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**Commercial Vessel Safety,
Economic Benefits.**

**APPENDIX A
ESTIMATION PROCEDURES FOR BENEFITS
OF MARINE SAFETY REGULATIONS.**

PRC Systems Services Company
7600 Old Springhouse Road
McLean, VA 22102



FEBRUARY 1980
FINAL REPORT.

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Prepared for
**DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD**
Office of Research and Development
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COMMERCIAL VESSEL SAFETY

ECONOMIC BENEFITS

APPENDIX A

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SECTION I INTRODUCTION

This manual is designed to aid in the regulatory evaluation process. Its primary goal is to provide Coast Guard analysts with systematic procedures for estimating and comparing benefits of alternative Coast Guard regulatory actions.

To this end, this manual contains:

- (1) Procedures for calculating benefits and benefit factors for use when applicable;
- (2) Formats for categorizing and tallying the benefits of alternative regulations.

The overall objective of this manual is to apprise decision-makers of the relative consequences of regulatory actions. The regulatory staff can satisfy this objective by adhering to the guidelines contained in the following sections. Two examples of applications of these procedures that address proposed Coast Guard regulations are presented in Appendix B.

This manual has eight sections. A brief description of each section is provided as a quick reference guide to assist the reader in locating manual segments of immediate interest.

SECTION I. INTRODUCTION

A brief description of the objectives of the manual.

SECTION II. METHODOLOGY OVERVIEW

A discussion of how marine safety cost-benefit analysis relates to overall marine safety programs for reducing marine accidents, to include basic steps in conducting cost-benefit analyses.

SECTION III. ASSUMPTIONS AND DEFINITIONS

This section is used to define the scope and ground rules of the cost-benefit analyses to be conducted. It itemizes commonly used techniques and assumptions employed in cost-benefit analysis.

SECTION IV. BENEFIT CATEGORIES AND ELEMENTS

Provides a listing of benefit categories and benefit elements used to collect benefits of regulatory actions.

SECTION V. FORMATS FOR BENEFIT MEASUREMENT

Formats contained in this section provide the structure for calculating total benefits to be incurred by industry, government and society from the implementation of a regulation. This section contains an example set of completed formats plus a complete set of blank formats.

SECTION VI. BENEFIT PROCEDURES AND FACTOR DEVELOPMENT

This section explains how to develop benefit factors, defines techniques to be employed in making benefit estimates and provides guidance on what to look for in developing benefits of regulations to vessels, cargo, personnel, property and the environment.

SECTION VII. BENEFIT FACTORS

This section contains a collection of selected benefit factors which may be employed to fill in formats contained in section V.

SECTION VIII. FLEET FORECAST

This section contains forecasts of changes in U.S. and world fleet sizes by vessel groupings. This is useful in estimating benefits to different vessels that are impacted by regulatory changes.

SECTION II METHODOLOGY OVERVIEW

The application of cost-benefit techniques to regulatory analysis enables the regulatory staff to determine if the value of what is produced by the regulation, e.g., increased safety, is greater than the value of the resources consumed. It is axiomatic that the benefits and costs of regulations can be valued only if they can be counted.

Figure 1 graphically depicts the flow of this relationship between risk assessment and cost-benefit analysis as it relates to the total risk management decision process. A brief walk-through of the blocks in this flow chart reveals the following methodology points:

Block 1 - Events: Many events may trigger Coast Guard actions which require a regulatory analysis; among these events are vessel casualties. Vessel casualty types supported by historical frequency data include:

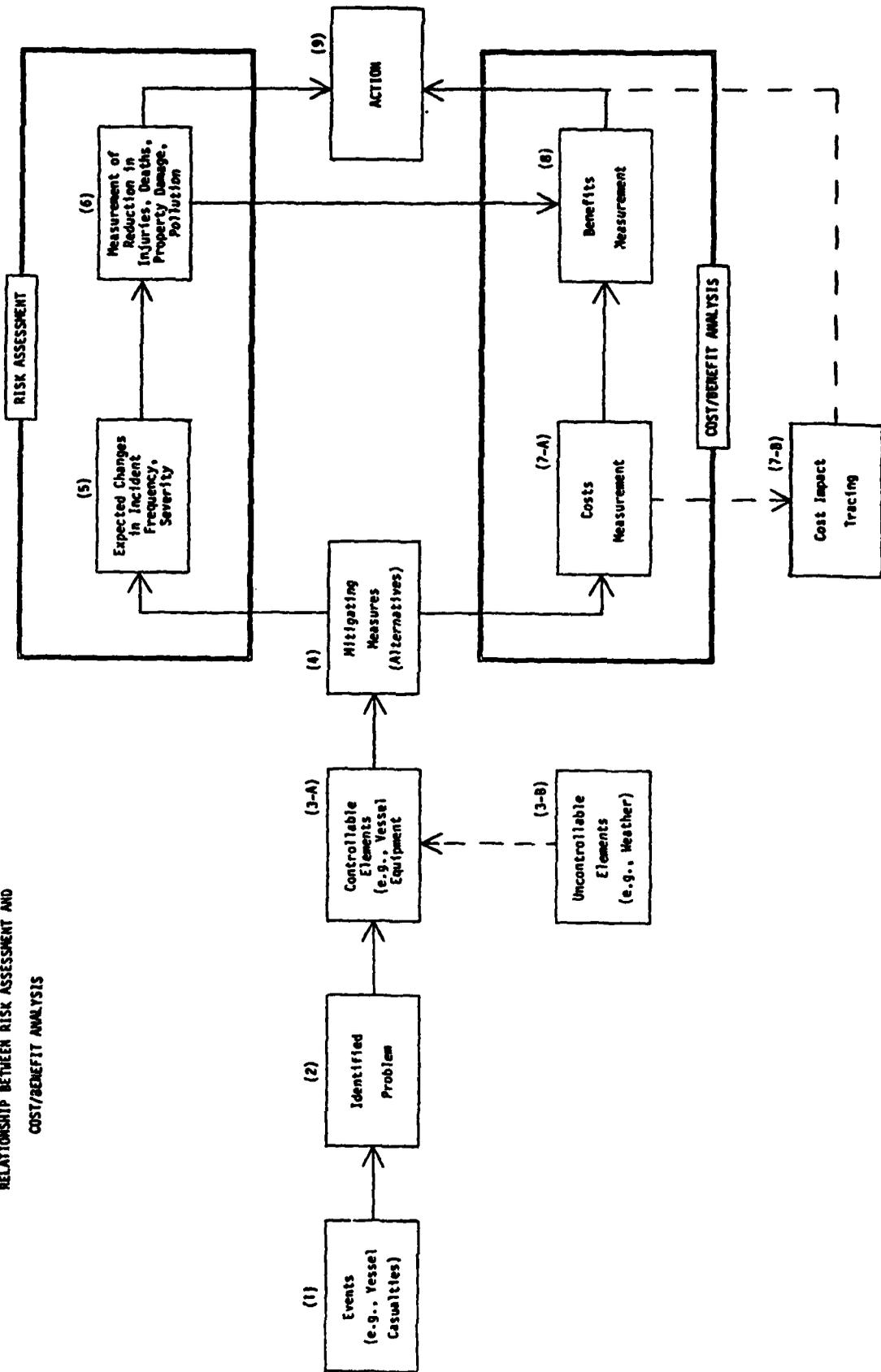
- o Collision
- o Grounding
- o Fire/Explosion
- o Ramming
- o Capsizing
- o Foundering
- o Flooding
- o Weather Damage
- o Structural Failure
- o Other

Block 2 - Identified Problem: If a specific problem can be pinpointed, e.g., vessel groundings and breakups associated with oil spills, it is possible to develop competing alternatives to either solve the problem or mitigate the consequences.

Blocks 3A & B - Controllable/Uncontrollable Elements: A distinction must be made between those actions which are controllable such as vessel equipment and those which are not, such as weather.

Block 4 - Mitigating Measure: For any given problem with controllable elements, there may be several competing alternatives to improve safety such as vessel design changes, improved training, or operational procedure changes. It is also possible that a

FIGURE 1
 RISK MANAGEMENT — A DECISION PROCESS
 RELATIONSHIP BETWEEN RISK ASSESSMENT AND
 COST/BENEFIT ANALYSIS



single regulation will have been selected with no alternatives under consideration. It is important that the status of alternatives be clearly delineated.

Block 5 - Expected Changes In Incident Frequency: Initially, the vessel population subject to potential regulatory action must be identified by type and size and by U.S. and foreign flag. An estimate must be made of the probable change in frequency of incidents that will result from implementing mitigating measures (e.g., ten less collisions per year).

Block 6 - Measurement of Reduction In Injuries, Deaths, etc.: The estimated reduction in incidents must also identify specific reductions in loss of life, injuries, property damage, cargo spills, and environmental damage expected to result from alternative mitigating measures.

Block 7A - Cost Measurement: This segment of the analysis identifies the total costs over an extended period of time (25 years) to industry and government to implement alternative mitigating measures.

Block 7B - Cost Impact Tracing: These procedures are designed to assess the measurable interindustry impacts of the costs identified in Block 7A and to determine their measurable impacts on GNP, inflation and other economy-wide indicators. When total regulation costs are not large enough to measure dollar impacts, industries most likely to be impacted can be identified, as well as the direction of expected changes in economy-wide and industry indicators.

Block 8 - Benefits Measurement: After estimates have been made of the number of reduced losses in life, property damage, etc., the benefit analysis estimates a dollar value, where possible, for avoided losses.

Block 9 - Action: If sufficient evidence indicates mitigating measures are feasible and benefits exceed costs of implementation, the decision maker is in a position to either proceed with regulatory action or request the results of the analysis be subjected to additional sensitivity testing. However, at this point, the decision maker should have sufficient data to decide to either act or take no action.

The level of detail to which the estimates in the reduction of incidents can be conducted limits the level of detail that can be achieved in the cost-benefit analysis. For example, the estimated number of incidents prevented could be done using the Vessel Casualty Reporting System (VCRS), data base to develop before and after casualty frequencies associated with potential regulatory actions. This data base groups all cargo vessels of 15,000 deadweight tons or more into one category. Therefore, operating benefit factors for cargo vessels must necessarily be lumped into a 15,000 and over DWT average benefit category to conform to this data base.

This manual focuses upon cost-benefit procedures to be used in the marine safety management process. The key steps involved in the use of cost-benefit procedures are:

1. Identify all benefit elements impacted by an alternative regulation.
2. Count the number of vessels by type and size impacted by the regulation for existing vessels, new vessels to be constructed over the time horizon of the analysis, and vessels retiring during the time horizon.
3. Determine the incremental benefits of the regulation by applying or developing the correct benefit factor for each benefit element.
4. Discount the total benefits incurred by the appropriate discount factor for each year of the analysis.
5. Follow essentially the same sequential procedures for calculation of benefits.

In cost-benefit analysis, the cost and benefits associated with a regulatory alternative are aggregated without regard to the individual or group to whom they accrue. The magnitudes of the estimated costs and benefits are then compared. Based solely on abstract efficiency criteria, determination of who pays the costs or reaps the benefits of alternative actions is not applicable in determining the best alternative. It is legitimate, however, for decision makers to take equity criteria into account and separate the dollar value of costs and benefits according to who in society bears them.

The importance of this to the regulatory staff is that the cost and benefit measurements must be performed separately from the impact analysis. This separation avoids the problem of double counting which arises when costs or benefits accruing initially to one group, but passed on to other groups, are included more than once in measurement calculations.

The procedures and formats contained in this manual are designed to be applicable to both complex regulatory actions affecting numerous aspects of industry, government and society and to simple regulatory actions affecting single benefit elements and/or short time horizons. The regulatory staff must select that level of detail, including the selection elements that will need to be investigated, and a time frame appropriate for, and unique to each proposed regulatory action.

SECTION III ASSUMPTIONS AND DEFINITIONS

A. CVS Program

The benefit procedures described in the following sections focus on analyzing regulatory alternatives which fall under the aegis of the Commercial Vessel Safety (CVS) Program. Procedures for estimating the benefits of CVS regulations are described in Section VI. The benefits are divided into five groups: vessel, cargo, personnel, in-house, and environmental/property. Similarly, the benefit formats described in Section V are designed for CVS regulatory analysis.

B. U.S. Versus World

Whenever a cost-benefit analysis is undertaken, the regulatory staff must identify the group for which costs and benefits will be measured. Usually, U.S. government cost-benefit analyses are undertaken on behalf of the United States, but not other nations. Accordingly, the procedures found in this manual focus on benefits gained by U.S. individuals and groups. Benefits gained by foreign groups are addressed only if there is reason to believe they will affect U.S. citizens economically.

Although foreign benefits are not appropriate for inclusion in the cost-benefit analysis, they are often of interest due to the fact that the Coast Guard works closely with the Intergovernmental Maritime Consultative Organization (IMCO). While emphasis in this manual is on U.S. benefits, the procedures are directly applicable to determining foreign benefits. In the event the regulatory staff is interested in these benefits, a forecast of foreign flag vessels engaged in world trade is presented in Section VIII.

C. Burden

The benefits of CVS regulations may accrue to many different groups: the maritime industry which must comply with the regulations, the U.S. Coast Guard which develops, administers and enforces the regulations; and society which ultimately bears the costs of marine casualties. This manual concentrates on procedures for estimating benefits to the commercial shipping industry.

Even though the procedures and formats are designed especially for commercial shipping industry benefits, the regulatory staff must not completely ignore benefits to other groups.

Often, certain benefits of a regulation will be impossible to measure. Nevertheless, significant benefits should be described in detail by the regulatory staff. This enables the policy maker to have the most complete information possible. This will be of particular significance in the benefit analysis since benefits with potentially high impacts are difficult to quantify.

D. Time Horizon

Any cost-benefit analysis must have a time horizon. There will be benefits attributable to a CVS regulation not only in the year the regulation is passed, but as long as it is in effect and vessels are complying with it. Theoretically, the time horizon of the regulatory analysis should be the effective life of the regulation, whether it is 50, 100 or 200 years. Realistically, the time horizon must be limited. In all cases, the time horizon for the benefit analysis should conform to the time frame used in the cost analysis. The recommended approach in this manual is to limit the time horizon for analysis purposes to 25 years. This figure was chosen for several reasons:

1. It is considered by many experts to represent the average retirement age of most commercial vessels. However, there are exceptions that the regulatory staff should attempt to take into account.
2. Beyond 25 years, the quality of fleet forecasts declines precipitously.
3. Benefits discounted after 25 years are increasingly insignificant. Despite these reasons, it must be acknowledged 25 years is a conventional rather than an objective figure. If the regulatory staff wants to use another time horizon, the benefit formats can be readily adapted.

E. Discounting

Because the costs and benefits of a CVS regulation accrue over many years, it is important to explicitly recognize the time value of money in the cost-benefit analysis. Money is a productive resource which commands interest payments for its use; a dollar today is worth more than a dollar to be received at some later date. Consequently, benefits received in the future are valued at a lower rate than benefits received now. Similarly, costs payable ten years hence, are worth less than costs payable sooner.

The appropriate discount rate allows the regulatory staff to convert dollar amounts of costs and benefits expended or received in different years into their present value. The recommended discount rate in this manual is 10 percent. This rate is intended to represent the returns to the private sector foregone by complying with a regulation rather than investing in other projects. A 10 percent discount rate conforms to current Department of Transportation and Office of Management and Budget practice. The Office of Management and Budget guidelines for the use of discount rates are published in Circular No. A-94 Revised.

The Office of Management and Budget requires the use of a discount rate in evaluating Government decisions concerning the initiation, expansion or renewal of projects and programs for which measurable costs extend over three or more years. OMB defines the discount rate as the interest rate used to calculate the present value of expected yearly costs and benefits. In most cases, all costs and benefits are to be stated in constant dollars.

To use the discount rate to determine present values requires the calculation of discount factors corresponding to the chosen discount rate for each year of analysis. For the convenience of the regulatory staff, the average discount factors corresponding to a 10 percent discount rate for a 25-year time horizon are displayed on Formats 4 and 6, Section V. These factors are appropriate for use when annual benefits are received throughout the year. Other discount factors should be employed whenever annual benefits are accrued on a different schedule, for example, once yearly. Multiplying the benefits in each year by the appropriate discount factor for that year yields the present value of the benefits discounted at a rate of 10 percent.

The regulatory staff may be interested in using a different discount rate. In this case, the formula to be used in calculating the corresponding discount factors, plus a detailed

description of the mechanics involved can be found in Richard S. Brown, et al. Economic Analysis Handbook, NTIS AD-A020859, June 1975, pp. 12- 23. For additional discussion of discounting and the choice of a discount rate, a recommended reference is Principles of Engineering Economy, by Eugene L. Grant and W. G. Ireson, Ronald Press Company, 1960.

F. Inflation

Cost-benefit analysis is complicated by the fact prices usually exhibit an increasing trend over time. This price trend or rate of inflation can only be estimated. To ensure consistency in the analysis of alternative regulations and in comparative studies, this manual recommends all dollar estimates of costs and benefits be made in constant dollars. This means the estimates will be in terms of the general purchasing power of the dollar as of the base year of the analysis (year 0).

This recommendation is predicated on the fact that application of a standard 10 percent discount factor to constant-dollar costs (or benefits) adjusts for an average rate of inflation over the 25-year time horizon. In the unlikely event the regulatory staff expects costs or benefits will not escalate at or near the average price growth rates, special adjustments for inflation can be made. The details of these adjustments plus inflation-adjusted discount factors can be found in Richard S. Brown, Economic Analysis Handbook, pp 88-90 and Appendix E.

G. Escalation Factor

The analysis of regulations under the CVS Program requires projections of benefits that will be realized in future years. The method used for analyzing and comparing alternatives is to state the sum of all benefits for each alternative in terms of the general purchasing power of the dollar in the baseline year of the analysis. Estimates of the benefits of a regulation will generally be stated first in terms of today's (or some other recent year's) known prices. The problem is that the benefits of a proposed regulatory action will not begin to be realized until some time in the future, defined as the base year of the analysis. The question is not whether prices will escalate between the present and the base year but how much they will escalate.

Escalation factors provide the means of transforming benefit values today to equivalent values in the base year. Projections of price escalation may take the form either of percentages or price indices. The basis for these percentages or price indices are trends in historical price changes for individual benefit elements. For most CVS regulations no single annual escalation factor will be applicable for all benefit elements or for all time periods over which the available data must be inflated.

The recommended procedure is to develop an appropriate escalation factor, individually, for each benefit (cost) element or a weighted average factor for a group of cost elements. Such factors may be based upon expert judgment or may be developed through a time-series analysis of available historical data. For example, the regulatory staff may need an escalation factor by which to project future shipbuilding costs. In the absence of a more rigorous approach, the solution is as follows. Review a number of previous Maritime Administration Annual Reports. Analyze the trend in published shipbuilding costs, calculating an annual rate of change. Then, using this rate as the basis, develop an escalation factor that will project current costs to the baseline year of the analysis.

H. Uniform Annual Benefit (Costs)

Once all estimated regulation benefits have been discounted back to the base year of the analysis, these discounted benefits when summed yield the total discounted or present value benefit of the regulation. This total can be compared with other regulations analyzed over the same time period. Total discounted benefit cannot be used for comparison when regulations are analyzed for different time periods.

To assure consistency, the use of the uniform annual cost/benefit technique is recommended to circumvent the problem of different time horizons. Basically, uniform annual benefit is a method to uniformly distribute the discounted regulation benefits over the time horizon of the analysis. The uniform annual benefit of a regulation can be compared legitimately with the uniform annual benefits of competing alternatives analyzed over any time period.

The procedure for calculating uniform annual benefits for a 25 year time horizon is as follows: Divide the total discounted regulation benefit by the sum of the discount factors for years 1 through 25, which is 9.427 at a discount rate of 10 percent.

I. Selected Readings

The regulatory staff may discover its interests are best served by a review of the literature addressing these issues and assumptions surrounding cost-benefit analysis. The following list identifies some pertinent writings which should enhance the regulatory staff's view of cost-benefit analysis.

Baumol, W.J. "On the Discount Rate for Public Projects," Robert Havemann and Julius Margolis, Editors. Public Expenditures and Policy Analysis. Chicago: Rand McNally College Publishing Co., 1970.

Brown, Richard S., et al. Economic Analysis Handbook. Alexandria, Virginia: Naval Facilities Engineering Command, June 1975.

Hirshleifer, J., Investment, Interest and Capital. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.

Klausner, Robert F., "The Evaluation of Risk in Marine Capital Investments," Engineering Economist, 14 (Summer 1969), pp. 183 - 214.

Layard, Richard, Editor. Cost-Benefit Analysis. New York: Penguin Books, Ltd., 1977.

Miller, M. H., and Franco Modigliani, "Cost of Capital to Electric Utility Industry," American Economic Review, 56 (June 1966), pp. 333 - 91.

Mishan, E.J. Cost-Benefit Analysis. New York: Praeger Publishers, 1976.

Modigliani, Franco, and M. H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," American Economic Review, 48 (June 1958), pp. 261-97.

-----, "The Cost of Capital, Corporation Finance and the Theory of Investment: Reply," American Economic Review, 48 (September 1958), pp. 655-69; "Taxes and the Cost of Capital: A Correction," ibid., 53 (June 1963), pp. 433-43; "Reply," ibid., 55 (June 1965), pp. 524-27; "Reply to Heins and Sprengle," ibid., 59 (September 1969), pp. 592-95.

Office of Management and Budget Circular Number A-94. Subject: Discount Rates to be Used in Evaluating Time Distributed Costs and Benefits, 1972.

Schwab, Bernhard, and Peter Lusztig, "A Comparative Analysis of the Net Present Value and the Benefit-Cost Ratios as Measures of the Economic Desirability of Investments," Journal of Finance, 24 (June 1969), pp. 507-16.

Solomon, Ezra, "The Arithmetic of Capital-Budgeting Decisions," Journal of Business, 29 (April 1956), pp. 124-29.

Van Horne, James C., The Function and Analysis of Capital Market Rates. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1970.

Zechauser, R., et al. Benefit-Cost and Policy Analysis 1974. Chicago: Aldine Publishing Co., 1975.

SECTION IV

BENEFIT CATEGORIES AND ELEMENTS

The benefit formats contained in Section V are keyed to a set of benefit categories. These categories are further subdivided into benefit elements. (See Figure 2.) The purpose for separate categories within which to collect benefits are twofold:

- o To segregate benefits by type.
- o To provide a checklist against which alternative regulations can be measured.

Benefit elements fall into five broad categories: Vessel; Cargo; Personnel; In-house; and Environment/Property. This list of benefit elements is specific to CVS regulations. It is unlikely any one CVS regulation will benefit all five categories or all elements within any one category. These benefit elements may not be completely appropriate for analysis of regulations of other Coast Guard programs. In this case, the regulatory staff can augment the list as necessary.

Industry

Vessel, cargo and vessel related personnel benefit categories represent benefits that will accrue to industry.

Vessels - Include all benefits for vessel losses and vessel damages averted. Vessel losses averted are the benefits of not having to replace a vessel prior to the end of its expected useful life. The primary component of vessel damages averted are repair costs not incurred. Both vessel damages and losses averted will also benefit from towing charges and service losses avoided. In most cases, these latter benefits will be difficult to quantify.

Cargo - The benefits to cargo include the total loss of a vessel's cargo, partial loss of a vessel's cargo and damage to all or part of a vessel's cargo. A distinction is made between total and partial cargo loss to facilitate the benefit estimate for cargo losses incurred when

Figure 2

BENEFIT CATEGORIES

<u>Industry</u>	<u>In-House</u>	<u>Other (Societal)</u>
1. Vessel	1. Investment	1. Personnel
A. Losses Averted	A. Non-Recurring	A. Injuries Prevented
(1) Replacement	B. Recurring	B. Deaths Prevented
(2) Towing		
(3) Service Loss	2. Operating	2. Environment/ Property
B. Damages Averted	A. Personnel	A. Commercial Resources
(1) Repair	(1) Civilian	B. Private Structures
(2) Towing	(2) Military	C. Recreational Resources
(3) Service Loss	B. Materials & Supplies	D. Water Supply
	C. Government Furnished Services	E. Natural Resources
2. Cargo		
A. Losses (Total) Averted		
B. Damages (Partial Loss) Averted		
3. Personnel Injuries		
A. Losses Averted		
(1) Non-Recurring		
(2) Recurring		
B. Damages Averted		
(1) Non-Recurring		
(2) Recurring		
4. Deaths Prevented		

a vessel is lost versus the partial loss of cargo due to a damaged vessel, or, a situation in which only a portion of the cargo is lost. Cargo damages are generally damages to cargo that can be mitigated by repair, or replacement of part(s) of an individual item.

Personnel - Industry personnel, for purposes of this manual, are defined as persons serving aboard vessels. This narrow definition was adopted because the primary purpose of the manual is to analyze regulations under the Commercial Vessel Safety Program. However, since the manual can readily be adapted to analyze regulations in other areas, such as port safety, the regulatory staff should be aware that the primary benefits of these latter regulations will accrue to dock and facility workers.

The benefits to industry personnel from a reduction in marine incidents include deaths avoided, and injuries averted. Personnel injury benefits have two components, production benefits valued in terms of wages not lost, and resource benefits defined as medical services not consumed. Personnel injury benefits may be recurring or non-recurring. This distribution is made to differentiate between injuries of a one-time (non-recurring) nature expected to last less than one year and those individual injuries that are more severe, lasting more than one year. In the latter case salary and/or medical costs would have been incurred in two or more years.

In-House

In-House benefits include investment and operating benefits attributable to the regulation.

Investment benefits - These may be recurring or non-recurring over the life of the regulation. Included in this category are any costs not incurred for capital items such as equipment.

Operating benefits - Include all benefits of the regulation recurring on an annual basis. These will include:

Personnel - This category is made up of two sub-categories, civilian and military. Personnel benefits are realized primarily as a result of a regulation that causes a reduction in required manpower.

Materials & Supplies - Include all costs not incurred for consumable or expendable support related items.

Government Furnished Services - Include all costs not incurred for Government services such as training or other support facilities.

Societal Benefits

These are defined as benefits to individuals, property and the marine environment.

Personnel - This category is made up of the general population and dock/facility workers. The benefits to these individuals include deaths and injuries averted. In the case of injuries the benefits are valued in terms of salaries not lost and medical resources not consumed.

Environment/Property - These regulation benefits will generally be included in the analysis in qualitative rather than quantitative terms. They are divided into five sub-categories:

- o Commercial Resources - The sub-elements in this group include: fin fish; shell fish; hatcheries; commercial vessels; piers, docks and other waterside facilities; and tourism.
- o Private Structures - Includes any private property not related to commerce or recreation, such as dwellings.
- o Recreational Resources - The sub-elements in this group are: public and private waterfront property; other recreational facilities such as nature trails; privately owned recreational boats; and sport fishing.
- o Water Supply - The sub-elements in this group are: municipal drinking water; other municipal intake; industrial intake; and agricultural intake.
- o Natural Resources - This category's sub-elements include: non-commercial fish; other marine biota; waterfowl and other birds; marine mammals; marine sanctuary and wilderness areas; and reefs.

Economy-Wide Versus Regional Benefits

The benefits of regulations promulgated under the CVS Program, or other related programs, may be evenly distributed throughout the economy or accrue to specific segments of the economy. An example of the latter case would be a regulation applicable to a specific geographic region or location. Although it will generally be difficult to incorporate this consideration in quantitative terms, the regulatory staff should clearly define, in qualitative terms, those segments of industry or society that will benefit from a particular regulation.

