REPORT OF THE
AWO/USCG QUALITY ACTION TEAM

ON Tank Barge Major and Medium Spills

Presented to

The AWO/Coast Guard National Quality Steering Committee

December 2000

Report of the AWO/USCG Quality Action Team on Tank Barge Major and Medium Spills

Finding the Cause of Safety

Executive Summary

The American Waterways Operators (AWO)/United States Coast Guard (USCG) Quality Action Team (QAT) on Tank Barge Major and Medium Spills was formed under charter by the AWO/USCG National Quality Steering Committee (NQSC) as a follow-up to the AWO/USCG QAT on Tank Barge Transfer Spills. Although the majority of tank barge spills **by number** were found to result from cargo transfers, the majority of the oil spilled into the water **by volume** was caused by other factors. In addition, the Coast Guard database indicated that over 50% of all major and medium marine spills by volume can be attributed to tank barges.

The purpose of the QAT was to:

> "Conduct a comprehensive and detailed examination of major and medium spills of oil and hazardous substances from tank barges . . . . The QSC believes that an assessment of the root causes of these spills will yield information on whether or not the prevention strategies of the Coast Guard and the tank barge industry are appropriately targeted to achieve a reduction in their frequency and seriousness."

The QAT consisted of five representatives of the industry and four representatives of the Coast Guard.

Approach: The QAT reviewed several problem-solving approaches and elected to use the FADE process for this QAT. FADE stands for Focus, Analyze, Develop, and Execute. The FADE process requires participants to complete each stage of the process in sequence before moving on to the next step.

The QAT used the Focus stage of the FADE process to produce a problem statement that identified the following issues: the current state of the problem, the negative impacts of that state, the QAT's desired state, and the impacts of achieving that desired state. The team produced the following problem statement:

> This QAT is studying marine transportation of petroleum and chemical products in tank barges that results in the potential for events (excluding transfers) that might evolve into the entry of these products into the navigable waters of the United States. We have identified that there is a degree of pollution from barges operating in United States waters that is undesirable, since pollution is entering the environment. We will recommend practices and procedures that eliminate medium and major pollution events from petroleum and chemical tank barges, in order to reduce the negative impact of petroleum and chemical pollution from tank barges on people, property, the economy and the environment.

In the Analyze stage of the FADE process, the QAT looked at the 67 cases that were found in the Coast Guard database using a Root Cause Analysis (RCA) flowchart. The QAT performed a literature survey and determined that no other similar studies had been

done in the past. The QAT developed basic categories that the casualties appeared to fall under.

Findings: After analyzing the cases available for review, the team developed a number of findings. They are as follows:

- There was a significant drop in the number of major and medium spills after 1990.
- The average number of major and medium spills per year in the United States is relatively low.
- A majority of the companies involved in the type of spills investigated are AWO members.
- Of the root causes identified, the AWO Responsible Carrier Program addresses a significant number.
- A significant number of incidents involved special risks that could be anticipated in proper voyage planning.
- A significant number of large spills may have been prevented or mitigated by double hulls.
- A significant number of USCG investigations did not develop sufficient causal information to identify root causes.
- The incidents were mainly concentrated in the Northeast or states along the Gulf of Mexico.
- The vast majority of pollution volume from tank barges is a result of either a major or a medium spill, and a single event typically accounts for the vast majority of the annual volume spilled.
- It appears that a chain of causes, often rooted in management issues, combined to result in numerous major and medium pollution cases.
- A failure to communicate information in a timely manner to the Coast Guard Captain or the Port (COTP) or Officer in Charge-Marine Inspection (OCMI) may contribute to the severity of an incident.
- Several cases involved poor navigational practices, such as relying on "seaman's eye."
- Mooring-related damages account for a percentage of larger, non-transfer spills.

Recommendations: Based on these findings, the team developed the following recommendations:

- The Coast Guard should continue the program of encouraging all tug and barge companies to adopt a safety management system such as the AWO Responsible Carrier Program. The Coast Guard should develop further incentives or continue to offer current incentives, such as reduced USCG compliance boardings, to tug and barge companies that adopt safety management systems and that pass third-party audits.
- AWO should modify the RCP and RCP audit checklist to include an explicit requirement for voyage planning and establish guidelines as to what proper voyage planning should include.

- Companies operating towing vessels and tank barges should review the list of Possible Preventative Actions to reduce oil spills contained in Appendix D in conjunction with the company's existing policies and procedures, casualty history, etc. Companies should consider incorporating into their Responsible Carrier Program or other safety management system those preventative measures appropriate to the company's mission, experience, and area of operations.
- The Coast Guard and AWO should jointly develop minimum information requirements for investigating the "root cause" of significant tank barge casualties.
- The Coast Guard should develop an improved standard investigation process designed to uncover the "root cause" of significant casualties. The PTP Root Cause Analysis method could serve as a model.
- The Coast Guard should develop a new casualty investigation module for the Marine Safety Information System that adopts the recommendations of the 1994 Rothblum Report and is aligned with a root cause analysis process.
- The Coast Guard should investigate and report on industry concerns about criminal liabilities that pose barriers to the " root cause" investigation process.
- Coast Guard COTPs should investigate the potential pollution hazards posed by regulated oil transfer facilities and other waterway structures.
- The Coast Guard and AWO should investigate the implementation of a system to readily disseminate "best practices" and "lessons learned" from tank barge casualties and near-miss events.
- The Coast Guard and AWO should consider developing a system of tracking vessel movements by loaded barges, by size of barge, and by nature of voyage. A method of comparing tank barge to tank ship incidents should be developed that fairly reflects the two industries.

Part I: INTRODUCTION

1. CHARTER

The Quality Action Team on Tank Barge Major and Medium Spills[1] was chartered to "investigate the root causes of all tank barge major and medium spills occurring since 1990, as identified within the Coast Guard database, and to develop a list of proposed recommendations to reduce the incidence of such spills for consideration by the National Quality Steering Committee." A copy of the charter is found in Appendix A.

The charter suggested exploring the following areas:

- The circumstances and proximate causes of the casualties/spills, including:
  - the operating environment and role of the human element;
  - the training and experience of vessel personnel;
  - management controls and business practices;
  - vessel and equipment standards/conditions;
  - the impact of the waterways management system;
  - risk management measures used by industry;
  - the impact of existing or pending Coast Guard regulations;
- Impacts and costs of the recommended actions;
- Lessons learned from "near misses"; and,
- Other areas the QAT finds important to achieve the goals stated above.

There were nine members participating in the QAT, five from industry and four from the Coast Guard. The list of members is included in Appendix A.

2. FOCUS ON MAJOR & MEDIUM OIL SPILLS

The Coast Guard first set a goal to reduce major and medium oil spills in its 1994 Performance Plan under the Government Performance and Results Act (GPRA). The goal called for a 50% reduction in the number of oil spills of 10,000 gallons or more impacting U.S. waters, from regulated vessels and marine transportation facilities ("maritime sources").

[1] The National Contingency Plan defines "major" oil spills in "coastal waters" as discharges into the waterway which are greater than or equal to 100,000 gallons. "Medium" oil spills in coastal waters range from 10,000 to 99,999 gallons. Releases of hazardous substances other than oil are characterized as major or medium based on the judgment of the predesignated Federal On-Scene Coordinator.

The idea to focus on major and medium pollution incidents from tank barges emerged from data analysis performed by the Coast Guard in 1996 and 1997.

a. Large Drop in Oil Pollution After 1990

Oil pollution from all maritime sources dropped sharply after the passage of the Oil Pollution Act of 1990.

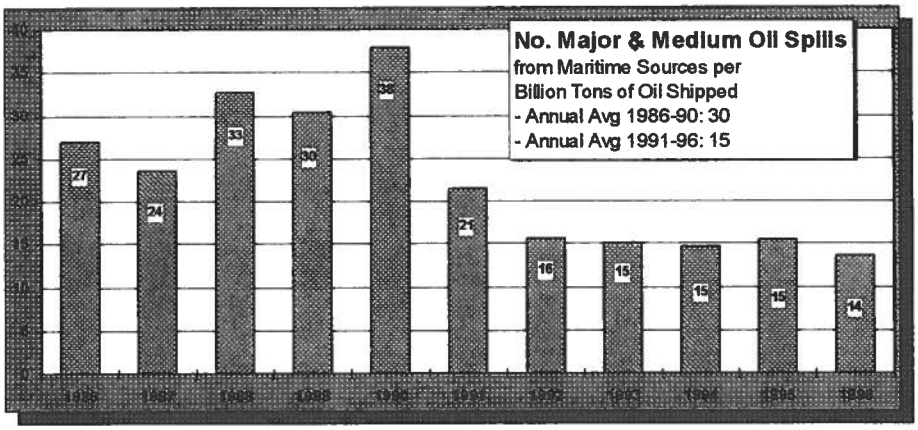


Figure 1. No. of Major & Medium Oil Spills

Figure 1 depicts the rate of major and medium oil spills entering U.S. waters from maritime sources from 1986-96.

The rate is the number of oil spills greater than or equal to 10,000 gallons from regulated vessels and marine transportation facilities, per billion tons of oil shipped. The chart reveals a 50% drop in the number of large oil spills after 1990:

- Avg. Annual Rate 1986-90: 30 spills per billion tons shipped
- Avg. Annual Rate 1991-96: 15 spills per billion tons shipped

The sharp drop in these large spills corresponds to a 75% drop in the volume of oil pollution in U.S. waters after 1990.

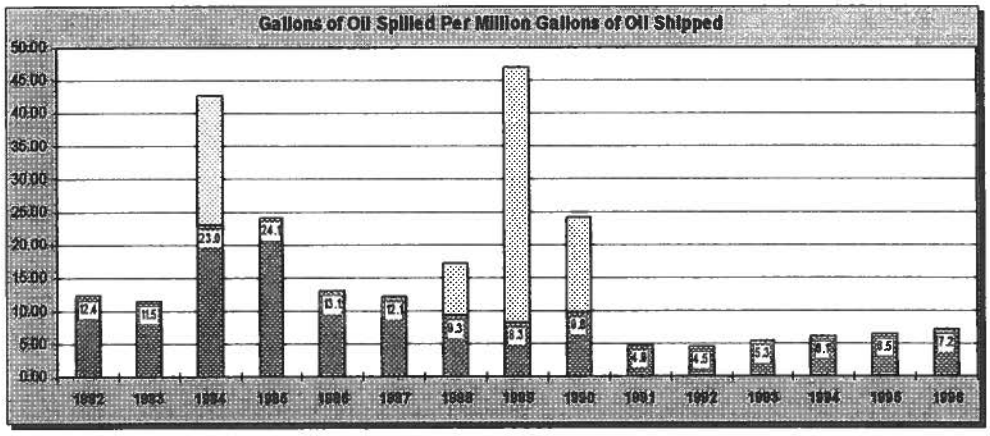


Figure 2. Volume of Oil Pollution

Figure 2 depicts the volume of oil spilled from maritime sources, normalized per million gallons of oil shipped, from 1982-96.

The four "stacked bars" (1984, and 1988-90) indicate years involving very large oil spill events exceeding 1 million gallons spilled (such as Exxon Valdez in 1989). For comparison to Figure 1, the sharp drop in the volume of pollution is summarized as follows:

- Avg. Annual Rate 1986-90: 22.7 gallons spilled per million gallons shipped
- Avg. Annual Rate 1991-96: 5.8 gallons spills per million gallons shipped

b. Sharp Drop in Pollution from Tank Ships & Tank Barges

The sharp decline in oil pollution after 1990 was driven primarily by the decline in pollution from two major sources: tank ships and tank barges. After 1990 there was a 95% drop in the volume of oil pollution from tank ships. Oil pollution from tank barges also dropped sharply after 1990.

