REPORT OF THE COAST GUARD-AWO QUALITY ACTION TEAM ON TOWING VESSEL CREW FATALITIES

JULY 26, 1996

Executive Summary

The Quality Action Team (QAT) on Towing Vessel Crew Fatalities was chartered in November 1995 as the first subject-specific QAT to be established under the auspices of the Coast Guard-AWO Safety Partnership. Inaugurated in September 1995, the Coast Guard-AWO Safety Partnership centers around a National Quality Steering Committee (QSC), a small group of senior Coast Guard and barge and towing industry leaders whose principal function is to identify safety or environmental protection problems of national scope for cooperative Coast Guard-industry attention. The QSC's selection of towing vessel crew fatalities as the focus of the first national QAT to be chartered under the new partnership stems from its view that safety of life at sea is, and must be, the paramount marine safety concern of both the Coast Guard and the marine transportation industry. The QSC's decision to charter the Towing Vessel Crew Fatalities QAT reflected its view that the cooperative, non-regulatory process of analysis and problem-solving envisioned by the Coast Guard-AWO Safety Partnership is the most effective way to address such human factors concerns.

Co-chaired by team leaders CAPT Scott Cooper, Chief, Investigation and Analysis Division, Coast Guard Headquarters, and Mr. Steve Frasher, Senior Vice President-Operations, Midland Enterprises, Inc., the QAT brought together participants from the inland towing industry, U.S. Coast Guard Headquarters and field units, the Army Corps of Engineers, and the Tennessee Valley Authority. The QAT conducted its work between November 1995 and July 1996, undertaking what the team believes to be the most comprehensive effort launched to date to gather data on the incidence and causes of inland towing vessel crew fatalities and to develop recommendations to eliminate such incidents. The report includes a review of relevant literature and previous studies of note; a quantitative analysis of casualty data from the Coast Guard's Marine Safety Management System (MSMS) database for the 10-year period 1985-1994; an analysis of 19 fall overboard case studies which shed further light on the causes of inland towing vessel crew fatalities; conclusions and recommendations; and an epilogue focusing on the elusive but essential concept of safety "culture" in fostering an accident- and fatality-free workplace. Among the five Appendices to the report is a compilation of "Best Practices," measures which some inland towing companies are employing to reduce the risk of fall overboard incidents and which may be suitable for incorporation in company fall prevention programs.

The scope of the QAT's analysis was specifically focused on fatalities in the inland towing industry (essentially the Mississippi and Ohio River systems and the Gulf Intracoastal Waterway from Brownsville, Texas, to St. Marks, Florida) for the years 1985-1994, the last 10-year period for which complete statistics are available. During this period, there were 136 inland towing vessel employee fatalities, generating an annualized average fatality rate of 68 per 100,000 employees. Vessel employees classified as deck crew suffered a fatality rate more than twice that of all other towing vessel crewmembers (88/100,000 employees vs. 39/100,000 employees).

Corroborating the findings of previous studies conducted by Mercer Management Consulting, Inc., and the National Transportation Safety Board, a minority (22 percent, or 30) of inland

towing vessel crew fatalities resulted from vessel casualties such as collisions, fires, capsizings, and the like. Strikingly, of the 106 fatalities not resulting from vessel casualties, some 83 percent resulted from crewmembers falling overboard from a boat or barge. Deck crewmembers suffered a higher number of fatalities from falls overboard than any other crew position, with deck crewmembers under the age of 25 incurring the highest fatality rate of any other age category. With respect to experience, deck crewmembers with less than one year of towing industry experience suffered the highest fatality rate.

The QAT's analysis revealed that falls overboard resulting in fatality tend to occur in roughly equal numbers from barges and towing vessels; generally during clear weather; at any time, night or day; while the vessel is underway; and during the performance of routine tasks, such as line handling, deck maintenance, or moving on the vessel. Only seven fatalities during the 10-year study period occurred during locking operations. While more than one-third of crewmembers suffering fall overboard fatalities were reported to have been wearing a personal flotation device (PFD) at the time of the casualty, no conclusion was possible concerning the question of whether PFD use increased survivability when a fall overboard did occur.