SECTION V

FORMATS FOR BENEFIT MEASUREMENT

A. General

The procedures, data sources, benefit factors, problems to be aware of and other facets of benefit measurement for regulations promulgated under the Commercial Vessel Safety Program are described in Sections VI and VII. The purpose of this section is to explain the use of the benefit formats to be employed in cost-benefit analysis.

The benefit formats are designed to help the regulatory staff keep track of the quantifiable and non-quantifiable benefits of a regulation; present the results to others (for example, for budgetary justification or OMB approval); and compare the benefits of alternative regulations.

This section will explain, step by step, the uses of the different formats and how to fill in the blanks. To facilitate the explanation an example regulation will be used. The completed formats for this example will be found on pages 43 to 56 of this section. Blank formats which can be copied for use by the analyst will be found on pages 59 to 81 of this section.

Before the formats are discussed in detail, it is worthwhile to point out two key considerations involving their use. First, benefit analysis of regulations is concerned with the incremental benefits directly attributable to implementation of the regulation. Benefits which will occur regardless of whether the regulation is implemented should not be included. Similarly, the analysis applies only to future benefits which the decision to implement the regulation can affect. Benefits expected to be gained prior to the beginning of the time frame of the analysis must not be included.

The benefit formats capture both benefits for which a dollar value can be assigned and benefits that cannot be readily quantified.

Formats 1 through 4 allow the regulatory staff to develop total benefits expected to accrue to industry as the result of implementing a regulation. Formats 5 and 6 are designed to capture in-house government benefits. Formats 7, 8 and 9 develop quantifiable benefits to

society. Format 10 provides the regulatory staff with a means of presenting the non-quantifiable environmental and property benefits in summary form. Format 10A is designed to quantify environmental and property benefits, at a specific site under a specified set of circumstances. Format 11 merges total quantifiable benefits to industry, government and society and allows for comparison of alternatives. Use of the formats is best demonstrated by means of a hypothetical regulation.

B. Example Regulation

A regulation issued in 1980 requires new and existing oil tankers, gas, and chemical carriers to have certain emergency steering gear control systems which meet specific design criteria. All vessels must have the equipment installed by June 1982. In addition, the manual steering gear must be tested after prolonged use of the automatic pilot; specific maintenance checks and tests must be conducted within twelve hours of departure; and emergency steering drills must be conducted at least once every three months. It is determined that the equipment will be installed on vessels beginning in 1981. Therefore, the baseline year for the analysis was set at 1981.

An incident reduction assessment will, in most cases, provide the regulatory staff with a basis for estimating vessel cargo and personnel benefits. It will probably not directly provide useful information on potential in-house government benefits or environmental/property benefits. These latter benefits must be developed by the regulatory staff using the procedures described in Section VI.

Suppose for the sake of illustration the regulatory staff has been supplied with estimates of the number of incidents avoided. Since the benefits of a regulation will often be different for different sizes and types of vessels the incident reduction estimate has divided the impacted vessel population into five classes:

- Class 1 - Oil tankers 125,000 DWTs
- Class 2 - Oil Tankers 75,000 to 125,000 DWTs
- Class 3 - Oil Tankers 75,000 DWTs
- Class 4 - Gas Carriers, all sizes
- Class 5 - Chemical Carriers, all sizes.

The illustration of the benefit formats will be developed in detail only for class 1 vessels. The procedures for filling in the benefit formats for the other vessel classes are identical, although the numbers will be different.

For this example the population for vessel class 1 (oil tankers > 125,000 DWTs) is as follows:

1. There are six existing tankers > 125,000 DWTs which must comply with the regulation. Three will have the equipment installed in 1981, and three will have it installed in 1982. In 1997, one of these vessels will retire, another will retire in 1998, another in 1999, another in 2000, and two in 2001. The retiring vessels will be replaced by new vessels in the year the old ones retire.
2. Two new vessels will be constructed in 1981, one in 1983, two in 1985, and one in 1989. Because of the retiring vessels mentioned above (number 1), one new vessel will be constructed in 1997, another in 1998, another in 1999, another in 2000, and two in 2001 as replacements for the retiring vessels.

The results of an incident reduction estimate for Class 1 vessels, supplied to the regulatory staff, consist of the following hypothetical information:

1. Vessel Losses - Vessel losses averted are estimated at one in 1990 and one in the year 2000. The average size of the vessels lost is 150,000 DWT.
2. Vessel Damage - The number of vessels not incurring damages are as follows:
 - 1981 - 1983 - 1 vessel per year
 - 1984 - 1989 - 2 vessels per year
 - 1990 - 2005 - 3 vessels per year
3. Cargo, Total Loss - Cargo losses avoided for the two vessels not lost are estimated at 75,000 gross tons per vessel.
4. Cargo, Partial Loss - Cargo losses avoided are estimated at 8000 gallons per damaged vessel.
5. Personnel - Death - Two deaths will be avoided for each vessel lost. No deaths will be avoided from a reduction in vessel damages.

6. Personnel, Injury - Crew

A. Vessel losses averted - 6 injuries avoided per vessel.

B. Vessel damages averted - 2 injuries per incident.

7. Personnel Injury - Longshoremen and General Population - No deaths or injury reductions affecting these two groups will result from the proposed regulation.

For purposes of illustration it is assumed that all necessary manipulations of the incident reduction estimates have been completed and the regulatory staff has obtained estimates of all pertinent quantifiable benefits. The results of the manipulation of personnel data are as follows:

Personnel, Injury - Crew:

a) Vessel losses - 6 injuries avoided per vessel, average workdays not lost is 10 per individual, average hospital days avoided per person is 2.

b) Vessel damages - 2 injuries avoided per incident; average workdays not lost is 3 per person; medical expense is estimated at the equivalent of 1 day in the hospital per person.

What remains to be done is insert the information into the blanks on the benefit formats and perform the necessary addition and multiplication to arrive at the final discounted benefit of the regulation. The benefit formats should be filled in sequentially starting with Format 1 and ending with Format 11.

C. Format 1: Industry Benefit Categories

The first four lines on this format (page 30) are designed to give the regulatory staff places to identify (1) the regulation under analysis using a few key words (e.g., improved emergency steering); (2) the type of vessel to be analyzed on this format (e.g., tankers); (3) the size of the vessels under analysis on this format (e.g., > 125,000 DWTs); and (4) the vessel class identification number, an arbitrary number given by the regulatory staff for identification purposes only (e.g., vessel class 1).

Next, the regulatory staff must fill in the blanks next to all the benefit categories listed for which he or she has estimated the dollar benefits of the regulation. The replacement cost for a tanker of 150,000 DWT is estimated at \$ 72.75 million in 1981 dollars. It should be noted that the regulatory staff must inflate current construction costs to the baseline year of analysis, 1981 for this example. This information is inserted in the space opposite "Construction or Repair Benefit" under the column "Vessel Losses Averted".

For the working example, the regulatory staff places \$11200 in the blank for vessels (damages averted) in the appropriate blank. This means that it would have cost an average \$11200 to have each damaged tanker repaired. For this example it is assumed the staff was unable to quantify either the tow charge or service loss benefits for either damaged or lost vessels.

Format I

INDUSTRY BENEFIT CATEGORIES

Regulation:	<i>IMPROVED EMERGENCY STEERING</i>	
Vessel Type:	<i>TANKER</i>	
Vessel Size:	<i>>125,000 DWT</i>	
Vessel Class:	<i>1</i>	
	<u>Losses</u> <u>Averted</u>	<u>Damages</u> <u>Averted</u>
	\$	\$
I. VESSEL		
A. Replacement or Repair	<i>72,250,000</i>	<i>11,200</i>
B. Towing	—	—
C. Service Loss	—	—
Total	<i>72,250,000</i>	<i>11,200</i>

Next, the regulatory staff completes the section dealing with cargo. The estimated value of petroleum and related product losses not incurred due to the reduction in vessel losses is \$ 7.1 million for a 150,000 DWT tanker. Cargo losses avoided per vessel damage incident averted are estimated at \$ 6750 per incident.

Format I

INDUSTRY BENEFIT CATEGORIES

Regulation:	<i>IMPROVED EMERGENCY STEERING</i>	
Vessel Type:	<i>TANKER</i>	
Vessel Size:	<i>>125,000 DWT</i>	
Vessel Class:	<i>1</i>	
	<u>Losses</u> <u>Averted</u>	<u>Damages</u> <u>Averted</u>
	\$	\$
I. VESSEL		
A. Replacement or Repair	<i>72,250,000</i>	<i>11,200</i>
B. Towing	—	—
C. Service Loss	—	—
Total	<i>72,250,000</i>	<i>11,200</i>
II. CARGO	<i>7,100,000</i>	<i>6,750</i>

The regulatory staff then completes the blanks for vessel personnel losses avoided. Only non-recurring industry personnel benefits are impacted by this regulation. The total per person benefit when vessel losses are avoided is \$1280. For damaged vessels the per person benefits are \$480. Since there are no recurring personnel benefits, these items are left blank.

Format 1

INDUSTRY BENEFIT CATEGORIES

Regulation:	<i>IMPROVED EMERGENCY STEERING</i>		
Vessel Type:	<i>TANKER</i>		
Vessel Size:	<i>>125,000 DWT</i>		
Vessel Class:	<i>1</i>		
		Losses Averted \$	Damages Averted \$
I. VESSEL			
A. Replacement or Repair		<i>72,250,000</i>	<i>11,200</i>
B. Towing		<i>---</i>	<i>---</i>
C. Service Loss		<i>---</i>	<i>---</i>
Total		<i>72,250,000</i>	<i>11,200</i>
II. CARGO		<i>7,100,000</i>	<i>6,250</i>
III. PERSONNEL - INJURIES PREVENTED (Per Person)			
A. Non Recurring		<i>1,280</i>	<i>480</i>
B. Recurring		<i>---</i>	<i>---</i>
IV. DEATHS PREVENTED (number)	<i>4</i>		

Explanatory Notes:

D. Format 2: Industry Benefit Totals

These formats (See pages 44 to 49) are designed to let the regulatory staff take the different benefit categories found on Format 1, combine them separately with the number of vessels, incidents and personnel, by type, that will incur the benefits and the years the benefits will be received, to arrive at the total quantifiable benefit of the regulation in each year of the analysis for that particular vessel class. There are several things to note about Format 2.

1. Like Format 1, it leaves a space at the top for the regulatory staff to identify the regulation with a few key words, the type and size of vessels to be analyzed on this format, and the vessel class identification number.

2. For each cost category impacted on Format 1, there are separate Format 2's. For our example, six benefit categories are impacted on Format 1: Vessels Damaged; Vessels Lost; Cargo - Partial Loss; Cargo - Total Loss; Personnel - Vessel Loss, Injury - Non Recurring; Personnel - Vessel Damaged, Injury - Non Recurring.

3. This format, and the following ones, constrains the analysis to a 25-year time horizon. This can be modified by the regulatory staff by contracting or expanding the format. Year zero is the first year of compliance. In the example, the first year of compliance is 1981 and this is put in the blank next to year zero. Labelling year zero with the actual year aids the regulatory staff in knowing the years in which benefits will begin and be received.

In order to explain the columns, it is appropriate to describe all the Format 2's for the example regulation beginning with Format 2A.

Format 2A - Vessel Benefits (Losses Averted). Format 1 shows that the per vessel replacement cost for a tanker of 150,000 DWT is \$72.75 million. The first step in completing this format is to enter the number of vessel losses averted in column 1 in the appropriate years. In this example the incident reduction estimate has indicated one vessel loss avoided in 1990 and one in the year 2000. Column 3 provides a place to enter the estimated average age of the tanker fleet in the years when benefits will occur. In this case the average age of tankers in this class is estimated to be 12 years in 1990 and 14 years in the year 2000. Column 4 provides for the depreciation factor application to the average fleet age entered in column 3. To obtain the total annual vessel benefits (from losses avoided) of the regulation for vessel class 1 multiply column 1 times column 2 times column 4 and enter the result in column 5. In the year 1990, the benefit is \$37.8 million.

FORMAT 2A
INDUSTRY BENEFIT CATEGORY: VESSEL BENEFITS (LOSSES AVERTED)

REGULATION: IMPROVED EMERGENCY STEERING
VESSEL TYPE: TANKER
VESSEL SIZE: 150,000 DWT
VESSEL CLASS: 1

Year	No. of Incidents Averted (1)	Per Vessel Replacement Value (2)	Estimated Average Fleet Age (3)	Depreciation Factor % (4) (26 col 3 ÷ 25)	Total Vessel Benefit (5) (1) · (2) · (4)
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
1990	1	72,750,000	12	52.0	37,830,000
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
2000	1	72,750,000	14	44.0	32,010,000
21					
22					
23					
24					

Format 2B deals with Vessel Benefits (Damages Averted). The regulatory staff enters the number of incidents averted in column 1, based on the information supplied from the incident reduction estimate. Enter the dollar benefit per incident averted of \$11,200 from Format 1, into column 2 for each year in which incidents are averted. To obtain the annual vessel (damaged) benefit of the regulation multiply column 1 times column 2 and enter the result in column 3.

FORMAT 2B
INDUSTRY BENEFIT CATEGORY VESSEL BENEFITS (DAMAGES AVERTED)

REGULATION Improved Emergency Steering
VESSEL TYPE TUGBOAT
VESSEL SIZE 2,35,000 DWT
VESSEL CLASS

Year	No. of Incidents Averted (1)	Benefit Per Incident Averted (\$) (2)	Total Vessel Benefit of Regulation Per Year (3) (2) x (1)
0 1981	1	11,200	11,200
1	1	11,200	11,200
2	1	11,200	11,200
3	2	11,200	22,400
4	2	11,200	22,400
5	2	11,200	22,400
6	2	11,200	22,400
7	2	11,200	22,400
8	2	11,200	22,400
(1990) 9	3	11,200	33,600
10	3	11,200	33,600
11	3	11,200	33,600
12	3	11,200	33,600
13	3	11,200	33,600
14	3	11,200	33,600
15	3	11,200	33,600
16	3	11,200	33,600
17	3	11,200	33,600
18	3	11,200	33,600
(2000) 9	3	11,200	33,600
20	3	11,200	33,600
21	3	11,200	33,600
22	3	11,200	33,600
23	3	11,200	33,600
24	3	11,200	33,600

Formats 2C and 2D: Cargo Benefits (Total Losses) and Cargo Benefits (Partial Loss, Damages). The procedures for completing these formats are essentially the same as for Format 2B. Enter the number of incidents avoided in column 1, enter the appropriate dollar benefit per incident, from Format 1, in column 2 for each year in which incidents are avoided. To obtain the annual regulation benefits multiply column 1 times column 2 and enter the results in column 3 for each year from 0 through 24.

FORMAT 2C
INDUSTRY BENEFIT CATEGORY: CARGO BENEFITS (TOTAL LOSS)

REGULATION IMPROVED EMERGENCY STEERING
VESSEL TYPE TANKER
VESSEL SIZE > 125,000 DWT
VESSEL CLASS 1

Year	No. of Incidents Avoided (1)	Benefit Per Injury Prevented (2)	Total Cargo Benefit of Regulation Per Year (3) (2) x (1)
0 1981			
1			
2			
3			
4			
5			
6			
7			
8			
1990 9	1	2,100,000	2,100,000
10			
11			
12			
13			
14			
15			
16			
17			
18			
2000 9	1	2,100,000	2,100,000
20			
21			
22			
23			
24			

FORMAT 2D
INDUSTRY BENEFIT CATEGORY: CARGO BENEFITS (PARTIAL LOSS, DAMAGES)

REGULATION IMPROVED EMERGENCY STEERING
VESSEL TYPE TANKER
VESSEL SIZE > 125,000 DWT
VESSEL CLASS 1

Year	No. of Incidents Avoided (1)	Benefit Per Incident Avoided (2)	Total Cargo Benefit of Regulation Per Year (3) (2) x (1)
0 1981	1	6,750	6,750
1	1	6,750	6,750
2	1	6,750	6,750
3	2	6,750	13,500
4	2	6,750	13,500
5	2	6,750	13,500
6	2	6,750	13,500
7	2	6,750	13,500
8	2	6,750	13,500
9	3	6,750	20,250
10	3	6,750	20,250
11	3	6,750	20,250
12	3	6,750	20,250
13	3	6,750	20,250
14	3	6,750	20,250
15	3	6,750	20,250
16	3	6,750	20,250
17	3	6,750	20,250
18	3	6,750	20,250
19	3	6,750	20,250
20	3	6,750	20,250
21	3	6,750	20,250
22	3	6,750	20,250
23	3	6,750	20,250
24	3	6,750	20,250

Formats 2E through 2G deal with the benefits of vessel personnel injuries avoided. A distinction is made between personnel benefits that will accrue when vessel losses are avoided versus benefits to personnel from vessel damages averted. Format 2E deals with Nonrecurring Personnel Injury Benefits (Losses Averted). Since vessel losses avoided are only anticipated in two years of the analysis, 1990 and 2000, personnel benefits will only be entered for these two years. The number of injuries avoided is entered in column 1. Enter the per individual dollar benefit, of \$1280 from Format 1 in column 2. Multiply column 1 and column 2 and enter the results in column 3. For year 1990 the total annual personnel benefit is \$7680.

FORMAT 2E
 INDUSTRY BENEFIT CATEGORY: NON-RECURRING PERSONNEL
 INJURY BENEFITS (LOSSES AVERTED)

REGULATION *IMPROVED EMERGENCY STEERING*
 VESSEL TYPE *TUGGER*
 VESSEL SIZE *5-25000 DWT*
 VESSEL CLASS *1*

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year	
			(3)	(2) * (1)
0 1989				
1				
2				
3				
4				
5				
6				
7				
8				
9	6	1280		7680
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20	6	1280		7680
21				
22				
23				
24				

Format 2F deals with Nonrecurring Personnel Injury Benefits (Damages Averted). The procedures for completing this Format are identical to those for Format 2E.

FORMAT 2F
INDUSTRY BENEFIT CATEGORY: NONRECURRING PERSONNEL
INJURY BENEFITS (DAMAGES AVERTED)

REGULATION *IMPROVED EMERGENCY STEERING*
VESSEL TYPE *TANKER*
VESSEL SIZE *7,25,000 DWT*
VESSEL CLASS *1*

Year	No of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year	
			(3)	(1) * (2)
0 / 1981	2	480	960	
1	2	480	960	
2	2	480	960	
3	4	480	1,920	
4	4	480	1,920	
5	4	480	1,920	
6	4	480	1,920	
7	4	480	1,920	
8	4	480	1,920	
9	6	480	2,880	
10	6	480	2,880	
11	6	480	2,880	
12	6	480	2,880	
13	6	480	2,880	
14	6	480	2,880	
15	6	480	2,880	
16	6	480	2,880	
17	6	480	2,880	
18	6	480	2,880	
19	6	480	2,880	
20	6	480	2,880	
21	6	480	2,880	
22	6	480	2,880	
23	6	480	2,880	
24	6	480	2,880	

Format 2G deals with Recurring Personnel Injury Benefits (Losses Averted). Format 2H deals with Recurring Personnel Injury Benefits (Damages Averted). In this example there are no anticipated injuries that would result in either wage or medical benefits beyond one year. Therefore these Formats can be omitted from analysis of this regulation. In cases where recurring benefits do occur, the procedures for completing these Formats are the same as those for Formats 2E and 2F.

E. Format 3: Industry Summary (Single Class)

Format 3, page 50, serves as a summary sheet for the benefits of the regulation to a particular vessel class (in this example, vessel class 1, tankers > 125,000 DWTs). It contains columns in which the regulatory staff can place the vessel, cargo and personnel benefits found in the last column of the individual Format 2's.

Column 1 presented findings from Column 5 of Format 2A, Vessel Benefits (Losses Averted). Column 2 presents the findings from Column 3 of Format 2B, Vessel Benefits (Damages Averted). Column 3 presents Cargo Benefits (Total), Column 4 presents Cargo Benefits (Partial Loss, Damages), Column 5 presents Nonrecurring Personnel Injury Benefits (Vessel Losses Averted), and Column 6 presents Nonrecurring Personnel Injury Benefits (Vessel Damages Averted). Columns 7 and 8 are blank since there are no recurring personnel benefits in this particular example.

To obtain the total cost of the regulation to vessel class 1 in each year, add horizontally columns 1, 2, 3, 4, 5, and 6. This completes the use of Formats 1, 2, and 3 for vessel class 1. The regulatory staff must then perform the same procedures for every other vessel class (or vessel size and type division). Once this has been done, the regulatory staff is in a position to move to Format 4 and determine the annual cost of the regulation to the total impacted vessel population.

FORMAT 3
SUMMARY OF INDUSTRY BENEFIT CATEGORIES*
TOTAL ANNUAL \$(000)

REGULATION IMPROVED EMERGENCY STEERING
VESSEL TYPE TANKER
VESSEL SIZE >125,000 DWT
VESSEL CLASS 1

Year	Vessel Benefits (Losses) (1)	Vessel Benefits (Damages) (2)	Cargo Benefits (Total) (3)	Cargo Benefits (Partial Loss Damages) (4)	Personnel Nonrecurring (Losses Averted) (5)	Personnel Nonrecurring (Damages Averted) (6)	Personnel Recurring (Losses Averted) (7)	Personnel Recurring (Damages Averted) (8)	Total Industry Benefits of Regulation (1+2+3+4+5+6)
0 1981		11.2		6.8		1			19
1		11.2		6.8		1			19
2		11.2		6.8		1			19
3		22.4		13.5		1.9			38
4		22.4		13.5		1.9			38
5		22.4		13.5		1.9			38
6		22.4		13.5		1.9			38
7		22.4		13.5		1.9			38
8		22.4		13.5		1.9			38
1989	37,830	33.6	7,100	20.2	7.7	2.9			44,994
10		33.6		20.2		2.9			57
11		33.6		20.2		2.9			57
12		33.6		20.2		2.9			57
13		33.6		20.2		2.9			57
14		33.6		20.2		2.9			57
15		33.6		20.2		2.9			57
16		33.6		20.2		2.9			57
17		33.6		20.2		2.9			57
18		33.6		20.2		2.9			57
1989	37,830	33.6	7,100	20.2	7.7	2.9			39,174
20		33.6		20.2		2.9			57
21		33.6		20.2		2.9			57
22		33.6		20.2		2.9			57
23		33.6		20.2		2.9			57
24		33.6		20.2		2.9			57

* From last Column of appropriate Format 2

F. Format 4: Industry Summary (All Vessels)

There are several points to be made about Format 4, page 51. This format deals with all vessel classes impacted by the regulation. Hence, the only identifying heading at the top of the format is for the name of the regulation.

This format allows the regulatory staff to present the results for nine vessel classes. In the event there are more, the form can be expanded to include more columns.

For the working example, there are five vessel classes:

- Class 1 - oil tankers > 125,000 DWTs
- Class 2 - oil tankers 75,000 to 125,000 DWTs
- Class 3 - oil tankers < 75,000 DWTs
- Class 4 - gas carriers, all sizes
- Class 5 - chemical carriers, all sizes

For the sake of simplification, it is assumed the regulatory staff has gone through all the benefit procedures and has filled in Formats 1 through 3 for vessel classes 2, 3, 4 and 5. The regulatory staff has found (somewhat unrealistically) for vessel class 2, total annual regulation benefits are \$200,000 in each year from year 0 to year 24; for vessel class 3, total annual regulation benefits are \$250,000 in each year; for vessel class 4, \$150,000 in each year; and for vessel class 5, \$100,000 in each year.

In column 1, Format 4, the regulatory staff places the annual regulation benefits for vessel class 1 obtained from column 6 of the associated Format 3. In column 2, the benefits to vessel class 2 are presented. Column 3 presents the benefits to vessel class 3; column 4, the benefits to vessel class 4; and column 5, the benefits to vessel class 5. To obtain the total industry benefits of the regulation for all vessel classes, the regulatory staff sums across columns 1 through 9 and places the resulting figures in column 10.

The next step involves discounting these benefits. Column 11 presents the discount factors (mid-year) corresponding to a discount rate of 10 percent. Column 12 is left blank to allow the regulatory staff to use another discount rate if desired. To obtain the discounted annual benefits of the regulation, the regulatory staff must multiply column 10, the undiscounted annual benefits, by column 11, the discount factor at a 10 percent discount rate. Note, if the regulatory staff is using another discount rate, column 10 should be multiplied by column 12 instead of column 11.

The results of multiplying columns 10 and 11 are placed in column 13. These benefits are still identified with a certain year. To obtain the total discounted industry regulation benefit for all 25 years of analysis, vertically add the numbers contained in column 13.

FORMAT 4
INDUSTRY REGULATION BENEFITS—SUMMARY FOR ALL VESSEL CLASSES*
TOTAL ANNUAL \$(000)

Year	Benefit Class 1 (1)	Benefit Class 2 (2)	Benefit Class 3 (3)	Benefit Class 4 (4)	Benefit Class 5 (5)	Benefit Class 6 (6)	Benefit Class 7 (7)	Benefit Class 8 (8)	Benefit Class 9 (9)	Total Annual Benefits All Classes (10) (1)+(2)+(3)+(4)+(5)+(6)+(7)+(8)+(9)	Discount Factor 10% (11)	Other Discount Factor (12)	Discounted Annual Benefits (13) (10) x (11)
0	19	200	250	150	100					719	1.000		719
1	19	200	250	150	100					719	.904		646
2	19	200	250	150	100					719	.807		579
3	38	200	250	150	100					738	.708		522
4	38	200	250	150	100					738	.611		450
5	38	200	250	150	100					738	.514		378
6	38	200	250	150	100					738	.417		307
7	38	200	250	150	100					738	.320		236
8	38	200	250	150	100					738	.223		165
9	38	200	250	150	100					738	.126		94
10	419	200	250	150	100					45,694	.029		1,328
11	57	200	250	150	100					757	.406		307
12	57	200	250	150	100					757	.360		273
13	57	200	250	150	100					757	.314		238
14	57	200	250	150	100					757	.268		203
15	57	200	250	150	100					757	.222		168
16	57	200	250	150	100					757	.176		133
17	57	200	250	150	100					757	.130		98
18	57	200	250	150	100					757	.084		63
19	57	200	250	150	100					757	.038		28
20	57	200	250	150	100					757	.000		0
21	57	200	250	150	100					757			0
22	57	200	250	150	100					757			0
23	57	200	250	150	100					757			0
24	57	200	250	150	100					757			0
25	57	200	250	150	100					757			0
Total	8525	5000	6250	3750	2500					102,750	Cumulative Discount Factor .627		64,532

*Uniform Annual Industry Regulation Benefit = Total Discounted Industry Regulation Benefit / 0.627 = 3,653,124
From Column 13, Format 11

This total discounted industry regulation benefit (in our example, \$ 36,425,000) can be divided by a cumulative discount factor to obtain a measure of uniform annual regulation benefit. The cumulative discount factor is found by vertically adding the discount factors for years 1 through 24 (column 11 if a 10 percent rate of discount is used; column 12 otherwise). Note that the discount factor for year 0 (1.000) is omitted. For the working example, the cumulative discount factor is 9.427, the total discounted industry regulation benefit is \$ 3,863,902 (\$ 36,425,000 - 9,427). Insert this figure on Format 11, Column 5.

G. Formats 5 & 6: In-House Benefits (Categories and Summaries)

Formats 5 and 6, pages 52 and 53 deal with benefits that accrue to the Government as a result of regulations promulgated under the Commercial Vessel Safety Program. These benefits are specific to the regulation, not to individual vessel types. Therefore, the only heading at the top of the page is a description of the regulation.