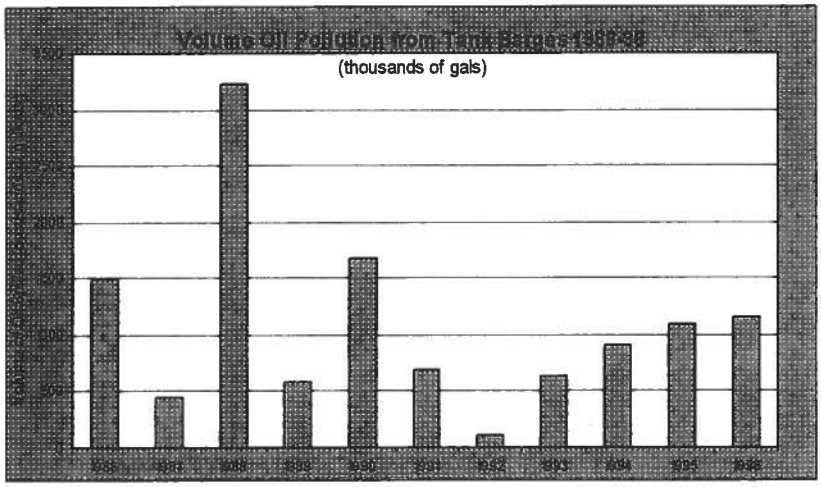


Figure 3.
Tank Barge Pollution.

Figure 3 depicts total tank barge oil pollution from 1986-96, showing a 50% drop in the average annual volume of oil pollution after 1990.

c. Tank Barges Remain Leading Source after 1990

While oil pollution from tank barges has dropped since 1990, tank barges continue to be a leading source of pollution from maritime sources. The signing of the partnership agreement[2] between the U.S. Coast Guard and the American Waterways Operators offered a means to pursue a joint investigation of the problem.

[2] The AWO/USCG Partnership Agreement pledged a joint effort to prevent loss of life and property and damage to the environment resulting from marine casualties involving barges and towing vessels.

Part II: Findings

1. Drop in Big Spills from Tank Barges after 1990

Tank barge pollution from major and medium oil spills[3] was cut in half after the passage of the Oil Pollution Act of 1990.

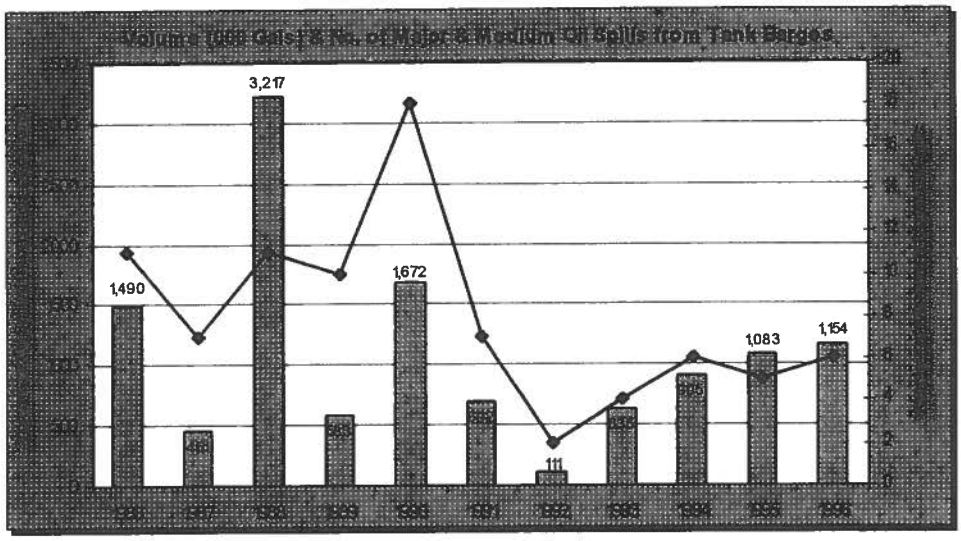


Figure 1. Vol. & No. of Major & Medium Oil Spills from Tank Barges

Figure 1 depicts these events involving tank barges, portraying the number of events (line chart corresponding to the right axis) and the resulting volume of pollution (bar chart relating to the left vertical axis).

The decline in major and medium oil spills from tank barges can be summarized using data from 1986-96.

- 1986-90 Annual Average: 11 events and 1.5 million gallons of pollution
- 1991-96 Annual Average: 5 events and 760,000 gallons of pollution

The large drop in tank barge pollution after 1990 is similar to the pattern for tank ships, as well as the drop in oil pollution from all maritime sources after 1990. After 1990, the average annual number of "major and medium oil spills" from tank barges has been very low, and has remained in the single digits.

The list of "major and medium oil spills" from tank barges (1986-96) represented in Figure 1 is found in Appendix B.

Because of the declining number of major and medium oil spills since 1990, the QAT elected to expand the scope of its root

[3] Oil spills from tank barges greater than or equal to 10,000 gallons impacting U.S. waters.

cause analysis to include oil and chemical spills > 1,000 gallons. This allowed the QAT to capture the greatest number of sizable spills. Spill cases were selected from the period January 1992 to October 1997. Transfer-related spills were excluded from the analysis, as these were studied in depth by the 1997 QAT on Tank Barge Transfer Spills.[4] The QAT reviewed 67 oil and chemical spill cases, extracted from the Coast Guard's Marine Safety Information System. The list of cases and information from the review of those cases is contained in Appendix C.

2. BIG SPILLS DOMINATE TANK BARGE POLLUTION

Single oil spill events dominate the volume of pollution from tank barges in the period after 1990.

The bar chart in Figure 2 depicts the total volume of oil pollution from tank barges from 1992-96, and the relative impact of large oil spills. The tallest bar in the foreground indicates the overall pollution, the bar immediately behind the total is the portion from major and medium spills (greater than or equal to 10,000 gallons), and the dark bar in the background for each year shows the impact of the single largest oil spill.

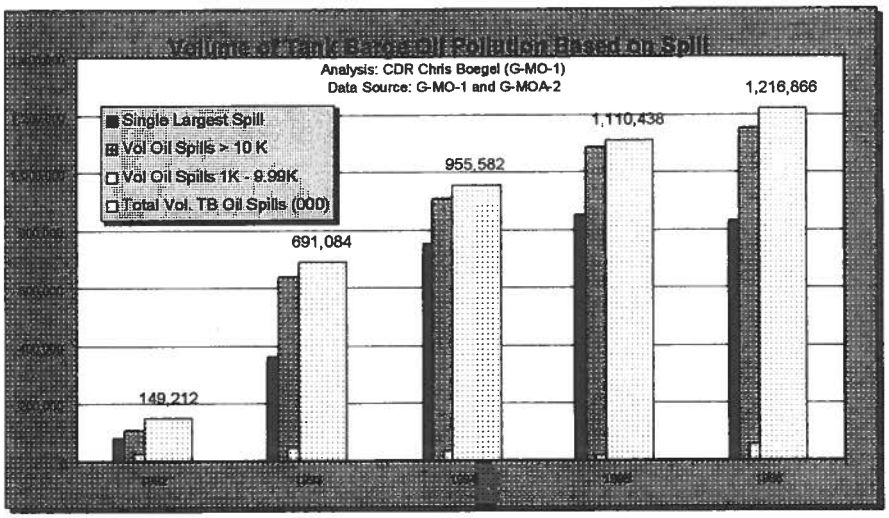


Figure 2.
Volume of Tank Barge Oil Pollution Based on Spills

Figure 2 shows three important aspects of tank barge pollution during the period:

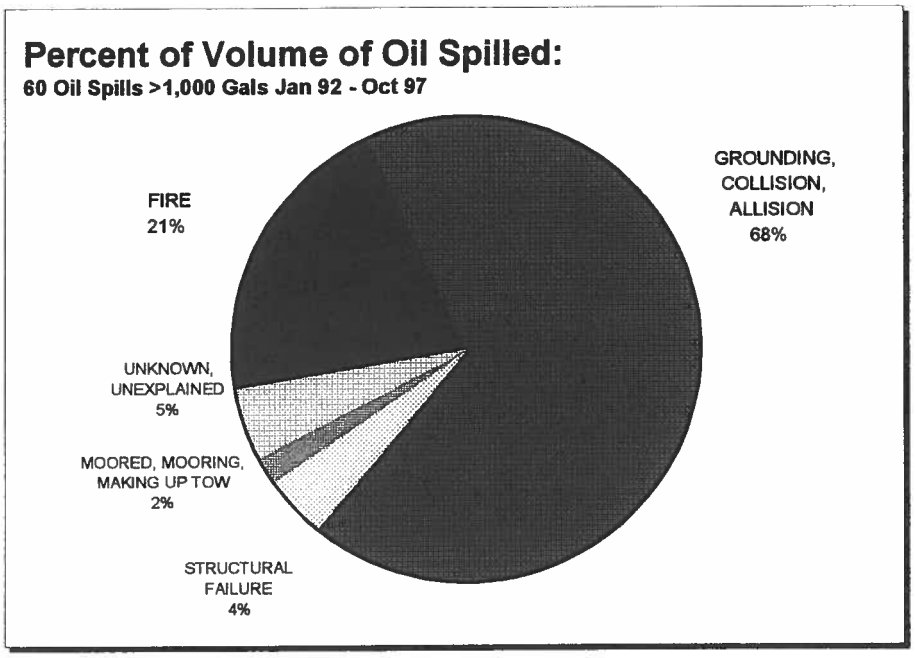
(1) Each year is dominated by a single large spill event;

(2) 70% of the total pollution comes from the five single largest spills; and,

(3) Nearly 95% of the total pollution comes from 23 major and medium oil spills (about 1% of the total number of 1696 oil spills).

[4] "Managing Toward Zero Spills," AWO/USCG Quality Action Team, Oct 97.

3. NAVIGATION-RELATED EVENTS DOMINATE SPILLS



Groundings, collisions, and allisions, representing 35 cases (nearly 70% of the oil spill cases) accounted for almost 90% of the volume of oil spilled in tank barge oil spills > 1,000 gallons.

4. 90% OF LARGE SPILLS OCCURRED IN PROTECTED WATERS

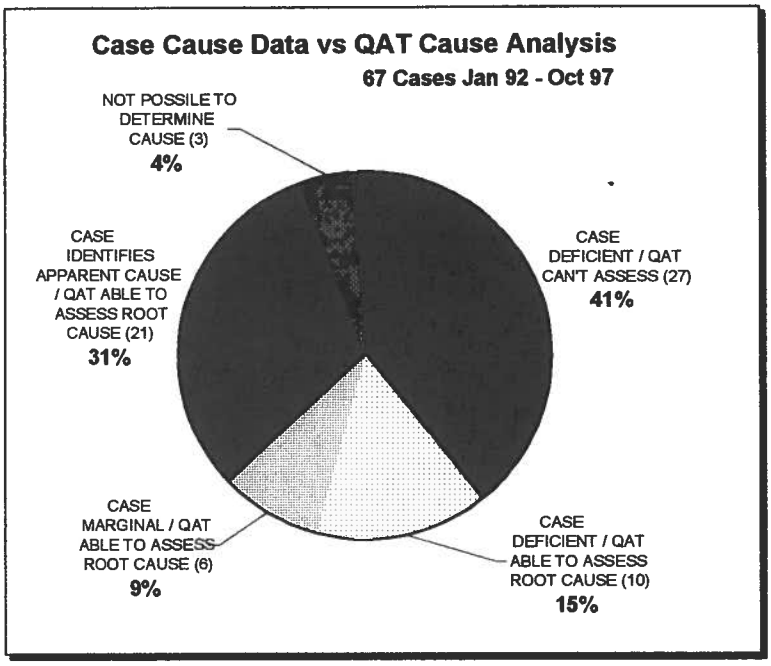
Seven out of 67 of the spill cases occurred in coastal waters or sounds, accounting for approximately 20% of the oil spilled. 90% of the cases studied occurred in rivers, harbors, and other protected waters, contributing nearly 80% of the total oil pollution.

5. DOUBLE HULLS & POLLUTION PREVENTION

The QAT judged that in 21 cases, double hulls clearly would have prevented or reduced pollution. Twelve of those 21 cases involved sideshell penetrations that occurred or are suspected of having occurred from low energy impacts during mooring operations or making up tows.