The QAT's analysis supports the conclusion that the towing vessel environment is a dynamic workplace with inherent hazards, most prominent among them the need for crewmembers to regularly perform routine tasks in close proximity to the edge of a boat or barge. While Coast Guard and Corps of Engineers casualty data does not allow for in-depth analysis of the causes of fall overboard incidents and fatalities, the QAT was able to identify a list of key causal factors which contribute to fall overboard incidents in the inland towing industry, based on the empirical evidence provided through its review of company-furnished fall overboard case studies. Those factors include: lack of orientation or training, including skill assessment; lack of planning or pre-briefing for routine maneuvers, including a clear assignment of individual responsibilities; violation of or absence of company policies and procedures, in particular policies dealing with communication, safe work practices, and teamwork; lack of supervision or inadequate supervision; lack of communication; taking shortcuts; failure to use available safety equipment; and lapses in situational awareness.

The QAT believes that these causal factors can be addressed and the incidence of towing vessel crew fatalities reduced through a four-part program encompassing prevention measures, collection and dissemination of lessons learned, improved investigation and data collection techniques, and regular assessment of towing industry performance over time using a fatality rate model developed in this study. Key recommendations made by the QAT include the following:

- Barge and towing companies should develop and implement a fall overboard prevention program as part of an overall company safety management program (e.g., the AWO Responsible Carrier Program), incorporating seven essential elements laid out in the QAT report;

- AWO should add to its Responsible Carrier Program a requirement for company fall overboard prevention programs;

REPORT OF THE COAST GUARD-AWO QUALITY ACTION TEAM ON TOWING VESSEL CREW FATALITIES

July 26, 1996

Introduction

The Coast Guard-AWO Safety Partnership was established in September 1995 to strengthen the working relationship between the Coast Guard and the barge and towing industry and to provide a mechanism for cooperative Coast Guard-AWO action aimed at advancing the two organizations' mutual goals of enhanced marine safety and environmental protection. A memorandum of understanding signed September 19, 1995, by Rear Admiral J. C. Card, Chief, Marine Safety and Environmental Protection, U.S. Coast Guard, and AWO President Thomas Allegretti lays out the structure of the safety partnership, which centers around the Coast Guard-AWO National Quality Steering Committee (QSC). The National QSC is a small group of senior Coast Guard and AWO leaders whose principal function is to identify safety or environmental protection problems of national scope and to establish subject-specific Quality Action Teams (QATs) comprised of Coast Guard and industry experts to analyze the issues and develop recommended process improvements based on total quality management principles. The National Quality Steering Committee held its inaugural meeting in November 1995 and selected the issue of inland towing vessel crew fatalities as the first subject for cooperative Coast Guard-industry attention via this new process. A copy of the charter establishing the QAT is included as Appendix A.

The QSC's selection of towing vessel crew fatalities as the focus of the first national QAT to be established under the auspices of the Coast Guard-AWO Safety Partnership was based on its view that safety of life at sea is, and must be, the paramount marine safety concern of both the Coast Guard and the marine transportation industry. The necessity of reducing crew fatalities and injuries is a principal focus of the Coast Guard's Marine Safety Business Plan and the agency's ongoing "Prevention Through People" initiative. In addition, the August 1994 "Evaluation of Casualty Incidents for the U.S. Towing Industry, 1981-1990," conducted for AWO by Mercer Management Consulting, Inc., identified towing vessel crew fatalities (and specifically deckhand fatalities on inland towing vessels) as one of two priority safety issues for industry attention. The QSC's decision to charter the Towing Vessel Crew Fatalities QAT reflected its view that the cooperative, non-regulatory process of analysis and problem-solving envisioned by the Coast Guard-AWO Safety Partnership is the most effective way to address such human factors concerns.