In this example it is assumed that \$60,000 per year in military personnel benefits will occur as a result of reducing marine casualties through improved emergency steering gear.

Format 5
IN-HOUSE BENEFIT CATEGORIES

Regulation: *IMPROVED EMERGENCY STEERING*

I. INVESTMENT BENEFITS		
A. Non Recurring		_____
B. Recurring		_____
II. OPERATING BENEFITS		
A. Personnel		
1. Civilian		_____
2. Military		<u>60,000</u>
B. Materials and Supplies		_____
C. Government Furnished Services		_____
D. Other		_____
Total Operating Benefits		<u>60,000</u>

Explanatory Notes:

Carry these annual benefits forward to Format 6.

Format 6 arrays the per year In-House benefits and allows for discounting procedures similar to those discussed under Format 4.

FORMAT 4
SUMMARY OF IN-HOUSE BENEFITS*
(\$1000)

REGULATION *IMPROVED ENERGY STEERING*

Year	Annual Investment Benefits Non recurring (1)	Annual Investment Benefits Recurring (2)	Annual Operating Benefits (3)	Total Amount In-house Benefits of the "regulation" (4) (2) + (3) + (1)	Discount Factor 10% (5)	Other Discount Factor — % (6)	Discounted Annual In-house Benefits (7) (4) * (5) (6)
0		60		60	1.000		60
1		60		60	.954		57
2		60		60	.907		52
3		60		60	.868		47
4		60		60	.817		43
5		60		60	.762		39
6		60		60	.712		36
7		60		60	.658		32
8		60		60	.609		29
9		60		60	.556		27
10		60		60	.506		24
11		60		60	.458		22
12		60		60	.414		20
13		60		60	.372		18
14		60		60	.332		17
15		60		60	.294		15
16		60		60	.258		14
17		60		60	.224		12
18		60		60	.192		11
19		60		60	.162		10
20		60		60	.134		9
21		60		60	.108		8
22		60		60	.084		8
23		60		60	.062		7
24		60		60	.042		6
Totals		1,500		1,500	Cumulative Discount Factor 9.427		Total Discounted In-house Regulation Benefit 1,264

Uniform Annual Industry Regulation Benefit Total Discounted In-house Regulation Benefit : 9 427 *46*
Enter this in Column 5 Format 11
From Format 5

H. Formats 7, 8, and 9: Quantifiable Societal Benefits (Categories, Totals and Summaries)

Formats 7, 8 and 9, (not used in this example), deal with the quantifiable societal benefits of regulations, namely those personnel benefits that are not included in industry or Government. These are benefits to society rather than to industry or Government. Therefore, the only identifying heading at the top of each of these formats is a description of the regulation.

Format 7 provides spaces for inserting the annual dollar benefit per person for two groups, General Population and Longshore/Dock Workers. Separate columns are provided for inserting different dollar values for Non-Recurring and Recurring annual benefits per person. Space is also provided to enter the number of deaths avoided for each group, General Population and Longshore/Dock Workers.

For the working example no deaths or injury reductions affecting these two groups will result from this proposed regulation. Therefore, this Format will not be completed.

Format 8: This Format is used to accumulate the annual personnel benefits over the life of the regulation. The format is divided into 4 parts as follows:

Format 8A: Societal Benefits - Personnel Injuries Prevented, General Population, Non Recurring

Format 8B: Societal Benefits - Personnel Injuries Prevented, General Population, Recurring

Format 8C: Societal Benefits - Personnel Injuries Prevented, Longshore/Dock Workers, Non Recurring

Format 8D: Societal Benefits - Personnel Injuries Prevented, Longshore/Dock Workers, Recurring

These Formats are not used in this example since there is no anticipated reduction in societal personnel injuries. However, the procedures for completing these formats, when used, are identical to those for completing Format 2E through 2G, described above.

Format 9 when used, summarizes the annual quantifiable societal benefits over the life of the regulation or period of the regulatory analysis. Annual benefits are discounted and added to arrive at a uniform annual quantifiable societal benefit. The detailed procedures for completing this format are identical to those described above for Format 4.

I. Formats 10 and 10A: Environmental and Property Benefits

Format 10, pages 54 and 55, is a summary sheet for identifying those environmental and property resources that are likely to benefit from the proposed regulation. This format can be used to describe the generalized future benefits of the regulation to all U. S. waters or, it can be specific to a particular geographic area (such as the Great Lakes) or a specific site. This Format is also intended for use in describing the environmental and property impacts of past spills.

The first four lines on this Format are designed to give the regulatory staff places to identify; (1) the regulation under analysis using a few key words (e.g., improved emergency steering); (2) the geographic area to be analyzed on this Format, and when applicable, (3) identification of a "typical" site or specific past incident. In this example the geographic area is "all U. S. Coastal Waters." No site or incident is specified.

Column 1 lists the elements that could benefit from a reduction in marine casualties. Column 2 provides space for the regulatory staff to check those elements that will NOT benefit from the proposed action. For this example, it has been determined that Hatcheries, all 4 elements under Category V, Water Supply and Marine Sanctuaries are unlikely to benefit from this regulation.

All other elements may benefit from this regulation. Columns 3 through 9 provide space to indicate the effects on impacted resources.

- o Column 3 - Clean-up/Rehabilitation Required. The regulatory staff checks those Column 1 elements that will require clean-up or rehabilitation.

Format 10
SUMMARY OF BENEFITS TO MARINE RELATED RESOURCES
(NON MONETIZED)

Regulation: *IMPROVED EMERGENCY STEERING*
Geographic Area: *ALL U.S. COASTAL WATERS*
Site/Incident:

Resource	Not Impacted	Clean-up Rehabilitation Required	Degree of Impact ¹	Duration of Impact		Previous Incidents in Affected Area		
				Short Term	Long Term	Minimal	Moderate	Heavy
I. Commercial Resources								
A. Fin Fish			2	x		x		
B. Shell Fish			2	x		x		
C. Hatcheries	x							
D. Vessels								
E. Piers, Docks & Facilities								
F. Tourism								
G. Other								
II. Private Structures								
III. Recreational Resources								
A. Public waterfront property			/	x		x		
B. Private waterfront property			/	x		x		
C. Other recreational facilities								
D. Recreational boats								
E. Sport fishing			/	x		x		
F. Other								

¹ Enter degree of impact from the following codes:
0 Potential
1 Minimal
2 Moderate
3 Heavy
U Unknown

- o Column 4 - Degree of Impact. Indicate the degree of impact, using the key at the end of the Formats as follows:
0 - Potential, 1 - Minimal, 2 - Moderate, 3 - Heavy, or U - Unknown.
- o Columns 5 and 6 - Duration of Impact. The regulatory staff checks either "short term" or "long term" for each element determined to benefit from the proposed regulation.
- o Columns 7, 8 and 9 - Previous Pollution In Affected Area. For each element determined to benefit indicate, by checking the appropriate box, whether the benefits will be realized in areas relatively unpolluted or areas that have had, or continue to have, moderate to high levels of pollution.

SUMMARY OF BENEFITS TO MARINE RELATED RESOURCES
(NON MONETIZED)

Regulation: *IMPROVED EMERGENCY STEERING*
 Geographic Area: *ALL U.S. COASTAL WATERS*
 Site/Incident:

	Resource Not Impacted	Clean-up Rehabilitation Required	Degree of Impact	IMPACTED RESOURCES			Previous Incidents in Affected Area		
				Duration of Impact	Short Term	Long Term	Minimal	Moderate	Heavy
IV. Water Supply									
A. Municipal drinking water	X								
B. Other municipal intake	X								
C. Industrial intake	X								
D. Agricultural intake	X								
E. Other									
V. Natural Resource									
A. Fish (Non-commercial)			0	X					
B. Other Marine Biota									X
C. Waterfowl and other birds			0	X					
D. Marine mammals									X
E. Marine sanctuary or wilderness areas	X								
F. Reef									
G. Other									

Enter degree of impact from the following codes:
 0 Potential
 1 Minimal
 2 Moderate
 3 Heavy
 U Unknown

When the effect on an element listed in Column 1 is not known, columns 2 through 9 should be left blank.

In this example it is determined that eight elements will benefit, the benefits will all be in areas predominately unpolluted and the degree of damages averted range from potential to moderate.

Format 10A (not used in this example), is used to estimate the dollar impact of a specific incident under a specified set of circumstances. The headings at the top of the Format identify the regulation, specific site and a brief description of the incident. The description should include: volume spilled, cargo spilled, weather conditions and elements impacted.

The first column provides space for listing the impacted elements under broad categories. Space is provided for a low, high and best estimate valuation of the damages incurred.

J. Format 11: Comparison of Alternatives

Format 11, page 56, is designed to aid the regulatory staff in comparing the quantified benefits of alternative regulations. It allows space for a short description of the alternative regulations, identification of the impacted resources, the earliest date of compliance and a short description of the expected costs or reasons for the regulation. The last column presents the industry, in-house and societal uniform annual benefits of the regulation which are found on the bottom lines of Formats 4, 6 and 9.

Format 11 has space for only 5 alternative regulations. Again, if more than 5 are to be compared, the format can be expanded by adding more rows at the bottom of the form.

FORMAT 11
COMPARISON OF ALTERNATIVES—QUANTIFIABLE BENEFITS
(* THOUSANDS)

Description of Alternative Regulations (1)	Impacted Resources (2)	Compliance Date (3)	Description of Costs (4)	Uniform Annual Benefits (5)
IMPROVED EMERGENCY STEERING 1 (46 CFR)	VESSELS, CARGO, PERSONNEL, ENVIRONMENT	6/81	INSTALL AND MAINTAIN EQUIPMENT, INSPECTIONS	Industry* 3,653 In-house** 66 Societal*** TOTAL 3,719 Deaths**** Prevented #
2				Industry* In-house** Societal*** TOTAL Deaths**** Prevented #
3				Industry* In-house** Societal*** TOTAL Deaths**** Prevented #
4				Industry* In-house** Societal*** TOTAL Deaths**** Prevented #
5				Industry* In-house** Societal*** TOTAL Deaths**** Prevented #

* From Format 4
** From Format 6
*** From Format 9
**** Sum of Tables 1 and 7

Note: The Formats included in this Section were designed to be applicable to a wide range of regulatory actions. Therefore, the exact Format titles and particularly the column headings on some Formats can be altered to fit a particular regulatory analysis.

Format 1

INDUSTRY BENEFIT CATEGORIES

Regulation: *IMPROVED EMERGENCY STEERING*
 Vessel Type: *TANKER*
 Vessel Size: *>125,000 DWT*
 Vessel Class: *1*

	<u>Losses</u> <u>Averted</u> \$	<u>Damages</u> <u>Averted</u> \$
I. VESSEL		
A. Replacement or Repair	<u>72,750,000</u>	<u>11,200</u>
B. Towing	—	—
C. Service Loss	—	—
Total	<u>72,750,000</u>	<u>11,200</u>
II. CARGO	<u>7,100,000</u>	<u>6,750</u>
III. PERSONNEL - INJURIES PREVENTED (Per Person)		
A. Non Recurring	<u>1,200</u>	<u>400</u>
B. Recurring	—	—
IV. DEATHS PREVENTED (number)	<u>4</u>	

Explanatory Notes:

FORMAT 2A

INDUSTRY BENEFIT CATEGORY: VESSEL BENEFITS (LOSSES AVERTED)

REGULATION: IMPROVED EMERGENCY STEERING
 VESSEL TYPE: TANKER
 VESSEL SIZE: 2125,000 DWT
 VESSEL CLASS: 1

Year	No. of Incidents Avoided (1)	Per Vessel Replacement Value (2)	Estimated Average Fleet Age (3)	Depreciation Factor % (4) = (25 - col. 3 ÷ 25)	Total Vessel Benefit (5) = (1) × (2) × (4)
0 = 1981					
1					
2					
3					
4					
5					
6					
7					
8					
1990-9	1	72,750,000	12	52.0	37,830,000
10					
11					
12					
13					
14					
15					
16					
17					
18					
1991-9	1	72,750,000	14	44.0	32,010,000
20					
21					
22					
23					
24					

INDUSTRY BENEFIT CATEGORY: VESSEL BENEFITS (DAMAGES AVERTED)

REGULATION: IMPROVED EMERGENCY STEERING
 VESSEL TYPE: TANKER
 VESSEL SIZE: 5,25,000 DWT
 VESSEL CLASS:

Year	No. of Incidents Avoided (1)	Benefit Per Incident Avoided (\$) (2)	Total Vessel Benefit of Regulation Per Year (3) (2) x (1)
0-1981	1	11,200	11,200
1	1	11,200	11,200
2	1	11,200	11,200
3	2	11,200	22,400
4	2	11,200	22,400
5	2	11,200	22,400
6	2	11,200	22,400
7	2	11,200	22,400
8	2	11,200	22,400
(1990)9	3	11,200	33,600
10	3	11,200	33,600
11	3	11,200	33,600
12	3	11,200	33,600
13	3	11,200	33,600
14	3	11,200	33,600
15	3	11,200	33,600
16	3	11,200	33,600
17	3	11,200	33,600
18	3	11,200	33,600
(2000)9	3	11,200	33,600
20	3	11,200	33,600
21	3	11,200	33,600
22	3	11,200	33,600
23	3	11,200	33,600
24	3	11,200	33,600

FORMAT 2C

INDUSTRY BENEFIT CATEGORY: CARGO BENEFITS (TOTAL LOSS)

REGULATION: IMPROVED EMERGENCY STEERING

VESSEL TYPE: TANKER

VESSEL SIZE: 2,25,000 DWT

VESSEL CLASS: 1

Year	No. of Incidents Avoided (1)	Benefit Per Injury Prevented (2)	Total Cargo Benefit of Regulation Per Year (3) = (2) x (1)
0 1981			
1			
2			
3			
4			
5			
6			
7			
8			
1990 9	1	7,100,000	7,100,000
10			
11			
12			
13			
14			
15			
16			
17			
18			
2000 19	1	7,100,000	7,100,000
20			
21			
22			
23			
24			

FORMAT 2D

INDUSTRY BENEFIT CATEGORY: CARGO BENEFITS (PARTIAL LOSS, DAMAGES)

REGULATION: IMPROVED EMERGENCY STEERING

VESSEL TYPE: TANKER

VESSEL SIZE: > 125,000 DWT

VESSEL CLASS:

Year	No. of Incidents Avoided (1)	Benefit Per Incident Avoided (\$) (2)	Total Cargo Benefit of Regulation Per Year (3) (2) · (1)
0 1981	1	6,750	6,750
1	1	6,750	6,750
2	1	6,750	6,750
3	2	6,750	13,500
4	2	6,750	13,500
5	2	6,750	13,500
6	2	6,750	13,500
7	2	6,750	13,500
8	2	6,750	13,500
9	3	6,750	20,250
10	3	6,750	20,250
11	3	6,750	20,250
12	3	6,750	20,250
13	3	6,750	20,250
14	3	6,750	20,250
15	3	6,750	20,250
16	3	6,750	20,250
17	3	6,750	20,250
18	3	6,750	20,250
19	3	6,750	20,250
20	3	6,750	20,250
21	3	6,750	20,250
22	3	6,750	20,250
23	3	6,750	20,250
24	3	6,750	20,250

FORMAT 2E

INDUSTRY BENEFIT CATEGORY: NON-RECURRING PERSONNEL
INJURY BENEFITS (LOSSES AVERTED)

REGULATION: IMPROVED EMERGENCY STEERING
VESSEL TYPE: TANKER
VESSEL SIZE: >125,000 DWT
VESSEL CLASS: 1

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (2) x (1)
0 = 1981			
1			
2			
3			
4			
5			
6			
7			
8			
9 = 1990	6	1,280	7,680
10			
11			
12			
13			
14			
15			
16			
17			
18			
19 = 2000	6	1,280	7,680
20			
21			
22			
23			
24			

FORMAT 2F

**INDUSTRY BENEFIT CATEGORY: NONRECURRING PERSONNEL
INJURY BENEFITS (DAMAGES AVERTED)**

REGULATION: *IMPROVED EMERGENCY STEERING*
VESSEL TYPE: *TANKER*
VESSEL SIZE: *125,000 DWT*
VESSEL CLASS:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (1) x (2)
0 = 1981	2	480	960
1	2	480	960
2	2	480	960
3	4	480	1,920
4	4	480	1,920
5	4	480	1,920
6	4	480	1,920
7	4	480	1,920
8	4	480	1,920
9	6	480	2,880
10	6	480	2,880
11	6	480	2,880
12	6	480	2,880
13	6	480	2,880
14	6	480	2,880
15	6	480	2,880
16	6	480	2,880
17	6	480	2,880
18	6	480	2,880
19	6	480	2,880
20	6	480	2,880
21	6	480	2,880
22	6	480	2,880
23	6	480	2,880
24	6	480	2,880

FORMAT 3

SUMMARY OF INDUSTRY BENEFIT CATEGORIES*
TOTAL ANNUAL \$(000)

REGULATION: IMPROVED EMERGENCY STEERING
VESSEL TYPE: TANKER
VESSEL SIZE: >125,000 DWT
VESSEL CLASS: 1

Year	Vessel Benefits (Losses) (1)	Vessel Benefits (Damages) (2)	Cargo Benefits (Total) (3)	Cargo Benefits (Partial Loss, Damages) (4)	Personnel Nonrecurring (Losses Averted) (5)	Personnel Nonrecurring (Damages Averted) (6)	Personnel Recurring (Losses Averted) (7)	Personnel Recurring (Damages Averted) (8)	Total Industry Benefits of Regulation 9 = 1 + 2 + ... + 8
0 7/82		11.2		6.8		1			19
1		11.2		6.8		1			19
2		11.2		6.8		1			19
3		22.4		13.5		1.9			38
4		22.4		13.5		1.9			38
5		22.4		13.5		1.9			38
6		22.4		13.5		1.9			38
7		22.4		13.5		1.9			38
8		22.4		13.5		1.9			38
9	37,830	33.6	7,100	20.2	7.7	2.9			44994
10		33.6		20.2		2.9			57
11		33.6		20.2		2.9			57
12		33.6		20.2		2.9			57
13		33.6		20.2		2.9			57
14		33.6		20.2		2.9			57
15		33.6		20.2		2.9			57
16		33.6		20.2		2.9			57
17		33.6		20.2		2.9			57
18		33.6		20.2		2.9			57
19	37,830	33.6	7,100	20.2	7.7	2.9			39174
20		33.6		20.2		2.9			57
21		33.6		20.2		2.9			57
22		33.6		20.2		2.9			57
23		33.6		20.2		2.9			57
24		33.6		20.2		2.9			57

* From last Column of appropriate Format 2.

INDUSTRY REGULATION BENEFITS—SUMMARY FOR ALL VESSEL CLASSES*
TOTAL ANNUAL \$(000)

REGULATION: IMPROVED EMERGENCY STEERING

Year	Benefit Class (1)	Benefit Class (2)	Benefit Class (3)	Benefit Class (4)	Benefit Class (5)	Benefit Class (6)	Benefit Class (7)	Benefit Class (8)	Benefit Class (9)	Total Annual Benefits All Classes (10) = (1)+(2)+...+(9)	Discount Factor 10% (11)	Other Discount Factor — % (12)	Discounted Annual Benefit 13 = (10) × (11)
0/1981	19	200	250	150	100					719	1.000		719
1	19	200	250	150	100					719	.954		686
2	19	200	250	150	100					719	.867		623
3	38	200	250	150	100					738	.788		581
4	38	200	250	150	100					738	.717		529
5	38	200	250	150	100					738	.652		481
6	38	200	250	150	100					738	.592		437
7	38	200	250	150	100					738	.538		397
8	38	200	250	150	100					738	.489		360
9	4494	200	250	150	100					45,694	.445		20,334
10	57	200	250	150	100					757	.405		307
11	57	200	250	150	100					757	.368		278
12	57	200	250	150	100					757	.334		253
13	57	200	250	150	100					757	.304		230
14	57	200	250	150	100					757	.276		209
15	57	200	250	150	100					757	.251		190
16	57	200	250	150	100					757	.228		173
17	57	200	250	150	100					757	.208		157
18	57	200	250	150	100					757	.189		143
19	39174	200	250	150	100					39,874	.172		6,858
20	57	200	250	150	100					757	.156		118
21	57	200	250	150	100					757	.142		107
22	57	200	250	150	100					757	.129		98
23	57	200	250	150	100					757	.117		89
24	57	200	250	150	100					757	.107		81
Totals	85251	5000	6250	3750	2500					102,751	Cumulative Discount Factor = 9.427		34,438 Total Discounted Industry Regulation Benefit

Uniform Annual Industry Regulation Benefit = Total Discounted Industry Regulation Benefit ÷ 9.427 = 3,653,124.
* From Column 9, Format 3

Format 5

IN-HOUSE BENEFIT CATEGORIES

Regulation: *IMPROVED EMERGENCY STEERING*

I. INVESTMENT BENEFITS

- A. Non Recurring _____
- B. Recurring _____

II. OPERATING BENEFITS

- A. Personnel
 - 1. Civilian _____
 - 2. Military 60,000
- B. Materials and Supplies _____
- C. Government Furnished Services _____
- D. Other _____
- Total Operating Benefits 60,000

Explanatory Notes:

FORMAT 6
SUMMARY OF IN-HOUSE BENEFITS*
\$(000)

REGULATION IMPROVED EMERGENCY STEERING

Year	Annual Investment Benefits, Non-recurring (1)	Annual Investment Benefits, Recurring (2)	Annual Operating Benefits (3)	Total Amount In-house Benefits of the Regulation (4) - (3) + (2) + (1)	Discount Factor 10% (5)	Other Discount Factor % (6)	Discounted Annual In-house Benefits (7) = (4) x (5)
0 = 1981		60		60	1.000		60
1		60		60	.954		57
2		60		60	.867		52
3		60		60	.788		47
4		60		60	.717		43
5		60		60	.652		39
6		60		60	.592		36
7		60		60	.538		32
8		60		60	.489		29
9		60		60	.445		27
10		60		60	.405		24
11		60		60	.368		22
12		60		60	.334		20
13		60		60	.304		18
14		60		60	.276		17
15		60		60	.251		15
16		60		60	.228		14
17		60		60	.208		12
18		60		60	.189		11
19		60		60	.172		10
20		60		60	.156		9
21		60		60	.142		9
22		60		60	.129		8
23		60		60	.117		7
24		60		60	.107		6
Totals		1,500		1,500	Cumulative Discount Factor 9.427		1,424 Total Discounted In-house Regulation Benefit

Uniform Annual Industry Regulation Benefit Total Discounted In-house Regulation Benefit ÷ 9.427 = 146

Enter this in Column 5, Format 11
* From Format 5

SUMMARY OF BENEFITS TO MARINE RELATED RESOURCES
(NON MONETIZED)

Regulation: *IMPROVED EMERGENCY STEERING*
 Geographic Area: *ALL U.S. COASTAL WATERS*
 Site/Incident:

Resource Not Impacted	Clean-up Rehabilitation Required	Degree of Impact ¹	IMPACTED RESOURCES						
			Duration of Impact		Previous Incidents In Affected Area				
			Short Term	Long Term		Minimal	Moderate	Heavy	
I. Commercial Resources									
A. Fin Fish		2							
B. Shell Fish		2	X					X	
C. Hatcheries			X					X	
D. Vessels	X								
E. Piers, Docks & Facilities									
F. Tourism									
G. Other									
II. Private Structures									
III. Recreational Resources									
A. Public waterfront property		/						X	
B. Private waterfront property		/	X					X	
C. Other recreational facilities			X						
D. Recreational boats									
E. Sport fishing		/	X					X	
F. Other									

¹ Enter degree of impact from the following codes:

- 0 Potential
- 1 Minimal
- 2 Moderate
- 3 Heavy
- U Unknown

SUMMARY OF BENEFITS TO MARINE RELATED RESOURCES
(NON MONETIZED)

Regulation: *IMPROVED EMERGENCY STEERING*
 Geographic Area: *ALL U.S. COASTAL WATERS*
 Site/Incident:

Resource Not Impacted	Clean-up Rehabilitation Required	Degree of Impact ¹	Duration of Impact		IMPACTED RESOURCES		
			Short Term	Long Term	Previous Incidents In Affected Area		
					Minimal	Moderate	Heavy
IV. Water Supply							
A. Municipal drinking water	X						
B. Other municipal intake	X						
C. Industrial intake	X						
D. Agricultural intake	X						
E. Other							
V. Natural Resource							
A. Fish (Non-commercial)		0	X				X
B. Other Marine Biota							
C. Waterfowl and other birds		0	X				X
D. Marine mammals							
E. Marine sanctuary or wilderness areas	X						
F. Reef							
G. Other							

¹ Enter degree of impact from the following codes:

- 0 Potential
- 1 Minimal
- 2 Moderate
- 3 Heavy
- U Unknown

FORMAT 11
COMPARISON OF ALTERNATIVES—QUANTIFIABLE BENEFITS
 (\$ THOUSANDS)

Description of Alternative Regulations (1)	Impacted Resources Resources (2)	Compliance Date (3)	Description of Costs (4)	Uniform Annual Benefits (5)
IMPROVED EMERGENCY STEERING 1. (46 CFR)	VESSELS, CARGO, PERSONNEL; ENVIRONMENT	6/81	INSTALL AND MAINTAIN EQUIPMENT; INSPECTIONS	Industry* \$ 3,653 In-house** _____ Societal*** _____ TOTAL 3,719 Deaths**** _____ Prevented # 4
2.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
3.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
4.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
5.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____

* From Format 4
 ** From Format 6
 *** From Format 9
 **** Sum of Tables 1 and 7

BLANK FORMATS

Format 1

INDUSTRY BENEFIT CATEGORIES

Regulation:
Vessel Type:
Vessel Size:
Vessel Class:

	<u>Losses</u> <u>Averted</u> \$	<u>Damages</u> <u>Averted</u> \$
I. VESSEL		
A. Replacement or Repair	_____	_____
B. Towing	_____	_____
C. Service Loss	_____	_____
Total	_____	_____
II. CARGO	_____	_____
III. PERSONNEL - INJURIES PREVENTED (Per Person)		
A. Non Recurring	_____	_____
B. Recurring	_____	_____
IV. DEATHS PREVENTED (number)	_____	

Explanatory Notes:

FORMAT 2A
INDUSTRY BENEFIT CATEGORY: VESSEL BENEFITS (LOSSES AVERTED)

REGULATION:
 VESSEL TYPE:
 VESSEL SIZE:
 VESSEL CLASS:

Year	No. of Incidents Avoided (1)	Per Vessel Replacement Value (2)	Estimated Average Fleet Age (3)	Depreciation Factor % (4) = (25 - col. 3 ÷ 26)	Total Vessel Benefit (5) = (1) × (2) × (4)
0 =					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

FORMAT 2B

INDUSTRY BENEFIT CATEGORY: VESSEL BENEFITS (DAMAGES AVERTED)

REGULATION:
VESSEL TYPE:
VESSEL SIZE:
VESSEL CLASS:

Year	No. of Incidents Avoided (1)	Benefit Per Incident Avoided (\$) (2)	Total Vessel Benefit of Regulation Per Year (3) (2) x (1)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
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16			
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19			
20			
21			
22			
23			
24			

FORMAT 2C
INDUSTRY BENEFIT CATEGORY: CARGO BENEFITS (TOTAL LOSS)

REGULATION:
 VESSEL TYPE:
 VESSEL SIZE:
 VESSEL CLASS:

Year	No. of Incidents Avoided (1)	Benefit Per Injury Prevented (\$) (2)	Total Cargo Benefit of Regulation Per Year (3) = (2) x (1)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
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21			
22			
23			
24			

FORMAT 2D

INDUSTRY BENEFIT CATEGORY: CARGO BENEFITS (PARTIAL LOSS, DAMAGES)

REGULATION:
VESSEL TYPE:
VESSEL SIZE:
VESSEL CLASS:

Year	No. of Incidents Avoided (1)	Benefit Per Incident Avoided (\$) (2)	Total Cargo Benefit of Regulation Per Year (3) (2) x (1)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
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20			
21			
22			
23			
24			

FORMAT 2E
**INDUSTRY BENEFIT CATEGORY: NON-RECURRING PERSONNEL
 INJURY BENEFITS (LOSSES AVERTED)**

REGULATION:
 VESSEL TYPE:
 VESSEL SIZE:
 VESSEL CLASS:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	(Personnel Benefit of Regulation Per Year (3) = (2) x (1)
0 =			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FORMAT 2F

**INDUSTRY BENEFIT CATEGORY: NONRECURRING PERSONNEL
INJURY BENEFITS (DAMAGES AVERTED)**

REGULATION:
VESSEL TYPE:
VESSEL SIZE:
VESSEL CLASS:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (1) x (2)
0 =			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FORMAT 2G

INDUSTRY BENEFIT CATEGORY: RECURRING PERSONNEL
INJURY BENEFITS (LOSSES AVERTED)

REGULATION:
VESSEL TYPE:
VESSEL SIZE:
VESSEL CLASS:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (1) x (2)
0 =			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FORMAT 2H

INDUSTRY BENEFIT CATEGORY: RECURRING PERSONNEL
INJURY BENEFITS (DAMAGES AVERTED)

REGULATION:
VESSEL TYPE:
VESSEL SIZE:
VESSEL CLASS:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) (1) x (2)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FORMAT 3
SUMMARY OF INDUSTRY BENEFIT CATEGORIES*
TOTAL ANNUAL \$(000)

REGULATION:
 VESSEL TYPE:
 VESSEL SIZE:
 VESSEL CLASS:

Year	Vessel Benefits (Losses) (1)	Vessel Benefits (Damages) (2)	Cargo Benefits (Total) (3)	Cargo Benefits (Partial Loss, Damages) (4)	Personnel Nonrecurring (Losses Averted) (5)	Personnel Nonrecurring (Damages Averted) (6)	Personnel Recurring (Losses Averted) (7)	Personnel Recurring (Damages Averted) (8)	Total Industry Benefits of Regulation 9 = 1 + 2 + ... 8
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									

* From last Column of appropriate Format 2.

