improved training of tankbarge personnel, and improved navigation methods and devices for preventing accidents involving tankbarges as they move along the country's waterways.

CHAPTER 2

THE CONGRESSIONAL MANDATE FOR CLEAN WATER

On April 3, 1970, President Nixon signed the Water Quality Improvement Act of 1970, which amended the Federal Water Pollution Control Act (FWPCA). Section 11 of this act states in part:

> 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, adjoining shorelines, or into or upon the waters of the contiguous zone.

The Coast Guard responded to this new national policy by proposing rules to prevent the discharging of oil by ships and other types of vessels. A portion of the proposed rule, published in the Federal Register on December 24, 1971, required double sides and ends (but not double bottoms) for tankbarges of 100 gross tons or more that were built, rebuilt, or converted for the purpose of carrying oil after December 31, 1972.

Meanwhile, in October 1972, Congress again amended the Federal Water Pollution Control Act. Section 101 of the act included the following statement: "(1) It is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1986." This congressional manifestation of increased urgency was one reflection of growing worldwide concern about pollution of the oceans due to discharges of oil. This concern led to the convening of an International Convention on the Prevention of Pollution from Ships (MARPOL) in 1973. Resolution 1 of the Convention stated:

> NOTING its main objectives as set out in Resolution A.237(VII) adopted by the Assembly of the Inter-Governmental Maritime Consultative Organization on 12 October 1971, as being the achievement, by 1975 if possible but certainly by the end of the decade, of the complete elimination of the willful and intentional pollution of the seas by oil and noxious substances other than oil and the minimization of accidental spills.

While this resolution made it clear that the international community wanted to accelerate the timetable for eliminating oil pollution of the oceans, it was also clear that a distinction was drawn between intentional and accidental discharges. Intentional acts were to be prohibited, resulting in zero discharge. Accidents were recognized as unavoidable, but measures to minimize their occurrence and their effects were deemed essential.

In commenting on the Coast Guard's proposed rule for double-wall barges early in 1972, the tankbarge industry expressed concern about the economic impact of this design requirement and suggested that the U.S. Maritime Administration and the Coast Guard jointly undertake a cost-effectiveness study of it, with industry participation. As a result, the Coast Guard and Maritime Administration performed a joint study that was completed in October 1974. The final conclusion of that study report states "adequate data is not yet available to make a cost/benefit determination with respect to required cost to prevent a given amount of oil from being spilled. The U.S. Coast Guard Pollution Incident Reporting System does not currently include sufficient data to identify 'inland water' oil spills or to determine those single-skin tank barge spills which could not have been prevented by a double wall or double-hull construction standard."

Then, in late 1976 and early 1977, a rash of oil tanker accidents occurred in or near U.S. waters. Consequently, in March 1977, President Carter sent a message to Congress recommending new legislation to control oil pollution, and he directed the Secretary of Transportation to undertake several relevant studies. One of the studies requested by the President was an evaluation of the design, construction, and equipment standards of tankbarges used to carry oil.

A second international convention on oil pollution was convened in 1978. The Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships called on the nations of the world to adopt additional measures to minimize pollution and to apply them to more ships, and established a timetable for doing so. Later that year, the U.S. Congress enacted the Port and Tanker Safety Act of 1978, which incorporated into federal law most of the provisions of the Protocol. Section 5 of the act includes the following statements:

> That the 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.
>
> ...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).

Throughout this period the Coast Guard was reexamining the problem of tankbarge pollution, and on June 14, 1979, published new proposals in the Federal Register. Accompanying the proposals was a "Draft Regulatory Analysis and Economic Impact Statement, Design Standards for New Tank Barges and Regulatory Action for Existing Tank Barge Oil Pollution Due to Accidental Hull Damage." The new proposals, among other things, would have required the eventual elimination of 2,130 single-hull barges for carrying oil and would have required all new barges used to carry oil to be constructed with double hulls.

A significant number of objections to the proposals were voiced at public hearings. These included objections to the Coast Guard's estimate of the increased costs of the proposals, objections to the stated effectiveness of the measures in reducing oil pollution, and objections to the absence in the rules of any alternative measures for dealing with oil pollution. A further objection was that the Coast Guard had misconstrued its mandate from Congress.

As a result of these objections, the Coast Guard again deferred its proposals and commissioned the National Academy of Sciences to study them as well as possible alternatives. The Academy then established this Committee for that purpose.

At a Workshop on Reducing Tankbarge Pollution, members of the workshop examined the issue of whether the Coast Guard has legal authority to control tankbarge pollution. After due analysis and deliberation, the Committee agreed that the Port and Tanker Safety Act of 1978 gave the Coast Guard authority to use a wide range of controls, including design standards, to reduce oil pollution from tankbarges. The Committee also concludes, however, that the Coast Guard had not taken into consideration other congressional policy mandates that have a bearing on any decision about how the mandated pollution goals are to be achieved.

It would appear that giving consideration to other national priorities would be in keeping with policy directions issued by the Department of Transportation. Under the heading "Departmental Requirements" in the 1980 document entitled Transportation Agenda for the 1980s: Issues and Policy Directions, DOT makes the following statement:

> Program evaluation must be strengthened and made part of policy development. We need faster feedback on the impacts of our policies and programs, and greater resilience in adapting them to new requirements and national priorities.

OTHER CONGRESSIONAL MANDATES

Over the years, Congress has made numerous policy statements in virtually every area of national interest. These include such matters as economic policy, inflation, deregulation of industry, energy, productivity, health and safety, transportation, and maritime policy. In addition, there have been numerous executive orders dealing with the same subjects.

Ultimately, the Committee found that the Coast Guard had not attempted to establish a specific priority for the problem of tankbarge pollution within the context of other federal goals, some of which conflict with the goal of reducing tankbarge pollution. In essence, there was no attempt to rationalize tankbarge pollution control within the full set of federal policies. To help in ascertaining what degree of priority should be assigned to the reduction of tankbarge pollution, the Committee commissioned two studies, one from the Center for Law and Social Policy of Washington, D.C.,[1] the other from Douglass Svendson and Austin P. Olney, private attorneys.[2] (Earlier, the Center had submitted material on behalf of sixteen environmental groups, and Svendson and Olney had submitted material on behalf of American Waterways Operators, Inc.)

The analysis by the Center for Law and Social Policy supports the Committee's conclusion that Congress has given a high priority to the goal of reducing oil pollution in marine environments. After citing laws and treaties designed to protect the marine environment from pollutants other than oil from ships--for example, laws to protect seabed resources, to limit the dumping of wastes in the oceans, and to prevent accidents during deepsea mining--the analysis concludes that "While it is always appropriate for government agencies to reach regulatory decisions that maximize environmental protection at the lowest cost, there is no basis for concluding that the scope of the government's mandate to protect the marine environment has somehow been reduced because of energy or economic development considerations."

The analysis prepared by Svendson and Olney found that the Coast Guard's proposed standards were likely to have some conflicting effects on federal policy in eleven other areas. These included credit control policy, tax and economic policy, anti-inflation policy, economic regulation policy, transportation policy, regulatory reform policy, environmental policy, merchant marine policy, productivity, energy conservation, and occupational safety.

This analysis supports the Committee's conclusion that the Coast Guard did not give sufficient attention to other federal policies in arriving at its proposed rules for preventing water pollution from tankbarges carrying oil. Svendson and Olney concluded that these other policies should have been considered by the Coast Guard in its decision-making process, and that failure to do so resulted in a lack of consideration of reasonable alternatives to early retirement and double hulls.

The Committee believes this issue is a fundamental one. It is therefore essential to evaluate the consequences of the Coast Guard's proposed rules as they might affect other federal policy mandates. Some rational procedure is needed to consider federal policy mandates and to rate the alternatives for eliminating oil pollution from tankbarges in terms of their impact on other mandates.

METHODOLOGY FOR EVALUATING TANKBARGE OIL POLLUTION RELATIVE TO OTHER FEDERAL POLICY MANDATES

It should be recognized that any rules adopted by the Coast Guard to reduce oil pollution from tankbarge operations will have both a direct and an indirect impact on other federal goals. The direct impacts will be the costs and the benefits that accrue to users and nonusers directly because of the implementation of a rule. For example, an effective strategy for reducing oil pollution from tankbarges may impose direct costs on the tankbarge industry while also directly benefiting other waterway users and abutting property owners by reducing pollution-caused damage; that is, to obtain an oil pollution reduction of a given amount, any policy alternatives will impose direct costs on the tankbarge industry and the public. If the costs of implementing any particular policy alternative are more than the costs imposed by the pollution itself, implementation of that alternative will lead to a result that is not cost-effective.

Another problem is that of determining the direct value of implementing any particular rule. It should be possible to estimate the number of gallons of oil that will be saved, and the cost of that oil, over a given time period by any particular alternative. Similarly, it should be possible to estimate how each alternative will reduce the costs of cleaning up oil spills in one or more marine environments. It should also be possible to estimate how much each alternative reduces costs by eliminating the need to replace destroyed or damaged property.

There are, however, certain kinds of costs that are much more difficult to quantify. These include the death of flora or fauna, or any long-lasting esthetic degradation that results from oil spills. Nonetheless, the quantifiable benefits should be determined so that some measure of the cost-effectiveness of each alternative can be obtained. This was not done in the analysis accompanying the announcement of the Coast Guard's proposed rules.

It is not sufficient, however, simply to estimate the direct costs and benefits. Society is also concerned with the indirect costs and benefits. These are the positive and negative effects that would occur as secondary consequences of the implementation of a rule. For example, any strategy that increases the direct costs to the barge industry may result in the transfer of those costs to the consumer. In short, the cost of oil to users may be increased to cover the cost of reducing pollution. Any such increase in oil costs would appear in most price indexes as inflationary. On the other hand, a regulation calling for a substantial increase in the construction of double-hull tankbarges might mean a greater need for shipbuilding personnel that might have the effect of reducing the rate of unemployment. The number of legislative and executive mandates under which society operates suggests a wider concern than simple cost-benefit analysis. This one analysis does not reveal all the effects of a specific decision. This applies to any attempt to reduce pollution from tankbarges. Thus, a large number of indirect effects must be considered in evaluating alternatives and selecting one or more of them as the means of dealing with the problem.

After reviewing federal policy mandates, the Committee concluded that certain ones should be considered in evaluating alternative methods for reducing pollution from tankbarges. These "impact dimensions" are

1. Environmental quality,
2. Economic growth,
3. Energy costs,
4. Health and safety,
5. Regulatory effects, and
6. Transportation efficiency.

On grounds that these reflect the major concerns of Congress that bear on the issue, the Committee concludes that alternatives aimed at reducing tankbarge pollution must be assessed in terms of the magnitude of their effects, direct or indirect, on these policy domains. The question that must be answered is: How much does each alternative aimed at reducing oil pollution from tankbarges affect these impact dimensions?

Ideally, it would be desirable to measure quantitatively how much of a change each alternative course of action causes in the impact dimensions. The best alternative would be the one that produces a positive effect in all of the dimensions. At the present time, however, there is no way to predict the effects of any pollution-reducing alternative on all the impact dimensions.

Thus arises the classic problem of decision-making under uncertainty. One approach in this situation is to use rating techniques. It has been found that judgments by experts provide a rational means of estimating the worth or effects of an action, and a variety of rating techniques have been developed and used for this purpose. It has been shown that, under appropriate conditions, these techniques produce results that reinforce each other and are stable within a group of expert raters.

Such an approach can be employed to evaluate the impact of each pollution-reducing alternative relative to the impact dimensions. The first step is to develop a matrix in which the rows list the impact dimensions and the columns list the pollution-reducing alternatives. This is shown in Figure 2-1. (The alternatives shown there are used only for illustrative purposes.) For each cell in the matrix, a rating would be made by a group of experts. The ratings would be their judgments of the effect of each alternative on the impact dimension, and they would use, for example, a seven-point rating scale such as that shown in Figure 2-2. The numerical value in each cell would be the average for the group. The column could then be summed (or averaged) to provide a single figure showing the merit of the alternative. The ratings for all of the alternatives could then be placed on a common scale to determine the merit of the set as a whole. This would provide a basis for an initial evaluation of the alternatives and, hence, a basis for action.

One additional step that could be taken would be to assign weights to each impact dimension. If each of the dimensions were deemed to be equally important, they would be given equal weight. Some of the congressional mandates, however, might be considered more important than others. If such were the case, the impact dimensions would receive different weights, based on their importance. A different scaling procedure (ratio rating) would then have to be used. It should also be noted that the use of a weighted evaluation procedure assumes that the raters can determine priorities among social goals. Generally, this is not a technical decision but a political one.

The best alternatives would be those with the highest positive ratings. However, the alternatives that would receive the most serious consideration should also have two additional characteristics. One would be that they would produce the greatest pollution reduction at a given cost (or alternately the least cost for a given amount of pollution reduction); the other that they could be fully implemented within the shortest period of time. Thus, a three-step evaluation process should be completed to determine the possible alternative for reducing oil pollution from tankbarges:

1. Rating feasible alternatives against the set of federal policy mandates;
2. Determining the implementation costs of the most effective alternatives; and
3. Estimating the speed at which each of the most effective alternatives could be implemented.