The Towing Vessel Crew Fatalities QAT conducted its work between November 1995 and July 1996. This report details the results of the QAT's research and analysis and represents what the QAT believes to be the most comprehensive effort undertaken to date to gather data on the incidence and causes of inland towing vessel crew fatalities and to develop recommendations to eliminate such incidents. To that end, the report makes six major contributions:

1. ***Quantitative Analysis***
   Using U.S. Coast Guard data accumulated for the 10-year period ending in 1994, this report quantifies the total number, frequency, and trends in employee fatalities in the inland towing industry;

2. ***Fatality Awareness***
   Quality principles applied to this quantitative analysis aid in the identification of the primary causes of fatalities as well as the class of employee at greatest risk of fatal injury;

3. ***Case Studies***
   This report provides an analysis of 19 actual case studies that either resulted in or could have resulted in a fatality, allowing for the identification of key causal factors which may lead to inland towing vessel crew fatalities;

4. ***Best Practices***
   A collection of policies and procedures used in the inland towing industry today and directed toward eliminating fatalities associated with fall overboard situations are included in this report as Appendix E;

5. ***Prevention Program***
   The report concludes with recommendations aimed at elimination of employee fatalities as well as a data collection and reporting process to be put into place for measurement of future results; and,

6. ***Template for Further Examination***
   This report specifically targets inland towing vessel operations. Recognizing that fatalities also occur in the coastal, Great Lakes, and other marine environments, this report may be used as a template for further examination by interested parties into fatality-prevention programs directed at other segments of the barge and towing industry or other marine trades.

The inland towing industry, its customers, the Coast Guard, and society as a whole have a vested interest in the development and implementation of effective programs aimed at the elimination of towing vessel crew fatalities. This report represents the QAT's best effort to advance this important marine safety objective using the quality process and the cooperative approach embodied in the Coast Guard-AWO Safety Partnership.

Analysis of Prior Studies/Literature Review

General

The team conducted a search for previous works that addressed safety in the towing industry. As the statistical analysis of deck crew fatalities evolved, the team's attention focused specifically on falls overboard of crew members performing certain kinds of deck activities. Topical searches were conducted of holdings at the National Safety Council, the Department of Transportation (DOT) Library, the Organization of Economic Cooperation and Development, and the U. S. Coast Guard Headquarters. A bibliography of pertinent works is attached at Appendix B. While the industry has benefited from numerous books and other documents on a variety of safety issues, few dealt with the crew safety concerns identified. However, two studies deserve consideration and are discussed below. Additionally, the American Waterways Operators' Responsible Carrier Program is highlighted because of its present utility and potential to deal specifically with procedures, standards and training issues addressing crew safety.

Review of Pertinent Safety Studies

1. *Study of Towing Vessel Safety and Accident Preventive Recommendations*, National Transportation Safety Board Study, 1969.

   a) Summary: This study evaluated the safety record of the uninspected towing vessel fleet based on Coast Guard statistical records for the period 1965 to 1968, an analysis of narrative reports of fatalities, and ten "typical" casualty case studies. Relevant findings revealed that falls overboard were the greatest single cause of fatalities -- about 78% of those not attributed to vessel casualties and that "a significant proportion" of casualties involved personnel errors. The Safety Board recommended that the Coast Guard improve the quality of its casualty database, seek legislation to require licensing of operators of uninspected towing vessels, study ways to reduce falls overboard, and determine the number of operators employed in the towing industry.

   b) Analysis: The study's results, when compared to the statistical analysis presented later in this report, suggest that risks to towing vessel deck crews have not changed materially over the past 25 years or so. The team notes that fatality trends have persisted despite a generally more enlightened and proactive effort on the part of many companies to improve safety through training, incentive programs, and other quality management initiatives. The persistent nature of the fatality rate prompted the team to carefully consider both workplace risks and the human response to those risks in its analysis of causal factors.