FORMAT 4

INDUSTRY REGULATION BENEFITS—SUMMARY FOR ALL VESSEL CLASSES*
TOTAL ANNUAL \$(000)

REGULATION:

Year	Benefits Class (1)	Benefits Class (2)	Benefits Class (3)	Benefits Class (4)	Benefits Class (5)	Benefits Class (6)	Benefits Class (7)	Benefits Class (8)	Benefits Class (9)	Total Annual Benefits All Classes 10 = (1)+(2)+...+(9)	Discount Factor 10% (11)	Other Discount Factor % (12)	Discounted Annual Benefit 13 = (10) × (11)
0											1.000		
1											.954		
2											.867		
3											.788		
4											.717		
5											.652		
6											.592		
7											.538		
8											.489		
9											.445		
10											.406		
11											.368		
12											.334		
13											.304		
14											.276		
15											.251		
16											.228		
17											.208		
18											.189		
19											.172		
20											.156		
21											.142		
22											.129		
23											.117		
24											.107		
Totals											Cumulative Discount Factor = 9.427		Total Discounted Industry Regulation Benefit

Uniform Annual Industry Regulation Benefit = Total Discounted Industry Regulation Benefit ÷ 9.427
Enter this in Column 5, Format 11
* From Column 9, Format 3

Format 5

IN-HOUSE BENEFIT CATEGORIES

Regulation:

I. INVESTMENT BENEFITS

A. Non Recurring

B. Recurring

II. OPERATING BENEFITS

A. Personnel

1. Civilian

2. Military

B. Materials and Supplies

C. Government Furnished Services

D. Other

Total Operating Benefits

Explanatory Notes:

FORMAT 6
SUMMARY OF IN-HOUSE BENEFITS*
 \$(000)

REGULATION	Annual Investment Benefits, Non-recurring (1)	Annual Investment Benefits, Recurring (2)	Annual Operating Benefits (3)	Total Amount In-house Benefits of the Regulation (4) = (3) + (2) + (1)	Discount Factor 10% (5)	Other Discount Factor (6)	Discounted Annual In-house Benefits (7) = (4) x (6)
Year							
0 =					1 000		
1					.954		
2					.867		
3					.788		
4					.717		
5					.652		
6					.592		
7					.538		
8					.489		
9					.445		
10					.405		
11					.368		
12					.334		
13					.304		
14					.276		
15					.251		
16					.228		
17					.208		
18					.189		
19					.172		
20					.156		
21					.142		
22					.129		
23					.117		
24					.107		
Totals					Cumulative Discount Factor 9 427		Total Discounted In-house Regulation Benefit

Uniform Annual Industry Regulation Benefit Total Discounted In-house Regulation Benefit : 9 427

Enter this in Column 5, Format 11
 * From Format 5

Format 7

QUANTIFIABLE SOCIETAL BENEFIT - PERSONNEL

Regulation:

	Annual \$ <u>Benefit/Person</u>	
	<u>Non Recurring</u>	<u>Recurring</u>
I. INJURIES PREVENTED		
A. General Population	_____	_____
B. Longshore/Dock Workers	_____	_____
II. DEATHS PREVENTED (number)		
A. General Population	_____	
B. Longshore/Dock Workers	_____	

Explanatory Notes:

FORMAT 8A
SOCIETAL BENEFITS—PERSONNEL, NON-RECURRING INJURY BENEFITS
GENERAL POPULATION

REGULATION:	Year	No. of Injuries Prevented (1)	Benefits Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (2) x (1)
	0			
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	16			
	17			
	18			
	19			
	20			
	21			
	22			
	23			
	24			

FORMAT 8B
SOCIETAL BENEFITS—PERSONNEL, RECURRING INJURY BENEFITS
GENERAL POPULATION

REGULATION:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (2) x (1)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FORMAT 8C
SOCIETAL BENEFITS—PERSONNEL NON-RECURRING INJURY BENEFITS,
LONGSHORE/DOCK WORKERS

REGULATION:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) (2) · (1)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FORMAT 8D

**SOCIETAL BENEFITS—PERSONNEL, RECURRING INJURY BENEFITS
LONGSHORE/DOCK WORKERS**

REGULATION:

Year	No. of Injuries Prevented (1)	Benefit Per Injury Prevented (\$) (2)	Personnel Benefit of Regulation Per Year (3) = (2) x (1)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
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19			
20			
21			
22			
23			
24			

**FORMAT 9
SUMMARY OF QUANTIFIABLE SOCIETAL BENEFITS*
\$ (000)**

REGULATION:

Year	Annual Benefits Gen'l Population, Non-Recurring (1)	Annual Benefits Gen'l Population, Recurring (2)	Annual Benefits Longshore/Doct, Non-Recurring (3)	Annual Benefits Longshore/Doct, Recurring (4)	Total Annual Quantifiable Societal Benefits (5) = (1)+(2)+(3)+(4)	Discount Factor 10% (6)	Other Discount Factor (7)	Discounted Annual Societal Benefits (8) = (6) x (5)
0						1.000		
1						.864		
2						.817		
3						.788		
4						.717		
5						.652		
6						.592		
7						.538		
8						4.89		
9						4.45		
10						4.05		
11						3.68		
12						3.34		
13						3.04		
14						2.76		
15						2.61		
16						2.28		
17						2.08		
18						1.89		
19						1.72		
20						1.56		
21						1.42		
22						1.29		
23						1.17		
24						1.07		
Totals						Cumulative Discount Factor = 9.427		Total Discounted Societal Regulation Benefit

* Uniform Annual Societal Benefit - Total Discounted Societal Regulation Benefit -- 9.427. Enter this in Column 5, Format 11.

* From Column 3 Format 8

SUMMARY OF BENEFITS TO MARINE RELATED RESOURCES
(NON MONETIZED)

Regulation:
Geographic Area:
Site/Incident:

Resource Not Impacted	IMPACTED RESOURCES								
	Clean-up Rehabilitation Required	Degree of Impact	Duration of Impact		Previous Incidents In Affected Area				
			Short Term	Long Term	Minimal	Moderate	Heavy		
I. Commercial Resources									
A. Fin Fish									
B. Shell Fish									
C. Hatcheries									
D. Vessels									
E. Piers, Docks & Facilities									
F. Tourism									
G. Other									
II. Private Structures									
III. Recreational Resources									
A. Public waterfront property									
B. Private waterfront property									
C. Other recreational facilities									
D. Recreational boats									
E. Sport fishing									
F. Other									

Enter degree of impact from the following codes:

- 0 Potential
- 1 Minimal
- 2 Moderate
- 3 Heavy
- U Unknown

SUMMARY OF BENEFITS TO MARINE RELATED RESOURCES
(NON MONETIZED)

Regulation:
Geographic Area:
Site/Incident:

Resource Not Impacted	Clean-up Rehabilitation Required	Degree of Impact ¹	Duration of Impact		IMPACTED RESOURCES		
			Short Term	Long Term	Previous Incidents In Affected Area		
					Minimal	Moderate	Heavy
IV. Water Supply							
A. Municipal drinking water							
B. Other municipal intake							
C. Industrial intake							
D. Agricultural intake							
E. Other							
V. Natural Resource							
A. Fish (Non-commercial)							
B. Other Marine Biota							
C. Waterfowl and other birds							
D. Marine mammals							
E. Marine sanctuary or wilderness areas							
F. Reel							
G. Other							

¹ Enter degree of impact from the following codes:

- 0 Potential
- 1 Minimal
- 2 Moderate
- 3 Heavy
- U Unknown

Format 10 A

QUANTIFIED ESTIMATE OF SITE SPECIFIC BENEFITS
TO MARINE RELATED RESOURCES

Regulation:
Site/Incident:
Brief Description:

		<u>Estimated Impact (\$)</u>		
		<u>Low</u>	<u>High</u>	<u>Best Estimate</u>
I.	Commercial Resources			
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
II.	Private Structures	_____	_____	_____
III.	Recreational Resources			
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
IV.	Water Supply			
	_____	_____	_____	_____
	_____	_____	_____	_____
	Total Above	_____	_____	_____
V.	Natural Resources*			

Explanatory Notes: _____

* Include ONLY if clearly definable

FORMAT 11
COMPARISON OF ALTERNATIVES—QUANTIFIABLE BENEFITS
 (\$ THOUSANDS)

Description of Alternative Regulations (1)	Impacted Resources Resources (2)	Compliance Date (3)	Description of Costs (4)	Uniform Annual Benefits (5)
1.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
2.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
3.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
4.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____
5.				Industry* \$ _____ In-house** _____ Societal*** _____ TOTAL _____ Deaths**** _____ Prevented # _____

* From Format 4
 ** From Format 6
 *** From Format 9
 **** Sum of Tables 1 and 7

SECTION VI

BENEFIT PROCEDURES AND FACTOR DEVELOPMENT

This section is divided into five parts which address benefit procedures for vessels, cargo, personnel, in-house and environment/property.

A. Vessel Benefit Procedures

The task of measuring vessel benefits attributable to U. S. Coast Guard regulatory or operational changes is complicated by three factors:

- o Classifying the vessel types likely to benefit from such U. S. Coast Guard activities.
- o Assessing the extent or degree of damage reduction associated with the reduced vessel casualties.
- o Developing the analytical elements necessary to the measurement of vessel benefits.

With such problems in mind, the steps necessary for the Coast Guard regulatory staff to measure the beneficial impact upon vessels of regulatory or operational changes are:

1. Analyze and describe the proposed regulatory or operational change in detail. Such a description should include a discussion of the affected vessels by type of vessel and by size of vessel. The discussion should include the applicable time frame of the regulatory or operational change. This step is of the utmost importance in estimating the vessel population beneficially affected by the proposed Coast Guard actions.

2. Review the output of the incident reduction estimations. Notably such estimates could include the number of vessel casualty reductions, the severity of such vessel casualty incidents, the applicable time frame, and the operational areas affected (e.g., ocean, inland waterways, Great Lakes). Make any adjustments necessary to utilize the estimated vessel

casualty reductions. For instance, if the incident reduction estimate provides only a total number of incidents avoided, the regulatory staff must distribute the total among the various vessel types.

The regulatory staff should recognize that the consequences and costs of vessel casualties vary greatly according to type and size of vessel. Thus, the benefits of Coast Guard activities will likewise vary among vessels. In estimating vessel benefits, the regulatory staff must remain continuously aware of the need to group vessels according to type and size to the extent practicable, and to perform the benefits estimation by groups or classes of vessels when possible.

In classifying vessel types, the regulatory staff must weigh the gain in the precision of some very specific classification against the quality of associated vessel class benefit factors. *The value of a specific breakdown of vessel types is compromised if the margin for error associated with benefit factors is very large.* Likewise, available vessel population data limits the classification of vessels. If population data is available for only five size groupings, it makes little sense to estimate benefit factors for ten size groupings.

3. Determine the vessel benefit elements which will be affected by the proposed Coast Guard regulatory or operational changes. The Coast Guard regulatory staff should recognize that such vessel benefit elements can be either recurring or nonrecurring in nature. Accordingly, the assessment of vessel benefits cannot fail to examine both categories.

Total Vessel Losses Averted

This category includes all total vessel losses that would have been incurred in the absence of the proposed Coast Guard actions. Two kinds of benefits can accrue to vessel owners through the reduction of total vessel losses. The first involves the avoidance of the loss of a valuable resource: the vessel. The vessel owner is spared the expense of a destroyed or sunken vessel. The second benefit involves the continued utilization of an income producing asset.

The former benefit involves a measurable benefit, the value of the resource retained. This can be determined by using "typical" vessels for each vessel group. The "typical" vessel would be a composite based upon average age for the vessel type, an average construction cost, and a representative depreciation scheme. These factors can be used to determine the vessel's value. The latter benefit, in contrast, involves merely an opportunity cost^{1/} averted. While the regulatory staff may be able to measure the value of the resource, the net of construction cost minus depreciation, it is cautioned against attempting to appraise the benefit of opportunity costs averted. Such estimates would be highly subjective and speculative in nature, and would not be amenable to rigorous defense.

A serious issue concerning development of vessel benefit factors by which to measure benefits of total vessel losses averted must be recognized. In measuring the economic costs of a regulation requiring the replacement of some equipment, the total replacement cost is not regarded as a cost of the regulation. The approach recommended here is intended to recognize that replacement of vessels is likely to far exceed original costs. However, it must also recognize that the vessels that would have been lost in the absence of Coast Guard regulations have lived some part of their normally expected useful life. The regulation's benefit is the net difference between the replacement cost and a value that represents the used up life (depreciated value) of the equipment retired prematurely. Therefore, the benefit of a vessel loss averted is not the total replacement cost of that vessel nor is it the original cost of acquiring the asset.

The approach recommended is as follows. Depending upon the level of detail of the analysis, develop pictures of "typical" affected vessels. This would require identification of certain mean or average characteristics by vessel classification. Table 2, Section VII provides summary data of significant features of the U. S. merchant fleet. These data were derived by the Maritime Administration, Office of Budget and Program Evaluation, Washington, D.C., Telephone (202) 377-3091.

^{1/}In economic terms, the cost of anything is often defined as the value of the best alternative, or the opportunity that is sacrificed. For instance, the opportunity cost of producing fuel oil in a refinery is the value of the gasoline that could have been produced from the same crude oil. Conversely, if a resource has no alternative use then the opportunity cost is said to be zero, or close to it.

The next step in the procedure is to determine current average construction costs per deadweight ton by vessel type. This will be done by the regulatory staff with rather gross numbers owing to the nature of the shipbuilding industry. There is no standardized method of costing; in fact, the "black box" approach seems to prevail. As the industry is highly competitive, the yards are sensitive about releasing such confidential data.

In addition, economies of scale likewise aggravate attempts to determine average costs. However, the Maritime Administration publishes estimated costs of ships under construction and under contract in their Annual Report. These estimates smooth over the regional differences in shipbuilding costs as well as differences caused by economies of scale. Nationwide average costs per deadweight ton can be developed both by vessel type and for all vessels. In addition, MarAd's Division of Program Evaluation is also a source of current shipbuilding costs. Table 1, below, summarizes estimated costs for ships under construction in U. S. Shipyards as of December 1, 1978.

Table 1

Ships Under Construction in U. S. Shipyards
December 1, 1978

Vessel Type	<u>\$/DWT</u>
Tug Barges	\$1,566
LNG	1,751
Tanker	447
Container	2,824
Cargo	3,890
LASH	1,721
RO-RO	2,723
Dredges	6,577
Research	12,134

Source: Maritime Administration, Office of Budget and Program Evaluation, Division of Program Evaluation.

Based upon the "typical" vessel's characteristics and associated construction costs, net vessel cost factors can be derived for vessel classes likely to benefit from Coast Guard regulatory actions. The procedure proposed to the regulatory staff is as follows. Multiply current construction costs per deadweight ton for the affected vessel type by the average size of that vessel classification. This yields an expected replacement value. Adjust this value based upon the average age within the vessel classification while assuming an average 25 year useful life. This is what most experts regard as the average life of commercial vessels.^{1/} Thus, \$6.13 million becomes the cost factor associated with tankers, derived as follows. The average cost per deadweight ton is \$447, and the average American tanker is 49,000 DWT. This yields a new construction cost of \$21.9 million for the "typical" tanker. Adjustment for the average age of 18 years yields a tanker cost factor of \$6.13 million.

$$(\$ / \text{DWT} \times \text{average DWT}) \times (\text{average useful life remaining} \div 25) = \text{Vessel Cost Factor}$$
$$(\$ 447 \times 49,000) \div (25 - 18) = \text{Tanker Cost Factor}$$

This approach to the development of vessel cost factors for appraising the benefits of vessel losses averted is flexible enough to use under a number of conditions. If the regulatory staff is examining proposed actions that do not specify particular vessels, cost factors can be developed for all classes. If the proposed Coast Guard action addresses vessels by type or size, the approach will also work.

Vessel Damages Averted

This category includes all the costs averted by a reduction in vessel casualty incidents resulting in damages to vessels. These costs would normally be incurred by industry and therefore the benefits accrue primarily to industry.

^{1/} There are several exceptions. Notably, many barges operating on the Great Lakes and Western Rivers and many of the new supertankers have considerably different expected life spans. The regulatory staff should investigate this possibility and attempt to make the necessary adjustments.

This category is comprised of three cost items: averted repair costs; tow charges; and lost service. Repair costs averted would be shipyard bills incurred in repairing damaged vessels. Measurement of the benefit is complicated by a number of factors. First, estimating the degree of damages averted is difficult. Also, repair costs would vary by damages, vessel type, and by the area or shipyard in which repairs would be made.

Development of cost factors for ship repairs is comparatively easy. The Shipbuilders Council of America publishes quarterly data on construction and repair labor costs. National average hourly rates are usually published, but occasionally the data are broken down by region. It is recommended that the regulatory staff limit itself to using national wage figures when attempting to analyze the benefits of vessel damages averted. Similarly, it is recommended that material costs be developed on a national average basis.

The primary component of the materials costs will be steel and steel products. Costs per ton can be developed from the monthly Bureau of Labor Statistics publication, Producer Prices and Price-Indexes.

Representative material and direct labor cost factors are:

<u>Element</u>	<u>Rate</u>	<u>Effective Date</u>	<u>Source</u>
Steel Sheets & Plates	\$400/ton	June 1979	Bureau of Labor Statistics
Average Hourly Labor Costs	7.42/hr	Feb. 1979	Shipbuilders Council of America

Added to these costs will be other shipyard costs passed on to the shipowner such as overhead and profit.

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

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

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

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

Difficulty arises in attempting to measure the benefits of averted tow charges, reductions in lost service and repatriation expenses. Averting all three situations are benefits to industry. It is recommended that the regulatory staff assess the reductions in charges for towing disabled vessels to the extent possible. However, a narrative discussion of this may be the only practical approach.

The valuation of the loss of service of a damaged vessel is a more tenuous undertaking. Inclusion of this element is dependent upon the regulatory staff's ability to develop a realistic estimate of the number of days vessels will be out of service. Loss of service may be accounted for, as applicable, in one of two ways. For regulations that affect vessel types operated primarily in liner service and single voyage or short term charters the procedure is as follows. Multiply the estimated days lost from service times the average daily fixed costs of operation.

The procedures for vessel types that are often chartered for long time periods, e.g., tankers, are only slightly different. In this case the benefits are defined as the fixed cost the charterer would not have to pay the owner/operator when a vessel is not in service. Additional benefits may accrue to the charterer if the total costs of chartering a replacement vessel are higher than the total costs of the damaged vessel. However, fluctuations in charter rates make this assumption baseless. It is recommended this latter consideration be ignored on the more plausible assumption that, on average, over the life of a regulation, charter rates for a replacement vessel will approximate those of the original vessel. When neither of the above approaches for assessing loss of service is feasible the regulatory staff is advised to discuss this benefit in as much detail as possible without attempting to assign any attendant dollar values.

Another benefit that may accrue to industry is a decrease in ship personnel repatriation expenses. These are the expenses of transporting personnel of a lost or damaged vessel from the point at which an incident occurs to their home port. While these are real, potential benefits the regulatory staff should be aware that these benefits are relatively small. In addition, the time and effort required to quantify this benefit will probably outweigh its value in the analysis. If a decision is made to quantify this benefit, the recommended procedure is to multiply the estimated number of personnel requiring repatriation times the standard airfare between a "selected" incident location and a "selected" home port.

B. Cargo Benefit Procedures

The task of assessing cargo benefits attributable to U. S. Coast Guard actions is complicated by several factors:

- o Projecting reductions in cargo losses associated with U. S. Coast Guard regulatory or operational activities designed to avert vessel casualty incidents.
- o Identifying the cargo types most likely to be affected by such U. S. Coast Guard activities.
- o Developing the analytical elements necessary for the assessment of cargo benefits.
- o Determining the timing and duration of the beneficial impact from Coast Guard actions.

These factors can have a significant impact upon the Coast Guard regulatory staff's ability to perform a meaningful and realistic assessment of the cargo benefits accruing to regulatory and operational changes. With that in mind, the procedures to be followed by the Coast Guard regulatory staff in measuring the beneficial impact to cargo of regulatory or operational changes are:

1. Describe the proposed regulation or operational change in detail. Such a description should include a discussion of the kinds of vessels affected by a regulation, an assessment of the cargo classifications likely to benefit, and an appraisal of the timing of the proposed regulation or operational change (e. g., existing container ships must comply by January 1, 1982, and all new container ships constructed under contracts awarded after December 31, 1979 must comply).
2. Analyze the data produced by the incident reduction estimation process. Make any necessary adjustments to these data to distribute cargo losses not incurred to types of vessels and areas of operation, e.g., Great Lakes, rivers, oceans.

3. Determine the cargo benefit elements which will be affected by the proposed regulatory or operational changes.

Regulations which result in a decrease in cargo losses have two major, measurable benefits. The major benefit is that cargo losses or damages not incurred represent resources that are not foregone. This cargo benefit will generally be composed of the value of the cargo plus transportation and insurance. The other benefit is a potential decrease in transit delay time that could result in a decrease in the cost of products. Both of these potential benefits are discussed below.

Cargo Losses Averted

This category comprises the bulk of cargo benefits which can be expected to be associated with Coast Guard regulatory or operational changes. These cargo benefits, cargo losses averted, are defined as the net difference between the level of losses expected after a proposed Coast Guard action had been implemented and that level of losses which would be expected in the absence of such proposed actions.

The benefits from cargo losses not incurred are one time, non-recurring benefits. This is because each individual cargo is generally involved in only one voyage and is, therefore, subject to loss/damage only one time. Most CVS regulations that involve the design and/or operation of the vessel will result in cargo benefits. A design change that, for instance, results in improved hatch covers, will benefit numerous different cargoes over the life of the vessel/regulation. The number of different cargoes benefitted will be reflected in the reduced number of future incidents, not as recurring cargo benefits.

For each regulation under analysis, calculate the value of total cargo losses averted by major cargo type. Such calculations are based upon the assumption that casualty reduction estimates have yielded projections of volumes of losses averted preferably by major vessel/cargo classification. It should be noted that it is not essential, and in many cases will not be feasible, to estimate cargo benefits by vessel type or at the same level of detail as the vessel analysis. Valuations of cargo losses are the products of the appropriate cargo unit cost factors and the casualty reduction estimates for each cargo type according to Section VII. Preparing a quality estimate of the value of cargo losses averted is a complicated task.

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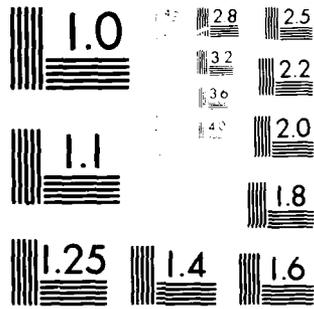
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since the value of cargo losses averted will vary according to cargo classification under consideration.

It is not essential that specific commodities be identified by the incident reduction estimating process. The objective of benefit analysis is to provide a reliable estimate of potential benefits. Coast Guard regulations under the Commercial Vessel Safety Program are generally directed at specific types of vessels, vessels operating in specified geographic areas, or vessels carrying specific types of cargoes. Therefore, it is only necessary that the regulatory staff develop weighted average estimates of cargo benefits for the commodities carried by major vessel type.

In the event the proposed regulatory action does not specify particular classes of vessels or cargoes moved by water, weighted cost factors for all commodities are adequate. The recommended approach is to utilize national weighted average dollar values for all commodities. It is possible for a single weighted average cost factor for all commodities to satisfy the regulatory staff's requirements. Or, it may be preferable to employ some more specific categories of commodities. In such an event, one recommended approach is to use the ten broad commodity descriptions frequently employed by the U. S. Department of Commerce, Bureau of Census (See Table 3, Section VII). These descriptions group like commodities moved by water into ten generic classifications. The regulatory staff must weigh the requirements of the cost-benefits analysis in order to choose between these two alternate approaches. If the cost-benefit analysis is being performed with rather gross numbers, the former approach should be adequate. In other cases, the latter approach may be more consistent with the analysis being done on costs.

In other cases the level of detail for U. S. flag vessels can generally be limited to the following major vessel types — dry cargo barge, tank barge, dry cargo vessel and tank vessel. These vessel types can be further subdivided by geographic area of operation —inland waterways, Great Lakes, and ocean. Estimates of the dollar value of cargo losses averted for each of these vessel types, by geographic areas, can then be developed and updated from the published sources cited below.

When the proposed Coast Guard action addresses vessels carrying specified commodities, weighted average value factors for the affected cargo classes should be developed.

The preponderance of Coast Guard actions that are commodity-specific tend to address certain flammable or hazardous cargoes. These include petroleum and petroleum by-products, gas, chemicals, and other hazardous materials. Weighted average cost factors for selected product groups are included in Table 5, Section VII. Sources for such dollar values are also provided. Again, as noted above, the degree of specificity desirable will be determined by the nature of the proposed action. The regulatory staff is cautioned to use its judgment in deciding the degree of detail desirable.