Although this rating technique is a way of discriminating among policy alternatives, it does not provide any objective quantitative measurements. It therefore would be desirable to estimate the net costs of each alternative. If it were possible to determine the real costs of each alternative, a measure of the net cost-effectiveness of each could also be obtained.

IMPACT DIMENSION	POLLUTION-REDUCING ALTERNATIVES				
	Double Hulls	20-year Retirement	Structural Changes	Improved Personnel	Waterway Modernization
Environmental Quality					
Economic Growth					
Energy Costs					
Health and Safety					
Regulatory Effects					
Transportation Efficiency					

FIGURE 2-1 Impact evaluation matrix.

-3	-2	-1	0	+1	+2	+3
Extremely Negative Impact	Very Negative Impact	Negative Impact	No Impact	Positive Impact	Very Positive Impact	Extremely Positive Impact

FIGURE 2-2 Rating scale for impact evaluation.

For certain of the congressional mandates, costing of the alternative is feasible, while in others it is not. Nonetheless, the Coast Guard should use existing techniques that would provide a more complete basis for evaluating future regulatory actions. At the very least, the Coast Guard should develop rating techniques as one way of evaluating the impact of any actions it may take to reduce oil pollution from tankbarges.

REFERENCES

1. Center for Law and Social Policy. Congressional Mandates Concerning Tankbarges and Pollution of the Marine Environment. Private communication, July 1980.
2. Douglas Svendson and Austin P. Olney. Congressional Mandates Relating to Coast Guard Tankbarge Rulemaking.

<u>Copies of these references may be obtained from</u>:

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

CHAPTER 3

SCOPE OF THE PROBLEM

One of the principal criticisms of the Coast Guard's proposals was that in some instances the Coast Guard had not made correct use of its data as justification for the proposals or had not considered all pertinent data. As a result of this criticism, the Committee studied various relationships within the data base and a Coast Guard-sponsored study of the questions pertaining to the use of data. More specifically, the Committee examined (a) the relationship between size of spill and incidence of spill, (b) the relationship between cause of spill and amount spilled, (c) the relationship between location of spill and amount spilled, (d) the relationship between the volume of spills and total amount handled, and (e) the relationship between the volume of oil spilled by tankbarges and that spilled by tankships.

To support its proposals, the Coast Guard used data obtained for the 5 years, 1973-1977, by means of its Pollution Incident Reporting System (PIRS). The Committee, however, was able to use more recent figures--that is, PIRS data for the 5-year period from 1974 through 1978--in much of its analysis because of the availability of 1978 data.

As a result of its investigation, the Committee found that accidental releases of oil from tankbarges into U.S. rivers, lakes, and coastal waters are frequent events and that efforts to eliminate them are a proper matter of concern for both the Coast Guard and the tankbarge operating companies. Most of the spill incidents, however, do not result in the release of large amounts of oil. It is a relatively few accidents that account for three-fourths of all the oil spilled from tankbarges. In overall terms, furthermore, the Committee believes that the tankbarge industry has a good record on oil spills. The domestic tankbarge fleet spills only 5 barrels of oil for every 240,000 barrels it transports, and its efforts to reduce both the number and volume of oil spills are continuing.

OIL POLLUTION OF U.S. INLAND WATERS

Tankbarges transporting oil presently contribute less than 5 percent of the petroleum hydrocarbons that enter the nation's inland waters. The vast majority of the petroleum hydrocarbons found in these waters comes from urban runoff, municipal waste plants, and industrial sources.

During the past 10 years the United States has taken significant steps to minimize the degradation of its waters and instituted measures to improve water quality. One illustration of this is a comparison prepared by the Council on Environmental Quality (CEQ) for its 1979 annual report. One of the tables in that report shows changes in the trends in water pollution at 44 selected cities on major rivers. (The cities were located disproportionately in the East and Midwest because comparable data were not available for many western cities.) Of the 149 comparisons of water quality found in the table, 69 show improvements in water quality, 41 show degradation, and 39 show no change. CEQ analysis also revealed that in 22 of the 44 cities the amount of wastewater receiving secondary treatment increased significantly between 1976 and 1978.

WATER POLLUTION DUE TO OIL SPILLS

Oil pollution from tankbarges can be discussed (a) in terms of its relationship to oil spills of all other types and to spills within the marine oil transportation system and (b) in terms of the causes of spills, the amount of oil spilled, and where and how incidents occurred. This explanatory scheme was shown in Figure 1-1. The specific data are shown in various tables and can be summarized as follows:

- Tankbarges accounted for 13.4 percent of total accidental oil pollution volume and 15.6 percent of all polluting incidents;
- Tankbarges accounted for 35.8 percent of the pollution incidents and 24.0 percent of the volume spilled in the marine transportation segment of oil marketing and distribution;
- Casualty-related incidents accounted for 34 percent of the incidents and 84 percent of the volume spilled;
- 64 percent of the incidents and 75 percent of the volume lost was within the Midcontinent River and Gulf Intracoastal Waterway systems; and
- 36 percent of the incidents and 25 percent of the volume spilled were in areas other than the Midcontinent River and Gulf Intracoastal Waterway Systems.

The following sections analyze the statistics in an attempt to better understand the sources of vessel oil pollution, the comparative performance of these modes of transportation, and the relative opportunity for achieving reductions in oil discharges.

ANALYSIS OF OIL POLLUTION INCIDENTS

The total number of reported oil releases into the marine environment from all commercial sources within the United States for the period 1974-78 in terms of the number and percentage of releases and the amount and percentage of volume is shown in Table 3-1. During that period, marine transportation accounted for 43.7 percent of the number of releases of oil and 55.8 percent of the volume. Tankships accounted for 31.6 percent of the volume, while tankbarges accounted for 13.4 percent.

Table 3-1 Oil Releases in and Around the Waters of the United States Marine and Land-Based Sources, 1974-1978

Source	Number of Releases	Percent of Releases	Volume of Releases (thousands of gallons)	Percent of Volume Released
Marine Transportation Sources	13,282	43.7	48,893	55.8
Tankships	3,504	11.5	27,707	31.6
Tankbarges	4,775	15.7	11,735	13.4
Cargo ships	1,803	5.9	406	0.5
Marine ports and terminals	2,984	9.8	8,842	10.1
Offshore pipelines	238	0.8	203	0.2
Offshore production	6,490	21.2	691	0.8
Land-based sources	10,688	35.1	37,990	43.4
Railroads	444	1.5	1,767	2.0
Tank trucks	1,350	4.4	1,725	2.0
Gas station	200	0.7	153	0.2
Onshore pipelines	2,609	8.5	17,857	20.4
Onshore bulk storage	1,468	4.8	8,780	10.0
Onshore refineries	669	2.2	1,052	1.2
Power plants	334	1.1	86	0.1
Onshore production	1,326	4.4	4,435	5.1
Industrial/processing	2,288	7.5	2,135	2.4
Total	30,482	100.0	87,574	100.0

Source: U.S. Coast Guard Pollution Incident Reporting System, 1974-1978.

Table 3-2 Oil Releases in and Around the Waters of the United States Marine Transportation Systems 1974-1978

Source	Number of Releases	Percent of Releases	Volume of Releases (thousands of gallons)	Percent of Volume Released
Tankships[a/]	3,504	26.4	27,707	56.7
Tankbarges	4,753	35.8	11,735	24.0
Cargo ships	1,803	13.6	406	0.8
Marine ports and terminals	2,984	22.4	8,842	18.1
Offshore pipelines	238	1.8	203	0.4
Total	13,282	100.0	48,893	100.0

Source: U.S. Coast Guard Pollution Incident Reporting System, 1974-1978.

a/ Includes spills from ARGO MERCHANT (7.5 million gallons, 29 miles from shore) and HAWAIIAN PATRIOT (9.6 million gallons, 120 miles from shore).

An analysis of oil releases from the marine transportation system alone is shown in Table 3-2. During the period 1974-8, tankships accounted for 26.4 percent of the number of oil spills, but 56.7 percent of the volume. Tankbarges, on the other hand, accounted for 24 percent of the volume but almost 36 percent of the number of spills.

The reasons for the larger number of spills from tankbarges are not hard to ascertain. Most barge trade occurs on congested inland waters, where maneuverability is restricted, where channels are frequently irregular and of varying (and shifting) depths, and where barges are frequently close to other vessels or to shoreside facilities. Tankships, meanwhile, travel in relatively uncongested waters and are therefore less likely to come into accidental contact with other vessels, shoreside facilities, or navigational hazards.

Moreover, barges carry smaller amounts of cargo over shorter distances, giving rise to a larger number of chances for spills during transfer operations. Accidents that occur on inland waterways and at terminals are more likely to be reported than spills by tankers, cargo ships, and pipelines that are offshore. The statistics in Table 3-2 on incidents and volume might therefore be more accurate and relatively higher for tankbarges and terminals than for tankships, cargo ships, and offshore pipelines.

There are, however, valid reasons for greater concern over oil pollution in inland and coastal waters, whatever the source, than in the open ocean. Inland and coastal waters are generally recognized as being more sensitive ecologically, although the long-term effects of oil pollution of these waters is still being debated. Furthermore, the use of inland and coastal waters for recreational purposes continues to increase, and the presence of oil in these waters has an immediate and drastic effect on their recreational value. In addition, many of our inland waterways also supply water for many communities, large and small. Oil in these waters can affect the cost, if not the quality, of municipal water supplies.

One method of analyzing the relative contributions of tankships and tankbarges is to compare the amount of oil spilled with the amount of oil handled. Although this comparison does not take into account the greater chances of accidents during the movement of barges and the transfer of oil from barges to shore storage facilities, tankbarges nonetheless showed a better ratio of gallons released per gallons handled. As Table 3-3 shows, barges released 2.73×10^{-5} gallons for every gallon handled, while tankers released 3.32×10^{-5} gallons for every gallon handled. Tables 3-4 and 3-5 show the volume of oil spilled as a function of the volume of oil handled for tankbarges and tankships, respectively, for the years 1973 to 1977 (1978 data not available). Except for 1974, barges had a better record. Given the greater chance of spills from barges because of their operating environment, the statistics actually understate the performance of the barges.

Table 3-3 Oil Releases in and Around the Waters of the United States Marine Transportation System as a Function of Volume Handled, 1974-1978

Source	Average Annual Volume Handled (millions of gallons)	Average Annual Volume Released (thousands of gallons)	Gallons Released per Gallon Handled
Tankships a/	202,440	5,541	3.32×10^{-5}
Tankbarges	82,740	2,347	2.73×10^{-5}
Cargo Ships	8,400	81	0.96×10^{-5}
Marine ports and terminals	284,760	1,768	0.62×10^{-5}
Offshore pipelines	18,060	48	0.27×10^{-5}

Source: U.S. Coast Guard Pollution Incident Reporting System, 1974-1978; American Petroleum Institute; Association of Oil Pipelines; U.S. Corps of Engineers Waterborne Commerce Statistics, 1974-1977.

a/ Includes spills from ARGO MERCHANT (7.5 million gallons, 29 miles from shore) and HAWAIIAN PATROIT (9.6 million gallons, 120 miles from shore).

TANKBARGE OPERATIONS AND CASUALTIES

Tankbarges spilled a total of 11,735,000 gallons of oil in a total of 4,753 incidents between 1974 and 1978, as shown in Table 3-6. Despite the frequency of loading and unloading, with the attendant chance for spills, only 16 percent of the volume spilled was operational in nature, i.e., due to loading or unloading. The other 84 percent was released as the result of casualty-related incidents--that is, collisions, rammings, and groundings.

In Table 3-7 barge releases of more than 500 gallons during the period 1973-1977 are divided between those that occurred on the Midcontinent River System and the Gulf Intracoastal System and those that occurred during offshore, estuarian, and coastal port movement. A total of 146 incidents occurred, and 93 of these were on the Midcontinent and Gulf Intracoastal Waterway systems. These 93 accidents accounted for 64 percent of all releases of 500 gallons or more, and they accounted for 75 percent of the total outflow. The remaining 36 percent of the releases occurred offshore or in estuaries

Table 3-4 Volume of Oil Spilled as a Function of Oil Handled, Tankbarges, 1973-1977

Category	1973	1974	1975	1976	1977
Volume handled (thousands of gallons)	8.34×10^{7}	8.10×10^{7}	7.93×10^{7}	8.46×10^{7}	8.69×10^{7}
Volume spilled (thousands of gallons)	1,572	2,354	2,577	1,910	1,614
Spilled/handled ratio, all spills	1.88×10^{-5}	2.91×10^{-5}	3.24×10^{-5}	2.25×10^{-5}	1.86×10^{-5}

Table 3-5 Volume of Oil Spilled as a Function of Oil Handled, Tankships, 1973-1977

Category	1973	1974	1975	1976	1977
Volume handled (thousands of gallons) a/	1.429×10^{8} (0.515×10^{8}) a/	1.37×10^{8} (0.505×10^{8})	1.38×10^{8} (0.493×10^{8})	1.62×10^{8} (0.494×10^{8})	1.877×10^{8} (0.523×10^{8})
Volume spilled (thousands of gallons)	4,494	1,187	8,332	8,320 b/	9,800 c/
Spilled/handled ratio, all spills	3.14×10^{-5}	0.87×10^{-5}	6.04×10^{-5}	5.14×10^{-5}	5.22×10^{-5}

a/ Figures in parentheses ( ) are U.S.-flag only.
b/ Includes 7.5 million gallon spill from ARGO MERCHANT, 15 December 1976, 29 miles from shore.
c/ Includes 9.6 million gallon spill from HAWAIIAN PATRIOT, 24 December 1977, 120 miles from shore.