Eighteen other cases, involving high-energy hull damage, clearly were not or probably would not have been prevented by double hulls. The effectiveness of double hulls was judged probable in most of the remaining 28 cases. While Coast Guard case files on many of these cases lacked the details needed to make a definite determination, the spill volumes in most cases indicated smaller hull penetrations.

6. OVERCOMING DATABASE PROBLEMS



The QAT's initial review of the 67 marine casualty cases found that none of the case files captured root causes, and over half of the case files were seriously deficient in the causal information recorded. These cases included 18 oil spills from groundings, collisions, and allisions. Evidence of poor database design, rooted in a lack of purpose, was the major finding of a 1994 report on the Coast Guard's Marine Casualty Investigation and Reporting System (the Rothblum report).[5]

Besides the problems of poor design, there are other problems with quality of data, including contradictory causal information, multiple cases for the same event, often without cross-references, and failure to complete relevant data supplements. These and other problems were documented extensively in the Rothblum report, and are symptomatic of a lack of database training, and a lack of a database management system.

The Rothblum report found that "much of the human factors causal data...is inaccurate, unreliable, and incomplete."[6] The Tank Barge Transfer Spills QAT also documented the poor quality of causal data in the Coast Guard database.[7] The human factors deficiencies were a particularly serious barrier to the QAT, since all but two of the 67 cases studied resulted from human factor causes. In most of the 67 cases, there were no human factors supplements filed. A copy of the Rothblum report is available from Coast Guard headquarters' Office of Investigations and Analysis (G-MOA).

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[5] *U.S. Coast Guard Marine Casualty Investigation and Reporting: Analysis and Recommendations for Improvement*, James Byers, Susan Hill & Anita Rothblum, U.S. Coast Guard R&D Center, CG-D-13-95, completed August 1994, transmitted 21 August 1995.

[6] Rothblum, p. x.

[7] Managing Toward Zero Spills, p.7.

To overcome these database problems, the QAT used a root cause analysis method adapted from Dr. Vernon Gross and recommended in the 1995 "Prevention Through People" (PTP) study published by the Coast Guard's Office of Marine Safety and Environmental Protection. Dr. Gross's root cause system uses a standard investigation process that develops two dimensions of information:

- **Root Cause Information**, proceeding from Apparent Cause to Propagating Cause to Originating Cause; and
- **Preventive Action Information** in four categories, including Management, Behavior, Work Environment, and Technology.

The QAT found that Dr. Gross's method was very effective in guiding a root cause analysis, and permitted the development of root cause and preventive actions in 37 of the 67 cases. Dr. Gross's root cause analysis form may be found in the "Prevention Through People" study.

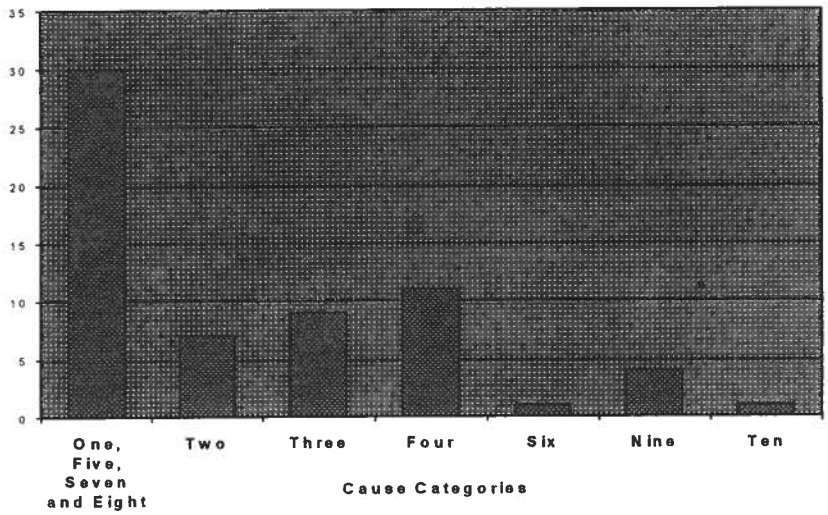
7. SIGNIFICANCE OF ROOT CAUSE ANALYSIS

The root causes and preventive actions flowing from the QAT's root cause analyses must be interpreted with a degree of caution. Due to the lack of information in many of the cases reviewed, much of the originating cause information developed by the QAT is based on judgments using the limited data available from the database files. The QAT believes that the originating causes identified are completely reliable for developing the related preventive actions. However, the originating causes cannot be used as corrections to the existing database.

In analyzing the cases, the QAT identified ten primary categories of causes, and created an eleventh category for those cases where the root cause could not be developed due to limited information in the case file. The categories identified are listed below in no particular order: 1) Lack of, or poor, voyage planning; 2) Loss of situational awareness; 3) Error in judgment; 4) Failure to follow procedures, standards, or regulations; 5) Lack of procedures, standards, or regulations; 6) Act of God; 7) Improper maintenance (vessel or facility); 8) Inadequate training; 9) Aids to navigation (ATON) discrepancy; and, 10) Environmental conditions.

The vast majority of originating causes identified by the QAT were rooted in management issues involving the vessel operating company.

8. 75% OF CASES HAVE MANAGEMENT-RELATED CAUSES



75% of the cases where a root cause could be developed had at least one management-related originating cause. The adjacent chart shows the number of times each cause occurred in the cases reviewed. The QAT has combined categories 1) voyage planning, 5) lack of procedures, 7) improper maintenance, and 8) inadequate training since these all relate in some way to management issues.

9. EVALUATION OF POSSIBLE PREVENTIVE ACTIONS

A number of possible preventive actions were identified in four categories: Management, Behavior, Work Environment, and Technology. The entire list of possible preventive actions can be found in Appendix D.

Under Management Actions, most important are proper voyage planning, a well defined planned maintenance system, proper procedures for reporting the failure of crucial equipment, a system of evaluating the performance of personnel, and well established emergency procedures covering all potential problems that may be encountered.

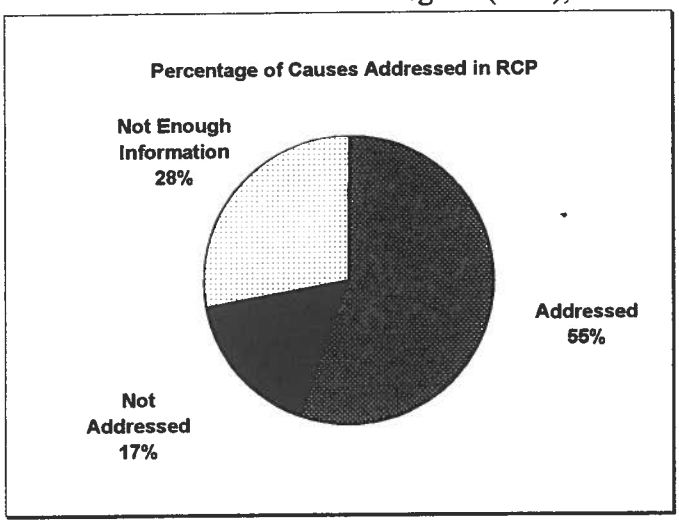
Preventive actions for the category of Behavior include proper training of personnel that would cover the problem areas that may be encountered during a voyage, including the recognition of equipment problems. The QAT also believes that supervisory training for masters would assist in the recognition of problems before they occur.

Environmental preventive actions include the establishment of an inspection process by each port community or harbor safety committee that would include all structures that may be encountered by a vessel. This would include locks, bridges, terminals, docks, fixed navigation structures or other structures that may be in contact with vessels.

Technology preventive actions include the greater use of current technology such as simulators or the adoption of technological improvements such as double hulls.

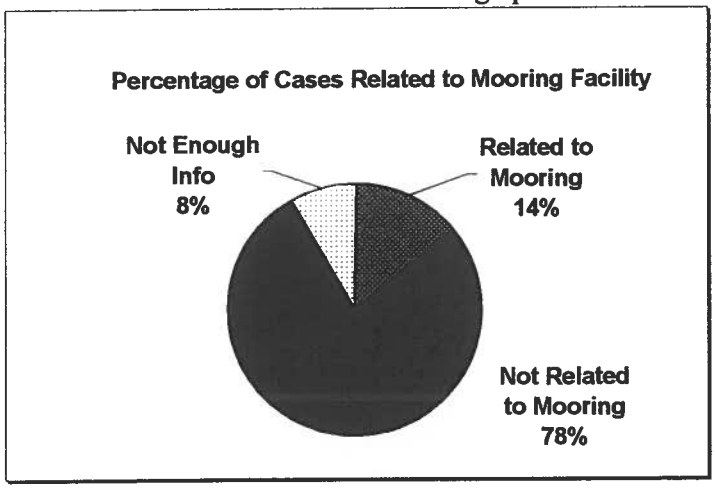
10. AWO RESPONSIBLE CARRIER PROGRAM

A majority of root causes identified in the QAT's review are addressed in a general fashion by the AWO Responsible Carrier Program (RCP), but more specific additional guidance should be added to enhance the RCP. With some minor enhancements, the RCP will be one of the best conduits for disseminating the guidance developed by this QAT, since the majority of the operators involved in the casualties reviewed were at the time or have since become members of The American Waterways Operators.



11. DAMAGE FROM MOORING OR STRUCTURES IN DISREPAIR

At least 14% of large spills involved apparent or possible mooring-related damage, or damage from structures in disrepair. Small fractures in the hull sides above and below the water can be attributed to soft allisions between barge sides and pier structures during mooring operations and while laying alongside. Many pier faces have missing or inadequate fendering that leaves exposed bolts sticking out that can gouge hull sides. Some cases resulted from underwater obstructions alongside piers ripping holes in barge hulls below the waterline, generally broken pilings and protruding cross bracings. Soft allision casualties such as these can be reduced by regular inspections and maintenance of pier facilities and fendering.



12. POOR NAVIGATIONAL PRACTICES

Six large spills reviewed during this study resulted from poor navigational practices, primarily sole reliance on "seaman's eye" or not making full use of all available navigational equipment. Companies need to make sure that crews are trained in the use of all available navigational tools onboard.

13. COMPARING DATA BETWEEN TANK BARGES AND TANK SHIPS

Trade characteristics between tank barges and tank ships differ significantly. Tank barges are smaller and have shorter voyages with increased frequency. Tank ships are larger, with longer voyages and less frequency. Tank ships have less exposure and less risk than tank barges, yet both are evaluated using the same data set, which may lead to invalid comparisons.

Part III: Recommendations

Recommendations: Based on the findings above, the QAT has developed the following recommendations:

- The Coast Guard should continue the program of encouraging all tug and barge companies to adopt a safety management system such as the AWO Responsible Carrier Program. The Coast Guard should develop further incentives or continue to offer current incentives, such as reduced USCG compliance boardings, to tug and barge companies that use safety management systems and that pass third party audits.

- AWO should modify the RCP and RCP audit checklist to include an explicit requirement for voyage planning and establish guidelines as to what proper voyage planning should include.

- Companies operating towing vessels and tank barges should review the list of Possible Preventative Measures to reduce oil spills contained in Appendix D in conjunction with the company's existing policies and procedures, casualty history, etc. Companies should consider incorporating into their Responsible Carrier Program or other safety management system those preventative measures appropriate to the company's mission, experience, and area of operations.

- The Coast Guard and AWO should jointly develop minimum information requirements for investigating the "root cause" of significant tank barge casualties.

- The Coast Guard should develop an improved standard investigation process designed to uncover the "root cause" of significant casualties. The PTP Root Cause Analysis method could serve as a model. The Coast Guard should investigate and report on industry concerns about criminal liabilities that pose barriers to the " root cause" investigation process.

- The Coast Guard should develop a new casualty investigation module for the Marine Safety Information System that adopts the recommendations of the 1994 Rothblum Report and is aligned with a root cause analysis process.

- Coast Guard COTPs should investigate the potential pollution hazards posed by regulated oil transfer facilities and other waterway structures that may be subjected to contact with tank barges.

- AWO and the Coast Guard should investigate the implementation of a system to readily disseminate "best practices" and "lessons learned" from tank barge casualties and near-miss events.