When a proposed Coast Guard regulation addresses specific types of dry cargo vessels (breakbulk, bulk, combination RO-RO, LASH, container, etc.) the task of developing weighted average value factors for the affected cargoes is more complicated. Data collected from customs documents and published by the Department of Commerce only recognize two vessel types, dry cargo and tanker. In order to develop weighted average value factors for specific vessel types, the regulatory staff must identify the major commodities carried by these vessels and compile the weight and value data from the data sources cited below. (See Table 4, Section VII.) In most cases the regulatory staff will have to use a greater level of detail than the ten broad generic classifications. Again, the staff must use its judgment in deciding the degree of detail desirable.

If the proposed Coast Guard action addresses vessels operating within particular bodies of water, weighted average values for commodities shipped into or from those waters should be utilized. (See Table 6, Section VII.) This is necessary because the value of any number of commodities can vary with location. Again, the detail required will be determined by the regulatory staff from the nature of the proposed Coast Guard action.

The regulatory staff is reminded that a necessary condition of cost-benefits analysis is the comparison of similar values. That is, if costs are to be analyzed in 1978 dollars, benefits must be expressed the same way. Therefore, the regulatory staff must strive to employ commodity cost factors which are consistent with the analysis being done. In all but the most unusual of circumstances, the regulatory staff will find annual reports prepared by the U. S. Departments of Commerce, Labor, and Energy to be adequate sources of the required data. In the event that data more current and timely than that reported in annual publications is needed, each of the aforementioned organizations publishes readily available periodic reports. In addition to such reports from government sources, trade association and

industry publications can be useful sources of commodity cost data that is most timely and current. The following is a list of easily accessible periodic annual government reports that can provide the regulatory staff with useful data on the volume and value of commodities moved through U. S. waters. Samples of the reports contained in these source documents are included in Table 7, Section VII.

Guide to Foreign Trade Statistics. U. S. Department of Commerce, Bureau of the Census. 1975 (Latest Edition.) This publication provides an index and sample formats for all import and export trade data. Several individual reports are cited below.

o General Cargoes

U. S. General Imports: Schedule A, Commodity Groupings by World Area, Report FT 150 U. S. Department of Commerce, Bureau of the Census, Washington, D. C. Annual.

U. S. General Imports: World Area by Commodity Groupings, Report FT 155. U. S. Department of Commerce, Bureau of the Census, Washington, D. C. Annual.

U. S. Exports: World Area by Commodity Groupings, Report FT 455. U. S. Department of Commerce, Bureau of the Census, Washington, D. C. Annual.

U. S. Waterborne Exports and General Imports, Report FT 985. U. S. Department of Commerce, Washington, D. C. Monthly/Annual.

Waterborne Commerce of the U. S. Department of the Army, Corps of Engineers, Vicksburg, Mississippi. Annual.

Producer Prices and Price Indexes. U. S. Department of Labor, Bureau of Labor Statistics, Washington, D. C. Monthly.

o Petroleum and Petroleum Products

Monthly Energy Review. U. S. Department of Energy, Energy Information Administration, Washington, D. C. Monthly.

Annual Report to Congress. U. S. Department of Energy, Energy Information Administration, Washington, D. C. Annual.

The regulatory staff should adjust the cost data available from the various sources into the form necessary for use. Various units of measurement may be employed in the numerous reports which can serve as data sources. Therefore, it may be necessary for the regulatory staff to convert such reported data into a form compatible with the output of the casualty reduction estimates.

The principal manipulation of data, other than conversion to similar units of measurements, will be the development of weighted average cost factors. This can be derived by dividing the total value of cargoes within a commodity classification or vessel type by the total moved volume of cargoes within the same classification.

The regulatory staff may find that commodity cost data are not expressed in similar terms (i.e., some are in 1977 dollars, some in 1978 dollars). When this occurs, it is necessary to adjust values to make them similar. The recommended approach is to use an escalation factor based upon relative changes in the Producer (formerly Wholesale) and Consumer Price Indexes. These are readily available through the U. S. Department of Labor, Bureau of Labor Statistics.

A further note on the development of cargo commodity cost factors is necessary before presenting values for selected commodities. It is incumbent upon the regulatory staff to examine the basis upon which commodity values are presented in various reports. In the case of the foreign trade statistics, virtually all export data and most import data exclude insurance and freight costs. In order to maintain consistency between import and export data the recommended approach is to utilize commodity values free of transportation and insurance costs. Therefore, the regulatory staff must avoid using valuations based upon f.o.b. (free on board) destination, or c.i.f. (cost, insurance, and freight) value. The recommended approach is to utilize f.o.b. origin, or f.a.s.(free alongside ship) values wherever possible.

In order to incorporate transportation and insurance costs into the analysis the regulatory staff has two alternatives with respect to ocean going vessels. One is to develop average unit value data for the applicable commodities based on import data that includes insurance and freight. These unit values can then be applied to the sum of the export and import cargo expected to benefit from the regulation.

The other alternative is to collect transportation cost data and add it to the commodity valuations. The Federal Maritime Commission is the regulatory agency that monitors ocean vessel freight rates. Ocean freight tariffs are available at the Federal Maritime Commission Tariff Section, Washington, D. C. Telephone: (202) 523-5796.

The Interstate Commerce Commission has jurisdiction over domestic freight rates. A major difficulty with domestic rates is that a large portion of the industry is exempt from ICC regulation. Inland rate tariffs for the regulated portion of the domestic industry are on file at the Interstate Commerce Commission, Tariff Section, Washington, D. C. Telephone: (202) 275-7348.

One current problem may be particularly vexing to the regulatory staff attempting to measure cargo benefits associated with some proposed Coast Guard action. Because petroleum prices have increased dramatically over recent years, it behooves the regulatory staff to have the most current values available for this cargo classification. The regulatory staff may want to utilize an escalation factor based upon expected changes in petroleum price levels for regulations that may become effective before 1985. The justification for this is that petroleum prices have been increasing at rates substantially greater than the Consumer Price Index.

Cargo Damage Reductions

It is unlikely that casualty reduction estimates can yield estimates of cargo damage reductions in a manner distinguishable from cargo loss reduction estimates. However, the regulatory staff should recognize that certain Coast Guard regulatory or operational changes could mitigate the damage associated with vessel casualty incidents. That is, in addition to averting cargo losses, Coast Guard actions could reduce cargo degradation or damage associated with vessel casualties.

The Coast Guard regulatory staff will probably be unable to appraise the benefit of cargo damage reductions associated with regulatory or operational changes. In cases where such damage reductions can be estimated, the regulatory staff should attempt to quantify this beneficial impact of Coast Guard actions. Otherwise, the regulatory staff should limit its efforts to a qualitative discussion of such benefits.

Cargo Delayed

Another beneficial impact of Coast Guard actions could be a reduction in delays in the delivery of cargoes. Such delays entail an opportunity cost to the shipper of goods.

However, it is also unlikely that casualty reduction estimates will yield much information addressing this possibility. Therefore, the regulatory staff may have to settle for a verbal description of this element.

C. Personnel Benefit Procedures

The task of assessing the benefits of regulations that impact personnel are complicated by several factors:

- o The ability of an incident reduction estimating process to estimate the reduced number of deaths and injuries associated with a proposed Coast Guard regulation.
- o The ability of an incident reduction estimation, or regulatory staff, to estimate the severity and duration of injury.

Personnel benefit estimates from a reduction in marine casualties should not be interpreted as the value placed on a life or the amount society is willing to pay to save a life or prevent an injury. Instead, the quantifiable sum of the personnel benefit components should be viewed as indicators of the significance of reducing marine casualties.

The personnel benefit procedures described below are based on the assumption that an incident reduction estimate has estimated the number of deaths and injuries prevented by the proposed regulatory action, or, a scenario has been developed that provides these estimates. The procedures described below only provide a method for estimating total benefits. They do not identify the distribution of benefits between individuals, society, industry or government.

The steps involved in the benefit analysis are:

1. Describe the regulation under analysis. Include in the discussion the type of personnel impacted - crew, dock facility workers, and general public. Determine the applicable time frame of the regulation in order to determine the baseline year of analysis.

2. Classify the vessel crews impacted by type and size of vessels according to any expected differences in the benefits of the regulation to different sizes and types of vessels.

3. Determine the personnel benefit elements which will be affected by the proposed regulation.

The individuals that will benefit from a reduction in marine casualties are divided into three major groups:

- o vessel crew
- o dock/shore facility personnel
- o general population/vessel passengers.

The potential personnel benefits from a reduction in marine casualties is a reduction in the number of deaths and a reduction in the number and/or severity of injuries.

Death

Provide estimates, based on the incident reduction estimates, of the number of deaths that will be prevented for each major personnel grouping. The total deaths prevented as a result of a regulatory action will be the net change in deaths before and after the regulation goes into effect. The recommended procedure is to include this element in the benefit assessment without attaching a dollar value. Numerous studies have attempted to place a dollar value on human life. However, to date there is no generally acceptable method or dollar amount. The value of a human life has been variously estimated from \$200,000 to \$3 million.

Inclusion of the estimated number of deaths prevented as a result of a regulation, without attaching a specific dollar value, still provides a valuable input into the decision-making process. It provides the regulatory staff with a method of including the relative importance of this benefit element to the regulation under analysis, both in terms of other benefits and in terms of the costs of the regulation.

Injury

The approach in personnel injuries avoided is to derive benefit estimates that adequately reflect benefits to individuals and industry. There are two basic benefit components to injuries not incurred. One is resources that are not consumed. The other is production benefits to individuals and society when individuals do not lose their ability to produce. Each of these components contains quantifiable and non-quantifiable benefit elements.

For a reduction in marine injuries quantifiable production benefits are measured in terms of wages and benefits not lost. Non-quantifiable production benefits include benefits to family and community outside the normal work day. The primary resource not consumed is medical care.

Production

The value of production benefits, time not lost from work, is dependent upon assessments of the degree of injury as it affects the production time that would have been lost. A significant problem for the analysis of Coast Guard regulations is that the current vessel casualty reporting systems do not provide data in sufficient detail for an incident reduction estimate to quantify the length of production time lost. The Vessel Casualty Reporting System data on length of production time lost are considered unreliable.

One source of injury data is the Marine Index Bureau. It maintains records of injuries or illnesses of U. S. merchant marine personnel. Reports of personnel injuries are sent voluntarily to the Marine Index Bureau by ship owners. Included in the report are the name and social security number of the injured or ill person, nature and date of injury or illness, and vessel name, owner, and destination. Information is stored on index cards, and data through 1976 have been computerized. Summaries of the computerized data are periodically sent to ship owners contributing to the Marine Index Bureau's data base. However, they are reluctant to release the data to others.

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

complete record of marine personnel casualties available. These data, if obtainable, should provide the regulatory staff with data on the distribution of injuries by severity and length of time lost from work. These distributions can then be applied to the regulatory analysis.

The time lost from work for dock/facility workers and the general population, particularly time lost resulting from the types of incidents CVS Program regulations are designed to affect are not available. The recommended procedure is to estimate the distribution of injuries prevented. Rather than provide the decision-maker with a single dollar value it is recommended that the regulatory staff provide a range of possible dollar values.

Table 3 included in Section VII provides one estimate of total injuries by length of time lost from work. These distributions can be applied to each of the three groups of individuals (vessel crew, dock/shore facility workers and general population/vessel passengers) impacted by a reduction in marine casualties. It should be noted that this estimate is based on normal work-related injury rates, not those directly applicable to a casualty. Therefore, estimates based on these distributions will provide conservative estimates of potential personnel benefits.

Once the average length of time lost from work is determined the next step is to determine the dollar benefits of avoiding these costs. The basis for this determination is the wage/salary rates for each group of individuals counted in terms of work days. Multiply the estimated number of days not lost from work times the average daily wage, separately for each of the three groups of individuals.

1. Crew

The best source of information for vessel crew wage costs is the Maritime Manpower Impact System administered by the Office of Maritime Manpower, telephone (202) 377-3018, Maritime Administration, Room 3069-A, Department of Commerce Building, Washington, D. C. This computerized system is updated annually and is capable of listing wage costs per person per day, month or year for any ocean going U. S. vessel greater than 1000 gross tons. The system can also give average total wage costs for specific vessel types which include chemical, oil and gas tankers, and conventional cargo, container, roll-on-roll-off, ore-bulk-oil, car carrier and LASH vessels.

The best source of information on wage costs for personnel serving aboard vessels operating in coastwise, Great Lakes, rivers or inland waterway trades are shipping companies and unions. An alternative source of information on domestic shipping wage costs is the Bureau of Accounts, and Office of Publications, telephone (202) 275-7356, U. S. Interstate Commerce Commission. The commission collects employment data for domestic water carriers. An ICC publication, "Table 4 - Selected Financial and Operating Data by Individual Maritime Carrier" in Transport Statistics in the United States, Part V, Carriers by Water contains data on average number of employees per year, total hours worked per year, and total compensation per year by region and by individual carrier.

2. Dock/Facility Workers

The best sources of information on wages for dock/facility workers are the individual unions. In addition, the U. S. Department of Labor, Bureau of Labor Statistics' Division of Trends in Employee Compensation, collects some wage data on dock workers. The basic hourly rates for selected longshore occupations covered by the Pacific Maritime Association are included in Table 8, Section VII.

3. General Population

Production losses for the third group of individuals, vessel passengers and the general population can be derived from average wage and salary data for the U. S. population. The mean wage/salary income for U S workers in 1977 was \$14,543.

The regulatory staff should apply these wage rates only to that portion of the passengers and general population that are current wage earners. For calendar year 1977 approximately 48% of the U. S. population were in the labor force. Updated data and/or more detailed data is readily available from the U. S. Department of Commerce, Bureau of Census, Current Population Report Series.

Medical Care

Medical care costs not incurred are the primary resource that will benefit from a reduction in marine incidents. Total medical care benefits can include medical treatment at

the scene, transportation and treatment enroute to a medical facility, emergency room treatment, hospitalization, rehabilitation and long term medical care. Examples of medical care benefit factors that can be applied to injuries for all three groups of individuals, crew, dock/facility workers and general population are included in Section VII of this manual.

Not all injuries will involve medical expenses. In addition, the medical cost factors provided in Section VII and applied to the distribution of total injuries will only provide an approximate estimate of medical costs. In most cases these estimates will probably understate total actual benefits since all medical benefit elements are not included and medical expenses from marine casualties will probably exceed the average cost for all types of hospitalization. It is recommended that the regulatory staff provide two or more estimates of potential medical benefits, high and low.

The source for these cost data is the American Hospital Association estimates of costs for all types of injuries. Table 10 in Section VII provides data for daily hospitalization and emergency room outpatient care. Since the regulatory staff is interested in calculating real benefits incurred as the result of resources not consumed, medical expenses rather than revenue received by medical facilities should be used.

D. In-House Benefit Procedures

The purpose of regulations promulgated under the Commercial Vessel Safety Program is to reduce the number of marine casualty incidents. New and/or revised regulations will result in both costs and benefits to the Coast Guard. The costs of regulations, measured in the analysis of a regulations cost, will include in-house investment and operating costs. The major elements will be equipment and manpower costs for such activities as administering and enforcing the new regulation.

The objective of most CVS Program regulations will be to reduce marine casualties. The regulatory staff must attempt to measure any benefits that will accrue to the Government since these benefits will offset the total costs of the regulation. The principle in-house benefit from a reduction in marine casualties is a reduction in manpower and other resources not consumed in responding to these incidents.

It is unlikely a reduction in marine casualties will result in a decrease in Coast Guard manpower and other resource requirements. The reason for this is that most Coast Guard activities are multi-mission. A decrease in resource requirements, particularly manpower, not required for one activity will often be transferred to other activities. The in-house benefits of reduced marine incidents are, then, efficiency/productivity increases in terms of freeing labor and other resources for other activities. It should be noted that in order for increased efficiency/productivity to be claimed as a benefit for a particular regulation there must be a documented alternative use to which the resource can be put.

It is possible that both equipment and personnel resources could benefit from a reduction in marine incidents. However, the recommended approach is to limit in-house annual operating benefits to personnel. In this case the benefit may be defined as the cost savings to Government of not having to employ additional manpower. Any labor benefits should be calculated to include all recurring labor costs not incurred.

An example of the potential in-house benefits from one type of regulation is as follows. At present, a significant portion of Coast Guard activity involves responding to spills of oil and other hazardous materials. All spills are investigated, clean-up operations are monitored and follow-up investigations (including litigation) are carried out. In this case, a decrease in resources, particularly manpower, not required to monitor clean-up operations may be transferred to preventive activities such as vessel and facility inspections, harbor patrols, and the monitoring of transfer operations.

In some cases the regulatory staff may only be able to describe these benefits. In others, the staff may decide to attempt to place a dollar value on these benefits.

The procedural steps involved in estimating the dollar benefits are as follows:

1. Analyze the regulation and describe in detail its impacts on Coast Guard activities. In particular, define the specific Coast Guard functions most likely to be impacted. These will include both field operations and headquarters administrative functions.

2. Develop an estimate of the reduction in Coast Guard resources required resulting from the proposed regulation. Include investment benefits, such as equipment, only

when a benefit (i.e., increased efficiency/productivity and a documented alternative use for the equipment) can be shown. The suggested method for developing an estimate of personnel benefits is to multiply the reduced number of incidents times some estimated average number of manhours per incident times annual personnel compensation. The man-hours per incident or activity avoided should include all applicable functions described in Step 1 above. When feasible attempt to distinguish between military and civilian personnel. (See Section VII, Table 11 for civilian annual salaries.)

The regulatory staff may consider developing a range of possible values since Coast Guard records do not contain sufficient data to develop an overall average number of hours expended per marine casualty incident. Any estimate of the manhours per incident will often be a function of the type of incident the regulation is attempting to prevent.

Since the grade levels of officers involved in various operations vary, the regulatory staff should use the pay grade contained in Section VII of this manual or \$23,400 per annum for commissioned officers when grade distribution is unknown (See Table 12, Section VII). All recurring costs should be calculated and added to pay to obtain total compensation. OG 20.00 Permanent Change of Station (PCS) should be calculated using the inside U. S. recurring factor of \$1,420 (See Table 13, Section VII). Total compensation would thus tally as follows:

		<u>1978</u>
Pay and Allowances	-	\$ 23,400
PCS	-	1,420
Operating and Maintenance	-	1,040
Training and Procurement	-	<u>198</u>
Total	-	<u>\$ 26,058</u>

Enter the results of these computations under military personnel benefits on Format 5, Section V. It should be noted that the above compensation is from a 1978 COMDTNOTE. In actual practice, compensation from the current COMDTNOTE 7100 Series should be used.

Other potential operating benefits of reduced marine casualties include:

- Materials and supplies
- Government Furnished Services

Data on these elements may be difficult to obtain or estimate. However, when these data are available they should be included.

E. Environmental and Property Benefit Procedures

Environmental and property benefits to society are attained through a reduction in environmental and property damages. Although these benefits generally cannot be readily quantified it is important that they be included in any regulatory analysis if only in descriptive form. These benefits can then be put in perspective vis-a-vis other quantifiable benefits so that the balance between total costs and total benefits of a proposed regulatory action can be more accurately assessed in the decision-making process.

The task of measuring the environmental benefits attributable to proposed U. S. Coast Guard regulations or operational changes is complicated by the following factors.

- o The state-of-the-art in environmental assessment is not sufficiently developed to provide much useful input on the potential benefits of partial reductions in marine casualties particularly in estimating the degree of benefits to particular elements of the environment. Historical records do not provide sufficient or consistent data on the short term, and particularly the long term consequences of marine casualties.
- o Acceptable methods have not been developed to assign benefit dollar values to many individual environmental elements.
- o It is not feasible to attempt to identify a "typical" geographical site or develop a "typical" spill and then attempt to generalize total environmental benefits or to quantify these benefits.

- o It is unlikely the incident reduction estimates will provide much concrete data on environmental and property impacts since currently available data bases on marine casualties contain little environmental and property impact information.

With these limitations in mind, this section provides procedures for identifying, describing and, to a very limited degree, quantifying those potential benefits of proposed Coast Guard regulatory actions. The procedures described below provide the regulatory staff with the ability to analyze the environmental benefits at three levels:

- A descriptive analysis of the total potential regulation benefits. This is a generalized non-site-specific approach.
- A descriptive analysis of the potential regulation benefits for an actual or "hypothetical" site, or a descriptive analysis of the impacts of an actual incident.
- A limited quantified analysis of the potential dollar benefits to a specific site(s) under specified circumstances, or a limited quantified analysis of the estimated dollar impacts of an actual incident.

It should be recognized that developing estimates of the benefits to the environment, whether descriptive or quantified for a specific site, will require a great deal of judgment on the part of the regulatory staff.

Descriptive Analysis

The steps necessary to measure the beneficial impact upon the environment resulting from proposed Coast Guard regulations are:

1. Analyze and describe the proposed regulation in detail.
2. Review the output from the incident reduction estimating process.
3. Determine the environmental elements that could benefit from Coast Guard regulatory actions.

The detailed procedures for each of these steps are described below.

1. Analyze and describe the proposed regulatory or operational change in detail. Include in this description as much detail as possible pertaining to the types of vessels required to comply, the cargo carried by these vessels, the geographic areas in which these vessels operate and the cause of marine casualties the proposed regulation will attempt to mitigate. Include in this discussion the applicable time frame of the regulatory actions.

2. Review the output from the incident reduction estimating process. It may be necessary for the regulatory staff to analyze and adjust these estimates to distribute any forecast reduction in casualties in U. S. waters by vessel type, cargo carried, waterway and, to the extent possible, types of locations.

The regulatory staff can begin to put the potential benefits in perspective by developing and analyzing the information from Step 1 and integrating this information with the data supplied by the incident reduction estimating process and the data analyses performed by the regulatory staff.

Once the basic data have been developed the regulatory staff can develop an "informed" judgment on whether, and to what extent, the proposed regulation will have a beneficial impact on property and the marine environment. It is recommended that the staff augment its analyses of the proposed regulation's impacts with descriptive accounts of similar past incidents and analyses by environmentalists of the effects of similar incidents on property and the marine environment. One problem the staff will encounter is that the published literature concentrates on the major incidents, particularly large oil spills, and their impacts. One useful source is:

The Vessel Casualty Reporting System (VCRS). This is a computerized summary of commercial vessel casualties reported by Coast Guard marine inspectors. This file contains data on vessel specifications, nature, cause, result and environmental conditions surrounding the casualty. The Coast Guard annually publishes a summary of the previous year's VCRS data called Statistics of Casualties. Source: Information and Analysis Branch, U. S. Coast Guard Headquarters, Washington, D. C.

Based upon the evidence from the numerous incidents that occur in U. S. waters each year the impact from these casualties can have a wide range of effects on the marine environment, property, water and commercial resources, i.e., from no noticeable impact to severe damage. Two examples of the suggested approach to analyzing the available data and estimating the potential environmental and property benefits are included in the two regulation examples contained in Appendix B.

Information currently available indicates that the following considerations will be important in determining the potential beneficial environmental impact of a reduction in marine casualties when oil and other hazardous materials are involved:

Geographic area or site in which the spill reductions will occur

Relative change in spill volume by geographic site

Type of cargo spilled

Weather conditions at the time of the spill

Marine and marine related resources subject to a reduction in potential damages, namely those resources generally found in the affected area.

Sources for developing a profile of the benefits of a reduction in incidents on the marine environment based upon previous incidents include the following:

The Pollution Incident Reporting System (PIRS). The Coast Guard computer file contains information on marine casualties in U. S. waters. Particularly useful are the data on spill size, average spill volumes, specific material spilled, cause of incidents and geographic spill distributions. Special analytical reports may be produced from the data base, or the regulatory staff may use Annual Pollution Incidents In and Around U. S. Waters. This latter report is the result of the Coast Guard staff analysis of the PIRS file. Samples of the data available from this report are included in Section VII. Source: Department of Transportation, U. S. Coast Guard Headquarters, Marine Environmental Protection Division, Washington, D. C. Telephone: (202) 426-9571.

- Environmental Protection Agency, Spill Prevention, Control and Countermeasures Plans. Source: Environmental Protection Agency, Oil and Special Materials Control Division, Washington D. C. Telephone: (202) 245-3045.

- National Response Center. This office maintains daily situation reports on spills of oil and hazardous materials in U. S. waters and case files by incident. The reports and files are based upon information supplied by a field response team. Useful data included in these files are: volume and location of incident, weather conditions at time of incident, cleanup effort undertaken and short term effects on resources. The incident is usually followed and reported on until cleanup efforts are completed. Source: Department of Transportation Headquarters, National Response Center, Washington, D. C. Telephone: (202) 426-1105.

3. Determine the environmental and property elements that could benefit from Coast Guard regulatory actions. The basis for this determination is the information developed and analyzed in Steps 1 and 2.

The elements in this category are benefits to property and the natural environment. For purposes of regulation analysis under the CVS Program they are divided into five groups:

- Commercial Resources
- Private Structures
- Recreational Resources
- Water Supply
- Natural Resources

Each of these groups is further divided into sub-elements. A brief description of the potential adverse effects on these elements and sub-elements, that could be reduced or eliminated by Coast Guard regulations, are included below. The bases for these descriptions are the past incidents that have been documented in the literature.

Commercial Resources

The subelements in this group include:

- o Fin Fish - Tuna, salmon, flounder etc.
- o Shell fish - Shrimp, lobster, crab etc.
- o Hatcheries - Areas where fish are hatched under protected conditions both to ensure their availability to commercial fisheries as well as preserve the species.
- o Vessels - Any commercial vessel operating in U. S. waters, and its related equipment
- o Piers, docks and other waterside facilities
- o Tourism

Past incidents have had adverse impacts on these resources that include:

- Killing and contaminating commercial fish, resulting in unsaleable catches, total bans on fishing and the disappearance of fish and shellfish populations from affected areas
- Requiring cleanup, rehabilitation or replacement of the above resources
- Damage to vessels and facilities

Private Structures

Includes any private property not related to commerce or recreation, such as dwellings.

Recreational Resources

The sub-elements in this group include:

- o Public waterfront property-public lands used for recreation, including public beaches and marinas
- o Private waterfront property-private land including beaches and marinas
- o Other recreational facilities-nature trails, campgrounds, waterski areas etc.
- o Recreational boats-all privately owned pleasure boats
- o Sport fishing-fishing by individuals or groups not affiliated with commercial fisheries and whose catch is intended for private use or sale. (Landings in sport fishing can be significant)

Past incidents have had adverse impacts on these resources that include:

- Reduction in beach visits due to polluted sand and the odor of hydrocarbons or other substances
- Disfigurement of waterfront homes and a reduction in property values
- Soiling of boats in harbors and marinas
- Cleanup and rehabilitation costs to restore above resources
- Loss of income to individuals and business in affected areas

Water Supply

The sub-elements in this group include:

- o Municipal drinking water
- o Other municipal intake
- o Industrial intake
- o Agricultural intake

Marine casualties have impacted these resources by:

- Requiring new and/or additional treatment of water supplies
- Shut down of industrial and utility plants which use seawater for coolant.

Natural Resources

The sub-elements in this category include:

- o Fish (non-commercial)
- o Other Marine Biota
- o Waterfowl and other birds
- o Marine Mammals
- o Marine sanctuary or wilderness areas
- o Reefs

Possible adverse affects to these resources that would be prevented include:

- Killing of numerous fish, birds and other wildlife
- Upsetting the ecological balance in specific areas, including migration patterns
- Reducing clean-up operations.

Table 15 in Section VII provides a brief summary of several major oil spills in U. S. waters and the environmental elements adversely impacted by these incidents.