Table 3-6 Oil Releases in and Around the Waters of the United States from Tankbarges, 1974-1978

Type	Number of Incidents	Percent of Incidents	Outflow (thousands of gallons)	Percent of Outflow
Casualty-related	1,623	34	9,899	84
Operational	3,130	66	1,836	16
Total	4,753	100	11,735	100

Source: U.S. Coast Guard Pollution Incident Reporting Service. 1974-1978.

Table 3-7 Location of Cargo Releases from Tankbarge Transport Incidents (Spills over 500 gallons), 1973-1977

Location	Number of Incidents	Percent of Incidents	Outflow (thousands of gallons)	Percent of Outflow
Midcontinent river system and GIWW (pushed barges with drafts less than 10 feet)	93	64	5,446	75
Offshore, estuarian, and coastal ports (pushed or towed barges)	53	36	1,758	25
Total	146	100	7,204	100

Source: U.S. Coast Guard Pollution Incident Reporting System, 1973-1977.

or coastal ports and accounted for the remaining 25 percent of the volume (Table 3-7). Although statistics on the comparative amounts of cargo movement in these areas are not available, the Coast Guard's Computerized Tank Vessel File shows that 71 percent of total tankbarge capacity is dedicated to service on the Midcontinent and Gulf Intracoastal Waterway systems. These figures suggest that there is little difference in the spill rates between the various operating areas.

The type of incident that results in an accidental release, however, does vary from area to area, as shown in Table 3-8. The table indicates that groundings accounted for the bulk of the outflow in offshore and estuarian areas and coastal ports. In the Midcontinent and Gulf Intracoastal Waterway systems, however, collisions were responsible for the largest amount of outflow, with rammings also causing a significant amount.

Table 3-8 Location and Accident Types for Cargo Releases from Tankbarge Transport Incidents (Spills over 500 gallons), 1973-1977

Location	Accident Type				Total by Location	Percent by Location
	Collision	Grounding	Ramming	Other		
Midcontinent river system and GIWW (pushed barges 10 ft. draft)						
Number of spill incidents	23	24	21	25	93	63
Outflow (thousands of gallons)	2,788	757	1,744	157	5,446	75
Offshore, estuarian, and coastal ports (pushed or towed barges)						
Number of spill incidents	6	27	6	15	54	37
Outflow (thousands of gallons)	29	1,576	86	67	1,758	25
Total						100
Number of spill incidents	29	51	27	40	147	
Outflow (thousands of gallons)	2,817	2,333	1,830	224	7,204	

Source: U.S. Coast Guard Pollution Incident Reporting System, 1973-1977.

The average annual volume of accidental releases from tankbarges is estimated at approximately 2 million gallons. The data in Tables 3-7 and 3-8 indicate that 75 percent of this volume is introduced into the Midcontinent and Gulf Intracoastal Waterway systems.

TANKBARGE ACCIDENT ANALYSIS BY LOCATION

A recent study sponsored by the Coast Guard and covering the period 1972-1976 addressed the location of accidents on the Gulf

Intracoastal Waterway (GIWW) and the Midcontinent River system, which includes

1. The upper, central, and lower Mississippi;
2. The Arkansas River;
3. The Missouri River;
4. The Illinois Waterway;
5. The Monongahela River;
6. The Ohio River;
7. The Allegheny River;
8. The Kentucky River;
9. The Kanawha River;
10. The Arkansas River;
11. The Tennessee River;
12. The Cumberland River; and
13. The Black Warrior, Warrior, and Tombigbee River System.

A total of 2,063 collisions, rammings, and groundings involving a towboat-barge configuration were reported to have occurred in these waters during the period. Eighty-six percent of the accidents occurred on four waterways--the Mississippi, the Ohio, the Illinois Waterway, and the Gulf Intracoastal Waterway (GIWW) West, as illustrated by Table 3-9. Except for the GIWW East, with 114 accidents (6 percent of the total) and the Tennessee River with 85 (4 percent of the total), fewer than 20 accidents were reported on any other waterway.

The distribution of accidents was determined by counting the number in specific 10-mile segments. Accidents on the nine waterways with relatively low accident frequencies were dispersed in both location and time. On the five waterways with high frequencies, accidents had occurred more often at specific locations. Thirty-eight 10-mile segments were identified where 10 or more accidents occurred during the study period. Tables 3-10 through 3-14 illustrate the findings by mile segment and accident type, with the mile segment defined as the midpoint of the 10-mile segment.

The 38 segments all have bridges or locks or a combination of bridges and locks. These 38 segments, with less than 10 percent of the total miles within the five river systems, accounted for 631 out of the 1,552 barge accidents on those river systems, or more than 40 percent.

THE EFFECTIVENESS OF DOUBLE-HULL TANKBARGES IN PREVENTING OIL POLLUTION

The Coast Guard has attempted to match each oil release shown by the Pollution Incident Reporting System (PIRS) with Commercial Vessel Casualty (CVC) reports to develop a profile of tankbarge oil spills. Despite this effort, considerable inaccuracies exist in the data. E.G. Frankel has further refined the Coast Guard data and presents

Table 3-9 Towboat/Barge Accidents by Location and Type

River/Waterway	Accident Type			
	Collisions	Rammings	Groundings	Total
Mississippi to Mile 125	75	123	15	213
Mississippi from Mile 125 to Cairo	85	110	90	285
Upper Mississippi	18	178	87	283
Ohio	38	220	88	346
Illinois	20	124	21	165
GIWW West	229	173	71	473
GIWW East	27	46	41	114
Cumberland	0	10	6	16
Allegheny	0	3	1	4
Monongahela	0	14	2	16
Missouri	0	6	2	8
Kanawha	0	8	2	10
Arkansas	0	5	1	6
Kentucky	0	0	0	0
Tennessee	4	48	33	85
Other rivers	4	23	12	39
Total accidents	500	1091	472	2063

Source: U.S. Coast Guard's Report of Vessel Casualty or Accident (CG-2692), Towing Addendum (CG-4724), and supplemental narrative statements for fiscal years 1972-1976.

Table 3-10 Location of Accidents on the Upper Mississippi River by Mile Segment and Type

Mile Segment	Number of Accidents			
	Collisions	Rammings	Groundings	Total
040	0	2	9	11
050	1	3	17	21
180	0	13	1	14
200	2	15	17	34
270	0	11	0	11
380	0	12	1	13
400	0	13		14
Total	3	69	46	118
Total all segments[a/]	18	178	87	283
Percent sample to total	17	39	53	42

Source: U.S. Coast Guard's Report of Vessel Casualty or Accident (CG-2692), Towing Addendum (CG-4724), and supplemental narrative statements for fiscal years 1972-1976.

a/ from Table 3-9.

Table 3-11 Location of Accidents on the Lower Mississippi River from Mile Point 125, by Mile Segment and Type

Mile Segment	Number of Accidents			
	Collisions	Rammings	Groundings	Total
170	6	6		12
220	5	5		10
230	3	16		19
440		9	2	11
530	2	15		17
Total	16	51	2	69
Total all segments[a]/	85	110	90	285
Percent sample to total	19	46	2	24

Source: U.S. Coast Guard's Report of Vessel Casualty or Accident (CG-2692), Towing Addendum (CG-4724), and supplemental narrative statements for fiscal years 1972-1976.

a/ from Table 3.9

Table 3-12 Location of Accidents on the Ohio River by Mile Segment and Type

Mile Segment	Number of Accidents			
	Collisions	Rammings	Groundings	Total
280	1	15		16
340	1	12		13
600	1	11	5	17
780	1	5	4	10
810	1	6	3	10
840	—	11	—	11
850	1	7	5	13
940	—	10	4	14
980	—	10	—	10
Total	6	87	21	114
Total all segments a/	38	220	88	346
Percent sample to total	16	40	24	33

Source: U.S. Coast Guard's Report of Vessel Casualty or Accident (CG-2692), Towing Addendum (CG-4724), and supplemental narrative statements for fiscal years 1972-1976.

a/ from Table 3-9

Table 3-13 Location of Accidents on the Illinois Waterway by Mile Segment and Type

Mile Segment	Number of Accidents			
	Collisions	Rammings	Groundings	Total
040	1	14	2	17
160		21		21
210	1	8	1	10
270		8	4	12
290	1	14	1	16
300	5	11		16
Total	8	76	8	92
Total all segments a/	20	124	21	165
Percent sample to total	40	61	38	56

Source: U.S. Coast Guard's Report of Vessel Casualty or Accident (CG-2692), Towing Addendum (CG-4724), and supplemental narrative statements for fiscal years 1972-1976.

a/ from Table 3-9

Table 3-14 Location of Accidents on the GIWW-West

Mile Segment	Number of Accidents			
	Collisions	Rammings	Groundings	Total
10	4	12	1	17
50	6	11	1	18
60	10	13	3	26
90	12	24	4	40
100	13	9	3	25
110	12	4	—	16
120	17	1	4	22
170	8	5	6	19
240	7	8	4	19
280	8	10	3	21
400	—	14	1	15
Total	97	111	30	238
Total all segments a/	229	173	71	473
Percent sample to total	42	64	42	50

Source: U.S. Coast Guard's Report of Vessel Casualty or Accident (CG-2692), Towing Addendum (CG-4724), and supplemental narrative statements for fiscal years 1972-1976.

a/ from Table 3-9

them as a volume-to-incident percentile distribution. (Frankel's report is listed in the references at the end of this chapter.)

Using Frankel's data base as a starting point, and restoring those accidents that he eliminated because the barges involved were outside the scope of the regulatory proposal, the Committee developed the curves shown in Figures 3-1 and 3-2. These curves show, by type and location, the volume of oil releases versus incident distributions for barge accidents. All show a similar distribution. The chief point that stands out is that a small number of accidents, regardless of location or type, caused most of the loss of oil resulting from barge accidents. From Figure 3-2, for example, it can be seen that, for all accidents, 90 percent of the incidents caused 30 percent of the volume spilled. That means that the 10 percent remaining caused 70 percent of the volume spilled.

The regulatory analysis that accompanied the Coast Guard proposal has been criticized on grounds that it overstates the effectiveness of double hulls. To quantify that effectiveness, the analysis multiplies the percentage of volume of releases attributable to hull damage by the effectiveness of double hulls as determined by the analysis. The value thus obtained was originally interpreted by the Coast Guard as representing the amount of spillage that would have been prevented. This was in error, since it assumed a linear relationship between volume and incident percentile rather than the logarithmic relationship demonstrated by the curves of Figures 3-1 and 3-2. If the Coast Guard's assumption with respect to effectiveness of double hulls is accepted (i.e., 95 percent) but applied to the skewed curve of Figure 3-2 by entering the curve with the 95 percent "effectiveness" (i.e., incident percentile), a reduction in volume lost through accidents of slightly less than 50 percent is indicated. In other words, the saving in pollution is only half that derived by the Coast Guard.

In comparison, Frankel states that about 20 percent of the oil pollution caused by barge hull failure is preventable by the use of double hulls. In a similar but reverse procedure, entering the curve of Figure 3-1 at 20 percent volume percentile, it can be seen that the effectiveness of double hulls in preventing penetration of the inner hull is only about 85 percent. The difference emphasizes the fact that the skewness of the volume-versus-incident percentile makes any judgment of effectiveness based on volume reductions extremely sensitive.