- The Coast Guard and AWO should consider a system of tracking vessel movements by loaded barges, by size of barge, and by nature of voyage to assist in the development of statistical data on future incidents. A method of comparing tank barge to tank ship incidents should be developed that fairly reflects the two industries.

References:

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U.S. Coast Guard Marine Casualty Investigation and Reporting: Analysis and Recommendations for Improvement; Byers, James C., Hill, Susan G.

Appendix A:

Charter

QUALITY ACTION TEAM CHARTER

to examine

TANK BARGE MAJOR AND MEDIUM SPILLS

PURPOSE

This charter provides procedures, authority, and guidance for a Quality Action Team (QAT) to conduct a comprehensive and detailed examination of major and medium spills of oil and hazardous substances from tank barges. The Coast Guard-AWO National Quality Steering Committee chose to examine major and medium spills from tank barges based on Coast Guard data which indicates that over 50% of all major and medium marine spills by volume comes from tank barges. The QSC believes that an assessment of the root causes of these spills will yield information on whether or not the prevention strategies of the Coast Guard and the tank barge industry are appropriately targeted to achieve a reduction in their frequency and seriousness. Identifying root causes and recommendations for process improvement offers a significant opportunity to advance the principal objectives of the Coast Guard-AWO safety partnership: the prevention of accidents, reduction of spills and enhancement of the marine environment.

ASSIGNED PROJECT

The Tank Barge Major and Medium Spills QAT is chartered by the Coast Guard-AWO National QSC to investigate the root causes of all tank barge major and medium spills occurring since 1990, as identified within the Coast Guard database, and to develop a list of proposed recommendations to reduce the incidence of such spills for consideration by the National QSC. In conducting this analysis, the QAT should consider, at a minimum, the following areas:

* The circumstances and proximate causes of the casualties/spills, including;
  - The operating environment and role of the human element;
  - The training and experience of vessel personnel;
  - Management controls and business practices;
  - Vessel and equipment standards/conditions;
  - The impact of the waterways management system;

- Risk management measures used by industry;

- The impact of existing or pending Coast Guard regulations;

* Impacts and costs of the recommended actions;

* Lessons learned from "near misses"; and,

* Other areas the QAT finds important to achieve the goals stated above.

STRUCTURE

The Tank Barge Major and Medium Spills QAT will consist of the following individuals. QAT leaders are designated below. Other necessary team roles and responsibilities will be determined by team members in the course of their analysis.

Quality Action Team:

Team Leaders:	CAPT Larry Hereth, USCG James Sweeney, Morania Oil Tanker Corp.
Team Members:	CDR Chris Bogel, USCG Jack Wilskey, Sause Bros. Ocean Towing CDR Kenneth Prime, USCG Phil Chase, Boston Towing & Transportation LCDR Mark Hamilton, USCG Bill Ludt, Sun State Marine LCDR Mark True, MSO Portland ME Jeanne Krause, Sea River Maritime Corp. David Ingels, Chevron Chemical Company
Team Facilitator:	(TBD)
Guidance Team:	Coast Guard-AWO National QSC

QAT METHODOLOGY AND DELIVERABLES

Recognizing that there are many different Total Quality Management (TQM) process improvement models in use within the Coast Guard and the marine transportation industry, no particular methodology for the QAT's work is prescribed. The Tank Barge Major and Medium Spills QAT may employ any process with which it is most

comfortable to identify root causes of these spills and to identify appropriate process improvements. At a minimum, the process should include the following steps (derived from the July 1995 "Report of the Coast Guard-AWO Quality Action Team"):

* Define the scope of the problem or process improvement needed (i.e., determine the baseline) using statistical data, case studies, etc., as available:

* Analyze the data and identify root causes of the problem;

* Identify solutions to the problem or improvements to the process based on analysis of available data and evidence;

* Identify the measure(s) by which the success of proposed solutions will be evaluated and check the validity of proposed solutions by measuring initial results;

* Refine proposed solutions as necessary; and,

* Develop an implementation plan for submittal to the National QSC.

The Tank Barge Major and Medium Spill QAT has the latitude to develop an implementation plan which lays out clearly and in some detail how and by whom the proposed quality improvements will be effected. To facilitate subsequent National QSC review, the implementation plan should identify the target audience for the proposed improvements and recommend a means by which to communicate the recommended improvements to the target group.

RESOURCES AND TIMETABLE

Members of the Tank Barge Major and Medium Spills QAT were selected for their analytical skills and experience with and knowledge of the tank barge industry. The QAT is expected to draw on its talents to access resources, conduct research, and analyze all relevant information available to it. The QAT may wish to seek assistance from other individuals or government agencies if such assistance would enhance the team's examination.

The U.S. Coast Guard's July 1995 "Prevention Through People" Quality Action Team Report, the American Petroleum Institute's annual report on Petroleum Industry Environmental Performance, the U. S. Coast Guard's annual Government Performance and Results Act performance reports, and the American Waterways Operators' annual safety survey data may assist the QAT in developing the initial statistical base from which to conduct its analysis. In addition to obtaining data from published sources, the QAT may obtain more precise information by reviewing U.S. Coast Guard and National Transportation Safety Board investigation reports for each major and medium tank barge

spill for the study period, and by contacting individual company officials or U.S. Coast Guard Marine Safety Office personnel. The Guidance Team will assist the QAT in obtaining and coordinating needed support from both AWO and the U.S. Coast Guard.

The QAT should begin work immediately so that interim reports are made available for the August 1997 and December 1997 Coast Guard-AWO National QSC meetings. The interim report should consist of a brief written synopsis of the major emphasis of the work completed, any particularly challenging or notable findings or events, and an assessment of whether targets for completion can be met. The team's leaders will orally present the interim report to the National QSC.

A final report, including the QAT's recommended implementation plan, should be completed at least one month in advance of the March 1998 National QSC meeting.

The QAT may meet as often as necessary to complete its task. Meetings should be held in locations which spread financial and time obligations equitably among the participants.

AUTHORITY TO ACT

We authorize the QAT to gather all necessary information from all available sources within our staffs to complete this task. All AWO and U.S. Coast Guard personnel shall render appropriate assistance to support the QAT, enabling it to fulfill the requirements set forth in this charter.

J. C. Card
Rear Admiral, U.S. Coast Guard
Assistant Commandant for Marine Safety
and Environmental Protection

May 1, 1997
Date

Thomas A. Allegretti
President
American Waterways Operators

May 3, 1997
Date

Appendix B:

Major & Medium Spills from Tank Barges 1986-96

The 222 Major Medium Oil Spills from Maritime Sources 1986-96

	CASE	PORT	YEAR	SPIL_DT	SOURCE	SERVICE	SUBSTANCE	TYP	SPIL_IN	MAJ	MED
1	MP86000090	LOSMS	1986	04-Jan-86		DWFF	OIL: CRUDE	P	18900		1
2	MP86001993	SFCMS	1986	01-Feb-86	APEX HOUSTON	TANK BARGE	OIL: CRUDE	P	25872		1
3	MP86000889	BOSMS	1986	04-Feb-86	B. F. T. NO. 24	TANK BARGE	OIL, FUEL: NO. 6	P	42000		1
4	MP86001117	SJPMS	1986	06-Feb-86	ST.THOMAS	TANK BARGE	OIL, FUEL: NO. 5	P	41392		1
5	MP86001760	NYCCP	1986	07-Mar-86		DWFF	OIL, FUEL: NO. 2-D	P	72342		1
6	MP86001738	PADMS	1986	07-Mar-86	TEXAS	TANK BARGE	OIL: CRUDE	P	378000	1	
7	MP86002202	WNCMS	1986	17-Mar-86	EDGAR O. SIKES	TANK BARGE	OIL, FUEL: NO. 6	P	13062		1
8	MP86002114	PHICP	1986	21-Mar-86		TANK SHIP	OIL: CRUDE	P	105000	1	
9	MP86002682	SFCMS	1986	05-Apr-86		FREIGHT SHIP	OIL: CRUDE	P	10000		1
10	MP86003178	SLMMS	1986	04-May-86	STC 3023	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	11172		1
11	MP87000141	MOBMS	1986	31-Jul-86	TTT 103	TANK BARGE	Various Oil/Petol	P	588000	1	
12	MP86006897	JACMS	1986	03-Sep-86		TANK SHIP	OIL, FUEL: NO. 6	P	10000		1
13	MP86006797	PATMS	1986	05-Sep-86	LSC 52	TANK BARGE	NAPHTHA: VM & P (75% NAPHTHA)	P	28560		1
14	MP87001901	PHICP	1986	10-Sep-86		TANK SHIP	OIL: CRUDE	P	264600	1	
15	MP86007329	PROMS	1986	17-Sep-86	S.T. 85	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	119762	1	
16	MP86009041	PITMS	1986	24-Sep-86		COMMERCIAL	OIL, MISC: LUBRICATING	P	11000		1
17	MP86008141	PATMS	1986	17-Oct-86		TANK SHIP	OIL: CRUDE	P	50000		1
18	MP86008330	SLMMS	1986	27-Oct-86	IB 2003 L	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	217098	1	
19	MP86008001	NEWCP	1986	28-Oct-86	BAYOU FERBLANC	TANK BARGE	FUEL OIL, DIESEL	P	25000		1
20	MP86008639	CORMS	1986	07-Nov-86		INDUSTRIAL VESSEL	OIL, FUEL: NO. 2-D	P	20000		1
21	MP86008820	NYCCP	1986	16-Nov-86		TANK SHIP	OIL, FUEL: NO. 6	P	105706	1	
22	MP86009300	SAVMS	1986	04-Dec-86		TANK SHIP	OIL, FUEL: NO. 6	P	500000	1	
23	MP87000350	SFCMS	1987	13-Jan-87		TANK SHIP	OIL: CRUDE	P	630000	1	
24	MP87000506	HONMS	1987	20-Jan-87	HANA	TANK BARGE	OIL, FUEL: NO. 6	P	42000		1
25	MP87001088	NYCCP	1987	17-Feb-87	PETER R HEARNE	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	10206		1

The 222 Major Medium Oil Spills from Maritime Sources 1986-96

26	MP87001081	NYCCP	1987	17-Feb-87	TEXACO 807	TANK BARGE	OIL, FUEL: NO. 2-D	P	301770	1	
27	MP87001361	JACMS	1987	26-Feb-87		FREIGHT SHIP	OIL: CRUDE	P	110000	1	
28	MP87001590	ANCMS	1987	08-Mar-87		RECREATIONAL	OIL: DIESEL	P	29000		1
29	MP87001705	NEWCP	1987	13-Mar-87	ALAMO 2103	TANK BARGE	OIL, FUEL: NO. 1 (KEROSENE)	P	19362		1
30	MP87001831	ANCMS	1987	20-Mar-87		FISHING BOAT	OIL: DIESEL	P	43250		1
31	MP87003037	ANCMS	1987	06-May-87		FISHING BOAT	OIL: DIESEL	P	125000	1	
32	MP87003498	SFCMS	1987	10-May-87		TOWBOAT/TUGBOAT	OIL: DIESEL	P	18000		1
33	MP87003182	PADMS	1987	11-May-87	IB 2505	TANK BARGE	OIL, FUEL: NO. 6	P	24570		1
34	MP87004617	MOBMS	1987	24-Jun-87		TANK SHIP	OIL: CRUDE	P	28560		1
35	MP87004651	ANCMS	1987	02-Jul-87		TANK SHIP	OIL: CRUDE	P	207564	1	
36	MP87004876	CORMS	1987	10-Jul-87	MC 100	TANK BARGE "OD"	GASOLINE: AVIATION (4.86G PB/GAL)	P	36540		1
37	MP87005984	PADMS	1987	18-Aug-87		PASSENGER BARGE	OIL, FUEL: NO. 2-D	P	25405		1
38	MP87006854	LOSMS	1987	21-Sep-87		FREIGHT SHIP	OIL, FUEL: NO. 5	P	378943	1	
39	MP87007257	JUNMS	1987	04-Oct-87		TANK SHIP	OIL: CRUDE	P	600000	1	
40	MP87007647	JUNMS	1987	27-Oct-87	SEASPAN 824	TANK BARGE	KEROSENE	P	16597		1
41	MP87007651	PADMS	1987	27-Oct-87		TOWBOAT/TUGBOAT	OIL, FUEL: NO. 2-D	P	24889		1
42	MP87007756	CORMS	1987	07-Nov-87		DWFF	OIL: DIESEL	P	18000		1
43	MP88000029	MEMMS	1988	03-Jan-88	EXXON BARGE NO. 241	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	168000	1	
44	MP88000221	NEWMS	1988	10-Jan-88		TANK SHIP	OIL, FUEL: NO. 6	P	40000		1
45	MP88000436	MOBMS	1988	17-Jan-88	DOMAR 115	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	294000	1	
46	MP88000495	MORMS	1988	20-Jan-88		DWFF	OIL, FUEL: NO. 6	P	12600		1
47	MP88000967	SFCMS	1988	21-Jan-88	MLC 340-1	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	27804		1
48	MP88001511	SEAMS	1988	31-Jan-88	M-C-N OIL BARGE NO. 5	TANK BARGE	GAS OIL: CRACKED	P	67357		1
49	MP88000778	ANCMS	1988	02-Feb-88		FISHING BOAT	OIL, FUEL: NO. 2	P	10000		1
50	MP88000986	MORMS	1988	11-Feb-88	CCMS 3002	TANK BARGE "OD"	JET FUEL: JP-4	P	18900		1
51	MP88001099	SLMMS	1988	15-Feb-88		TOWBOAT/TUGBOAT	OIL: DIESEL	P	39000		1