As a secondary effort, the regulatory staff should attempt to determine and describe the potential type and degree of impact on those elements and sub-elements likely to benefit from a particular regulatory action. For example:

- Will the resource benefit from reduced cleanup or rehabilitation requirements?
- What degree of potential damages will be prevented by the proposed regulation?
- Will the regulation prevent adverse impacts that would have been long term or short term?
- Will the reduction in incidents occur primarily in areas that have had few or frequent incidents in the past?

Limited Quantified Analysis

The regulatory staff may wish to attempt to quantify the impacts of individual, site specific marine incidents. Since any attempt to quantify these impacts can be time consuming, the following guidelines are suggested.

1. Select past incidents for which literature descriptions and some data are available.

2. Quantify only the impacts of those resources for which there are generally acceptable commercial values.
3. Provide high, low and best estimate values for all elements.
4. Select and analyze a minimum of three incidents. The impacts of the three incidents should be representative of past incidents, from little or no known impact to moderate to heavy damages. In all cases the selected incidents should be consistent with the benefits of the proposed regulation.

Section VII, Tables 14 and 16 - 21 contain data on benefit factors that may be useful in this effort. These data include the value of various resources such as commercial fishing and tourism in particular regions and the costs of cleaning up oil spills.

SECTION VII

BENEFIT FACTORS

General

Selected individual benefit factors to be used in estimating the benefits of regulations are contained in this section. This section is divided into five parts:

- A. Vessel Benefit Factors
- B. Cargo Benefit Factors
- C. General Personnel Benefit Factors
- D. In-House Benefit Factors
- E. Environmental and Property Benefit Factors

These factors are provided strictly for the convenience of the regulatory staff and to illustrate the types and sources of data available for use regulatory analysis.

A. Vessel Benefit Factors

The following selected factors are applicable in measuring the benefits of total vessel losses averted as a result of Coast Guard regulatory action. They are derived from a national average construction cost by vessel type and a straight line depreciation scheme using an average age per vessel type and assuming an average useful life of 25 years. This depreciation approach is recommended because it is more closely linked to the expected life of an asset than other depreciation methods.

<u>Vessel Classification</u>	<u>Cost Factor</u> <u>(\$million)</u>
Tankers	\$6.13
Bulk, Breakbulk	2.73
LNG	90.00
Ocean Tug/Barges	40.94
All Groups	10.38

The procedures used to develop the above cost factors are described in Section VI, Part A. The variance in cost factors among vessel types can be attributed to the difference in the wide range of construction costs per deadweight ton by vessel class and the range of average vessel ages by vessel types within the U. S. merchant fleet. The regulatory staff should be advised of the need to periodically review the fleet profile presented in Table 2. As older and smaller vessels retire, they tend to be replaced by fewer but larger vessels. Thus, characteristics such as mean age and deadweight tonnage will change over time. This will be of particular significance in the 1980's since, as Table 2 shows, the average age for several vessel types indicates the likelihood many of the older and smaller vessels will be retired.

Table 2
U. S. Merchant Fleet *
October 31, 1978

<u>Vessel Type</u>	<u>No.**</u>	<u>Total DWT (000)</u>	<u>Av. DWT (000)</u>	<u>Av. Age</u>
Combination	6	50	8.3	18.3
Breakbulk	141	1,947	13.8	17.4
Bulk	19	564	29.7	24.6
Tanker	271	13,282	49.0	18.1
Tug/Barge	8	243	30.4	3.5
Intermodal	142	2,831	19.9	15.3
Total	587	18,917	32.2	17.0

* Does not include 255 vessels owned by the Maritime Administration of which only 22 are currently active.

** Includes vessels built and operated without subsidy

Source: MarAd, Office of Budget and Program Evaluation, Division of Program Evaluation

B. Cargo Benefit Factors

The following discussion provides selected commodity cost factors for use by the regulatory staff in assessing the cargo benefits of proposed Coast Guard regulatory actions. The approach to developing cost factors is first described to aid the regulatory staff in that activity when circumstances require the staff to do so. Then, selected cost factors are presented.

The following summarizes the conversion factors most likely to be needed; any other conversions that prove necessary can be found in most standard desk references such as dictionaries.

UNITS OF MEASURE

Weight

1 metric ton	contains 1,000 kilograms (2,204.62 pounds)
1 long ton	contains 2,240 pounds
1 short ton	contains 2,000 pounds

Conversion Factors for Crude Oil

1 barrel	contains 42 gallons
1 barrel	weighs 0.136 metric tons (0.150 short tons)
1 metric ton	contains 7.33 barrels
1 short ton	contains 6.65 barrels

Selected Cost Factors

The following tables represent cargo cost factors for selected commodities moved by water and weighted average cost factors by vessel type. They are intended for use by the regulatory staff and are expected to be updated as necessary. Sources for the cost factors are presented as well to facilitate such updating.

Table 3

Value of Waterborne Imports/Exports by Commodity Type

Calendar Year 1977

<u>Commodity Description</u>	<u>Value (\$)</u>	<u>Volume (000 Pounds)</u>	<u>Value/ 1000 Pounds</u>
Food & Live Animals	\$22,863,886,025	220,573,622	\$103.66
Beverages & Tobacco	3,056,198,852	4,403,770	694.00
Crude Materials	15,451,373,035	309,662,215	49.90
Mineral Fuels, Lubricants & Related Materials	43,972,309,893	1,040,365,117	42.27
Oils & Fats	1,795,090,924	7,486,529	239.78
Chemicals	10,961,341,378	60,705,728	180.57
Manufactured Goods	19,549,033,852	92,065,331	212.34
Machinery & Transport Equipment	36,496,610,630	19,825,394	1,840.90
Miscellaneous Manufactured	11,217,715,922	5,130,439	2,186.50
Other	<u>735,096,799</u>	<u>1,166,970</u>	<u>629.92</u>
All Commodity Groups	\$166,098,657,310	1,761,385,155	\$ 94.30

Sources: U. S. Bureau of the Census, U. S. Exports/World Areas by Schedule B Commodity Groupings, Report FT-455, Annual 1977. U. S. Government Printing Office, Washington, D.C. 1978.

U. S. Bureau of the Census, U. S. General Imports/Schedule A Commodity Groupings by World Area, Report FT-150, Annual 1977. U. S. Government Printing Office, Washington, D.C. 1978.

Table 4

Principal Waterborne Commodities' Shares
of Total Waterborne Commerce

Commodity Group	Total Commerce		Foreign Commerce		Domestic Commerce	
	<u>1976</u> %	<u>1977</u> %	<u>1976</u> %	<u>1977</u> %	<u>1976</u> %	<u>1977</u> %
Petroleum and Petroleum Products	45.9	49.1	48.8	52.6	43.5	46.0
Coal & Coke	12.5	12.3	8.5	8.0	15.9	16.3
Iron Ore & Iron and Steel	8.5	6.6	8.6	7.2	8.4	6.0
Sand, Gravel & Stone	5.7	5.4	1.6	1.6	9.3	9.0
Grains	6.9	6.2	10.2	8.7	4.0	3.8
Logs & Lumber	2.9	2.8	3.4	3.2	2.5	2.4
Chemicals	5.0	5.3	4.6	4.9	5.4	5.7
Seashells	0.7	0.6	0.0	0.0	1.2	1.2
All Others	<u>11.9</u> 100.0	<u>11.7</u> 100.0	<u>14.3</u> 100.0	<u>13.8</u> 100.0	<u>9.8</u> 100.0	<u>9.6</u> 100.0

Source: Department of the Army, Corps of Engineers. Waterborne Commerce of the United States, Calendar Year 1977, Vicksburg, Mississippi, 1979.

Table 5

Domestic Inland Movements of Petroleum and Petroleum Products

<u>Product Type</u>	<u>Waterborne Short Tons (1977)¹</u>	<u>% Total Petroleum Products Moved</u>	<u>May, 1979 Average Wholesale Unit Cost²</u>
Crude Petroleum	54.076	22.9	\$15.40/bbl ³
Gasoline	39.258	16.6	.754/gal*
Distillate Fuel Oils	42.014	17.8	.531/gal*
Aviation Fuels	5.761	2.4	.607/gal*
Kerosene	2.315	1.0	.576/gal*
Residual Fuel Oils	78.628	33.3	15.71/bbl ³
Naptha	2.974	1.3	.441/gal*
Others	10.943	4.6	

* Excluding Taxes

¹ Source, Waterborne Commerce of the United States, C. Y. 1977. Department of the Army, Corps of Engineers, Vicksburg, Mississippi. 1979.

² Source, Monthly Energy Review, August 1979. U. S. Department of Energy, Energy Information Administration, Washington, D. C. 1979.

³ 42 gallons per barrel

Table 6

Commodity Benefit Factors for Waterborne Imports/Exports
By Customs District, For Dry Cargo and Tanker Service
 (Calendar Year 1978)

<u>District</u>	<u>Shipping Weight</u> (millions of pounds)		<u>Value</u> (\$ millions)		<u>Weighted Average</u> <u>Cost/1000 Pounds</u>	
	<u>Dry</u> <u>Cargo</u>	<u>Tanker</u> <u>Service</u>	<u>Dry</u> <u>Cargo</u>	<u>Tanker</u> <u>Service</u>	<u>Dry</u> <u>Cargo</u>	<u>Tanker</u> <u>Service</u>
N. Atlantic	195,013	270,658	58,387	11,478	\$299.40	\$42.41
S. Atlantic	43,523	55,115	13,556	2,391	311.47	43.38
Gulf	343,190	487,135	32,632	24,463	95.08	50.22
S. Pacific	57,465	68,814	25,832	3,264	449.53	47.43
N. Pacific	105,032	19,344	12,673	970	120.66	50.14
Great Lakes	135,761	5,494	6,848	254	50.46	46.23
All Districts	879,985	906,560	149,929	42,819	\$170.38	\$47.24

Source: U. S. Bureau of the Census, U. S. Waterborne Exports and General Imports, Report FT-985-78-13, Annual 1978. U. S. Government Printing Office, Washington, D.C. 1979.

Table 7

**EXAMPLE OF IMPORT/EXPORT CARGO COMMODITY DATA
AVAILABLE FROM U.S. FOREIGN TRADE STATISTICS**

**FT 985
U.S. WATERBORNE EXPORTS**

Table E-1. Customs District and Port of Lading by Dry Cargo and Tanker Service

(Totals represent sum of unrounded figures, hence may vary slightly from sum of rounded amounts)

F.A.A. Value

Customs district and port	Shipping weight (in millions of pounds)						Value (in millions of dollars)					
	Grand total	Dry cargo				Tanker		Dry cargo		Tanker		
		Total	Total—domestic, foreign, and in-transit	Domestic and foreign	In-transit	Dept. of Defense and Special Category Non-Dept. of Defense combined cargo	Domestic, foreign, and in-transit	Domestic and foreign	Domestic, foreign, and in-transit	Domestic and foreign	Domestic, foreign, and in-transit	Domestic and foreign
TOTAL ALL DISTRICTS:												
MONTHLY AVERAGE 1974	33 408	30 922	30 475	30 390	85	47	2 886	2 883	1 602	1 576	84	84
JANUARY 1974	19 998	17 671	17 614	17 603	11	56	2 327	2 325	522	517	63	63
DECEMBER 1974	35 820	32 412	32 358	32 285	72	55	3 488	3 405	1 792	1 764	108	107
JANUARY 1975	33 040	29 784	29 743	29 559	184	41	3 276	3 273	1 767	1 732	96	96
NORTH ATLANTIC TOTAL	11 575	11 376	11 362	11 299	63	14	199	196	854	830	9	8
PORTLAND, MAINE	2	1	1	1	-	(2)	2	2	(2)	(2)	(2)	(2)
PORTLAND, MAINE	2	-	-	-	-	-	2	2	-	-	(2)	(2)
BANGOR, MAINE	-	-	-	-	-	-	-	-	-	-	-	-
EASTPORT, MAINE	(2)	(2)	(2)	(2)	-	-	-	-	(2)	(2)	-	-
BATH, MAINE	-	-	-	-	-	-	-	-	-	-	-	-
BAR HARBOR, MAINE	-	-	-	-	-	-	-	-	-	-	-	-
CALAIS, MAINE	-	-	-	-	-	-	-	-	-	-	-	-
ROCKLAND, MAINE	-	-	-	-	-	-	-	-	-	-	-	-
JONESPORT, MAINE	-	-	-	-	-	-	-	-	-	-	-	-
PORTSMOUTH, N.H.	-	-	-	-	-	-	-	-	(2)	(2)	-	-
BELFAST, MAINE	(2)	(2)	(2)	(2)	-	-	-	-	(2)	(2)	-	-
SEARSPORT, MAINE	(2)	(2)	(2)	(2)	-	(2)	-	-	(2)	(2)	-	-
BOSTON, MASS.	194	194	194	194	(2)	(2)	(2)	(2)	10	10	(2)	(2)
BOSTON, MASS.	192	192	192	192	(2)	(2)	(2)	(2)	10	10	(2)	(2)
GLOUCESTER, MASS.	2	2	2	2	(2)	-	-	-	(2)	(2)	-	-
NEW BEDFORD, MASS.	-	-	-	-	-	-	-	-	-	-	-	-
PLYMOUTH, MASS.	-	-	-	-	-	-	-	-	-	-	-	-
FALL RIVER, MASS.	-	-	-	-	-	-	-	-	-	-	-	-
SALEM, MASS.	-	-	-	-	-	-	-	-	-	-	-	-
PROVINCETON, MASS.	-	-	-	-	-	-	-	-	-	-	-	-

Table E-2. Foreign Trade Area by Type of Service

(Shipping weight in millions of pounds. Data shown represent domestic and foreign merchandise. Export shipments of Special Category commodities are excluded from these data. See tables E-3, E-4, and E-5 for cargo in each service by coastal district. Totals represent sum of unrounded figures, hence may vary slightly from sum of rounded amounts)

Trade area	All services			Liner			Irregular			Tanker		
	Total	U.S. flag	U.S. percent	Total	U.S. flag	U.S. percent	Total	U.S. flag	U.S. percent	Total	U.S. flag	U.S. percent
GRAND TOTAL	32 832	2 217	6.8	5 894	1 207	20.5	23 666	725	3.1	3 273	285	8.7
FOREIGN TRADE AREAS, EXCEPT CANADIAN	32 347	2 166	6.7	5 891	1 206	20.5	23 263	711	3.1	3 192	290	9.0
CARIBBEAN	1 250	110	8.8	422	68	16.1	529	42	7.9	299	-	-
EAST COAST OF CANAL ZONE	65	6	9.2	17	6	35.3	4	-	-	44	-	-
ALL OTHER CARIBBEAN PORTS	1 186	104	8.8	405	62	15.3	525	42	8.0	256	-	-
EAST COAST OF SOUTH AMERICA	958	80	8.4	248	79	31.9	618	(2)	(8)	92	-	-
WEST COAST OF SOUTH AMERICA	403	73	18.1	218	73	33.5	170	(2)	(8)	15	-	-
WEST COAST OF CENTRAL AMERICA AND MEXICO	121	5	4.1	94	5	9.3	16	-	-	51	-	-
WEST COAST OF CANAL ZONE	61	3	4.9	13	3	23.1	1	-	-	48	-	-
ALL OTHER WEST COAST OF CENTRAL AMERICA AND MEXICO	59	3	5.1	41	3	7.3	15	-	-	3	-	-

Table 7 (Continued)

**EXAMPLE OF IMPORT/EXPORT CARGO COMMODITY DATA
AVAILABLE FROM U.S. FOREIGN TRADE STATISTICS**

FT 150
U.S. GENERAL IMPORTS

**Table 1. Schedule A Groupings of Commodities and Method
of Transportation (F.a.s. Value)**

For coverage, valuation, and sampling procedures, see Explanation of Statistics. Shipments individually valued at less than \$251 are shown only under Schedule A subgroup 800.0 and included in data for all methods of transportation and for vessel and air. Where a description for a division or group code is omitted, the description immediately following that division or group code is applicable. Where the symbol "DO" appears in the description column for a Schedule A code, the description immediately preceding the code is applicable. Z-Less than half of the unit of measurement shown)

Schedule A code	Commodity description	All methods, value (dollars)	Vessel		Air	
			Value (dollars)	Shipping weight (1,000 pounds)	Value (dollars)	Shipping weight (1,000 pounds)
	TOTAL U.S. GENERAL IMPORTS . . .	69 121 221 363	42 601 672 820	875 216 898	6 929 664 374	1 002 198
	SECTION 0--FOOD AND LIVE ANIMALS . .	7 986 196 224	6 663 797 779	31 444 201	60 736 870	78 579
00	ANIMALS--LIVE,	231 731 299	1 211 420	286	12 631 485	1 233
001	DO	231 731 299	1 211 420	286	12 631 485	1 233
001.1	CATTLE--LIVE	203 320 278	206 963	53	2 984 892	523
001.2	SHEEP, LAMBS, AND GOATS--LIVE,	350 758	-	-	5 254	3
001.3	SWINE--LIVE,	10 957 451	-	-	620	1
001.5	HORSES, ASSES, MULES, AND BURROS--LIVE, N.E.S.,	13 298 478	1 004 457	233	9 341 879	684
001.6	ANIMALS--LIVE, CHIEFLY FOR FOOD, N.E.S.,	3 804 334	-	-	298 838	23
01	MEAT AND MEAT PREPARATIONS	1 668 020 287	1 497 470 242	1 903 839	8 271 631	8 773
011	MEAT--FRESH, CHILLED, OR FROZEN,	1 122 510 702	963 469 283	1 325 610	7 604 238	6 276
011.1	BEEF AND VEAL, EXCEPT OFFALS--FRESH, CHILLED, OR FROZEN,	1 045 798 226	929 957 742	1 267 986	7 516 610	8 135
011.2	SHEEP AND GOAT MEAT, EXCEPT OFFALS--FRESH, CHILLED, OR FROZEN,	22 050 378	21 555 022	42 538	53 466	98
011.3	PORK, EXCEPT OFFALS--FRESH, CHILLED, OR FROZEN,	41 263 506	1 336 341	2 254	9 184	9
011.5	HORSEMEAT--FRESH OR FROZEN, NOT IN CONTAINERS BEIGHING WITH THEIR CONTENTS UNDER 10 POUNDS EACH,	766 363	-	-	-	-
011.6	OFFALS OF ANIMALS IN SUBGROUPS 011.1-011.5--FRESH, CHILLED, OR FROZEN,	3 351 223	1 886 362	3 038	5 633	10
011.9	MEAT AND EDIBLE OFFALS--FRESH, CHILLED, OR FROZEN, N.E.S.,	9 261 006	8 733 816	9 786	19 145	24
012	PORK--DRIED, SALTED, OR SMOKED	3 418 965	397 277	423	49 010	39
012.1	DO	3 418 965	397 277	423	49 010	39
013	MEAT IN AIRTIGHT CONTAINERS, N.E.S., AND MEAT PREPARATIONS, WHETHER OR NOT IN AIRTIGHT CONTAINERS,	542 090 620	533 603 682	577 806	618 363	458
013.3	MEAT EXTRACTS AND MEAT JUICES,	5 681 884	5 503 633	1 608	1 356	(2)
013.4	SAUSAGES	14 406 714	10 605 922	13 289	313 745	238
013.9	MEAT AND MEAT PRODUCTS--PREPARED OR PRESERVED, N.E.S.,	522 062 022	517 494 127	562 909	303 282	221
02	DAIRY PRODUCTS AND EGGS,	295 115 328	242 231 264	551 709	2 645 565	2 842
022	MILK AND CREAM	96 264 704	67 737 427	242 602	144 406	450
022.1	MILK AND CREAM--EVAPORATED OR CONDENSED	575 328	575 328	3 201	-	-
022.2	MILK AND CREAM--DRIED; AND WHEY--DRIED	91 227 256	62 770 079	201 393	144 406	450
022.3	MILK AND CREAM--FLUID, FRESH OR SOUR, CONTAINING NOT OVER 45% BUTTERFAT; AND FLUID WHEY, YOGHURT, AND OTHER FERMENTED MILK,	4 462 120	4 392 020	38 001	-	-
023	BUTTER AND FRESH OR SOUR CREAM--CONTAINING OVER 45% BUTTERFAT,	25 945 607	25 965 607	48 453	-	-
023.0	DO	25 945 607	25 965 607	48 453	-	-
024	CHEESE AND CURD,	156 217 604	147 394 251	254 543	2 336 586	2 254
024.0	DO	156 217 604	147 394 251	254 543	2 336 586	2 254
025	EGGS--BIRDS*; AND BIRD EGG ALBUMEN AND YOLKS	6 667 413	1 133 979	6 112	164 573	137
025.0	DO	6 667 413	1 133 979	6 112	164 573	137
03	FISH AND FISH PREPARATIONS	1 387 436 884	1 007 144 536	1 982 045	29 869 780	24 822
031	FISH, INCLUDING SHELLFISH--FRESH, OR SIMPLY PREPARED	1 219 722 771	865 308 880	1 700 790	27 823 484	22 367
031.1	FISH, EXCEPT SHELLFISH--FRESH, CHILLED, OR FROZEN,	719 632 699	562 127 837	1 477 557	13 352 771	12 712
031.2	FISH, EXCEPT SHELLFISH--SALTED, DRIED, OR SMOKED	74 772 147	16 735 651	36 288	387 026	327
031.3	SHELLFISH, EXCEPT PREPARED OR CANNED	493 317 925	286 445 392	186 945	14 063 687	9 328

Source: U.S. Bureau of the Census, Guide to Foreign Trade Statistics, 1975. U.S. Government Printing Office, Washington, D.C.

C. General Personnel Benefit Factors

The following personnel benefit factors may be used in calculating personnel benefits resulting from the implementation of a regulation. Factors are provided for both wages and medical expenses. In addition, data are provided on the extent of injuries in the maritime and longshore industries. These latter data provide at least some bases for estimating the average duration of work related injuries.

Table 8

Basic Hourly Rates For Selected Longshore Occupations
Pacific Maritime Association¹
 July 1977

Longshoremen - General Cargo:	
Basic rate first 6 hours	\$ 8.37
Overtime rate for next 2 hours	12.555
Container Freight Station (CFS) utility men	9.415

1) Excludes Benefit Package

Source: U. S. Department of Labor, Bureau of Labor Statistics, Wage Chronology: Pacific Maritime Association and the International Longshoremen's and Warehousemen's Union, 1934 - 1978, Bulletin No. 1960.

Table 9

Longshore and Harbor Workers Injuries Reported and Time Lost from Work

	<u>No. of Injuries</u>	<u>No. of Injuries Where Workers Lost More than 1 shift</u>
1976	195,198	39,262
1977	205,584	41,031
1978	217,367	46,798

Source: U. S. Department of Labor, Office of Longshore and Harbor Workers Compensation. Telephone: (202) 523-8721.

Table 10

HOSPITAL EXPENSE AND REVENUE

10A. Hospitalization Expense Per Inpatient Day

<u>Year</u>	<u>Daily Expense</u>	
	Private Community Hospital	Government Hospital
1975	\$133.81	\$132.41
1976	152.76	148.68
1977	173.98	167.37
1978	194.34	186.77

10B. Hospitalization Revenue¹ Per Outpatient Visit

1977	\$36.42	N/A
1978	41.85	N/A

¹ Expense per outpatient was not available.

Source: American Hospital Association, Hospital Statistics, 1979 Edition. This publication is available in the Department of Health, Education and Welfare Library.

D. In-House Personnel Benefit Factors

These factors were extracted from COMDTNOTE 7100, dated 31 January 1978, and are listed here strictly as a convenience to the regulatory staff. Factors are in 1978 dollars.

Table 11

Pay, Allowances and Salaries.

<u>Civilian</u>	<u>Annual Salary Budget Average</u> ¹
GS-18	\$ 51,400
GS-17	51,400
GS-16	45,900
GS-15	39,200
GS-14	33,400
GS-13	28,300
GS-12	23,900
GS-11	20,000
GS-10	18,200
GS-9	16,600
GS-8	15,500
GS-7	13,600
GS-6	12,300
GS-5	11,000
GS-4	9,900
GS-3	8,900
GS-2	7,900
GS-1	7,000
Wageboard	18,700

¹ General Schedule Pay Scales limit the basic compensation rate for employees at these levels to the rate for level V of the executive schedule at \$47,500. The additional amount of approximately \$3,900 is for the governments' contribution for Civil Service Retirement, FEHGA and FEGLIA. These factors do not include overseas station allowances.

Table 12
Military Pay and Allowances

When Grade Distribution Not Known:	
Commissioned Officers	\$ 23,400
Warrant Officers	20,700
Enlisted Men	11,600
0-6 (CAPT)	37,300
0-5 (CDR)	31,000
0-4 (LCDR)	26,200
0-3 (LT)	22,200
0-2 (LTJG)	18,000
0-1 (ENS)	13,100
W-4	25,000
W-3	21,100
W-2	18,300
E-9 (MCPO)	21,100
E-8 (SMPO)	18,300
E-7 (CPO)	16,200
E-6 (PO1)	13,800
E-5 (PO2)	11,600
E-4 (PO3)	10,000
E-3 (SN)	8,900
E-2 (SA)	7,700
E-1 (SR)	7,100
Flight Pay:	
Commissioned Officers	2,500
Warrant Officers	1,800
Enlisted Men	1,050
Sea or Foreign Duty Pay:	
Enlisted Men	170

Note: The above military pay and allowances cost estimates do not include overseas station allowances. Such costs are to be calculated separately based on current rates, and where applicable, added to the above costs estimates.

2. Support Costs

See Table 13 for standard factors used in calculating Coast Guard personnel support costs.

Table 13
ANNUAL STANDARD PERSONNEL SUPPORT COSTS
(1978)

	PERMANENT CHANGE OF STATION PROGRAM		OPERATING AND MAINTENANCE COSTS		PERSONNEL TRAINING AND PROCUREMENT		
	OG 20.00		OG 30.00 ²		OG 56.00		
	INSIDE UNITED STATES ¹		OUTSIDE UNITED STATES				
	RECURRING	NON RECURRING	RECURRING	RECURRING ³	NON RECURRING ⁴	NON RECURRING	
Commissioned Officer	1,420	1,420	6,300	1,040	600	513	744
Warrant Officer	1,420	1,420	6,300	1,040	600	198	470
Enlisted Men	680	680	1,684	1,040	600	150	225
Civilians	250	NA	NA	1,040	600	171	80
Avia Training (Off)	...	...	...	...	...	3,780	10,915 ⁵
Fixed Wing	...	...	...	...	...	2,055	15,900
Rotary Wing	...	...	...	...	...

¹ Where recurring and nonrecurring costs are shown, the amount in the budget year will be the sum of the two figures.

² Because standard level user charges (SLUC) will be shown as a separate line item in budgets, it is inappropriate to include the cost in OG 30 SPC. However, when these figures are to be used for economic analysis, an imputed cost of \$1,784 recurring should be added for each billet newly created at SLUC-type units.

³ \$410 Headquarters retained funds.

⁴ \$180 Headquarters retained funds.

⁵ Two-year program; first year costs are applicable for two years.

Point of Contact: Budget Division, Office of the Comptroller, Room 8430, Nassif Building, Washington, D. C.
(202) 426-2421.

E. Environmental and Property Benefit Factors

The following benefit factors may be used in calculating the dollar value of benefits to marine and marine related resources. These factors will be applicable to the development of quantifiable es benefits when a scenario or past incident is used to provide a range of possible benefit values for a reduction in marine casualties.