Certain catastrophic causes of oil spills, such as severe collisions or the overturning of barges on bridge abutments, cannot be prevented by barge design. In almost every year for which data are available, a single barge accident has caused 20 percent or more of the total loss attributable to hull damage. Frankel's report provides a list of the amounts of oil lost in barge accidents from 1973 through 1977. The five most serious accidents accounted for 44 percent of the

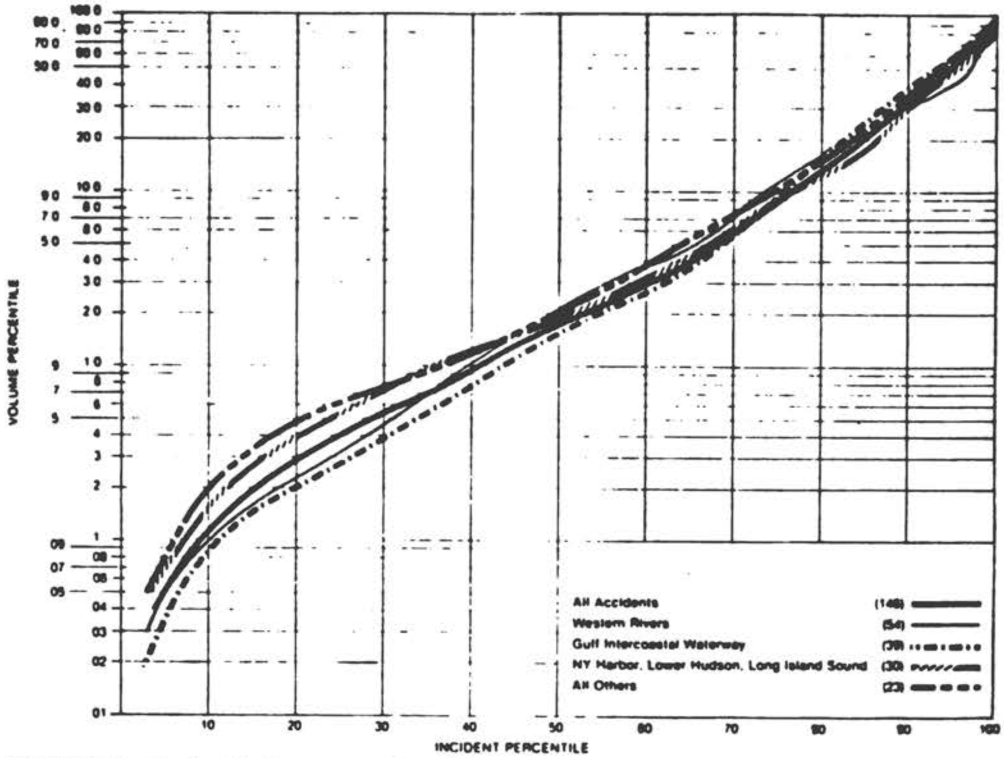


FIGURE 3-1 Volume of oil releases for barge accidents by location.

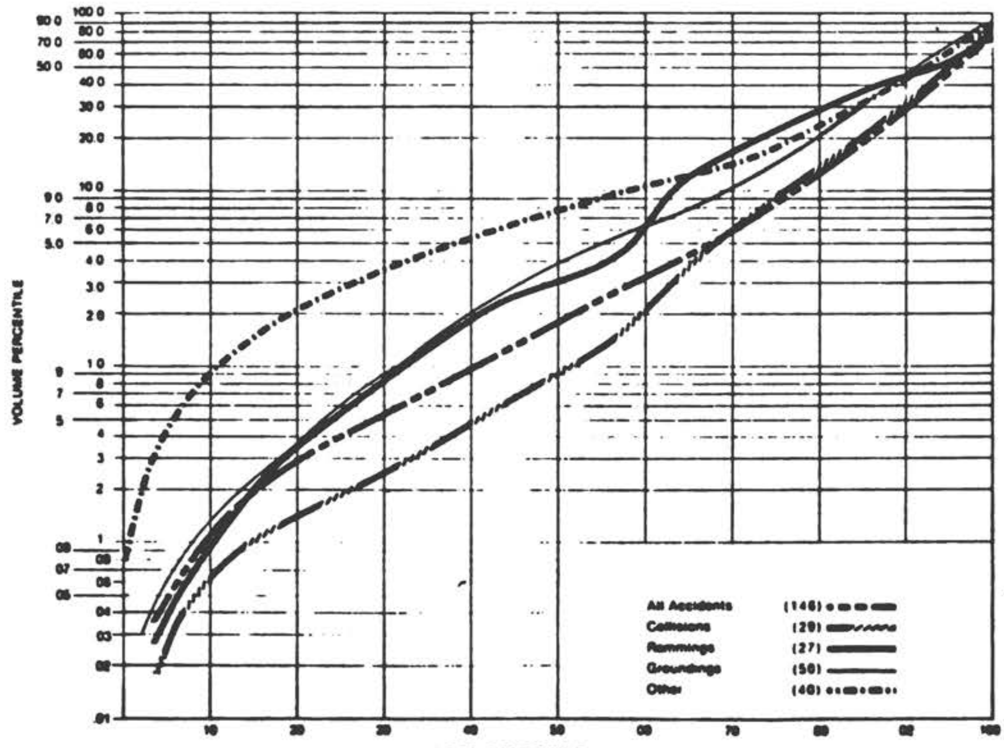


FIGURE 3-2 Volume of oil releases for barge accidents by type.

oil lost because of hull damage, and there is little that distinguishes the events that led to those massive spills from the more numerous incidents that resulted in little or no loss of oil.

Any attempt to compare the environmental impact of large spills with the impact of the more numerous smaller spills, or to compare the effectiveness of clean-up efforts on the basis of spill size, would be a major task. These matters deserve consideration, however, since the costs and impact of a small spill can be much greater than those of a large spill because of such factors as water temperature or the closeness of the release to ecologically sensitive areas. There are thus valid reasons to go beyond "dollars saved per barrel of spilled oil prevented" in determining the effectiveness of measures to prevent oil pollution from tankbarges.

Double-Hull Effectiveness Survey

The Coast Guard's regulatory analysis concludes that double hulls would prevent oil releases in 96.6 percent of future barge accidents. This figure is based on a special survey of damage to tankbarges conducted during 1973. A similar figure (95.5 percent) was obtained by comparing the spill rates for double-hull and single-hull tankbarges listed in the CVC file for fiscal year 1973. However, a relatively small number (61) of the reported incidents for that year involved double-hull barges.

The sensitivity of the measure of effectiveness of double hulls to the volume distribution of spills prompted a survey of the effectiveness of double-hull barges in actual conditions. This survey, while meaningful, should not be misinterpreted. Most double-hull tankbarges are used to carry chemicals and operate under conditions that are not identical to those of single-hull barges. The value of, and the hazards presented by, the chemical cargo dictate different handling procedures, but the differences in procedures and their effect on the susceptibility of the barges to damage have not been analyzed.

The Coast Guard's List of Inspected Tankbarges and Tankships was sorted to compile a list of tankbarges with double hulls. The number of double-hull barges certificated for the various routes is shown in Table 3-15, along with the number of tankbarges permitted to carry oil. This list contains both active and inactive barges and includes some barges not certified to carry oil. (The totals therefore differ slightly from those of Frankel.)

Meanwhile, the Commercial Vessel Casualty file for fiscal years 1974 through 1978 made it possible to compile a list of reported collisions, rammings, groundings with damage, and material failures involving barge structure. (The CVC file did not list all accidents, since only those that exceed specified limits of injury or property damage must be reported.)

Table 3-15 Tank Barge Populations by Route

Route	Route Code	Double Hulled Barges	Total Oil Carrying Barges
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	32
Total		1277	3882

Source: Coast Guard List of Inspected Tank Barges

Table 3-16 Double-Hulled Barges Collisions, Rammings, Groundings and Material Failures, Nature and Extent of Damages, FY 1973-1978

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	5a/	14/0	17/4	8/1
Material failure	0	2	0/0	1/1	0/0
Others b/	8	1	0/0	2/0	0/0
Totals	207	54	128/2	73/9	10/1

Source: Commercial Vessel Casualty File.

a/ Includes one incident where inner hull was ruptured

b/ Includes unclassified failures and some barge breakwaves

The two lists were then compared to identify accidents involving double-hull barges. Out of a total of 691 such accidents, there were 472 for which there was sufficient information to determine whether the outer and inner hulls were penetrated. The results are shown in Table 3-16. Further screening was undertaken to identify cases where the side or bottom of a loaded double-hull barge was penetrated, since more than 75 percent of the incidents involving penetration of the hull involved loaded barges. The results are shown in Table 3-17.

Penetration of the inner hull was avoided in nearly 90 percent of the accidents involving penetration of the side of an unloaded barge. This percentage dropped only slightly, to 89 percent, when loaded barges were considered. The added momentum of a loaded barge therefore only slightly reduced the effectiveness of the double hull in preventing penetration of the inner hull.

Penetration of the inner bottom did not occur in 88 percent of the accidents involving penetration of the outer bottom of unloaded barges. This percentage was reduced to 83 percent for loaded barges. Thus, for both loaded and empty barges the effectiveness of the double bottom compared favorably to that of double sides.

The 83 accidents in which double-hull barges sustained penetration of the inner side or bottom were categorized according to certificated route and type of waters in which the accident occurred. This is shown in Table 3-18. The frequency of penetration of the hull was approximately the same, regardless of route. No data were available to determine the amount of time spent in various waterways by either single- or double-hull tankbarges. Therefore, no conclusions regarding comparative risk can be made.

In addition, the length, route, subchapter of certification, and hull type were determined for the 79 double-hull barges involved in these 83 accidents. The results are shown in Table 3-19.

Given these statistics, the following observations can be made:

- In 265 of the 472 incidents studied, penetration of the outer hull occurred. Penetration of the bow, stern, or deck occurred in 128 (27 percent) of the 472 incidents. In view of this penetration rate, carrying oil in the end spaces of these barges is an unacceptable risk. Most operators, recognizing this risk, do not load oil in these spaces.

- If the operation of a double-hull oil tankbarge were to parallel the current operating practices of the double-hull fleet, the immediate breaching of the inner hull could be prevented in more than 88 percent of the accidents. (This assumes that an accident in which the outer hull of a double-hull barge would be penetrated would also result in the penetration of a single-hull barge.) A reduction of 88

Table 3-17 Loaded Double-Hull Barges Collisions, Rammings, Groundings and Material Failures Bottom and Side Penetration, FY 1973-1978

Incident Type	Side (Holed Outer Hull/Holed Inner Hull)	Bottom (Holed Outer Hull/Holed Inner Hull)
Collisions	20/1	0/0
Rammings	17/1	0/0
Groundings	16/3	6/1a/
Material failure	1/1	0/0
Othersb/	1/0	0/0
Totals	55/6	6/1

Source: Commercial Vessel Casualty File

a/ Load condition of one barge unknown

b/ Includes unclassified failures and some barge breakaways

Table 3-18 Double-Hulled Barge Incidents Resulting in Side or Bottom Penetration, Classified by Route and Location of Incident

Location of Incident	Number of Incidents (by route) (Holed Outer Hull/Holed Inner Hull) LL	LG	LC	GG	OO
Inland Atlantic	4/0	1/0			
Inland Gulf	20/3	3/1	1/0	1/0	
Western Rivers	46/4	2/0	1/1	2/0	
Great Lakes	1/0				
Atlantic Ocean					1/0
Totals	71/7	6/1	2/1	3/0	1/0

Source: Coast Guard List of Inspected Tank Barges.

Note: There were no incidents causing penetration of the hull of double-hulled barges reported for the Inland Pacific, in foreign waters or in the ocean waters of the Pacific, Arctic, Caribbean or Gulf.

Table 3-19 Characteristics of Double-Hulled Barges Having Sustained Side or Bottom Penetration

Length	Route					Subchapter			Hull Type		
(feet)	LL	LG	LC	GG	OO	D	O/D	O/I	1	2	3
	(Barges with Holed Outer Hull/Barges with Hcled Inner Hull)										
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			10/1	28/3		2/0	18/1	18/3
216-270	9/2	1/0		2/0		5/2	6/0	1/0		5/0	7/2
271-305	21/3	1/1			1/0	13/2	10/2		1/0	11/4	11/0
> 305	1/0						1/0				1/0
Totals	69/8	5/1	2/1	2/0	1/0	29/5	49/5	1/0	4/0	35/5	40/5

Source: Coast Guard List of Inspected Tankbarges.

percent in the number of penetrations would mean a reduction of 28 percent in the volume of oil spilled (see Figure 3-1).

Estimating the Effectiveness of Double-Hull Construction Standards

It is possible, utilizing the material presented in the previous section, to determine the amount of oil pollution that would be prevented by the Coast Guard's proposed regulations.

In the determination that follows, it should be realized, however, that actual determination of the amount spilled depends on a number of uncertainties. The values determined, therefore, should not be considered exact, rather an approximation of the numerical value given.

Double-hull construction has been shown to prevent the penetration of the cargo space in 88 percent of the grounding incidents and in 90 percent of the collision and ramming incidents involving tankbarges. Using the volume percentile versus incident percentile curves in Figure 3-2, we would expect to find the following approximate reductions in outflow:

- 45 percent, or 210,000 gallons, per year of the outflow resulting from rammings and groundings of single-hull tankbarges would be prevented through the use of double hulls.

- 30 percent, or 280,000 gallons, of the annual outflow resulting from collisions of single-hull tankbarges would be prevented by the use of double hulls.

In addition, the outflow from hull ruptures and leaks not directly related to a particular accident and assumed to be preventable by double-hull construction and current inspection procedures would amount to more than 200,000 gallons per year. Double-hull construction of barges, therefore, could prevent the loss of 690,000 gallons of oil per year from tankbarges.

Oil releases from tankbarges that would not be prevented by a change to double hulls would include approximately 360,000 gallons per year from operational spills and 910,000 gallons from infrequent catastrophic accidents.