The 222 Major Medium Oil Spills from Maritime Sources 1986-96

52	MP88001200	ANCMS	1988	18-Feb-88		FISHING BOAT	OIL: DIESEL	P	15000		1
53	MP88001202	ANCMS	1988	22-Feb-88		FISHING BOAT	OIL: DIESEL	P	27000		1
54	MP88007070	PATMS	1988	21-Mar-88		TANK SHIP	OIL, FUEL: NO. 6	P	25200		1
55	MP88002219	HONMS	1988	06-Apr-88	PEPEEKEO	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	17640		1
56	MP88002228	NYCCP	1988	07-Apr-88	SAM B	TANK BARGE	OIL, FUEL: NO. 6	P	16000		1
57	MP88002124	SLMMS	1988	14-Apr-88		TOWBOAT/TUGBOAT	OIL PRODUCT	P	17200		1
58	MP88003221	NYCCP	1988	22-May-88		TOWBOAT/TUGBOAT	Oil, fuel: No. 2	P	16000		1
59	MP88003549	JACMS	1988	04-Jun-88		INDUSTRIAL VESSEL	OIL: DIESEL	P	20000		1
60	MP88004534	CORMS	1988	13-Jul-88		TANK SHIP	OIL: CRUDE	P	644700	1	
61	MP88006911	MOBMS	1988	11-Aug-88		INDUSTRIAL VESSEL	OIL: CRUDE	P	25000		1
62	MP88005576	ANCMS	1988	21-Aug-88		OIL RECOVERY	OIL, FUEL: NO. 2	P	68289		1
63	MP88006302	HMRMS	1988	24-Aug-88	565	TANK BARGE	TRANSMIX OIL (80% DIESEL, 20% GASOLINE)	P	211974	1	
64	MP88006300	TAMMS	1988	05-Sep-88	EXXON BARGE 503	TANK BARGE	OIL, FUEL: NO. 2-D	P	126168	1	
65	MP88007097	PHIMS	1988	06-Oct-88		TANK SHIP	OIL: CRUDE	P	16800		1
66	MP88007394	ANCMS	1988	02-Nov-88		FREIGHT SHIP	OIL: DIESEL	P	59000		1
67	MP88007613	ANCMS	1988	03-Nov-88		FISHING BOAT	OIL: DIESEL	P	10000		1
68	MP88008225	ANCMS	1988	10-Dec-88		FREIGHT SHIP	Oil, fuel: No. 6	P	10000		1
69	MP89000186	PORMS	1988	23-Dec-88	NESTUCCA	TANK BARGE	OIL, FUEL: NO. 6	P	227304	1	
70	MP88008565	ANCMS	1988	26-Dec-88	UMTB 283	TANK BARGE	OIL, FUEL: NO. 2-D	P	2041662	1	
71	MP88008563	NYCCP	1988	26-Dec-88		TANK SHIP	Oil: Crude	P	63000		1
72	MP89000566	VALMS	1989	03-Jan-89		TANK SHIP	OIL: CRUDE	P	71400		1
73	MP89000341	ANCMS	1989	14-Jan-89		OIL RECOVERY	Oil: Diesel	P	84000		1
74	MP89000303	LISCP	1989	14-Jan-89	B. NO. 115	TANK BARGE	Oil, fuel: No. 6	P	60400		1
75	MP89000864	MORMS	1989	06-Feb-89	SFI 61	TANK BARGE	OIL, FUEL: NO. 6	P	16800		1
76	MP89000901	PATMS	1989	06-Feb-89	DC 50	TANK BARGE	OIL, FUEL: NO. 6	P	25074		1
77	MP89001224	ANCMS	1989	19-Feb-89		FISHING BOAT	Oil: Diesel	P	97000		1

The 222 Major Medium Oil Spills from Maritime Sources 1986-96

78	MP89001180	LOUMS	1989	19-Feb-89	AO C 245	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	48857		1
79	MP89001345	ANCMS	1989	27-Feb-89		FREIGHT SHIP	Oil, fuel: No. 6	P	44500		1
80	MP89004982	HONMS	1989	02-Mar-89		FACILITY	Oil: Crude	P	16800		1
81	MP89002004	VALMS	1989	24-Mar-89		TANK SHIP	Oil: Crude	P	10500000	1	
82	MP89001558	ANCMS	1989	26-Mar-89		OSV	OIL: DIESEL	P	30000		1
83	MP89002789	NEWMS	1989	14-Apr-89	EXXON BARGE NO. 223	TANK BARGE	GASOLINE: AUTOMOTIVE (4.23G PB/GAL)	P	22554		1
84	MP89002863	GALMS	1989	19-Apr-89		TANK SHIP	Oil: Diesel	P	25872		1
85	MP89003133	ANCMS	1989	28-Apr-89		COMMERCIAL	Oil, fuel: No. 2	P	41000		1
86	MP89003287	NYCCP	1989	03-May-89	NEW YORK 30	TANK BARGE	Oil, fuel: No. 2	P	13944		1
87	MP89005013	HOUMS	1989	23-Jun-89	COASTAL 2514	TANK BARGE	Oil, fuel: No. 6	P	252000	1	
88	MP89004983	PROMS	1989	23-Jun-89		TANK SHIP	Oil, fuel: No. 2	P	292000	1	
89	MP90005651	PHIMS	1989	24-Jun-89		TANK SHIP	Oil, fuel: No. 6	P	307000	1	
90	MP89006787	JUNMS	1989	12-Aug-89		FISHING BOAT	Oil, fuel: No. 2-D	P	20000		1
91	MP89007075	ANCMS	1989	19-Aug-89		TOWBOAT/TUGBOAT	Oil: Diesel	P	15000		1
92	MP89007939	NYCCP	1989	14-Sep-89	MORANIA NO. 440	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	84000		1
93	MP89008244	HONMS	1989	24-Sep-89		WWF	Jet fuel: JP-5 (Kerosene, heavy)	P	26000		1
94	MP89011253	MOBMS	1989	01-Oct-89	CTCO 240	TANK BARGE	Oil: Crude	P	30450		1
95	MP89008492	GALMS	1989	01-Oct-89		TANK SHIP	Oil: Crude	P	21000		1
96	MP89009306	ANCMS	1989	18-Oct-89		TOWBOAT/TUGBOAT	Oil: Diesel	P	13000		1
97	MP89010163	ANCMS	1989	15-Nov-89		FREIGHT SHIP	Oil: Diesel	P	237343	1	
98	MP89011258	NYCCP	1989	15-Dec-89	CIBRO PHILADELPHIA	TANK BARGE	Oil, fuel: No. 6	P	29400		1
99	MP89011730	SJPMS	1989	30-Dec-89		FREIGHT SHIP	Oil: Diesel	P	25500		1
100	MP90000173	GALMS	1990	05-Jan-90		FREIGHT SHIP	Oil, fuel: No. 6	P	77910		1
101	MP90000669	JUNMS	1990	20-Jan-90		TANK SHIP	Gasoline: Automotive (4.23g Pb/gal)	P	36657		1
102	MP90000835	NEWMS	1990	25-Jan-90	CHOTIN 2881& 2183	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	94500		1
103	MP90001030	ANCMS	1990	29-Jan-90		FISHING BOAT	Oil: Diesel	P	10600		1

The 222 Major Medium Oil Spills from Maritime Sources 1986-96

104	MP90001129	HONMS	1990	29-Jan-90		TANK SHIP	Gasoline: Automotive (4.23g Pb/gal)	P	16800		1
105	MP90001247	HOUMS	1990	03-Feb-90		PASSENGER BARGE	Naphtha: Solvent	P	10500		1
106	MP90001433	LOSMS	1990	07-Feb-90		TANK SHIP	Oil: Crude	P	397236	1	
107	MP90002042	NYCCP	1990	28-Feb-90	E-25	TANK BARGE	Oil, fuel: No. 6	P	20202		1
108	MP90002278	NYCCP	1990	06-Mar-90	CIBRO SAVANNAH	TANK BARGE	Oil, fuel: No. 2	P	54000		1
109	MP90002892	ANCMS	1990	22-Mar-90		FISHING BOAT	Oil: Diesel	P	25000		1
110	MP90002918	GALMS	1990	25-Mar-90	MB 2	TANK BARGE	CRUDE OIL CONDENSATE	P	54096		1
111	MP90003430	SLMMS	1990	28-Mar-90	APEX 2902	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	15330		1
112	MP90003454	CORMS	1990	05-Apr-90		TANK SHIP	Oil: Crude	P	12600		1
113	MP90004051	GALMS	1990	22-Apr-90	MGM 2001	TANK BARGE	Oil: Diesel	P	54012		1
114	MP90004359	LOUMS	1990	23-Apr-90	CHOTIN 2880	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	18132		1
115	MP90005022	NEWMS	1990	17-May-90	APEX 104 & APEX 101	TANK BARGE	Naphtha: Solvent	P	61530		1
116	MP90005334	NEWMS	1990	24-May-90		FREIGHT SHIP	Oil, fuel: No. 6	P	12600		1
117	MP90005551	NEWMS	1990	02-Jun-90		TOWBOAT/TUGBOAT	Oil: Diesel	P	10000		1
118	MP90005747	NYCCP	1990	07-Jun-90		TANK SHIP	Oil, fuel: No. 6	P	250000	1	
119	MP90005807	NEWMS	1990	08-Jun-90	C T CO. 196-20	TANK BARGE	Gasoline: Casinghead	P	13776		1
120	MP90005822	GALMS	1990	09-Jun-90		TANK SHIP	Oil: Crude	P	3900000	1	
121	MP90006522	PORMS	1990	24-Jun-90		FISHING BOAT	Oil: Diesel	P	20000		1
122	MP90006548	ANCMS	1990	27-Jun-90		FISHING BOAT	Oil: Diesel	P	60000		1
123	MP90008798	HMRMS	1990	01-Jul-90		FREIGHT SHIP	Oil, fuel: No. 4	P	35334		1
124	MP90007410	NYCCP	1990	18-Jul-90	INTERSTATE 53	TANK BARGE	Oil, fuel: No. 2	P	37000		1
125	MP90007763	GALMS	1990	28-Jul-90	APEX 3503 & APEX 3417	TANK BARGE	CATALYTIC FEED STOCK	P	703164	1	
126	MP90008339	HOUMS	1990	12-Aug-90	SFI-33	TANK BARGE	Oil, fuel: No. 6	P	21000		1
127	MP90008452	PATMS	1990	13-Aug-90	GOC-1	TANK BARGE	Jet fuel: JP-4	P	12600		1
128	MP90009466	PHIMS	1990	19-Aug-90	OCEAN 192	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	152000	1	
129	MP90009137	JUNMS	1990	29-Aug-90		WWF	Gasoline: Automotive (4.23g Pb/gal)	P	13752		1