TABLE 14

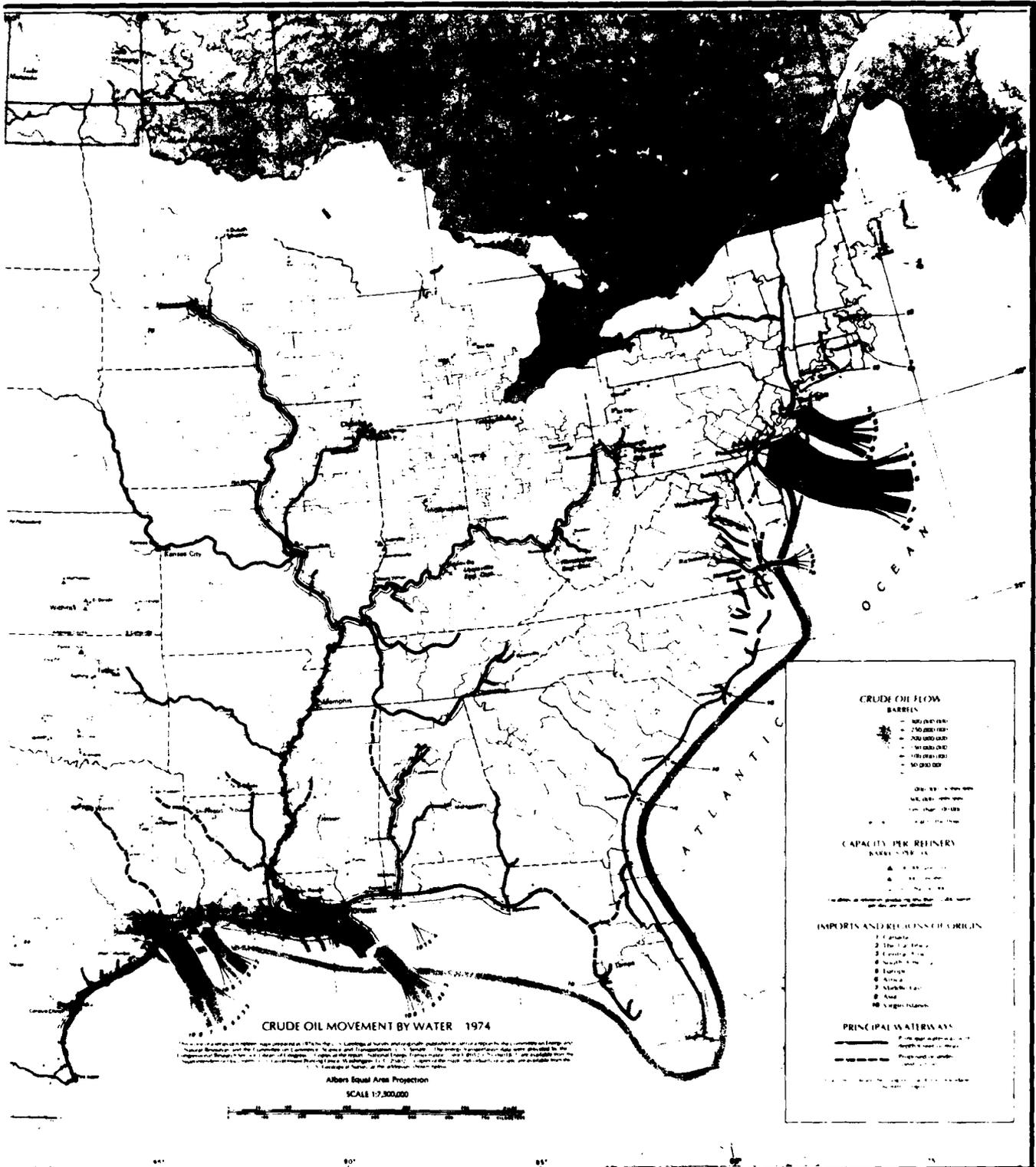
ESTIMATED CLEAN-UP COSTS OF SEVERAL MAJOR OIL SPILLS

Date	Spill Name (Location)	Spill Size Gallons (millions)	Substance Spilled	Vessel/Rig (Type of Accident)	Estimated Clean-up Costs \$(Millions)	Clean-up Costs/Gal.	Comments
1/28/69	Santa Barbara ^{1,2/} (off Santa Barbara Coast)	3.3	Crude Oil	Platform (blowout)	\$10.5	\$3.18	The 3.3 million gallons represents the net volume spilled after collection operations.
3/16/78	Amoco Cadiz ^{2,3,4/} (Brittany Coast of France)	70.8	Arabian Crude Oil	Tanker (steering failure)	30.0	0.42	The \$30 million includes damages paid by Amoco International. The Washington Post reported (10/28/79) that total clean-up costs were \$100 million.
2/4/70	Arrow ^{2,4/} (Chedabucto Bay, Nova Scotia)	1.5	Bunker C Fuel Oil	Tanker (grounding)	3.0	2.00	
12/15/76	Argo Merchant ^{2,5/} (off Nantucket, Mass.)	7.5	No. 6 Fuel Oil	Tanker (grounding)	1.8	0.24	
3/18/67	Torrey Canyon ^{2,4/} (English Channel)	36.7	Crude Oil	Tanker (grounding)	1.2	.03	Approximately 50% of the oil was burned to prevent its spread. Clean-up costs are for sea operations and sea sprayed detergents.
1/9/78	Brazilian Marina ^{3,4/} (Sao Sebastiao, Brazil)	3-4.6	Crude	Tanker (struck rock in channel)	3.0	0.65	
12/18/74	Mizushima Refinery ^{2/} (Seto Island Sea, Japan)	1.98-2.5	Desulphurized fuel	Tank rupture (or land)	160	64-81	12.4 million gallons were spilled but only the amount shown escaped to the sea.

Sources:

- ^{1/} Mead, Walter J. and Philip L. Sorensen, "The Economic Cost of the Santa Barbara Oil Spill." In: Santa Barbara Oil Symposium, University of California, Santa Barbara, December 16-18, 1970.
- ^{2/} Transportation Systems Center, Some Historic Massive Spill Cleanup Efforts, Washington, D.C., U.S. Department of Transportation, 1979.
- ^{3/} American Petroleum Institute, Proceedings, 1979 Oil Spill Conference, Los Angeles, March 19-22, 1979.
- ^{4/} Transportation Systems Center, Deployment Requirements for U.S. Coast Guard Pollution Response Equipment, Prepared for U.S. Coast Guard, Washington, D.C., February, 1979.
- ^{5/} General Accounting Office, Report of the Comptroller General of the U.S. Total Costs Resulting from Two Major Oil Spills, Washington, D.C., June 1977.

**TABLE 16
CRUDE OIL MOVEMENT BY WATER 1974**



Source: U.S. Department of the Interior, Geological Survey

TABLE 17
PETROLEUM PRODUCTS MOVEMENT BY WATER 1974

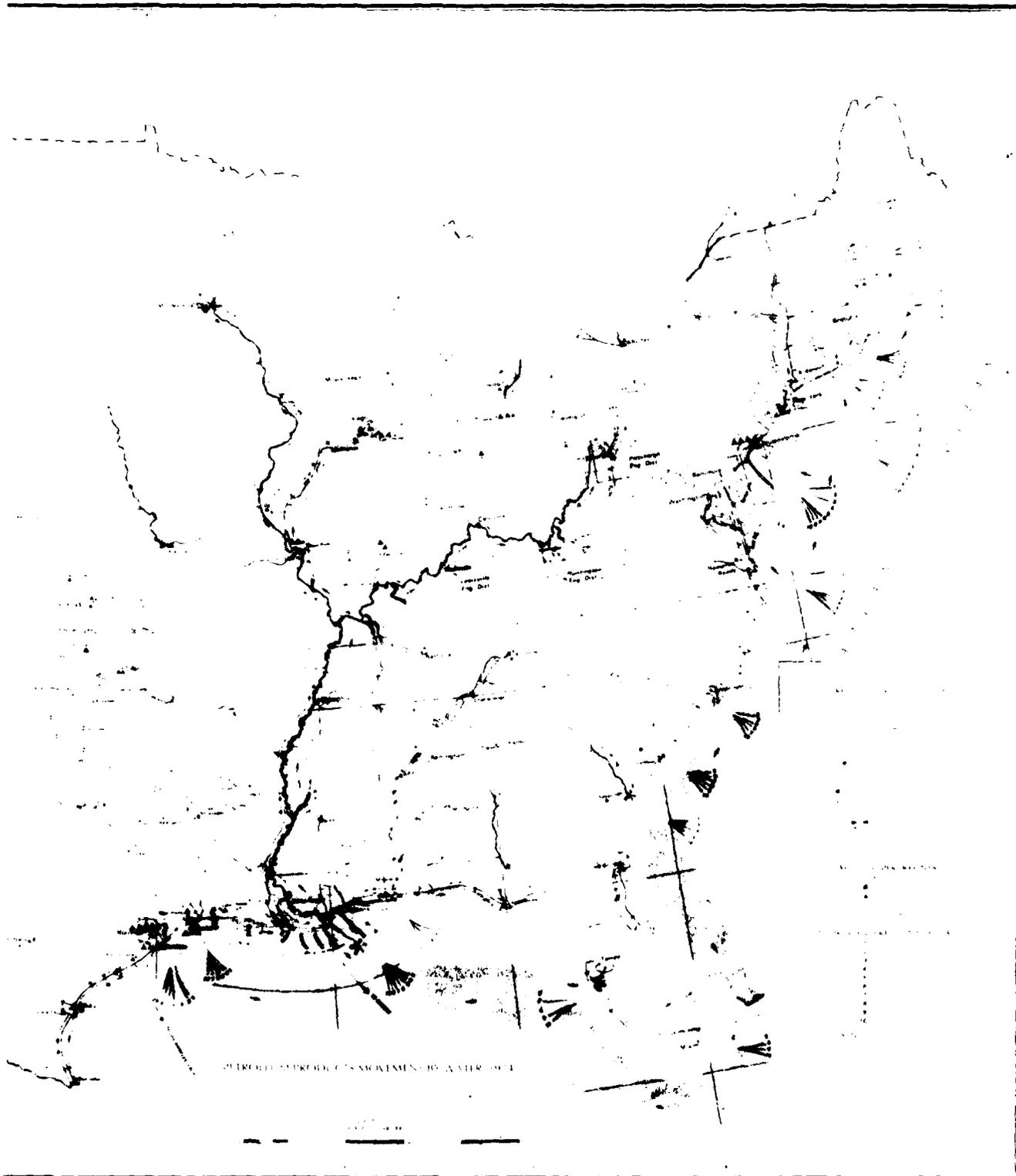


Table 18

Value of Tourism Trade
In Selected U. S. Coastal Counties

State	Counties No./ % of State	Year	Travel Expend. (000's)	Travel Generated Payroll (000's)	Travel Generated Empl. (Jobs)	Travel Expended State Total (000's)	Coastal Tourism As A % of State Total for Travel (%)
Washington	14/39 (36)	1977	\$1,289,576	\$337,868	47,093	1,801,000	71.60
Oregon	7/36 (19)	1977	310,309	79,788	14,940	1,372,000	22.61
Texas ¹	15/254 (6)	1978	583,929	141,303	21,138	7,000,000	8.34
Maryland	14/24 (58)	1976	769,751	179,716	27,815	1,753,889	43.88
Pennsylvania ¹	1/67 (1.5)	1976	135,296	27,672	4,951	4,690,050	2.88
S. Carolina	6/46 (13)	1976	824,970	175,612	33,179	1,704,643	48.39
Virginia	15*/95 (16)	1978	395,723	15,939	85,598	1,894,100	20.89
Ohio ¹	8/88 (9)	1976	1,044,600	244,722	38,846	3,183,484	32.81
Louisiana	15/64 (23)	1977	1,394,707	355,315	51,924	1,959,306	71.18
Deleware	3/3** (100)	1977	313,000	108,000	14,870	313,000	100.00**
Indiana	2/92 (2)	1977	60,946	11,796	2,311	1,771,639	3.44

* Includes Norfolk and Virginia Beach Figures

** However, Sussex County enjoys most of the travel trade, with most of the tourism resources located there.

Note:

¹ For 1976 these states were in the top ten in U. S. Travel Receipts

Source: U. S. Travel Data Center; 1899 L. St., N.W., Washington, D. C. Data compiled under contract to listed states

Table 19

Top Ten States Travel Receipts
1976

<u>State</u>	<u>Receipts \$(millions)</u>
California	\$11,140.7
Florida	8,762.2
New York	5,930.3
*Texas	5,666.7
*Pennsylvania	4,305.2
Michigan	3,616.1
Illinois	3,507.8
New Jersey	2,974.4
*Ohio	2,963.7
Minnesota	2,775.8

* Data provided for Coastal Counties of these States

Travel Receipts Include:

Public Transportation
Auto Transportation
Lodging
Food
Entertainment & Recreation
Incidental Purchases

Source: U. S. Travel Data Center, 1899 L. St., N. W., Washington, D. C.

Table 20. Preliminary Data Commercial Fish and Shellfish Industries

REGION	1976				1977				1978			
	FISH		SHELLFISH		FISH		SHELLFISH		FISH		SHELLFISH	
	Pounds (x 10 ⁶)	Dollars (x 10 ⁶)	Pounds (x 10 ⁶)	Dollars (x 10 ⁶)	Pounds (x 10 ⁶)	Dollars (x 10 ⁶)	Pounds (x 10 ⁶)	Dollars (x 10 ⁶)	Pounds (x 10 ⁶)	Dollars (x 10 ⁶)	Pounds (x 10 ⁶)	Dollars (x 10 ⁶)
New England (Total)	488.7	80.2	76.5	96.2	500.9	93.1	80.4	109.7	581.7	124.8	78.0	131.7
Maine	141.8	12.5	36.7	41.3	148.3	16.4	33.9	45.6	157.6	22.1	32.7	46.8
Massachusetts	260.5	56.9	28.0	41.7	283.7	63.8	35.8	50.3	342.1	84.7	34.8	67.6
New Hampshire	2.9	.4	.5	.7	3.5	.7	.5	.8	4.4	.9	.5	.8
Rhode Island	62.1	11.1	9.5	9.3	62.7	11.6	9.4	11.3	74.5	16.5	9.2	12.8
Connecticut	1.3	.2	1.3	2.3	2.7	2.4	.9	1.7	3.2	.7	1.9	3.7
Middle Atlantic (Total)	206.3	16.7	80.7	51.8	181.7	18.4	61.7	51.4	144.8	23.5	55.8	58.1
New York	16.6	4.4	17.6	27.8	17.3	5.5	15.4	25.0	22.7	9.1	13.2	24.5
New Jersey	118.0	12.1	39.0	22.3	133.9	12.7	44.7	26.8	121.6	14.2	42.1	30.2
Delaware	.7	.1	4.1	1.6	.5	.2	1.5	.6	.8	.2	.5	.3
Chesapeake (Total)	491.2	20.4	98.8	55.0	569.6	29.3	109.2	56.8	485.0	19.9	113.7	74.3
Maryland	13.6	2.3	45.8	29.0	15.8	2.7	44.6	26.0	14.0	3.1	45.7	30.4
Virginia	477.6	18.1	50.8	25.0	543.8	26.6	64.7	28.8	471.0	16.8	68.0	43.9
South Atlantic (Total)	267.4	27.1	57.7	44.7	290.6	33.2	54.7	38.5	324.1	43.8	74.9	62.4
North Carolina	206.6	14.7	20.5	12.8	231.4	16.6	19.9	12.3	206.2	24.4	30.3	16.2
South Carolina	5.7	1.1	15.8	13.0	3.2	1.1	13.1	8.4	3.8	2.2	18.8	13.8
Georgia	8	.3	13.7	12.0	.9	.5	12.4	8.5	1.1	.7	16.4	13.9
Fla.—East Coast	45.2	11.0	7.7	6.8	55.1	15.0	9.4	9.3	50.0	16.5	11.3	8.8
Gulf of Mexico	1472.7	80.2	280.0	308.4	1143.5	70.0	332.9	334.7	1683.9	110.4	323.1	362.8
Fla.—West Coast	63.3	20.8	48.7	49.6	42.3	17.5	56.0	53.7	56.0	18.7	54.2	53.7
Mississippi	277.8	11.3	10.4	9.7	299.1	13.7	13.8	11.7	362.9	18.9	10.9	10.5
Louisiana	1112.8	43.5	115.2	93.4	785.5	35.2	132.0	102.7	1534.1	70.9	139.8	119.2
Texas	8.2	2.8	84.5	123.8	5.7	2.3	102.3	131.0	5.1	2.6	94.2	148.2
Alabama	-	-	-	-	5.8	1.2	28.7	35.6	5.8	1.4	23.9	34.0
Pacific	1316.8	401.1	426.6	141.4	1283.2	434.0	483.8	216.6	1224.8	622.3	520.6	386.1
Washington	107.8	87.7	23.5	13.2	116.0	63.8	31.0	17.0	112.6	77.2	26.7	19.9
Oregon	64.1	38.1	34.7	10.6	44.3	27.4	68.2	21.1	65.6	32.3	66.0	24.3
California	845.8	168.5	51.1	17.1	795.7	175.2	78.7	19.7	638.6	207.2	53.9	27.1
Alaska	298.0	126.7	317.3	100.4	328.1	187.5	315.9	156.8	403.8	188.2	341.8	240.4
Great Lakes	66.9	10.8	-	-	65.6	9.4	-	-	19.2	10.4	-	-
Mississippi River & Trib.	59.3	12.3	3.1	.7	52.0	10.1	3.2	.6	54.9	12.3	3.3	.7
Hawaii	11.8	7.3	1	.2	15.1	9.1	15.3	9.4	14.3	11.2	3	.4

Source: National Marine Fisheries Service, Department of Commerce (NOAA), 3300 Whitehaven Street, N.W., Washington, D.C. Telephone: 624-7365

Table 21

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS**Type Of Location - 1976
Oil And Other Substances**

	Open Internal Waters	Rivers Channels	Ports And Harbors	Beaches Non-Navigable Waters	Territorial Zone (Shore to 3 miles)	Contiguous Zone (3-12 miles)	High Seas (12 miles or more)	Totals
INLAND AREA								
Number	70	810	456	1,000	---	---	---	2,236
%	0.6	6.4	3.6	7.9	---	---	---	18.5
Volume	99,257	3,499,819	47,841	3,489,043	---	---	---	7,135,950
%	0.3	10.3	0.1	10.3	---	---	---	21.1
ATLANTIC								
Number	---	614	1,532	155	228	52	48	2,627
%	0.0	4.9	12.1	1.2	1.8	0.4	0.4	20.8
Volume	---	202,756	679,182	194,266	275,123	2,437	7,622,235	8,876,019
%	0.0	0.6	2.0	0.6	1.0	0.0	22.0	26.2
PACIFIC								
Number	---	203	1,480	164	345	28	17	2,237
%	0.0	1.6	11.7	1.3	2.8	0.2	0.1	17.7
Volume	---	46,946	1,089,765	83,013	218,014	1,164	4,259	1,443,161
%	0.0	0.1	3.2	0.2	0.7	0.0	0.0	4.3
GULF								
Number	---	692	1,383	194	1,362	368	493	4,482
%	0.0	5.5	10.9	1.5	11.0	3.0	3.5	35.4
Volume	---	643,815	360,285	5,641,932	274,184	11,197	708,210	7,539,623
%	0.0	1.9	1.1	16.7	0.8	0.0	2.1	22.6
GREAT LAKES								
Number	85	488	142	268	---	---	---	973
%	0.7	3.9	1.1	2.0	---	---	---	7.7
Volume	15,014	6,382,606	2,114,632	244,725	---	---	---	8,757,067
%	0.0	18.9	6.2	0.7	---	---	---	25.9
TOTAL								
Number	153	2,807	4,993	1,771	1,975	448	656	12,655
%	1.2	22.2	39.5	14.0	15.2	3.5	4.4	100.0
Volume	114,271	10,776,032	4,291,705	9,652,999	767,321	14,798	8,234,704	33,861,830
%	0.3	31.3	12.7	28.5	2.2	0.1	24.3	100.0

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS**Oil And Other Substances
Type Of Material Discharge**

	<u>Number of Incidents</u>	<u>% of Total</u>	<u>Volume in Gallons</u>	<u>% of Total</u>
Crude oil	2,667	21.1	4,990,691	14.7
Fuel oil	909	7.2	9,780,886	28.9
Gasoline	658	5.2	764,168	2.3
Other distillate fuel oil	251	2.0	462,140	1.4
Solvent	34	0.3	95,317	0.3
Diesel Oil	2,063	16.3	1,100,133	3.2
Asphalt or residual fuel oil	132	1.0	4,982,195	14.7
Animal or vegetable oil	93	0.7	94,513	0.3
Waste oil	1,217	9.6	131,377	0.4
Other oil	2,636	20.8	724,294	2.1
Liquid chemical	296	2.3	2,110,048	6.2
Other pollutant (Sewage, dredge, spoil, chemical wastes, etc.)	130	1.0	6,468,940	19.1
Natural Substance	94	0.7	6,468	0.0
Other Material	146	1.2	2,120,386	6.3
Unknown material	<u>1,329</u>	<u>10.5</u>	<u>20,274</u>	<u>0.1</u>
TOTAL	12,655	100.0	33,851,830	100.0

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS**Oil And Other Substances
Sources**

	<u>Number of Incidents</u>	<u>% of Total</u>	<u>Volume in Gallons</u>	<u>% of Total</u>
VESSELS				
1. Dry Cargo Ships	41	0.3	11,679	0.0
2. Dry cargo barges	324	2.6	24,840	0.1
3. Tank ships	623	4.9	8,930,029	26.4
4. Tank barges	976	7.7	1,953,442	5.8
5. Combatant vessels	179	1.4	26,987	0.1
6. Other vessels	1,153	9.1	245,013	0.7
TOTAL	3,296	26.0	11,191,990	33.1
LAND VEHICLES				
1. Rail vehicles	82	0.6	269,440	0.8
2. Highway vehicles	335	2.6	323,391	1.0
3. Other/unknown vehicles	47	0.4	20,968	0.1
TOTAL	464	3.6	613,799	1.9
NON-TRANSPORTATION-RELATED FACILITIES				
1. Onshore refinery	101	0.8	211,614	0.6
2. Onshore bulk/storage	365	2.9	5,873,932	17.4
3. Onshore production	242	1.9	389,053	1.0
4. Offshore production facilities	1,358	10.7	274,732	0.8
5. Other facilities	1,055	8.3	9,759,869	28.8
TOTAL	3,121	24.6	16,469,200	48.0
PIPELINES	653	5.2	4,530,094	13.4
MARINE FACILITIES				
1. Onshore/offshore bulk cargo transfer	321	2.5	333,712	1.0
2. Onshore/offshore fueling	88	0.7	21,708	0.1
3. Onshore/offshore nonbulk cargo transfer	23	0.2	15,643	0.0
4. Other transportation related marine facility				
	<u>128</u>	<u>1.0</u>	<u>5,787</u>	<u>0.0</u>
TOTAL	560	4.4	376,850	1.1
LAND FACILITIES	182	1.4	442,730	1.3
MISC/UNKNOWN	4,379	34.8	227,167	0.7
TOTAL	12,655	100.0	33,851,830	100.0

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS**Oil and Other Substances
Discharge Versus Size**

<u>Volume</u>	<u>Number of Incidents</u>	<u>% of Total</u>	<u>Volume in Gallons</u>	<u>% of Total</u>
Unknown	2,650	20.9	10	0.0
0-9 gal.	4,444	35.1	11,041	0.0
10-49 gal.	2,470	19.5	51,582	0.2
50-99 gal.	774	6.1	49,248	0.1
100-499 gal.	1,202	9.5	253,266	0.7
500-999 gal.	304	2.4	200,622	0.6
1000-2499 gal.	344	2.7	515,236	1.5
2500-4999 gal.	187	1.5	636,753	1.9
5000-9999 gal.	134	1.1	927,112	2.7
10,000-49,999 gal.	97	0.8	1,913,964	5.7
50,000-99,999 gal.	17	0.1	1,154,916	3.4
100,000-999,999 gal.	19	0.2	5,018,516	14.8
Above 1 Million gal.	<u>7</u>	<u>0.1</u>	<u>23,120,000</u>	<u>10.0</u>
TOTAL	12,655	100.0	33,851,830	100.0

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS**Oil And Hazardous Substances
Causes**

	<u>Number of Incidents</u>	<u>% of Total</u>	<u>Volume in Gallons</u>	<u>% of Total</u>
Hull/tank rupture/leak	782	6.2	8,128,139	24.0
Transportation pipeline rupture/leak	522	4.1	2,281,746	6.7
Other structural failure	411	3.2	12,193,880	36.0
Pipe rupture/leak	875	6.9	4,120,886	12.2
Railroad/Highway/Aircraft Accidents	257	2.0	481,647	1.4
Valve failure	400	3.2	277,387	0.8
Pump failure	158	1.2	648,773	1.9
Other rupture/leak	343	2.7	80,343	0.2
Other equipment failure	1,025	8.1	905,502	2.7
Tank overflow	1,072	8.5	273,272	0.8
Improper handling operation	499	3.9	346,499	1.0
Other personnel error	530	4.2	434,786	1.3
Bilge pumping	242	1.9	9,407	0.0
Ballast pumping	34	0.3	2,085	0.0
Other intentional discharge	228	1.8	784,378	2.3
Natural or chronic phenomenon	318	2.5	118,798	0.4
Unknown	<u>4,959</u>	<u>39.2</u>	<u>2,764,352</u>	<u>8.2</u>
TOTAL	12,655	100.0	33,851,830	100.0