If the same effectiveness measures are applied to the outflow at the location groupings, as in Table 3-20, it can be seen that the reduction in pollution by type of accident would vary greatly by location. Given the differing patterns of tankbarge service, and the different patterns of accidents, it is unlikely that a requirement of

Table 3-20 Volume of Pollution Reduction Due to Double Hull Construction

	Type of Accident (in gallons)		
Location	Grounding	Collision and Ramming	Total
Western Rivers and GIWW	70,000	270,000	340,000
Others	140,000	7,000	147,000

double hulls for all tankbarges carrying oil would prevent oil releases from all catastrophic accidents.

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7. Joint Maritime Administration/Coast Guard Tank Barge Study, October 1974

CHAPTER 4

TECHNICAL ALTERNATIVES TO THE COAST GUARD PROPOSALS

This chapter discusses various aspects of design, structure, inspection, repair, and maintenance alternatives to the Coast Guard's proposals for double-hull tankbarges and the phasing out of single hulls. Several alternatives were identified that appear to provide cost-effective methods of reducing the amount of oil lost as a result of tankbarge accidents, and these alternatives deserve serious consideration by the Coast Guard. It is apparent, however, that a lack of information makes it difficult to compare the effectiveness of the many alternatives noted by participants at the workshop. This chapter therefore also raises six questions that should be given further consideration by the Coast Guard.

STRUCTURAL ALTERNATIVES

Possible structural alternatives to the Coast Guard's proposals include thicker hull plates, improved frame scantlings, the elimination of serrated frames, larger radius knuckles, additional rub bars, and changes in the size of cargo compartments. First, however, the Coast Guard should give consideration to revising the scope of its double-hull proposal.

Option 1--Reducing the Scope of the Double-Hull Proposal

The general consensus of the Committee is that the Coast Guard's proposal is too broad and all-encompassing. Operating conditions on inland rivers, intracoastal waterways, the Great Lakes, and ocean waters are so different that the mere substitution of double hulls for single hulls would appear to be too simplistic a way of dealing with the problem of oil spills from tankbarges.

Ocean-going tankbarges and tankbarges on the Great Lakes, for example, may only come into contact with a pier once a week. This contact is made under closely supervised conditions and in areas where spills can readily be controlled. Furthermore, these tankbarges are operated singly. Therefore, there is no reason to expect that they will suffer side damage from other barges in the same tow. Under these circumstances, it is difficult to see how double sidewalls (which would constitute part of the double hull) would make a significant contribution to reducing oil spills from tankbarges on the oceans or the Great Lakes.

The need for double bottoms (which would also constitute part of the double hull) for ocean and Great Lakes tankbarges is more difficult to assess. There have been tankbarge groundings in these environments that have resulted in significant spills, but it is difficult to know if double bottoms would have changed the outcome.

It should be noted in any case, however, that under new regulations that have been thoroughly debated, it is acceptable to carry petroleum in single-hull tankships. If that is acceptable, it is difficult to understand why it would not be equally acceptable to carry petroleum products in single-hull tankbarges operating in the same environment.

Mode of operation, furthermore, is sometimes more significant than the type of waters in which the tankbarge operates. A single-hull ocean-going tankbarge, for example, can also be operated on the lower part of the Mississippi River, where it will continue to operate in its normal fashion, that is, singly with a tug. And like tankbarge operations on the oceans and the Great Lakes, operations on the intracoastal waterways are also quite different from those on inland rivers. Tankbarges on the intracoastal waterways operate only in single file, with tow lengths not allowed to exceed 1,180 feet.

Another point that should be made with respect to requiring double hulls for Great Lakes and ocean-going tankbarges pertains to their procurement by towing companies. Ordinarily, such double-hull tankbarges would only be purchased one or two at a time. This would seriously retard the development of cost-efficient construction techniques similar to those that have been developed to reduce the cost differential between single-hull and double-hull tankbarges built for use on inland rivers.

In addition to considering the waters on which tankbarges operate and their mode of operation, it is also necessary to consider the products carried by the tankbarges. If asphalt, for example, leaked from a cargo compartment into the double bottom of a tankbarge, the cost of removing it might be very high. Asphalt leaking from a single-hull tankbarge, on the other hand, would simply sink to the bottom of the waterway. Similar arguments could probably be made for other products that are essentially nonpolluting but that might impose significant costs on towing firms if they leaked out of cargo compartments into the double ends, sides, and bottoms of a double-hull tankbarge.

Option 2--Thicker Hull Plates

The standard plate thickness today on single-hull tankbarges is 3/8 inch with normal frame spacing. Increasing plate thickness from 3/8 to 5/8 inch (a 66 percent increase) would strengthen existing single-hull tankbarges and reduce the number of small leaks resulting from routine operational side and end damage, and from minor collisions.

Option 3--Improved Frame Scantlings

The framing and other interior supports of tankbarges combine with the plating to provide structural integrity. Increased scantlings, and improved structural details, would help to maintain a balanced hull structure and thus do much to reduce the incidence of small spills. The design of the total tankbarge must be a balanced one. Heavy plating without the internal structure to support it will not achieve its full strength, while heavier framing without plating of the appropriate thickness will lead to premature punching and tearing of the plating. Attention to structural details is important to ensure that the stresses caused by the load are distributed as equally as possible among all the structural components.

Option 4--Elimination of Serrated Frames

Serrated frames serve different purposes, including reducing the weight of barges and allowing oil or other fluid cargo to flow unimpeded to the vessel's lowest point, from which it is pumped. If a barge's hull receives a hard exterior impact, the serrated frames may be forced into the hull. These intrusions may create "thin spots" that result in cargo leakage. Nonetheless, eliminating serrated frames would have to be carefully analyzed, since these frames do improve the efficiency of barges. Limber holes could be used as an alternative to serrated frames and would partially satisfy the need for good cargo flow.

Option 5--Larger Radius Knuckles

The knuckles are the bent plates along the entire length of the tankbarge where the deck plate joins the side plate and where the bottom plate joins the side plate. A knuckle with a small radius is more apt to crack following repeated contact with external objects than a knuckle with a large radius. Increasing the size of the radius would reduce the possibility of cracking as a result of operational wear and thus would reduce oil leakage from single-hull tankbarges.

Option 6--Additional Rub Bars

Exterior rub bars are placed on the sides and bottom of tankbarges; they are aligned either laterally for additional protection against minor collisions and for overall strengthening, or vertically to reduce damage from abrasion. Additional rub bars are a good way to help cushion the contact of a barge with a fixed object, such as a pier or the gateway of a lock.

Option 7--Changing the Size of Cargo Compartments

One means of reducing the volume of oil spills from tankbarges would be to increase the number of oil-carrying compartments by making each compartment smaller. A hole in a small compartment, in most cases, will result in less oil spillage than a hole in a large compartment. Double-hull tankbarges tend to have larger compartments than single-hull barges, and it was noted at the workshop that these larger sizes, when ruptured, have on some occasions produced larger spills.

NONSTRUCTURAL ALTERNATIVES

Option 1--Reconsider the Schedule for Phasing Out Single-Hull Tankbarges

It is generally accepted that the Coast Guard's proposal for the retirement of single-hull barges 20 years old or older after 1985 would have unpleasant consequences for the tankbarge towing industry. These tankbarges represent a substantial portion of the equity of many companies. Since most of the barges have not been fully depreciated, their early retirement would make it difficult, if not impossible, for the companies to borrow the money they would need to replace their present tankbarges. Normal retirement would permit these companies to make the transition to double-hull tankbarges in a more orderly and financially acceptable way. One way to speed up the retirement of older single-hull tankbarges would be to offer tax advantages or other financial incentives to the companies for doing so.

Option 2--Improved Inspection of Existing Tankbarges

Improved inspection and repair standards for existing single-hull tankbarges are a workable alternative to the proposed phasing-out. This alternative would rightly place the greatest burden on that portion of the tankbarge industry that attempts to operate with substandard or only marginally acceptable equipment.

The Coast Guard has already instituted an improved inspection program, and the initial results are quite positive. Additional data should be accumulated before further consideration is given to requiring accelerated retirement. As an alternative to retirement, the Coast Guard should make sure that the amount of wastage (rust and corrosion) permitted prior to replacement concurs with American Bureau of Shipping (ABS) standards. Requirements for heavier replacement plating and framing, or other structural requirements, should also be considered.

Option 3--Advanced Technology

The Port and Tanker Safety Act of 1978 noted that standards developed through regulation should incorporate the best available technology. A number of unusual alternatives were suggested during the workshop. These included such things as elastomer fendering strips, elastomer sheathing over tankbarge sides and bottom, and internal sealing materials that would close off small cracks or penetrations. None of these ideas has been developed to the point of determining if they are feasible. One point worth noting, however, is that insofar as inland barges are concerned, the cost of alternatives such as these would probably be far in excess of the estimated 15 to 20 percent increase in cost for the construction of new double-hull tankbarges.

QUESTIONS REQUIRING FURTHER STUDY

Barge Construction Costs

Comparisons of the costs of similar-size single-hull and double-hull barges have been confused by the failure to properly sort out data. That is, the costs of ocean-going barges have not been distinguished from the costs of special-purpose or standard river barges.

The cost of building double-hull ocean-going barges is markedly higher than the cost of single-hull barges. This is because very few ocean-going barges have been built with double hulls and builders have very little experience in making such vessels. A second reason is that ocean-going units are usually built one or two at a time, and builders do not have the opportunity to optimize construction techniques.

The additional steel needed and the somewhat higher labor costs per double-hull barge explain the cost differential between single- and double-hull barges used on the river system. While some yards are presently geared up for double-hull construction, many are not.

Special situations sometimes arise that emphasize the difficulties in establishing cost differentials. One example of a special situation that resulted in one of the highest cost differentials was the substitution of a double-hull for a single-hull barge where a height restriction made it impossible to put a trunk on the double-hull barge to provide the desired volumetric capacity. The only alternative was to make the double-hull barge substantially longer than the single-hull barge would have been.

For inland river barges of equal deadweight and volumetric capacity, a double-hull barge will probably cost 15 percent to 20 percent more than a single-hull barge, depending on market conditions, technical specifications, and delivery needs. The Coast Guard should make more complete analyses of comparative costs.

Definition of Single-Hull Construction Standards

Many single-hull barges are currently being built to higher scantling standards than minimum rules require. It may therefore be easy to require these higher scantling standards in conjunction with other technical changes. These new scantling standards would have to be defined. The effect would probably be to improve single-hull barge construction from several different standpoints.

Cost of Improved Single-Hull Construction

As an alternative to double-hull construction, a number of recommendations have been made earlier in this report to raise construction standards for single-hull barges. Any meaningful economic comparison between single-hull and double-hull construction must include the cost of higher standards for single-hull construction.

Barge Deadweight Carrying Capacity

There was considerable discussion within the workshop group on the deadweight capacity of single-hull and double-hull barges. Differences on this issue may have been caused by the inclusion of data on the ocean-going fleet and by the fact that barges intended solely for operation on the intracoastal waterway have deadrise in order to improve their maneuverability, whether they are single- or double-hulled.

The only significant data base available is for barges built for river service. The standard double-hull river barge has a flat bottom, while the standard single-hull river barge has 6 or 7 inches of deadrise. Assuming they are built to the same construction standards, a double-hull barge will have about the same deadweight capacity as a single-hull barge of equal size and volumetric capacity.

Possibility of Gas Explosions in Double-Hull Barges

Some concern has been voiced about the possibility that gases might accumulate in the void spaces of double-hull barges and perhaps explode. The use of double-hull barges on the inland and intracoastal waterways thus far offers no substantial evidence that this is a significant problem.

It is also true, however, that there is a lack of understanding as to why it has not been a problem. The gases in the voids may be too rich or too lean to ignite, or it may be that barge operators have been successful in keeping sources of ignition away from the voids. An explanation of the reason or reasons why explosions have not occurred would be helpful in preventing future problems.

Strength Assessment of Barge Types

Structural and nonstructural alternatives discussed in this chapter offer other ways of reducing oil pollution from tankbarges. Their cost, in most cases, would be considerably less than the cost of double-hull construction, and financing problems would be eliminated. These technical alternatives become even more significant in light of Frankel's estimate that double hulls would reduce the amount of oil spilled by only 20 percent, as opposed to the Coast Guard's estimate of from 28 to 50 percent. (The Frankel report is listed in the references for Chapter 3.)

During the workshop, a number of questions were raised about Frankel's structural assessment of single-hull and double-hull tankbarges. The most significant deficiency in the analysis, it was said, was the selection of barge designs. The single-hull design chosen by Frankel was a modern one with all-longitudinal framing and thicker plating. The double-hull design, however, was an old one that generally has been abandoned because of a number of structural problems. It had a combination of longitudinal and transverse framing, whereas later barges were entirely longitudinally framed. Modern double-hull barges will absorb greater energy from collisions and provide greater protection against limited spills than single-hull barges, regardless of any improvements in the latter's scantlings.

The structural assessment made by Frankel, however, demonstrates the need for improved methods of estimating the amount of energy a structure can absorb in a collision. The methods available today are heavily dependent on assumptions made in analyzing specific problems, and small changes in the assumptions can cause large changes in the results. Any real improvement in these methods will only come as a result of extensive analytical and experimental work.