The 222 Major Medium Oil Spills from Maritime Sources 1986-96

130	MP90010060	DETMS	1990	16-Sep-90		TANK SHIP	Gasoline: Automotive (4.23g Pb/gal)	P	316680	1	
131	MP91008941	NYCCP	1990	27-Sep-90	T/B SARAH FRANK 059	TANK BARGE	Oil, waste/lubricants - possible contaminant	P	50000		1
132	MP90010349	GALMS	1990	28-Sep-90	RIO 2508	TANK BARGE "OD"	REFORMATE	P	36061		1
133	MP90011477	NYCCP	1990	26-Oct-90	HYGRADE 42	TANK BARGE	Kerosene	P	190000	1	
134	MP90012520	MORMS	1990	02-Nov-90	COASTAL 2509	TANK BARGE	Oil: Crude	P	84504		1
135	MP91000366	LOSMS	1991	08-Jan-91		FREIGHT SHIP	Oil, fuel: No. 6	P	12936		1
136	MP91001976	SEAMS	1991	22-Feb-91		WATERFRONT FACILITY	Oil: Crude	P	84000		1
137	MP91002403	SJPMS	1991	06-Mar-91	T/B VISTABELLA	TANK BARGE	Oil, fuel: No. 6	P	500000	1	
138	MP91003589	NEWMS	1991	11-Apr-91	CBC 173	TANK BARGE "OD"	Oil, misc: Lubricating	P	123900	1	
139	MP91004453	BOSMS	1991	03-May-91		TANK SHIP	Oil, fuel: No. 2	P	16000		1
140	MP91004838	VALMS	1991	14-May-91		FISHING BOAT	Oil, fuel: No. 2-D	P	10000		1
141	MP91005622	PATMS	1991	04-Jun-91		DWFF	Oil, fuel: No. 2	P	18800		1
142	MP91006181	NYCCP	1991	18-Jun-91	B. NO. 100	TANK BARGE	Oil, fuel: No. 2	P	16800		1
143	MC92018429	BATD	1991	21-Jul-91		WATERFRONT FACILITY	Oil: Crude	P	11550		1
144	MP91007416	SEAMS	1991	22-Jul-91		FISHING BOAT	Oil, fuel: No. 6	P	100000	1	
145	MP91008094	ANCMS	1991	04-Aug-91	B & R 5	TANK BARGE	HEAT FUEL #1 (JET A 50)	P	13375		1
146	MP91008883	CORMS	1991	23-Aug-91	CCMS - 2101	TANK BARGE	Oil, fuel: No. 6	P	10500		1
147	MP91009201	BUFMS	1991	29-Aug-91		TANK SHIP	Asphalt	P	21000		1
148	MP91010072	PADMS	1991	25-Sep-91		TOWBOAT/TUGBOAT	Oil, fuel: No. 2-D	P	15000		1
149	MC92000894	JUNMS	1991	08-Oct-91		FISHING BOAT	Oil, fuel: No. 2-D	P	15750		1
150	MP91012348	HONMS	1991	20-Nov-91		TANK SHIP	Oil: Diesel	P	18000		1
151	MC92004086	NYCMI	1991	25-Dec-91	M 35	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	16800		1
152	MP91013655	PORMS	1991	28-Dec-91		FREIGHT SHIP	Oil, fuel: No. 6	P	11000		1
153	MP91013668	NEWMS	1991	29-Dec-91	LBTCO NO. 11	TANK BARGE	Oil: Crude	P	10500		1
154	MC93011836	SFCMS	1992	27-Jan-92		TOWBOAT/TUGBOAT	Oil: Diesel	P	35000		1
155	MC92001792	PHIMS	1992	06-Feb-92		WATERFRONT FACILITY	Oil, fuel: No. 6	P	12600		1

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156	MC92007063	PHIMS	1992	10-Apr-92		WATERFRONT FACILITY	Oil: Crude	P	18480		1
157	MC92005485	NYCCP	1992	15-Apr-92		WATERFRONT FACILITY	Asphalt	P	12600		1
158	MC92009419	MORMS	1992	17-May-92		WATERFRONT FACILITY	Oil: Crude	P	16800		1
159	MC92008084	MORMS	1992	24-May-92		WATERFRONT FACILITY	Oil: Crude	P	11760		1
160	MC92007963	NEWMS	1992	25-May-92	HOLLYWOOD 3021	TANK BARGE	Oil, fuel: No. 6	P	84000		1
161	MC92010164	NEWMS	1992	28-Jun-92		INDUSTRIAL VESSEL	Oil: Diesel	P	15682		1
162	MC92011364	GALMS	1992	17-Jul-92		TANK SHIP	Oil: Crude	P	98725		1
163	MC92012433	SFCMS	1992	03-Aug-92		WATERFRONT FACILITY	Oil: Crude	P	14700		1
164	MC92015161	NYCCP	1992	31-Aug-92		WATERFRONT FACILITY	Unknown material, Oil or Oil-like	P	20000		1
165	MC92016591	TAMMS	1992	01-Oct-92		FREIGHT SHIP	Oil: Diesel	P	144600	1	
166	MC92017346	PITMS	1992	14-Oct-92		TOWBOAT/TUGBOAT	Oil: Diesel	P	12000		1
167	MC92021467	NYCMI	1992	21-Dec-92	R. T. C. NO. 380	TANK BARGE	Oil, fuel: No. 2	P	27000		1
168	MC93001301	HMAD	1993	15-Jan-93		WATERFRONT FACILITY	Oil: Crude	P	34630		1
169	MC93003498	PORMS	1993	01-Mar-93		FISHING BOAT	Oil: Diesel	P	11000		1
170	MC93008995	LOSMS	1993	13-Mar-93		FREIGHT SHIP	Oil, waste/lubricants - possible contaminant	P	25200		1
171	MC93004894	BALMS	1993	22-Mar-93		WATERFRONT FACILITY	Oil, fuel: No. 6	P	19000		1
172	MC93006205	NEWMS	1993	09-Apr-93	IB2629	TANK BARGE	Oil, fuel: No. 6	P	235200	1	
173	MC93006356	MORMS	1993	13-Apr-93	STCO 220	TANK BARGE	Oil: Diesel	P	17892		1
174	MC93007205	PATMS	1993	20-Apr-93		WATERFRONT FACILITY	Oil: Crude	P	88200		1
175	MC93008587	JACMS	1993	19-May-93		TANK SHIP	Oil, fuel: No. 6	P	33558		1
176	MC93010245	CORMS	1993	11-Jun-93		WATERFRONT FACILITY	Oil: Crude	P	16170		1
177	MC93012948	KODD	1993	22-Jul-93		FISHING BOAT	Oil: Diesel	P	16000		1
178	MC93014220	TAMMS	1993	10-Aug-93	OCEAN 255, B. NO. 155	TANK BARGE	Miscel. petrl. subt.	P	362164	1	
179	MC93015037	KEND	1993	23-Aug-93		FREIGHT SHIP	Oil, fuel: No. 2-D	P	13561		1
180	MC93018928	HONMS	1993	14-Oct-93		FISHING BOAT	Oil, misc: Lubricating	P	96000		1
181	MC93020228	MORMS	1993	06-Nov-93	7008	TANK BARGE	Oil: Crude	P	20160		1

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182	MC94000365	SJPMS	1994	07-Jan-94	MORRIS J. BERMAN	TANK BARGE	Oil, fuel: No. 6	P	750000	1	
183	MC94002370	CORMS	1994	03-Feb-94	IB 2013 L	TANK BARGE	Asphalt	P	40152		1
184	MC94003633	HOUMS	1994	18-Feb-94	T/B S 16	TANK BARGE	Gasoline: unleaded	U	35658		1
185	MC94003584	ANCMS	1994	22-Feb-94		OSV	Oil: Diesel	P	12000		1
186	MC94009246	SJPMS	1994	22-Apr-94		FREIGHT SHIP	Oil, edible; diesel	O	21535		1
187	MC94008983	GALMS	1994	05-May-94		TANK SHIP	Oil, fuel: No. 6	P	35700		1
188	MC94012883	GALMS	1994	22-Jun-94		FREIGHT SHIP	Oil, misc: Lubricating	P	11111		1
189	MC94016378	ANCMS	1994	10-Aug-94		FREIGHT BARGE	Oil: Diesel	P	20000		1
190	MC94018743	NYCMI	1994	08-Sep-94	RTC 20	TANK BARGE	Oil, waste/lubricants - possible contaminant	P	15000		1
191	MC94019308	ANCMS	1994	15-Sep-94		FREIGHT SHIP	Oil: Diesel	P	12705		1
192	MC94020962	CORMS	1994	08-Oct-94		WATERFRONT FACILITY	Oil: Crude	P	90342		1
193	MC94022052	HOUMS	1994	23-Oct-94		SHORELINE	Oil: Crude	P	116000	1	
194	MC94026013	NEWMS	1994	22-Dec-94	LBT-62	TANK BARGE	Oil: Crude	P	38262		1
195	MC94026379	SEAMS	1994	30-Dec-94	BARGE 101	TANK BARGE	Oil: Diesel	P	26000		1
196	MC95002001	GALMS	1995	05-Feb-95		TANK SHIP	Oil, fuel: No. 6	P	37716		1
197	MC95002409	BOSMS	1995	10-Feb-95		TANK SHIP	Oil, fuel: No. 2-D	P	15918		1
198	MC95003274	ANCMS	1995	27-Feb-95		FISHING BOAT	Oil: Diesel	P	12500		1
199	MC95006093	CORMS	1995	13-Apr-95	LESLIE	TANK BARGE	Petroleum naphtha	P	13062		1
200	MC95009209	PATMS	1995	09-Jun-95		OSV	Other oil, oil with no CHRIS Code	P	14742		1
201	MC95009838	BATD	1995	16-Jun-95	APEX 3603	TANK BARGE	SLURRY OIL (DECANTED OIL); AROMATIC PETROLEUM OIL	P	848600	1	
202	MC95010568	NEWMS	1995	01-Jul-95		FREIGHT SHIP	Oil, fuel: No. 6	P	95550		1
203	MC95012185	PHIMS	1995	01-Jul-95	INTERSTATE 138	TANK BARGE	Oil: Crude	P	16800		1
204	MC95011648	PHIMS	1995	22-Jul-95		WATERFRONT FACILITY	Oil: Crude	P	60400		1
205	MC95012218	SAVMS	1995	02-Aug-95		TOWBOAT/TUGBOAT	Oil: Diesel	P	25000		1
206	MC95012293	PTCD	1995	04-Aug-95		TOWBOAT/TUGBOAT	OILS	P	35000		1
207	MC95013984	NYCCP	1995	02-Sep-95		TANK SHIP	Gasoline: Automotive (4.23g Pb/gal)	P	21000		1

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208	MC95014753	GRND	1995	08-Sep-95	CTCO 195-25	TANK BARGE	Oil: Crude	P	10500		1
209	MC96004304	NEWMS	1995	11-Oct-95	APEX 3512	TANK BARGE	OTHER OIL, OIL WITH NO CHRIS CODE, DECANTED, SLURRY OIL	P	194502	1	
210	MC96000914	PROMS	1996	19-Jan-96	*North Cape ?*	TANK BARGE			828492	1	
211	MC96003735	HOUMS	1996	09-Mar-96		TANK SHIP	Oil, misc: Absorption	P	62622		1
212	MC96003822	MOBMS	1996	11-Mar-96		TOWBOAT/TUGBOAT	Oil: Diesel	P	24135		1
213	MC96004119	GALMS	1996	18-Mar-96	BUFFALO 292	TANK BARGE	Oil, fuel: No. 6	P	176400	1	
214	MC96007906	MEMMS	1996	19-Apr-96	OMR 2770	TANK BARGE	Gasoline: Automotive (Unleaded)	U	36816		1
215	MC96006859	PHIMS	1996	09-May-96		TANK SHIP			40000		1
216	MC96007402	MORMS	1996	20-May-96		INDUSTRIAL VESSEL	Oil: Diesel	P	11000		1
217	MC96007674	HOUMS	1996	26-May-96	BUFFALO 286	TANK BARGE	Oil, fuel: No. 6	P	25998		1
218	MC96013203	BATD	1996	01-Sep-96		TOWBOAT/TUGBOAT	Oil, misc: Motor	P	12000		1
219	MC96014718	BALMS	1996	06-Sep-96		FREIGHT SHIP	Oil, fuel: No. 4	P	39000		1
220	MCUnknown	PORMS	1996	27-Sep-96		TANK SHIP			179000	1	
221	MC96016734	TAMMS	1996	09-Nov-96	LMI 150	TANK BARGE	Oil: Diesel	P	55933		1
222	MC96017324	BATD	1996	24-Nov-96	T/B STCO 231	TANK BARGE	Gasoline: Automotive (4.23g Pb/gal)	P	30,000		1