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS

SOURCE VS CAUSE: Oil and Hazardous Substances 1976

	Number of Incidents Volume in Gallons				
	Hull or Tank Leak	Trans Pipe Rupture or Leak	Other Struct Failure	Pipe Rupture or Leak	Other Rupture or Leak
Tankships	$\frac{69}{1321221}$	$\frac{6}{375}$	$\frac{6}{7502856}$	$\frac{14}{1176}$	$\frac{23}{10670}$
Tankbarges	$\frac{264}{1141910}$	$\frac{11}{92974}$	$\frac{17}{600}$	$\frac{20}{311}$	$\frac{39}{3844}$
Drycargoes	$\frac{8}{10381}$	x	$\frac{3}{12}$	$\frac{1}{6}$	$\frac{2}{102}$
Drycanship	$\frac{11}{1073}$	$\frac{2}{3}$	$\frac{6}{483}$	$\frac{3}{2060}$	$\frac{6}{708}$
Combatants	$\frac{7}{6081}$	x	$\frac{3}{1010}$	$\frac{3}{61}$	$\frac{11}{209}$
Other Vessels	$\frac{207}{71808}$	$\frac{3}{1030}$	$\frac{103}{80801}$	$\frac{8}{55}$	$\frac{37}{1533}$
Rail Vehicles	$\frac{18}{120000}$	x	x	$\frac{3}{530}$	x
Highway	$\frac{44}{28937}$	$\frac{1}{7}$	$\frac{7}{5302}$	$\frac{6}{237}$	$\frac{18}{1800}$
Other Vehicle	$\frac{4}{85}$	x	$\frac{3}{15}$	x	$\frac{6}{244}$
Onshore Refinery	$\frac{1}{1503}$	$\frac{2}{1}$	$\frac{1}{3}$	$\frac{9}{830}$	$\frac{4}{1665}$
Onshore Bulk Storage	$\frac{32}{5147125}$	$\frac{6}{41115}$	$\frac{8}{26851}$	$\frac{47}{62415}$	$\frac{18}{12283}$
Onshore Production	$\frac{6}{6867}$	$\frac{43}{22255}$	$\frac{12}{2209}$	$\frac{36}{38466}$	$\frac{8}{2325}$
Offshore Production	$\frac{8}{482}$	$\frac{271}{187738}$	$\frac{155}{18456}$	$\frac{129}{2940}$	$\frac{30}{3033}$
Pipelines	$\frac{1}{10}$	$\frac{142}{451864}$	$\frac{4}{16716}$	$\frac{410}{3848385}$	$\frac{11}{25137}$
Other Facility	$\frac{48}{68244}$	$\frac{8}{1500973}$	$\frac{43}{4445562}$	$\frac{102}{85804}$	$\frac{31}{2875}$
Onshore/Offshore Fuel Transfer	$\frac{2}{265}$	$\frac{8}{577}$	$\frac{4}{15}$	$\frac{9}{125}$	$\frac{17}{623}$
Onshore/Offshore Bulk Transfer	$\frac{7}{150620}$	$\frac{12}{1119}$	$\frac{9}{2714}$	$\frac{35}{23602}$	$\frac{47}{13875}$
Onshore/Offshore Non-bulk Transfer	$\frac{2}{3155}$	$\frac{1}{1}$	$\frac{2}{6}$	$\frac{3}{102}$	$\frac{6}{184}$
Other Transportation Marine Facility	$\frac{3}{175}$	$\frac{3}{272}$	$\frac{8}{1014}$	$\frac{13}{276}$	$\frac{18}{679}$
Other Transportation Land Facility	$\frac{11}{44000}$	$\frac{1}{1460}$	$\frac{7}{84200}$	$\frac{12}{47400}$	$\frac{3}{1104}$
Misc and Unknown	$\frac{11}{3126}$	$\frac{2}{20}$	$\frac{0}{122}$	$\frac{12}{3319}$	$\frac{6}{674}$
Causes: Grand Total	$\frac{782}{8128139}$	$\frac{522}{2281746}$	$\frac{411}{1218030}$	$\frac{675}{4120986}$	$\frac{343}{80343}$

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS

SOURCE VS CAUSE - 1976
Oil and Hazardous Substances

	Valve Failure	Pump Failure	Other Equipment Failure	Tank Overflow	Improper Equipment Operation/ Handling
Tankship	$\frac{58}{5282}$	$\frac{4}{167}$	$\frac{44}{2995}$	$\frac{182}{42383}$	$\frac{50}{15113}$
Tankbarge	$\frac{61}{6958}$	$\frac{21}{3989}$	$\frac{118}{4640}$	$\frac{224}{25101}$	$\frac{72}{8159}$
Dryerbarge	x	x	$\frac{4}{66}$	$\frac{6}{367}$	$\frac{5}{129}$
Dryership	$\frac{6}{412}$	$\frac{2}{152}$	$\frac{29}{955}$	$\frac{86}{9019}$	$\frac{32}{2350}$
Combatants	$\frac{13}{714}$	$\frac{2}{13}$	$\frac{16}{649}$	$\frac{45}{7365}$	$\frac{16}{4254}$
Other Vessels	$\frac{19}{2767}$	$\frac{3}{124}$	$\frac{66}{2236}$	$\frac{182}{19527}$	$\frac{60}{936}$
Rail Vehicles	$\frac{4}{7005}$	x	$\frac{1}{2000}$	$\frac{1}{4000}$	$\frac{1}{500}$
Highway	$\frac{9}{10692}$	$\frac{1}{300}$	$\frac{10}{1567}$	$\frac{40}{7216}$	$\frac{15}{3903}$
Other Vehicle	$\frac{2}{65}$	x	$\frac{3}{66}$	$\frac{1}{1}$	$\frac{4}{130}$
Onshore Refinery	$\frac{7}{176}$	$\frac{5}{60}$	$\frac{23}{1335}$	$\frac{7}{110}$	$\frac{10}{3332}$
Onshore Bulk Storage	$\frac{24}{17293}$	$\frac{10}{64653}$	$\frac{38}{43728}$	$\frac{50}{11233}$	$\frac{29}{47799}$
Onshore Production	$\frac{27}{25514}$	$\frac{8}{3255}$	$\frac{36}{18503}$	$\frac{18}{5692}$	$\frac{7}{6469}$
Offshore Production	$\frac{112}{6755}$	$\frac{68}{856}$	$\frac{297}{52267}$	$\frac{53}{1707}$	$\frac{29}{1036}$
Pipelines	$\frac{5}{13336}$	$\frac{2}{35180}$	$\frac{18}{5683}$	$\frac{1}{4}$	$\frac{5}{9199}$
Other Facility	$\frac{36}{21413}$	$\frac{16}{504602}$	$\frac{218}{570673}$	$\frac{97}{69119}$	$\frac{66}{25419}$
Onshore/Offshore Fuel Transfer	$\frac{2}{219}$	x	$\frac{8}{16}$	$\frac{8}{452}$	$\frac{9}{491}$
Onshore/Offshore Bulk Transfer	$\frac{9}{3591}$	$\frac{4}{363}$	$\frac{55}{14634}$	$\frac{33}{18538}$	$\frac{40}{55386}$
Onshore/Offshore Non-bulk Transfer	x	$\frac{1}{80}$	$\frac{1}{42}$	$\frac{3}{12026}$	x
Other Transportation Marine Facility	$\frac{3}{86}$	$\frac{1}{10}$	$\frac{9}{1237}$	$\frac{15}{607}$	$\frac{19}{597}$
Other Transportation Land Facility	$\frac{3}{4800}$	$\frac{5}{300}$	$\frac{14}{5618}$	$\frac{24}{7728}$	$\frac{20}{150145}$
Misc and Unknown	$\frac{5}{610}$	$\frac{5}{569}$	$\frac{17}{2113}$	$\frac{16}{1677}$	$\frac{10}{1122}$
Causes: Grand Total	$\frac{400}{277387}$	$\frac{158}{648773}$	$\frac{1025}{605502}$	$\frac{1072}{273272}$	$\frac{499}{348449}$

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERS

SOURCE VS CAUSE - 1976
Oil and Hazardous Substances

	Other Personnel Error	Railroad Highway Aircraft Accident	Bilge Pumping	Ballast Pumping
Tankships	$\frac{42}{8730}$	$\frac{3}{202}$	$\frac{28}{4251}$	$\frac{14}{1276}$
Tankbergs	$\frac{62}{88636}$	x	$\frac{6}{427}$	$\frac{1}{x}$
Drycerbergs	$\frac{8}{196}$	x	$\frac{1}{100}$	x
Dryership	$\frac{38}{2447}$	x	$\frac{31}{2216}$	$\frac{10}{268}$
Combatants	$\frac{14}{3246}$	x	$\frac{7}{66}$	$\frac{2}{20}$
Other Vessels	$\frac{78}{2430}$	x	$\frac{157}{1886}$	$\frac{4}{20}$
Rail Vehicles	x	$\frac{48}{135606}$	x	x
Highway	$\frac{16}{4814}$	$\frac{149}{232906}$	x	x
Other Vehicle	$\frac{3}{50}$	$\frac{13}{16768}$	x	x
Onshore Refinery	$\frac{5}{200368}$	x	$\frac{1}{16}$	x
Onshore bulk Storage	$\frac{27}{30516}$	$\frac{4}{11120}$	x	x
Onshore Production	$\frac{8}{3440}$	$\frac{4}{8149}$	x	x
Offshore Production	$\frac{36}{478}$	x	x	$\frac{1}{6}$
Pipelines	$\frac{13}{30136}$	$\frac{3}{850}$	x	$\frac{1}{600}$
Other Facility	$\frac{89}{43556}$	$\frac{11}{18267}$	x	x
Onshore/Offshore Fuel Transfer	$\frac{6}{22}$	$\frac{1}{0}$	x	x
Onshore/Offshore Bulk Transfer	$\frac{23}{6532}$	$\frac{1}{4000}$	x	x
Onshore/Offshore Non-bulk Transfer	$\frac{2}{18}$	x	x	x
Other Transportation Marine Facility	$\frac{10}{56}$	$\frac{1}{420}$	$\frac{1}{0}$	$\frac{1}{6}$
Other Transportation Land Facility	$\frac{20}{8862}$	$\frac{14}{33167}$	$\frac{1}{18}$	x
Misc and Unknown	$\frac{41}{2731}$	$\frac{6}{12148}$	$\frac{10}{437}$	x
Causes Grand Total	$\frac{630}{434786}$	$\frac{257}{481647}$	$\frac{242}{9407}$	$\frac{24}{2086}$

Table 21 (Continued)

PROFILE OF POLLUTING INCIDENTS IN U.S. WATERSSOURCE VS CAUSE - 1976
Oil and Hazardous Substances

	Other Intentional Discharge	Natural or Chronic Phenomenon	Unknown	Sources: Grand Total
Tankships	$\frac{19}{1809}$	$\frac{7}{611}$	$\frac{75}{13645}$	$\frac{623}{8930029}$
Tankberges	$\frac{9}{575519}$	$\frac{2}{2}$	$\frac{40}{2373}$	$\frac{976}{1953442}$
Drycarberges	x	$\frac{1}{2}$	$\frac{2}{20}$	$\frac{41}{11679}$
Drycarship	$\frac{6}{64}$	$\frac{3}{6}$	$\frac{53}{2635}$	$\frac{324}{24840}$
Combatants	$\frac{2}{65}$	x	$\frac{38}{3345}$	$\frac{179}{26987}$
Other Vessels	$\frac{32}{17240}$	$\frac{12}{130}$	$\frac{182}{42480}$	$\frac{1153}{245013}$
Rail Vehicles	$\frac{1}{84}$	$\frac{1}{5000}$	$\frac{6}{716}$	$\frac{82}{268440}$
Highway	$\frac{6}{1517}$	$\frac{1}{6000}$	$\frac{12}{7323}$	$\frac{335}{323391}$
Other Vehicle	$\frac{3}{3451}$	x	$\frac{6}{76}$	$\frac{47}{20968}$
Onshore Refinery	$\frac{5}{11}$	$\frac{7}{1244}$	$\frac{14}{1265}$	$\frac{101}{211614}$
Onshore Bulk Storage	$\frac{19}{104014}$	$\frac{22}{10948}$	$\frac{29}{14529}$	$\frac{255}{5873932}$
Onshore Production	$\frac{4}{30524}$	$\frac{8}{220}$	$\frac{21}{4585}$	$\frac{242}{349053}$
Offshore Production	$\frac{5}{58}$	$\frac{9}{13}$	$\frac{155}{18342}$	$\frac{1358}{274732}$
Pipelines	$\frac{10}{17456}$	$\frac{3}{18257}$	$\frac{24}{55402}$	$\frac{653}{4530094}$
Other Facility	$\frac{60}{17293}$	$\frac{47}{3804}$	$\frac{182}{2302706}$	$\frac{1055}{9759869}$
Onshore/Offshore Fuel Transfer	$\frac{1}{1}$	x	$\frac{12}{17293}$	$\frac{98}{21708}$
Onshore/Offshore Bulk Transfer	$\frac{7}{261}$	$\frac{26}{41027}$	$\frac{13}{650}$	$\frac{321}{333712}$
Onshore/Offshore Non-bulk Transfer	x	$\frac{1}{1}$	$\frac{1}{50}$	$\frac{23}{15643}$
Other Transportation Marine Facility	$\frac{4}{16}$	$\frac{6}{62}$	$\frac{13}{335}$	$\frac{128}{5787}$
Other Transportation Land Facility	$\frac{11}{6144}$	$\frac{13}{616}$	$\frac{23}{38027}$	$\frac{182}{442730}$
Misc and Unknown	$\frac{24}{8751}$	$\frac{140}{39356}$	$\frac{4057}{156195}$	$\frac{4379}{227167}$
Causes: Grand Total	$\frac{228}{784378}$	$\frac{318}{118798}$	$\frac{4699}{2764352}$	$\frac{12655}{33851830}$

Source: U.S. Coast Guard, U.S. Department of Transportation, Polluting Incidents In And Around U.S. Waters, 1976 (Draft).

SECTION VIII FLEET FORECAST

A. Introduction

The preceding sections of this manual present procedures and factors with which the regulatory staff can measure industry and government benefits of CVS regulations. This section contains forecasts of U.S. and world commercial fleets necessary to complete many of the formats for benefit measurement. In addition, recommendations are presented for those occasions when these forecasts are not adequate as presented.

B. Forecast Background

The U.S. and world fleet forecasts presented herein summarize the findings published in Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade, a report prepared by Temple, Barker and Sloan, Inc. (TBS), under contract to the Office of Commercial Development, Maritime Administration, U. S. Department of Commerce. The TBS study, which was released in May, 1978, is one of several analyses of merchant fleets frequently prepared under the aegis of the Maritime Administration.

Several such forecasts were examined. The TBS study was chosen as the source of the enclosed forecasts because it was the most current and detailed analysis available. The TBS forecasts were prepared using Maritime Administration cargo forecasts by trade routes; commercial, operating, and national maritime policy as well as general commercial factors. The resultant fleet forecast prepared by TBS contained the number, size, and design characteristics of nine types of commercial vessels. In addition, U. S. and worldwide projections of new construction by vessel type were prepared for the forecast period. Such projections can be of particular use to the regulatory staff when analyzing regulations which specifically address newly constructed vessels. The forecasts provided in this section also summarize those TBS findings. If detail greater than that provided herein is needed, the regulatory staff can turn to the original report.

It has been noted that the TBS study is just one of many analyses of U.S. and worldwide merchant vessel fleets sponsored by the Maritime Administration. As time passes or needs and requirements change, it will become necessary for the regulatory staff to seek other, perhaps more timely fleet forecasts. It is likely the Maritime Administration will

continue to be the best source of such information and it is, therefore, recommended that future searches for fleet forecasts begin within that organization. Among the Maritime Administration offices frequently sponsoring such fleet analyses are: the Office of Trade Studies and Statistics; the Office of Maritime Manpower; and, the Office of Commercial Development.

C. Using Forecasts

As indicated in Section V, Formats for Benefit Measurement, one of the first things the regulatory staff must do in measuring benefits is to separate the impacted vessel population into classes by size and by type. This is, of course, because the benefits of a regulation often will vary with different sizes and different types of vessels. Having done so, the regulatory staff then provides the identifying information required at the top of Formats 1 - 3 as appropriate. The regulatory staff identifies the vessel type (e.g., general cargo ships), describes the vessel size (e.g., 5 - 10 DWT), and indicates the vessel class according to the system decided upon. Only those formats pertinent to the analysis need be completed.

The regulatory staff may encounter certain difficulties in utilizing these fleet forecasts. The first area of difficulty could be the TBS classification system which assigns 51 vessel types to 9 groups. Table 22 presents the composition of the 9 vessel groupings. A regulation which addresses a vessel type within a vessel group (e.g., tanker) could pose problems to the regulatory staff. In such cases, one of two courses is recommended. First, the regulatory staff could examine alternate sources of information. For example, the Coast Guard regularly publishes lists of inspected tankships including information about cargo carried, size, age, etc. This data is current and rather detailed, and provides the means by which the regulatory staff can determine the ratio of a particular ship type to the larger vessel grouping. The second option would be to use expert estimates of the ratio of ship type to vessel group. Such ratios can then be used to multiply the total values for a vessel group to come up with an estimated count of a particular type within the group.

Another source of difficulty could be the forecast's use of 5-year increments extending only to year 2000. In the event the regulatory staff needs annual forecasts or forecasts beyond the study's horizon, a simple linear extrapolation should be adequate. If, for example, the regulatory staff needed annual forecasts for 1980 - 1990, a simple method would be to: (1) calculate TBS forecast changes in fleet size from 1980 - 1985; (2) divide TBS forecast

Table 22
**ASSIGNMENT OF SHIP TYPES
 TO VESSEL GROUPS**

<u>Conventional General Cargo</u> Freighter Freighter/Nuclear Freighter/Refrig. Combo. Pass. & Cargo Combo/Refrig. Combo/Nuclear	<u>Dry Bulk</u> Bauxite Carrier Bulk Carrier Cement Carrier Colliers Limestone Carrier Nickel Carrier Ore Carrier Pellett Carrier Phosphate Carrier Salt Carrier Sand Carrier Urea Carrier Woodchip Carrier
<u>Partial Container</u> Pallet Carrier Partial Container	<u>Combination Carriers</u> Bulk/Oil Ore/Bulk/Oil Ore/Oil Carrier
<u>Full Containership</u> Containership Container/Car Carrier Container/Rail Carrier Container/Ro-Ro Roll-on/Roll-off	<u>Liquefied Gas</u> LPG Tanker LNG Tanker
<u>Barge Carrier</u> Barge Carrier Container/Barge Carrier	<u>Liquid Bulk Carrier</u> Asphalt Tanker Asphalt/Bitumen Bitumen Chemical Tanker Molasses Tanker Nuclear Tanker Phosphorus Tanker Solvents Tanker Sulphur Tanker Tanker Whaling Tanker Wine Tanker
<u>Neobulk</u> Bulk/Car Carrier Bulk/Containership Bulk/Timber Carrier Car Carrier Timber Carrier Cattle Carrier	

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade,
 Temple, Barker & Sloane, Inc., Table V - 10

changes in fleet size over that period by 5 to estimate annual rate, adjust 1980 values to estimate 1981, then use 1981 values to estimate 1982 and continue through to 1985; (4) repeat the procedure for the period 1985 - 1990. In the event the regulatory staff needs a forecast beyond 2000, analysis of the trend forecast between 1980 - 2000 should be done to estimate a rate of change in the fleet size. The calculated rate of change can then be used to project forward as far as needed. It should be noted again that the regulatory staff might also consider seeking additional forecasts from other sources.

Another shortcoming of the TBS fleet forecast is its focus upon the world fleet rather than U. S. Flag fleet. This focus is, however, somewhat predictable because it is far easier to estimate worldwide vessel numbers than it is to distribute that world fleet among particular flags. The former requires estimates of worldwide cargo movements while the latter requires numerous presumptions about matters political in nature. The regulatory staff should understand this situation exists even though little can be done about it. The regulatory staff must assume that the factors that determine which flag of registry a vessel uses will balance themselves and that present circumstances will continue into the future.

The regulatory staff should recognize that both the fleet forecasts and the projections of new construction exclude vessels under 1,000 DWT. As a result, certain vessels such as inland waterway barges are ignored by the forecasts. If the regulatory staff has a need for data on such vessels, other sources will have to be explored. One recommended avenue would be Coast Guard records of inspected or certificated vessels.

Tables 23 to 34 are representative of fleet forecast information the regulatory staff can use in their manipulations for benefit procedures.

Table 23
MERCHANT FLEET FORECAST: GENERAL CARGO SHIPS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-5	428	3	365	3	249	3	179	3	114	3
5-10	472	2	411	2	340	0	257	0	198	0
10-15	700	69	587	65	479	28	388	11	294	10
15-20	245	0	258	0	249	0	189	0	153	0
20-25	20	6	23	6	27	6	28	4	28	5
25-30	0	0	1	0	2	0	5	0	6	0
30+	0	0	0	0	0	0	0	0	0	0
TOTAL	1865	80	1645	76	1346	37	1046	18	793	18

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-1, -10, -19, -28, -37.

Table 24
MERCHANT FLEET FORECAST: PARTIAL CONTAINERSHIPS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	80	0	88	0	91	0	61	0	50	0
10-15	118	19	185	26	288	38	416	54	575	69
15-20	27	1	56	1	99	2	155	2	233	2
20-25	23	0	41	0	68	0	105	0	149	0
25-30	0	0	3	0	7	0	15	0	27	0
30+	0	0	0	0	3	0	4	0	8	0
TOTAL	248	20	373	27	556	40	756	56	1042	71

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-2, -11, -20, -29, -38.

Table 25
 MERCHANT FLEET FORECAST: FULL CONTAINERSHIPS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	63	5	64	3	69	3	53	4	37	4
10-15	45	3	55	4	69	6	85	9	105	11
15-20	65	27	79	29	97	39	112	45	140	58
20-25	39	19	47	22	60	28	79	37	103	48
25-30	31	15	39	18	47	21	62	28	69	31
30-40	16	0	18	0	23	0	34	1	44	2
40+	0	0	1	0	2	0	3	0	11	0
TOTAL	259	69	303	76	367	97	428	124	509	154

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-3, -12, -21, -30, -39.

Table 26
MERCHANT FLEET FORECAST: BARGE CARRIERS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-20	0	0	0	0	0	0	0	0	0	0
20-30	7	7	7	6	7	6	6	5	0	0
30-40	3	3	3	3	3	3	4	4	7	7
40-50	13	9	19	13	23	15	27	17	33	20
50+	0	0	0	0	0	0	0	0	0	0
TOTAL	23	19	29	22	33	24	37	26	40	27

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-4, -13, -22, -31, -40.

Table 27
 MERCHANT FLEET FORECAST: NEOBULK CARRIERS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-15	24	0	26	1	30	1	26	1	25	1
15-20	25	0	33	0	40	1	43	1	51	2
20-25	13	0	20	0	27	0	35	1	45	1
25-35	33	0	36	0	43	0	50	2	44	2
35-60	7	0	8	0	11	0	17	0	26	0
60+	0	0	0	0	2	0	5	0	11	0
TOTAL	102	0	123	1	153	2	176	5	202	6

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-5, -14, -23, -32, -41.

Table 28
MERCHANT FLEET FORECAST: DRY BULK CARRIERS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	32	0	36	0	37	1	40	1	34	1
10-20	177	0	156	2	143	4	118	4	109	5
20-30	328	1	342	6	334	9	328	12	283	14
30-50	239	5	264	9	275	11	302	17	324	20
50-70	109	0	128	2	149	3	164	5	195	9
70-125	19	0	28	0	43	0	67	2	98	5
125-175	1	0	3	0	6	0	14	0	27	1
175+	0	0	0	0	0	0	3	0	10	0
TOTAL	905	6	957	19	987	28	1036	41	1080	55

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-6, -15, -24, -33, -42.

Table 29
MERCHANT FLEET FORECAST: COMBINATION CARRIERS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	0	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	0	0	0	0	0	0
20-30	3	0	1	0	1	0	1	0	1	0
30-50	13	0	15	0	13	0	12	0	10	0
50-70	27	0	24	0	18	0	15	0	17	0
70-125	49	2	57	2	63	3	56	3	56	3
125-175	4	0	8	0	13	0	21	0	26	0
175-225	0	0	1	0	2	0	7	0	11	0
225+	0	0	0	0	0	0	2	0	3	0
TOTAL	96	2	106	2	110	3	114	3	124	3

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-7, -16, -25, -34, -43.

Table 30
 MERCHANT FLEET FORECAST: LIQUEFIED GAS CARRIERS
 (deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	0	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	0	0	0	0	0	0
20-30	0	0	0	0	0	0	0	0	0	0
30-50	1	0	1	0	1	0	0	0	0	0
50-70	10	6	41	23	57	31	58	32	58	32
70+	0	0	0	0	0	0	14	7	24	12
TOTAL	11	6	42	23	58	31	72	39	82	44

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-8, -17, -26, -35, -44.

Table 31

MERCHANT FLEET FORECAST: LIQUID BULK CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	62	0	62	0	55	0	40	0	17	0
10-20	27	0	29	0	24	0	24	0	22	0
20-30	151	2	156	3	147	4	120	4	99	4
30-50	200	25	183	24	191	26	178	26	133	25
50-70	152	6	95	4	92	3	99	4	65	4
70-125	175	8	166	9	129	7	119	8	64	6
125-175	14	0	28	1	38	1	43	1	52	2
175-225	6	0	13	0	19	0	21	0	26	0
225-300	11	4	23	2	33	2	38	3	42	3
300+	7	3	15	6	21	7	26	9	28	9
TOTAL	805	48	770	49	749	50	708	55	548	53

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-9, -18, -27, -36, -45.

Table 32
 MERCHANT FLEET FORECAST SUMMARY
 World Fleet New Constructions¹
 (deadweight in thousands)
 1976-2000

	1976-1980		1981-1985		1986-1990		1991-1995		1996-2000	
	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight
General Cargo Ships	230	2,471	139	1,615	111	1,322	243	3,094	72	804
Partial Containerships	116	1,626	141	2,146	199	3,080	249	3,969	338	5,544
Full Containerships	96	1,664	60	1,090	68	1,293	110	2,271	189	4,021
Barge Carriers	0	0	6	264	4	176	5	214	25	1,066
Neobulk Carriers	21	464	27	612	32	769	50	1,263	75	2,319
Dry Bulk Carriers	102	3,209	134	5,095	172	7,027	313	13,682	359	17,539
Combination Carriers	19	1,535	19	1,794	20	2,075	36	3,956	31	3,729
LNG Carriers	10	576	31	1,706	16	922	15	1,717	10	1,185
Liquid Bulk Carriers	430	26,532	114	13,843	76	8,741	93	7,745	266	20,557
Total	1,022	38,077	670	28,246	690	25,404	1,114	37,911	1,365	56,845

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade,

Temple, Barker & Sloane, Inc., Table II - 6

Table 33

MERCHANT FLEET FORECAST SUMMARY
 U.S.-Flag Fleet New Constructions,¹
 (deadweight in thousands)
 1975-2000

	1976-1980		1981-1985		1986-1990		1991-1995		1996-2000	
	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight
General Cargo Ships	3	12	0	0	0	104	7	124	1	27
Partial Containerships	0	0	19	260	21	292	15	211	16	228
Full Containerships	25	434	22	384	25	450	43	892	60	1,277
Barge Carriers	0	0	4	176	2	88	3	126	18	758
Wobulk Carriers	0	0	1	20	2	45	2	60	3	92
Dry Bulk Carriers	5	178	11	364	12	438	13	552	15	797
Combination Carriers	0	0	1	51	1	58	0	36	2	204
LNG Carriers	6	346	17	979	8	461	8	807	5	593
Liquid Bulk Carriers	15	2,715	21	1,776	13	1,250	9	1,073	13	2,506
Total	54	3,685	96	4,029	91	3,194	100	3,962	133	6,482

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade,
 Temple, Barker & Sloane, Inc., Table II - 10

Table 34

MERCHANT FLEET FORECAST
PERCENT DISTRIBUTION OF NEW CONSTRUCTIONS

	1976-1980		1981-1985		1986-1990		1991-1995		1996-2000		1976-2000	
	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag
General Cargo Ships	6.5	.3	6	0	5	3	8	3	2	0	5	1
Partial Containerships	4.3	0	0	7	12	9	10	5	10	4	9	5
Full Containerships	4.4	11.0	4	10	5	14	6	23	7	20	6	16
Barge Carriers	0	0	1	4	1	3	1	3	2	12	1	5
Neobulk Carriers	1.2	0	2	1	3	1	3	2	4	1	3	1
Dry Bulk Carriers	0.4	4.0	18	9	28	14	36	14	31	12	25	11
Combination Carriers	4.0	0	6	1	8	2	10	1	7	3	7	2
LNG Carriers	1.5	9.4	6	24	4	14	4	22	2	9	3	15
Liquid Bulk Carriers	69.2	73.2	49	44	34	40	20	27	35	39	41	44
Total Percent	100.0	100.0	100	100	100	100	100	100	100	100	100	100
Total Deadweight	38,077	3,605	28,246	4,629	25,404	3,194	37,911	3,962	56,845	6,482	186,483	21,351

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade,
Temple, Barker & Sloane, Inc., Table II - 19

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