The statistical data available provide some information on the effectiveness of double-hull barges in reducing the number of oil spills. These data are included in Chapter 3. In essence, the double-hull barge is effective in preventing a spill when the force of an accident is large enough to cause penetration of the outer shell but not large enough to cause penetration of the inner one. In catastrophic accidents, it is unlikely that either type of hull structure will prevent a spill.

CHAPTER 5

PERSONNEL STANDARDS, TRAINING, AND ENFORCEMENT

It is well documented that human error is a major cause of the accidents that result in oil pollution from tankbarges. Studies of the causes of such pollution have concluded that a majority (66 percent) of oil spills occur during transfer operations, as shown in Table 3-6. The table also indicates, however, that the volume of oil spilled during transfer operations is a small portion (16 percent) of the total volume spilled.

Even when hull damage or equipment failure is the immediate cause of oil pollution, human error is often responsible for the hull damage or equipment failure. The navigation error that leads to a collision or a grounding, or improper maintenance and operating practices that result in equipment failure, are the acts or omissions of human beings, even though they may not be classified as such. Even well-trained and conscientious personnel can cause accidents when fatigued or preoccupied by concerns other than their work.

PRESENT REGULATIONS

Personnel who navigate tankbarges in tow are required to hold a license that qualifies them to act as an Operator of Uninspected Towing Vessels. The personnel responsible for transferring cargo to or from tankbarges are required to hold tankerman certificates, which are valid for life.

Tankerman

The eligibility criteria for obtaining a tankerman certificate are as follows. First, the applicant must submit to the Coast Guard what the Coast Guard deems to be satisfactory documentary evidence that the applicant has been trained to perform, and is capable of performing efficiently, those tasks on tankbarges that pertain to the handling of cargo. The applicant also must pass both a physical examination and a written or oral examination during which he must demonstrate that he is familiar with cargo tanks, suction and discharge pipelines and valves, and cargo pumps and hose; that he has been properly trained in the operation of cargo pumps and in all other tasks pertaining to the loading and discharging of cargo; and that he understands and is capable of operating fire-extinguishing equipment. Finally, the applicant must demonstrate knowledge of water pollution laws and an understanding of the procedure necessary for containing and cleaning up oil spills.

What constitutes satisfactory documentary evidence depends on the judgment of the local Coast Guard Officer-in-Charge, Marine Inspection (OCMI). This authority is granted to the OCMI to allow him to take account of variations in training programs or other factors. As a result, there may be some candidates who "shop around" for an OCMI who takes a more liberal view of the qualifications needed by a candidate.

The use of standardized written examinations has led to more uniform testing of each candidate's professional knowledge, but other factors appear to have reduced the validity of the examinations. The examinations should be changed more often, since the result now is that some students are taught to prepare for a specific test or specific types of questions instead of being taught job skills and general knowledge about barge operation and navigation.

When oil pollution incidents occur, the Coast Guard's policy is to institute proceedings leading to the assessment of civil penalties or criminal fines against the owner of the vessel. If it is believed that the incident was the result of negligence or inattention to duty by a licensed or documented individual, the Coast Guard usually initiates license suspension or revocation proceedings. It is not normal practice for the Coast Guard to seek to assess a monetary penalty against the individual while at the same time proceeding with suspension or revocation measures.

Towing Vessel Operator

The eligibility requirements for obtaining a license as an Operator of Uninspected Towing Vessels are well-defined. Problems exist in the administration of this licensing program, primarily in that the content of the examination is not specifically tailored to different geographical areas and the fact that the examinations are compromised because they are used for extended periods of time without change. Many applicants who have a substantial amount of experience in towing barges but who have poor reading ability have trouble passing the examination on the basis of knowledge of members of the Committee. Others, with little practical experience but with more academic background, find the test relatively easy.

NEW TANKERMAN REGULATIONS

Several years ago the Coast Guard proposed new regulations for the certification of tankermen. The proposed regulations encountered opposition from the barge industry. One of the requirements was that a tankerman had to attend a marine fire-fighting school. At that time there were only two such schools in the country, and neither could have handled the large number of students who would have sought admission as a result of the regulations. The proposed regulations also divided liquid cargoes into several classes, established a "restricted" tankerman classification, made the tankerman document renewable every 5 years, and required a tankerman endorsement on an officer's license to ensure that an officer had proper training and experience before being granted authority to supervise the handling of liquid cargoes.

Public comment on the proposal prompted the Coast Guard to review it and to begin work on a revised proposal. (On December 18, 1980, subsequent to the preparation of this text, the Coast Guard published in the Federal Register proposed regulations; they are not yet final as this report goes to press.)

Among other things, this proposal redefines and establishes more stringent qualifying criteria for individuals engaged in transporting and transferring various categories of oil and hazardous materials. The proposed regulations will require more officers on tankships to have the appropriate tankerman certification to ensure that licensed officers are available to serve as person in charge or tankerman or both and will expand the definition of tankerman and require the possession of a tankerman certificate for all merchant marine personnel aboard tank vessels involved in the handling or transfer of hazardous liquid cargo in bulk. In addition, the proposed regulations will require persons now posssessing tankerman certificates to meet the new upgraded qualifications, both the classroom training or testing and the minimum experience criteria.

WORKSHOP DISCUSSIONS

The workshop group agreed that it would deal with both pilothouse personnel and tankermen, since the former are often responsible for tankbarge spills due to collisions and groundings whereas the latter are usually responsible for spills during transfer operations. The group felt that a reduction of oil pollution to zero was impossible if oil was to continue to be transported by water.

The Coast Guard was criticized on grounds that it lacks enough personnel experienced in matters of inland water transportation, and it was said that this failing arose from the Coast Guard's organization. Because all Coast Guard officers are considered to be "line" officers, the Guard finds it necessary to transfer its officers frequently from one geographical location to another and from one specialized assignment to another. The purpose of these transfers is to maintain a ready cadre of qualified, "multi-mission" officers. This "jack-of-all-trades" policy has definite effects on the professional development of Coast Guard officers, it was said, one of which is to prevent them from developing full expertise in all the subject areas for which they are responsible. It also results in a lack of continuity among the personnel assigned to specific Coast Guard installations.

The Coast Guard itself, it should be noted, was aware prior to the workshop of criticisms of its training and assignment policies. In a report commissioned by the Coast Guard and completed in December 1979 it is pointed out that until about 1972 many of the officers dealing with merchant marine safety had originally been members of the Bureau of Marine Inspection and Navigation of the Commerce Department. (This cadre of about 450 officers had been transferred to the Coast Guard in 1942.) These officers were exempted from the statutory requirements under which regular officers of the Coast Guard must retire after specific periods of time if they fail to be selected for promotion. Considered to be limited-duty officers, the men who were transferred from the Commerce Department to the Coast Guard could--and for the most part did--remain in the field of merchant marine safety for the rest of their careers.

As these officers retired in the 1970s, they were replaced by regular Coast Guard officers. That had a twofold effect. First, the distribution of officers dealing with merchant marine safety shifted to resemble the distribution of officers, in terms of rank and experience, of the Coast Guard as a whole. Second, the limited-duty distinction was lost, and officers were not permitted to remain specialists in one area.

The Coast Guard believes that its policies, which require rotation from one specialty to another and transfers from one geographical area to another, allow its officers to learn to handle a wide range of tasks and are quite valid, given the diversity of the Coast Guard's legislated responsibilities. It believes that tours of duty in different specialties produce officers with a broad viewpoint who are therefore more effective policy makers. The Coast Guard also believes that its transfer policies produce not only a greater degree of regulatory standardization but also tend to preclude the conflicts of interest that have sometimes been a problem in the investigative and inspection branches of other regulatory agencies.

The 1979 report indicates Coast Guard acknowledgment that a lack of experienced officers in some areas, such as the investigation of casualties, is a problem. Certain possibilities for improvement are suggested in the report. One would be for the Coast Guard to find a way (probably through some type of legislation) to allow officers in certain specialities to remain in them if they wish to do so. Another would be to use civilians to supplement the ranks of its officers, specifically within the areas of marine inspection and investigation. The best source of such civilian personnel, the report suggests, would probably be retired Coast Guard officers.

The participants at the workshop strongly urged publication of the Coast Guard's revised regulations for tankerman certificates and agreed that representatives of the tankbarge industry should be given an early opportunity to comment on them. In the absence of published regulations, it was said, the training that is presently under way or that is being developed can only be based on supposition as to what will be accepted or required by the regulations. The workshop group also agreed that the revised regulations would be more appropriate if they allowed alternative methods of obtaining the requisite experience for qualification as a tankerman or a towing vessel operator.

Another suggestion made at the workshop was that the Towing Industry Advisory Committee, which served as a forum for discussions among Coast Guard, industry, and labor representatives, should be reinstituted. It was reported to the Committee later, however, that the Coast Guard has now created a Towing Safety Advisory Committee for this purpose as a result of recent legislation.

Coast Guard officials at the workshop disagreed with other participants on certain questions pertaining to radiotelephone communications. The Coast Guard representatives said that some of the communications problems, such as procedures, were not a part of their jurisdiction and fell under the authority of the Federal Communications Commission (FCC). Other participants said they were not suggesting that the Coast Guard license radio operators but rather that the Coast Guard should ensure that pilothouse personnel are trained in radio communication techniques and that Coast Guard resources should be used to assist the FCC in enforcing the laws on radio communications. It was also said that the inclusion of questions about communications on Coast Guard examinations would encourage more communications training.

Also discussed and critized was the lack of examination questions on areas that should be covered (such as cargo operations), the use of local or colloquial terminology in national examinations, and the poor format of many questions on the examination for Operator of Uninspected Towing Vessels.

The need for a "skill-performance-based" examination was stated, and the propriety of a coastal navigation problem on an examination for an applicant whose operations were wholly within rivers, bayous, canals, and buoyed channels was questioned. The Coast Guard's reluctance to remedy this situation by making greater use of pilot licenses for a "limited local area," as provided for by the Towing Vessel Licensing Act of 1972, was also discussed and criticized.

The workshop group also suggested that the Coast Guard reinstitute the "pollution open-book exercise" at the time of license renewal. This was seen as a valuable way of reminding licensed personnel of the importance of preventing pollution.

CHAPTER 6

THE OPERATING ENVIRONMENT OF TANKBARGES

The Coast Guard's proposal to require double hulls for oil tankbarges entails a structural modification intended to make tankbarges less susceptible to a release of oil because of the hazards of the operating environment. It appears to the Committee that a reduction of the hazards in the operating environment is a parallel and logical approach to achieving the same objective. The data presented to the Committee indicate that some accidents are so severe that even double hulls will not prevent a spill. In fact, as pointed out in Chapter 3, the very large spills that account for 70 percent of the volume of oil spilled from tankbarges would not have been prevented by double hulls. Therefore, new ways of preventing accidents through improvements in the operating environment seem worth investigating.

At the Workshop on Reducing Tankbarge Pollution the working group on the operating environment addressed a large number of alternatives to the Coast Guard's proposals. These included

- Vessel traffic service (VTS) systems and radiotelephone communications;
- Improved aids to navigation;
- Initial and maintenance dredging; and
- Better channel design and closer attention to the design and location of structures crossing or adjacent to waterways.

The overall objective of the working group was to find better ways of preventing accidents involving tankbarges. This is particularly important because any tankbarge is susceptible to damage if the force of an accident is sufficiently great.

In this connection, Tables 3-10 through 3-14 in Chapter 3 indicate that a large number of barge accidents occur in a relatively few short segments of the total waterways system of some 25,000 miles. The studies also indicate that the physical design of the operating environment is a factor in such accidents. While the data are insufficient to determine if catastrophic accidents involving tankbarges are equally likely to occur in these areas, they do suggest that efforts to eliminate the causes of accidents might focus on a relatively small portion of the waterway system. They also suggest that effort to clean up oil spills can be localized, thereby minimizing their costliness.

Two of the alternatives proposed by the Workshop working group are related to protection of the natural environment. The first of these was that there should be an in-depth study of the long-term ecological effects of oil pollution. One of the papers presented at the Workshop, using data on total petroleum hydrocarbons in river outflows rather than relying solely on reports of oil releases from barges, concluded that barge spills accounted for less pollution than shown by Coast Guard estimates. In connection with the proposed study, a suggestion was made to examine the benefits of using oil-dispersing agents to supplement natural forces. Such a study might show that less stringent preventive measures may be acceptable where natural forces quickly reduce the adverse effects of oil spills.

The second alternative involves adequate and timely dredging to maintain project depth. Ironically, the continuing efforts of environmentalists to restrict dredging in navigational channels seem likely to increase the possibility of oil spills by making it more likely that tankbarges will run aground. The depth and width of the navigation channel have a profound effect on safe operation. If channel depths are less than authorized project depth, the risk of groundings or sinkings (and the subsequent risk of environmental damage resulting from oil spills) clearly increases. While operator judgment must always be considered a potential factor in tankbarge accidents, such physical constraints as inadequate channel depth and width reduce the operator's margin of error. Under certain environmental conditions, this reduction in the margin of safety may be crucial.