Appendix C:

Case and Cause Information

CASE NUMBER	DATE	APPARENT CAUSE	PROPAGATING CAUSE	ORIGINATING CAUSE (why apparent cause happened)
MC92000635	18-Jan-92	Pilot error: wrong approach for small tow approaching bridge, resulting in loss of vessel control, allision with bridge, holing of barge.	Strong currents 500 ft above bridge	1) Poor voyage planning, not anticipating known hazards for smaller tows. 2) Inadequate knowledge of this navigational area. 3) Channel changes by ACOE to correct one navigational hazard created a second, greater hazard.
MC92000880	26-Jan-92	Failed to maintain port to port passing agreement	Strong currents; possibly underpowered (1700 HP tow, 3 barges)	Situational awareness of strong current effect. Possible management failure to emphasize voyage planning for margin of safety
MC92002183	16-Feb-92	Barge sank at mooring after falling under dock	Failure to tend/monitor a moored barge Dock design unsatisfactory for the barge	Mgmt - decided not to comply with procedures/regs
MC92002224	12-Feb-92	Crack in hull discovered while moored	Possible damage while mooring	Root cause not developed in case
MC92004074	18-Mar-92	Vessel moored, struck by assisting tug and tow losing control.	Strong wind	IO-No negligence; wind caused QAT-Pilot failed to account for high wind in approaching dock, with moored vessels.
MC92007501	15-May-92	Allision due to lost visibility and loss of control	Heavy rain and high winds (60 mph)	Act of God; unpredictable 60 mph wind change.
MC92007963	25-May-92	Hull puncture below waterline	Not developed in case	Not developed in case
MC92015164	31-Aug-92	Grounding resulting from missed turn	Pilot error	Root cause not developed in case
MC92021467	21-Dec-92	Grounding Failure to fix position	Relying on "Seaman's Eye" Not using available navigation tools Inexperience	Mgmt - lack of navigation procedures Behavior - poor navigational training systems
MC93006205	9-Apr-93	Loss of control; allided with bridge	1) Strong prevailing currents (6.5 knots) 2) Unrepaired bridge fender may have posed increased risk.	Error in judgment: failure to heed management warning to use an assist tow for topping around in downstream current.
MC93006356	13-Apr-93	Grounding due to loss of steering	Improper electrical circuit breaker in steering pump motor failed.	1) Failure to properly maintain steering motor system 2) Failure to recognize risk inherent in previous loss of steering due to breaker trips.
MC93007546	3-May-93	Hull breached due to impact between two barges side by side in tow	Improper fendering Improper lashing Inexperience	Behavior - poor training on lashing
MC93013129	6-Jul-93	Appears to be the same case as MC93011997 - not enough info in file Hole in bottom apparently from grounding in transit	Not developed in case	Not developed in case
MC93014220	10-Aug-93	Triple collision in high risk passing/meeting situation.	1) Poor communication with involved vessels. 2) Lack of situational awareness.	Error in judgment: unwittingly creating a high risk meeting situation when passing another vessel but failing to contact approaching vessel.
MC93018205	5-Oct-93	Spill at sea from damaged fuel vent	Heavy seas connected to damage of fuel vent.	Cannot be determined due to limited investigation, probably due to remote location in Alaska

CASE NUMBER	DATE	APPARENT CAUSE	PROPAGATING CAUSE	ORIGINATING CAUSE (why apparent cause happened)
MC93019905	18-Sep-93	Grounding: failure to stay in channel	Inexperienced crew Unfamiliarity w/tow Failure to stop/report	Mgmt - lack of procedures on emergency Behavior - lack of training time
MC93020228	6-Nov-93	Struck uncharted submerged object.	None	Known and unmarked obstruction at mile 147 of channel, 3 feet above channel depth.
MC93022224	3-Dec-93	Struck uncharted submerged object	None	Known and unmarked obstruction at mile 147 of channel, 3 feet above channel depth.
MC94000268	5-Jan-94	Tug holed barge while making up tow	1) High winds (35 MPH) 2) Cold temperatures (5 F)	Misjudged approach to barge while maneuvering to make up tow.
MC94000293	14-Nov-93	Not enough info in file	Not developed in case	Not developed in case
MC94000365	7-Jan-94	Grounding due to parted tow line	Didn't inspect or maintain towing wire Use "jury rigged" wire Negligent watch keeping	Mgmt - No safety mgmt system in place
MC94001627	26-Jan-94	Breakaway barge from mooring	1) High current 8-12 mph 2) Heavy ice flows	Failure to anticipate inadequacy of standard mooring arrangement in extremely high risk situation involving heavy ice and heavy rain.
MC94003633	18-Feb-94	Holed barge: allision w/mooring dolphin	Sharp object on dolphin	Mgmt - lack of pier inspection procedures on part of facility
MC94004090	1-Mar-94	Hull fracture of unknown origin	Possible dock damage	Not developed in case
MC94005120	15-Mar-94	TB sank at pier, discharge from vents and ullages failure to secure cargo valves	PIC not a licensed tankerman, not regular tankerman - fill in	Mgmt - Company assigned inexperienced/untrained person to job
MC94005511	19-Mar-94	Not enough info in file	Not developed in case	Not developed in case
MC94018743	8-Sep-94	Allision with jetty at night due to pilot error	High winds and current Poor lighting at basin entrance	Behavior - poor judgment by operator.
MC94021564	18-Oct-94	Rudder jammed. Lost vessel control, resulting in allision/grounding on sea wall.	Hydraulic valve failure in steering system	Equipment failure not investigated
MC94025070	9-Dec-94	Holed by tow entering fleeting area, pushed by M/V DAVID WALKE, whose master was charged with negligent operation.	Insufficient information (improper procedures in close quarters?)	Insufficient information.
MC94026013	22-Dec-94	Struck submerged object, not enough info in file	Not enough info in file	No information developed in CG investigation
MC94026379	30-Dec-94	Grounding at night	Failure to fix position properly Lack of better ATONs (lighted buoy/sector lights)	Mgmt - policy on navigation procedures about taking fixes. Work Environment - Evaluate/improve ATONs for night transits.
MC95004084	12-Mar-95	Tug collided with barge while shortening tow.	1) Fast current (4 knots) 2) High wind (20 knots)	Operator error: Pilot misjudged approach in higher risk current while maneuvering to shorten tow.
MC95006093	13-Apr-95	Leak in hull discovered at mooring due to unsafe facility dock	Failure of persons in charge to detect hazards due to damaged fendering	Mgmt - policy on inspection and maintenance of facility dock
MC95006398	20-Apr-95	Loss of control by pilot of MAERSK SHETLAND due to overpowering bank effect induced by excessive speed.	Low margin for safety due to choice to overtake a tow in restricted waterway	Investigations of NTSB and USCG did not explore possible "originating causes" flowing from pilot's standard of care

CASE NUMBER	DATE	APPARENT CAUSE	PROPAGATING CAUSE	ORIGINATING CAUSE (why apparent cause happened)
MC95006828	29-Apr-95	Poor navigating procedures	1) Failure of pilot on watch to acknowledge and investigate for damage after off watch pilot awakened by bump. 2) Insufficient information in MC case	MC case does not probe originating causes.
MC95007356	6-Apr-95	Hole in side shell of barge	Not developed in case	Not developed in case
MC95009838	16-Jun-95	Loss of vessel control transiting bridge resulting in breakaway/grounding of barges	1) Fast Current (6-8 knots) 2) High water	Tug was underpowered (3800 hp) for multiple/loaded tow in fast water.
MC95009990	22-Jun-95	Cause of grounding not investigated due to location in EPA jurisdiction	Cause of grounding not investigated due to location in EPA jurisdiction.	Cause of grounding not investigated due to location in EPA jurisdiction.
MC95010592	5-Jul-95	Hole in barge	Not developed in case	Not developed in case
MC95011187	8-Jul-95	Leak in hull discovered at mooring due to unsafe facility dock Spill discovered while undocking	Failure of persons in charge to detect hazards due to damaged fendering	Mgmt - policy on inspection and maintenance of facility dock
MC95012185	1-Jul-95	Unknown cause of puncture hole in #4P Cargo Tank, 6ft above the bottom, possibly from making up or assisting	Insufficient Investigation	Insufficient Investigation
MC95014753	8-Sep-95	Barge holed by uncharted submerged hazard (old lock and dam)	Army Corps didn't mark a known hazard Army Corps didn't report the known hazard to the USCG	Work Environment - Army Corps review contractor oversight procedures for project control
MC96000914	19-Jan-96	Tank barge abandoned underway after tug caught fire, tank barge grounded.	Investigation still pending at time of study	Investigation still pending at time of study
MC96001123	20-Jan-96	Negligence resulted in navigating out of channel and grounding.	1) Inexperience with deep draft towing in the area. 2) Failure to use available depth charts.	Deficient voyage planning
MC96003028	12-Feb-96	Barge grounding due to unsatisfactory navigational practice	Failure to use radar to fix position Wrong chart Failure to report hazardous condition to CG Failure to stop after indication of grounding Failure of tug pilot and barge tankerman to communicate	Mgmt - Substandard navigation policy by tug company Mgmt - not following existing reporting procedures.
MC96003729	12-Mar-96	Tow allided with moored barge causing a hole in barge, due to navigational error	Situational awareness - relative to wind and swing of moored barge	Behavior - Abiding by good navigational practices
MC96003875	7-Mar-96	Tow grounded as a result of poor navigational practice	Failure to use navigation tools (e.g. radar) Failure to fix position Sudden loss of visibility due to snow	Mgmt - Company navigation procedures for inclement weather conditions
MC96004119	18-Mar-96	Structural failure due to combination of [P] and [O] causes.	1) Stress forces due to poor loading procedures. 2) Unrepaired "moderate to heavy" damage in way of ultimate hull failure (unrepaired for several years) 3) Failure of USCG inspectors to detect internal examination of cargo tank	Insufficient ABS design standards for tank barges in River/ICWW.