Notwithstanding environmentalist concerns about increased turbidity and damage to the riverbed ecosystem, some accommodation should be reached on dredging to reduce the possibility that tankbarges may run aground in navigable channels. This alternative needs objective examination.

Most of the other alternatives, it is believed, would not raise significant environmental objections but would reduce the possibility of accidents. Improved fendering of locks, bridges, and other structures, for example, would do much to reduce spills resulting from barges ramming into these structures. Similarly, situating new structures with greater attention to the operational needs of waterway traffic would also be an effective way to reduce accidents and, hence, the possibility of oil spills.

An upgrading of traditional aids to navigation with an increased use of electronic technology would reduce tankbarge accidents. Engineers in the field of electronic aids to navigation have proved their technology in assisting aircraft and surface vessels during conditions of low visibility.

It should be noted that improved aids to navigation would add to the costs of the federal government, as would the development and implementation of vessel traffic management, domestic ice-breaking operations, and improved communication and use of navigation information. The Coast Guard's proposal, on the other hand, would place most of the added financial burden on the private sector of the economy.

The costs of any alternatives, including double hulls, will ultimately be borne by the consumer. However, it appears that improving the operating environment would provide benefits to other waterway users and thus could be regarded as a cost that could be appropriately assessed on the general public.

The alternatives that were discussed in the working group and that are detailed in the proceedings of the Workshop are well proved. Major ports throughout the world have reduced vessel accident rates through improved channel maintenance, improved aids to navigation, and the use of ice-breaking vessels. The Netherlands has set an example for the rest of the world with the modernization of its navigation aids and vessel traffic management in the approaches and the channels leading to the port of Rotterdam. The Scandinavian countries, particularly Finland, have shown that domestic shipping can be conducted safely and efficiently in heavy ice conditions.

In summary, the Committee concluded that the Coast Guard should take a broader approach to the problem of oil pollution from tankbarges by considering the application of the alternatives discussed in this chapter. It should be recognized, however, that some of the proposed alternatives are not under the direct authority of the Coast Guard, and their implementation would require coordination with other government agencies.

CHAPTER 7

INSURANCE, LIABILITY, AND PENALTIES

At the Workshop on Reducing Tankbarge Pollution it became apparent to the working group on insurance, liability, and penalties that its subject matter was conceptual in nature and that any conclusions it reached regarding the prevention of oil pollution from tankbarges would be more theoretical than practical.

The group studied the question of whether the cost of liability insurance acts as an incentive to prevent pollution from tankbarges. Insurance and barge company representatives described how the insurance premium is calculated. The premiums differ according to the type of vessel to be insured and reflect the degree of risk of the different classes of vessel. As oil-carrying vessels, tankbarges are rated considerably higher than other vessels that do not carry oil. Since the tankbarge company's limit of liability for removal costs under existing law is fixed at a dollar amount per gross ton, the insurance premium rate is also applied per gross ton. The pollution insurance premium for a tankbarge whose owner has a good record amounts to less than 5 percent of the amount paid for all other insurance coverage. An owner with a poor loss record will have to pay a higher premium, but it is still not likely to amount to much more than 10 percent of the premium for all insurance coverage.

The Workshop group concluded, therefore, that the cost of pollution insurance cannot be considered a significant incentive for reducing oil pollution from tankbarges.

The Water Quality Insurance Syndicate (WQIS) advised the group that it does not make any distinction between single-hull and double-hull tankbarges. It has been the syndicate's experience that almost 80 percent of the number of spills from tankbarges it has insured are due to overflows during loading and unloading operations. Such overflows are attributable to human error or to valve malfunctions and are therefore irrelevant to barge design. During the period 1973 through 1977 there were 53 collisions and groundings involving tankbarges insured by WQIS that resulted in spills of more than 500 gallons. Those 53 accidents resulted in an estimated loss of 5,469,000 gallons of oil. Six of the collisions involving single-hulled barges accounted for 4,053,000 gallons, or 74 percent of the total amount spilled. WQIS concluded from its investigation of the six collisions that "even if the barges were of the double-skinned type, they would not have resisted the force and mechanics of impact in each, nor would there have been any reduction in quantities spilled." One of the groundings involved a double-hull barge that spilled an estimated 72,450 gallons. WQIS also reported that since

1977 there had been three transportation accidents involving double-hull tankbarges, and that these three accidents had resulted in the loss of an estimated 546,000 gallons of oil.

The insurance syndicate has concluded that the spills from the small number of transportation accidents and the large number of transfer incidents that accounted for most of the oil spilled from tankbarges insured by the syndicate from 1973 through 1977 and since then would not have been reduced even if all of the barges had double hulls. WQIS reasons, therefore, that there is no basis for giving double-hull tankbarges a preferential rating. (The syndicate's data, of course, differ from the PIRS data cited in Chapter 3.)

The Federal Water Pollution Control Act, as amended in 1977 and 1978, requires tankbarge owners to reimburse the government for costs incurred by the government in dealing with oil spills, including the restoration of natural resources. Barring willful negligence or misconduct, the owner of an inland oil barge may limit his liability for removal costs to $125 per gross ton or $125,000, whichever is greater. The owner is completely absolved from liability if the spill results solely from an act of God, an act of war, an act or omission of a third party, or negligence of the government.

Although the FWPCA places no obligation on the companies to do so, more than 90 percent of all identified tankbarge spills are cleaned up by the companies. But since the FWPCA places a limit on barge owner liability in the event of a government demand to pay the costs of cleaning up a spill, the owner who acts responsibly by quickly cleaning up a spill may incur costs far in excess of what it would cost him if he took no action and thus compelled the government to clean up the spill.

Furthermore, in situations where the company and the government both incur clean-up costs, the owner is exposed to liability up to the statutory limit in addition to the costs that he incurs himself. This happens because the FWPCA does not specify that the owner's liability may be reduced by the amount he himself spends on cleaning up a spill.

Workshop participants agreed that the FWPCA does not give barge companies an incentive to clean up their spills. They recommended amending the act to permit a company to deduct from its statutory liability any sum expended by it.

The workshop was also told that in 95 percent of all tankbarge spills the clean-up costs fall below the applicable liability limit. Of the remaining 5 percent, most involve costs that are two or three times more than the liability limit. The group was informed that reasonable liability limits and equitable defenses, as provided under the FWPCA, are necessary to ensure the continued availability of liability insurance. Some participants expressed the view that, barring willful negligence or misconduct on the part of a tankbarge company, removal costs in excess of the liability limits should properly be borne by the public.

It appears to be extremely doubtful that insurance would be available to tankbarge companies if their liability in oil spills was unlimited or if the defenses provided for unwitting offenders under existing law were withdrawn. The comprehensive pollution legislation (H.R. 85) proposed in the House of Representatives in 1980 (the "Superfund") has been supported both by insurers and by the tug and barge industry. H.R. 85 incorporates higher limits of liability than the FWPCA, and it also would allow the company to recover from the federal government all the costs that it incurs in a situation where it has the benefit of an approved defense. In addition, the bill would permit the barge company to recover costs incurred in excess of the applicable liability limit where the company does not have the benefit of a defense but the spill did not result from willful or gross negligence.

The FWPCA and all versions of the proposed comprehensive pollution legislation require certification of financial responsibility for tankbarge companies. Evidence of financial responsibility to the extent of the applicable liability limits must be in the form of insurance, surety bond, or through qualification of the tankbarge company as a self-insurer. This certification of financial responsibility is to assure that the government can recover the costs of cleaning up spills, at least to the extent of the liability limits. A discrete advantage to the certification requirement is that its absence could encourage entry into the oil transportation industry of speculative tankbarge owners whose chief asset would be the tankbarge itself.

Relatively few tankbarge companies can, or are willing to, satisfy the financial responsibility requirements by purchasing a surety bond or by acting as a self-insurer. Since most companies satisfy the current requirement by purchasing liability insurance, laws or regulations that did not provide reasonable liability limits and equitable defenses like those accorded under the FWPCA would have a major impact on the firms. The workshop group therefore urged that any future legislative action should retain the principles of reasonable liability limits and justifiable defenses.

The FWPCA provides a maximum penalty of $5,000 in the event of a spill. Unlike the provision concerning liability for clean-up costs, the penalty provision in the statute does not afford any defenses to the barge company. The criteria to be considered in determining the amount of the penalty are the seriousness of the spill, the size of the business, and the firm's ability to continue in business after being fined. The group was informed that insurance to cover the company's liability in the event of a penalty being imposed generally is not available.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

As a result of its investigations, the Committee has arrived at the following conclusions and makes the following recommendations, based on the material in Chapters 2 through 7.

CHAPTER 2

Conclusions

1. The Coast Guard has the authority and the responsibility to issue rules and regulations to reduce pollution of the marine environment by tankbarges carrying oil.

2. In its proposals, the Coast Guard did not satisfactorily consider federal policy mandates other than the mandate to reduce oil pollution from tankbarges. The reduction of such pollution is a problem that must be viewed in the context of other national economic and social goals that may be affected directly or indirectly by the proposals.

3. The Coast Guard has not satisfactorily utilized a methodology for evaluating the direct and indirect impact of alternative actions to reduce oil pollution from tankbarges.

Recommendation

1. The Coast Guard should use an appropriate method to evaluate alternatives for reducing oil pollution from tankbarges in terms of various national policy mandates to determine whether its proposals are appropriate actions at this time.

CHAPTER 3

Conclusions

1. Double-hull construction of tankbarges has been shown to prevent the penetration of the cargo space in 88 percent of the grounding incidents and in 90 percent of the collision and ramming incidents.

2. The substitution of double-hull tankbarges for single-hull tankbarges could reduce the annual volume of oil lost in tankbarge

spills by approximately 690,000 gallons. That reduction would include approximately 280,000 gallons that would otherwise be lost in collision and ramming incidents, approximately 210,000 gallons that would otherwise be lost in grounding incidents, and approximately 200,000 gallons that would otherwise be lost because of hull ruptures and leaks not traceable to a particular accident.

3. The substitution of double-hull tankbarges for single-hull tankbarges would not prevent the annual loss of oil from operational (loading and unloading) spills or from catastrophic accidents, which together amount to approximately 1,270,000 gallons annually. That figure includes approximately 360,000 gallons lost from operational spills and approximately 910,000 gallons lost in catastrophic accidents.

4. Given the differing patterns of tankbarge service and the differing patterns of pollution incidents, it is unlikely that a single regulation covering the entire tankbarge industry would be a cost-effective way of significantly reducing the amount of oil lost from tankbarges annually.

5. Analysis of the Coast Guard's proposals is complicated by a lack of appropriate data. (The Appendix of this report discusses the Coast Guard's data files and suggests changes that would make them more useful for the formulation of regulatory policy.)

Recommendations

1. The Coast Guard should reexamine its proposals in light of the data assembled above to find the most appropriate mix of options, policies, and regulations to reduce oil spills. To be cost-effective, any regulations designed to reduce the amount of oil spilled from tankbarges must take account of the enormous variety of conditions in which tankbarges operate. For example, operating conditions on the Yukon River are far different from those on the Mississippi River, just as operating conditions on the Mississippi differ greatly from operating conditions on the Chesapeake Bay. Therefore, in lieu of a single general regulation designed to cover all locations, the Coast Guard should tailor its regulations to specific types of locations and operations.

2. The Coast Guard should give serious consideration to making the changes in its data files that are suggested in the Appendix.

CHAPTER 4

Conclusions

1. There are many alternative methods for reducing oil pollution from tankbarges.

2. The Coast Guard's proposals for reducing oil pollution from tankbarges focus on only one of those alternatives--double hulls--and appear to overstate its ability to reduce the number and volume of oil spills.

3. Double hulls would appear to provide better protection against oil spills in minor, low-energy accidents involving single-hull tankbarges, but they would appear to provide only marginally better protection in accidents resulting in large spills.

4. The Coast Guard's proposals are much too broad and all-encompassing. The hazards associated with various operating locales, the properties of the products being transported, and the differences in the various types of barge service have not been adequately considered.

5. The Coast Guard has not adequately considered the structural and nonstructural alternatives discussed in Chapter 4 that would reduce the spillage resulting from damage to single-hull tankbarges.

6. The retirement of usable single-hull tankbarges would be wasteful and would create unnecessary demands for new capital investment. These financial burdens could be of sufficient magnitude to bankrupt barge operating companies in some cases.

7. As a result of economic pressures, the size of cargo tanks in tankbarges has increased, thus increasing the chances of larger spills.

8. A variety of innovative solutions have been suggested for reducing the number and volume of oil spills from tankbarges.

9. A number of questions about tankbarge design and construction require further investigation.

Recommendations

1. The Coast Guard should give thorough consideration to alternatives that may be more effective and more efficient ways of reducing the number and volume of oil spills from tankbarges than a general requirement for double-hull tankbarges.

2. The alternative of improved repair and inspection procedures, and possibly additional technical features for existing single-hull tankbarges, should be seriously considered by the Coast Guard.

3. The Coast Guard should give greater consideration to the hazards associated with various operating locales, the properties of the products being transported, and the various types of barge service. Each of these should be dealt with individually in any regulatory proposals.

4. The Coast Guard should consider limiting the size of cargo tanks in tankbarges, since that would reduce the volume of oil spills from both single-hull and double-hull tankbarges.

5. Research and development efforts should be initiated to deal with the six questions raised in Chapter 4 and to investigate the opportunities suggested there.

CHAPTER 5

Conclusions

1. Improvements in the training of operating personnel are an important factor in reducing oil pollution from tankbarges.

2. Insufficient knowledge is available to determine the effects of personnel training and other human factors as causes of oil spills.

3. There is an urgent need for the Coast Guard to publish its revised regulations on the qualifications for tankerman certification, but alternative means of demonstrating qualifying experience should be permitted.

4. The Coast Guard's personnel policies also have an impact on the problem of oil spills from tankbarges. Frequent rotation of Coast Guard officers, and Coast Guard promotion and retirement policies, tend to prevent officers from gaining needed experience in such aspects of marine safety as casualty investigation and vessel inspection.

Recommendations

1. The Coast Guard should issue its revised rules on the qualifications necessary to obtain a tankerman's license as soon as possible.

2. The tankbarge towing industry should respond to the Coast Guard's revised tankerman qualifications by providing positive alternative ways of demonstrating qualifying experience.

3. The Coast Guard should review and revise its examinations for Operators of Uninspected Towing Vessels and tankermen. Examination questions should be changed more often to discourage "test teaching" and to encourage concept and skill training.

4. The Coast Guard should reinstitute the open-book pollution exercise for renewal of all licenses.

5. The Coast Guard should consider the use of civilians to supplement the ranks of its officers, specifically within the areas of marine inspection and investigation.

CHAPTER 6

Conclusions

1. Improvements in the operating environment show a significant potential for reducing the number and volume of oils spills from tankbarges.

2. Examples of possible improvements in the operating environment include improved technology for the containment and cleaning up of oil spills; improved channel design; timely maintenance dredging; the fendering of existing structures; greater attention to navigational problems in the design and location of new structures, such as bridges; improved and expanded aids to navigation and the installation of vessel traffic service (VTS) systems; and improved communications.

3. Many of these improvements are not under the direct authority of the Coast Guard and would have to be carried out by other government agencies.

Recommendations

1. The Coast Guard should investigate and implement improvements in the operating environment for the purpose of reducing oil pollution from tankbarges.

2. When such improvements are under the authority of other government agencies, the Coast Guard should refer them to those other agencies for study and possible implementation.

CHAPTER 7

Conclusions

1. The cost of pollution liability insurance for tankbarge towing companies is not a major factor in reducing oil pollution.

2. The insurance industry does not believe that the difference in exposure to hazards between single-hull and double-hull tankbarges is significant enough to justify any differential in their premium ratings.

3. The Federal Water Pollution Control Act (FWPCA) does not give tankbarge towing companies a significant incentive to mitigate the

effects of oil spills because it does not permit them to deduct the costs of cleaning up spills from their statutory liabiity.

Recommendations

1. Any future legislative or regulatory agency action should retain the principles of reasonable liability limits and justifiable defenses for tankbarge towing companies.

2. Serious consideration should be given to amending the FWPCA to permit tankbarge towing companies to deduct the costs of cleaning up oil spills from their statutory liability.

APPENDIX

SUMMARY OF U.S. COAST GUARD DATA FILES

POLLUTION INCIDENT REPORTING SYSTEM (PIRS)

Authority

Section 311 of the Federal Water Pollution Control Act, as amended, requires that any discharge of oil or hazardous substance be reported to the "appropriate agency of the United States Government." The Coast Guard has been designated as that agency by Executive Order 11735.

Types of Information

The data base contains information on all spills reported to the Coast Guard since 1973. PIRS was first initiated in December 1971 for the purpose of collecting certain information concerning discharges of oil and other polluting substances reported to or detected by the Coast Guard. PIRS originally collected data relating only to the nature of the discharge itself. In 1973 the system was expanded to include data concerning response activities and penalty action. The types of information currently maintained on each spill are summarized as follows:

Discharge	Response	Penalty
District	Cleanup party	Initiating agency
Time of occurrence	Equipment used	Authority
Location	Personnel	Action against
State	Cleanup duration	Action date
Water body	Amount recovered	Penalty assessed
Source	Cleanup cost	Penalty collected
Cause		Hearing results
Operation		Appeal results
Material		Case status
Quantity		
Affected resources		
Weather		
Notifier		

Intended Uses of the Data Base

The PIRS data base is intended to serve two purposes: (a) it provides management and planning information to the Coast Guard Commandant, District, and Unit Commanders so that they can effectively administer the Marine Environmental Protection (MEP) program; and (b) it provides a statistical data base on which the Commandant can draw in order to respond to inquiries from Congress, industry, academic institutions, and the public concerning marine pollution and Coast Guard activities relating to the MEP program.

Source

The PIRS report is completed by the Coast Guard investigator, reviewed by the Marine Safety Office (or Captain of the Port as applicable), reviewed by the District Commander, and submitted, in encoded form, to the Commandant. Currently, the information undergoes two machine audits before being accepted into the data base.

VESSEL CASUALTY DATA FILE

Authority

The principal authority for the requirement to report vessel casualties is contained in 33 USC 361 and 46 USC 239, 375, and 416. The authority to maintain a data base is derived from 46 USC 375 and 416 for casualties in general. However, 46 USC 391a (as amended by the Port and Tanker Safety Act of 1978) provides additional authority with respect to tank vessels carrying oil and certain hazardous materials in bulk.

Types of Data

The data base contains information on marine casualties that result in any of the following:

- Actual physical damage to property in excess of $1500.
- Material damage affecting the seaworthiness or efficiency of a vessel.
- Stranding or grounding.
- Loss of life.
- Injury causing any person to remain incapacitated for a period in excess of 72 hours, except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.

The current data base was established in 1962 for the purpose of providing an index to the Coast Guard's commercial vessel casualty files. The data base structure has been modified several times to provide expanded information. The types of information currently maintained are summarized as follows:

Vessel Data	Casualty Data
Vessel type	Date/time
CG inspected/uninspected	Nature of the casualty
Type of propulsion	Degree of involvement
Vessel identification	Primary cause
Gross tonnage	Causal connection
Length	Additional causal factors
Hull material	Geographic location
Age	Weather particulars
Service	Damage or injuries incurred

Intended Uses of the Data Base

The data base is intended for use in regulatory program administration and as a general statistical data base.

Source

The data are obtained primarily from the reports of vessel casualty (CG-2692) or personal casualty (CG-924E) submitted by a vessel owner, agent, master, or person in charge to a Coast Guard marine inspection office or marine safety office. These forms are reviewed by a Coast Guard investigator and, depending on the nature of the incident, are eventually forwarded to the Commandant by a letter of transmittal, a narrative report of the incident, or a Marine Board of Investigation. The data are then encoded using the information on the CG-2692 or 924E and the conclusions of the investigation (if any).

LIST OF INSPECTED TANKBARGES AND TANKSHIPS (COMDTINST M16711.7)

Authority

The Coast Guard uses information available to it under the authority of 46 USC 391a to compile and maintain this data base.

Types of Data

The data base was established in order to develop a profile of the tankbarge fleet for regulatory purposes. Primary data collection began in 1973. Until recently the data base has not been a historical file but contained only current information. More recently information on inactive barges has been maintained as a part of the data base. The information currently maintained includes:

Vessel name	Document number or CG assigned number
Gross tonnage	Construction type (double/single hull, etc.)
Year built	Certificate of inspection information, such as:
Hull type (I, II, or III)	Route
Status	Highest cargo grade
Owner	Last drydocking
Operator	Subchapter under which certificated
Hull material	OCMI issuing certificate
Length	Expiration date

Intended Use of the Data Base

The data base is intended as a general-purpose statistical data base.

Source

The primary information source for this information is the vessel's certificate of inspection as issued. Additional information is obtained from the vessel's documentation records. The Certificate of Inspection originates in the Marine Inspection or Marine Safety Office. Documentation information originates with the documentation officer in the vessel's home port. The information sources are combined by the commandant (G-MA) to produce this data base.

PROBLEMS ASSOCIATED WITH COAST GUARD DATA COLLECTIONS

1. Inability to provide common access.

- The only commonality between the data collections is the official vessel number.

- There is no means of simultaneously working two different files. For example, it is not possible to obtain a list of all reported incidents involving tankbarges from PIRS in a manner that would automatically eliminate all those barges not listed as having double hulls in the List of Inspected Tankbarges.

2. Lack of commonality within the Coast Guard data encoding.

- Gross tonnage limits differ between the PIRS file and the Vessel Casualty Data file.

• The PIRS file and the Vessel Casualty Data file use differing coding systems to identify vessel type.

• The PIRS file and the Vessel Casualty Data file use differing coding systems for the various western rivers, Gulf, and inland rivers and waterways. Both systems lack precision in identifying incident location on the inland waterways.

• The PIRS file and the Vessel Casualty Data file have different reporting limits. A report prepared for the National Maritime Research Center found that the Vessel Casualty file tends to treat only ship damaging incidents as bona fide casualties. Thus a collision is almost certainly viewed as a casualty, but a grounding may or may not be, depending on the damage and/or expense incurred. According to the report, "Damage to cargo or shore installations and injury to individuals or the environment, while regrettable, are generally not considered casualties unless they occur concurrently with ship damage." This report goes on to give the following comparison between Coast Guard files and the Marine Index Bureau files:

Year	Coast Guard			Maritime Index Bureau
	Casualties	Vessels	Pers. Injury/ Death	Pers. Injury/Death
1972	2424	4117	1878	9741
1971	2577	4152	2311	9923
1970	2582	4063	2625	15141
1969	2684	4183	2985	17518
1968	2570	4011	2830	21856

For whatever reason, the Coast Guard figures show that personnel injuries are closely related to ship casualties and fail to reflect the almost 2:1 decrease in billets over this period. Most of the personnel injury incidents reported to the MIB clearly met the Coast Guard criterion but, since they did not occur concurrently with a ship-related incident, were not reported to the Coast Guard.

The same problem apparently exists when one compares the PIRS data with the Vessel Casualty Data file. There are numerous PIRS incidents in the file where the loss to cargo was obviously in excess of the $1500 minimum of the reporting criterion, yet no casualty report was filed.

3. Inherent problems with using the data bases.

• Changes in the reporting base cannot be assessed. For example, increased public awareness may lead to more thorough reporting in a system such as PIRS; increased industry awareness, such as results from expanded licensing programs, may lead to more reliable reporting in the Vessel Casualty Data file; or because of the $1500 minimum, inflation will expand the reporting baseline for the Vessel Casualty Data file.

• The Coast Guard lacks the ability to readily obtain corresponding use/frequency data. For example, PIRS may indicate that the quantity of a particular pollutant entering a waterway is decreasing. The Coast Guard would not be able to determine if the decrease was due to either a general or a localized reduction in the amount of the substance at risk or if it was due to increased system safety.

Casualty data may similarly indicate an increase in the number of groundings in a given waterway, but the Coast Guard could not determine from the information in its data files whether the change was due to an increase in the number of vessel transits, a change in the depth of the waterway, or a change in the characteristics of the vessels in transit.

Other than for vessels carrying oil or hazardous cargoes, the Coast Guard lacks direct authority to gather information regarding amounts and types of cargoes transported.

RECOMMENDATIONS

1. The Coast Guard should provide administrative guidance to ensure that incidents reported to the PIRS system that meet the reporting criterion for the Vessel Casualty Data file are properly reported. For example, a 1000-gallon oil spill almost inevitably involves damage to property (vessel, cargo, and environment) of over $1500.

2. The Coast Guard should provide common access to the three data bases, either through special programming or by combining the files.

3. The Coast Guard should take the necessary steps to obtain waterway use, cargo movement, and personnel employment data to make possible statistical studies based on exposure and incidence frequency factors rather than strictly the number of incidents. This is a necessary first step to begin to approach regulation from a system safety standpoint.

4. The Coast Guard should investigate alternative encoding systems for the inland waterways and rivers that would provide more precise incident location information and should coordinate the coding systems with other agencies that maintain related data bases (i.e., the Army Corps of Engineers) so that data such as an incident location will be reported with approximately the same precision in the related data bases.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The report examines the issues and problems resulting from the U.S. Coast Guard's proposed regulations requiring (a) double hulls for all future tank-barges carrying oil and (b) the early phase-out of single-hull oil-carrying barges. The total national policy context of which such environmental regulations are a part is reviewed. The Coast Guard's oil spill data are re-analyzed; and insurance, liability and penalty issues are examined. Alternatives to the proposed regulations are examined, including structural

(continued)

20. Abstract (continued)--

and nonstructural tankbarge modifications, accident-prevention measures, enforcement procedures, and personnel training and standards problems. Means for evaluating the alternatives are suggested. The report concludes that for such a complex and multi-faceted problem, the single solution proposed--i.e., double hulls--is too broad and all-encompassing.