CASE NUMBER	DATE	APPARENT CAUSE	PROPAGATING CAUSE	ORIGINATING CAUSE (why apparent cause happened)
MC96004304	11-Oct-95	Pilot error, failing to maneuver to effect safe margin for passing agreement resulting in collision of two tows.	1) Failure to make visual sighting relying solely on radar. 2) Restricted visibility of tow pushing light barge with 35 ft of freeboard	Pilot negligence, arranging unnecessary and dangerous starboard to starboard passing agreement at close range with high relative closing speed (20+ knots)
MC96004840	2-Apr-96	Crack in side plate of undetermined cause	Not developed in case	Not developed in case
MC96007088	9-May-96	Crack in side plate of undetermined cause	Not developed in case	Not developed in case
MC96007674	26-May-96	Uncertain combination of known and unknown factors	Stress forces due to poor loading procedures.	Insufficient hull design standards
MC96007906	19-Apr-96	Grounding due to loss of orientation	Sudden severe hail storm	Inability of operator to maintain orientation using radar in heavy /sudden weather change.
MC96011088	24-Jul-96	Crack in cargo tank	Possible corrosion problem	Root cause not developed in CG investigation
MC96011712	6-Aug-96	Overpressure of cargo tank due to cargo reaction with water leaking through wastage holes in tank top, resulting in hull failure.	Unrepaired wastage holes in tank tops	Failure to detect and repair wastage holes in routine company maintenance and USCG inspections
MC96014139	9-Sep-96	Loss of control in strong head current transiting lock, allided with lock.	1) Strong head current (6 knots) MC case failed to probe issue of possible tow-tug HP mismatch.	MC case did not probe
MC96015448	21-Jun-96	Collision between two tows	No passing agreed to Failure to follow the rules of the road on giving way Failure to monitor radio Failure to maintain lookout Drug/alcohol use	Behavior - Failure to follow rules of the road Behavior - Negligent operating practice Mgmt - Failure of USCG investigation to develop information on company drug/alcohol policy
MC96016415	31-Oct-96	Pilot error navigating river bend, went aground.	1) Fast current (3 knots) 2) Unfamiliar with river (one transit 4 years prior) 3) Navigating at night on unfamiliar waterway. 4) Difficult bends in river.	1) Voyage plan failed to account for cumulative risk factors [P1 - P4]. 2) Company assigned unfamiliar operator in situation with combined risk factors.
MC96017324	24-Nov-96	Tow grounded due to inattention to navigation	Distraction by off-watch captain High risk situation: passing, bend, strong current	Behavior - Failure to follow good nav practices Behavior - Failure to follow good company policy
MC96018799	12-Dec-96	Crack in hull, probable grounding en route	Not developed in case	Not developed in case
MC97001651	15-Jan-97	Tow grounded due to nav error	Failure to fix position ATON missing	Behavior - failure to follow good navigational practices Mgmt - failure of USCG investigation to probe the mgmt policy on navigation Work Environment - failure of USCG investigation to probe the missing ATON process (detection/correction)
MC97003749	15-Mar-97	Intentional grounding of 2 barge tow after loss of vessel control in current	Very high water w/10 knot current	Not enough information MC case did not probe why tow got underway in high risk posed by heavy current
MC97003800	17-Mar-97	Loss of control of tow resulting in allision with bridge.	Fast current due to high river stage (witness statements and MVPS)	Insufficient HP for 25 barge tow in fast current on downbound river transit.

CASE NUMBER	DATE	APPARENT CAUSE	PROPAGATING CAUSE	ORIGINATING CAUSE (why apparent cause happened)
MC97004664	3-Apr-97	Allision of tow with moored vessels in fleeting area, resulting from maneuver when forced into extremis by 3rd tow. Oncoming tow failed to respond to security calls	Radar return w/lock hindered by structures/levees.	Behavior - Failure to observe good radio communications by oncoming tow operator Prevailing heavy radio traffic & interference
MC97004972	7-Apr-97	Puncture in hull discovered while loading	Not developed in case	Root cause not developed in CG investigation
MC97005467	20-Mar-97	Gash in side shell, discovered while mooring	Not developed in case	Root cause not developed in CG investigation
MC97005981	29-Apr-97	Crack in bottom plate, grounding or submerged object	Not developed in case	Root cause not developed in CG investigation

Appendix D:

Possible Preventative Actions

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
	Management				
M1	Policy for voyage planning to assess risk of currents expected versus the HP to tow size ratio	High	Low	Medium	MC92000880
M2	Policy for voyage planning to assess risk of high wind and effect on HP to tow size ratio and develop voyage constraints	High	Low	Medium	MC92004074
M3	Policy on reporting and repairing failures in vessel control systems and high risk maintenance problems	High	Low	Medium	MC93006356
M4	Policy on risk factors to consider when contemplating passing in a channel	High	Low	Medium	MC93014220
M5	Policy on evaluating risk and reinforcing mooring lines in high ice/current situations	Medium	Low	Medium	MC94001627
M6	Procedures for determining tow Hp per DWT in high/swift water conditions	High	Low	High	MC95009838
M7	Policy on voyage planning should address possible unforeseen risks when changing operating routine.	High	Low	High	MC96001123
M8	ABS consider improving ABS rules for building/classing on Rivers and ICWW	High	Medium	Medium	MC96007674
M9	USCG consider changes to 46 CFR 31 (loading guidance tank barges >175'); 46 CFR 42 & 45 (define "unacceptable stresses"); 46 CFR 32 (limit compressive stress in any loading conditions).	High	Low	Medium	MC96007674

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
M10	Owner/surveyor policy on reporting damage of inspected vessels to OCMI	High	Low	High	MC96004119
M11	Owner procedures for repairing damage discovered in surveys/inspections	High	Medium	High	MC96004119
M12	USCG evaluate procedures for internal examination of tank barges to ensure detection of observable damage	High	Low	High	MC96004119
M13	Policy on assigning masters and mates must consider experience and ability to manage risks expected in voyage planning	High	Low	High	MC96016415
M14	Policy to specify risk factors to consider in voyage planning	High	Low	High	MC96016415
M15	Policy on prompt ordering of defective tow rope	High	Low	High	MC94000365
M16	Policy on prompt replacement of defective tow rope when delivered	High	Low	High	MC94000365
M17	Policy on recording/communicating/resolving critical repairs when changing masters	High	Low	High	MC94000365
M18	Policy on effective maintenance management for tow rope and towing equipment	High	Low	High	MC94000365
M19	Policy on voyage planning to identify and minimize risks due to critical towing systems before getting underway	High	Low	High	MC94000365

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
M20	Policy on procedures for underway repairs to parted tow ropes	High	Low	High	MC94000365
M21	Policy on complying with hazard reporting requirements of 33 CFR	Medium	Low	High	MC94000365
M22	Pilots association to develop guidelines limiting vessel speed during overtaking and restricting deep draft vessels from overtaking tug/tow or deep draft vessels in channel	High	Low	Medium	MC95006398
M23	USCG/industry group identify all possible navigational hazards for Coast Pilot and information dissemination	High	High	Low	MC95006398
M24	Pilots association develop information for pre-underway procedures and policy	High			MC95006398
M25	Policy on procedures for reporting, responding to and investigating possible hull damage when suspected by operators	High	Low	High	MC95006828
M26	Clarify USCG policy to require investigations of tank barge groundings in all US waters.	High	Low	High	MC95000990
M27	Policy on voyage planning to assess ability to maintain vessel control in expected conditions	High	Low	High	MC97003749
M28	Procedure for intentional groundings	Medium	Low	High	MC97003749
M29	Procedures for handling tow in extreme current	Medium	Low	High	MC97003749

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
M30	Policy on Hp needed for effective vessel control in high river/fast current	High	Low	High	MC97003800
M31	Company investigate why wastage holes undetected and/or unrepaired, and improve routine maintenance procedures	Medium	Low	High	MC96011712
M32	USCG OCMI investigate why wastage holes not detected in regular tank barge inspection/examination and improve inspection procedures	Medium	Low	High	MC96011712
M33	USCG OCMI review and improve investigation process to ensure effectiveness of USCG inspection process is evaluated in cases involving hull maintenance	Medium	Low	High	MC96011712
M34	Policy to fire/suspend any master or mate found to be a negligent navigator	High	Low	High	MC96004304
M35	Publish document identifying navigation hazards in routine operating areas, with guidelines for navigating to maintain control under various tow configurations/sizes	High	Low	High	MC92000635
	Environment				
E1	Bridge fender repairs may have reduced amount of spill	Low	Medium	Medium	MC93006205
E2	Vessel traffic controls restricting passing maneuvers in higher risk sectors of channel (e.g. bends)	High	Low	Medium	MC93014220
E3	USCG execute UMIB to alert mariners and facilities on high risk ice/current conditions	Medium	Low	Medium	MC94001627

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
E4	USCG broadcast UMIB for tows in high/swift water conditions	Medium	Low	High	MC95009838
E5	Clarify Army Corps of Engineers policy on Broadcast Notice to mariners with regard to removal of channel obstructions or any channel hazards	High	Low	Medium	MC93022224
E6	Clarify Army Corps of Engineers policy on Broadcast Notice to mariners with regard to removal of channel obstructions or any channel hazards	High	Low	Medium	MC93020228
E8	Form Industry/USCG/ACOE "regional partnerships" to assess and correct unexpected hazards in waterways and establish new planning approach to avoid unintended consequences of ACOE and other waterways projects.	High	Medium	High	MC92000635

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
	Behavior				
B1	Training on situational awareness that current would overpower tow with low HP	High	Medium	Medium	MC92000880
B2	Training on situational awareness that high wind could overpower tow during mooring operations	High	Medium	Medium	MC92004074
B3	Training on situational awareness and overconfidence in high risk maneuvers	High	Medium	Medium	MC93006205
B4	Training to recognize risk factors associated with maintenance and vessel control	High	Medium	Medium	MC93006356
B5	Training on recognizing accumulating risk factors (passing, bend in river, horsepower constraints)	High	Medium	Medium	MC93014220
B6	Training to improve situational awareness to consider risk factors (e.g. high wind, cold) when making up tow	High	Medium	Medium	MC94000268
B7	Training to improve situational awareness about risk factors posing high risk of barge breakaways	Medium	Medium	Medium	MC94001627
B8	Training on awareness of risk factors in maneuvering while making up tow	Medium	Medium	Medium	MC95004084
B9	Training on anticipating/evaluating Hp requirements in high/swift water conditions during voyage planning	High	Medium	High	MC95009838

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
B10	Training on new operations risks before being assigned to pilot deeper draft tows	High	Medium	High	MC96001123
B11	Standing orders on use of multiple navigation tools for piloting	High	Medium	High	MC96001123
B12	Pilots should evaluate their fitness for assignment in voyage planning with management	High	Low	High	MC96016415
B13	Pilots need to recognize accumulating risk factors while navigating	High	Low	High	MC96016415
B14	Training on effective underway repairs and operations after parted tow rope	High	Medium	High	MC94000365
B15	Training on recognizing danger indications when watching how tow is tending	High	Medium	High	MC94000365
B16	Training on maintenance of towing system	High	Medium	High	MC94000365
B17	Training on identifying and reducing risks during voyage planning	High	Medium	High	MC94000365
B18	Pilots association develop training program for pilots concerning hydrodynamic effect of restricted channel on deep draft vessel	Medium	Medium	Medium	MC95006398
B19	Pilots association provide professional training review for overtaking in narrow channel with regards to safe speed and channel effects.	Medium	Medium	Medium	MC95006398

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
B20	Tanker company develop training program for masters concerning hydrodynamic effects of restricted channel on deep draft vessels	High	Medium	Medium	MC95006398
B21	Training for operators on procedures for reporting, responding to and investigating possible hull damage when suspected by operators	High	Medium	High	MC95006828
B22	Training on assessing ability to maintain control of tow under risk conditions identified in voyage planning	High	Medium	High	MC97003749
B23	Training on tow handling and emergency procedures in fast current	Medium	Medium	Medium	MC97003749
B24	Training for pilots on navigating in fast river conditions	High	Medium	High	MC97003800
B25	Standing orders for masters/crew on safe passing procedures	High	Medium	High	MC96004304
B26	Train all pilots and mates on operational area navigation hazards and related "vessel control" guidelines.	High	Medium	High	MC92000635

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
	Technology				
T1	Double hull would likely have prevented casualty	High	High	Medium	MC92004074
T2	Double hull would likely have prevented casualty	High	High	Medium	MC92007501
T3	Double hull would likely have prevented casualty	High	High	Medium	MC93006356
T4	Double hull would likely have prevented casualty	High	High	Medium	MC94000268
T5	Double hull would likely have prevented casualty	High	High	Medium	MC94001627
T6	Double hull would likely have prevented casualty	High	High	Medium	MC95004084
T7	Double hull would likely have prevented casualty	High	High	Medium	MC96001123
T8	Double hull would likely have prevented casualty	High	High	Medium	MC93022224
T9	Double hull would likely have prevented casualty	High	High	Medium	MC93020228

Possible Preventative Actions

Number		Risk Control	Cost	Feasibility	MC Number
T10	Model the casualty to determine probability of loss of control in large tow/fast current scenario	Medium	Medium	High	MC97003800
T11	Model river stage conditions on simulator to determine problems locations and Hp requirements	High	Low	High	MC97003800