2. *Evaluation of Casualty Incidents for the U.S. Towing Industry 1981-1990*, Mercer Management Consulting study commissioned by AWO, 1994.

a) Summary: AWO engaged Mercer Management Consulting (Mercer) "to perform an analysis that could contribute to the effectiveness of ongoing efforts to enhance the safety of the U.S. towing industry."[1] Mercer analyzed vessel and personnel casualties for causes and for evidence that would indicate whether uninspected towing vessels were less safe than inspected vessels. Mercer was also asked to determine the size of the towing industry work force. The evaluation provided a comprehensive assessment of casualties in the offshore and inland towing fleets for the specified period and developed a reliable methodology for determining the towing industry work force by sorting the towing vessel population by size and operating area and by applying carefully determined assumptions about crew sizes and vessel utilization within these categories. The study also determined that casualties related to the material condition of towing vessels were a relatively low percentage (17%) of all vessel casualties which occurred during the period. Personnel casualties unrelated to vessel casualties accounted for 66% of all fatalities, and deckhands accounted for 79% of those deaths. Furthermore, nearly 80% of deckhand deaths were directly attributable to falls and accidents related to barge work. The Mercer study concluded,

> . . . [a] critical areas for industry attention is towboat deckhand activities aboard dry cargo hopper barges on the inland waterways. While supporting data is incomplete, many of the personnel casualties on towing vessels appear to involve deckhands on smaller and mid-sized towboats operating near ports where barges are being shifted and fleeted to and from tows for loading or discharging.[2]

Mercer attributed crew risks to the "unique nature of towing vessel operations [which] exposes crew to both vessel- and personnel-related casualties."[3] It highlighted narrow deck edges, hazards associated with deck and mooring gear, and conditions which create slipping risks.

b) Analysis: The team carefully reviewed the Mercer work force model as a basis for determining the rates of the various types and causes of fatalities, for measuring the impacts of safety initiatives, and for monitoring trends in the future. Although the study's scope dealt with all sectors of the towing industry, the model's basic validity allowed the team to assess the inland work force with a high degree of confidence. The work force figures permitted an effective comparison of casualty counts to populations and an accurate understanding of historic casualty rates.

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[1] Mercer Management Consulting, Inc. *Evaluation on Casualty Incidents for the U.S. Towing Industry, 1981-1990*, pg. I-1.
[2] Mercer, pg. II-8.
[3] Mercer, pg. II-6.

Used in this way, the model will provide a consistent mechanism for measuring future trends and determining safety program effectiveness for specific duties aboard towing vessels within specific segments of the industry.

3. *AWO Responsible Carrier Program*, American Waterways Operators Board of Directors, 1994.

a) Summary: The Responsible Carrier Program is a code of recommended practices for barge and towing companies which has three principal parts -- management and administration, equipment and inspection, and human factors -- reflecting the role which each of these components plays in ensuring safe and efficient vessel operations. The program is intended to serve as a template for AWO member companies to use in developing company-specific safety programs which are "consistent with applicable law or regulation, which incorporate sound operating principles and practices. . ., and which are practical and flexible enough to reflect a company's unique operational needs."[4]

b) Analysis: The Responsible Carrier Program is an easy-to-use and highly regarded guide for safety plan development. Its general acceptance by major towing companies makes it a convenient tool to establish and disseminate consensus-based standards for safety improvements within the industry. While non-AWO member companies may not have access to guidance provided in the program, guidelines dealing with fall overboard prevention can be borrowed and communicated via other means.

Statistical Methodology and Analysis

Data Sources

The data in this study were compiled primarily from the U. S. Coast Guard Marine Safety Management System (MSMS) database, which is managed by the Marine Safety and Environmental Protection program at Coast Guard Headquarters. The MSMS database, in part, contains data regarding marine casualties of which the Coast Guard received notification and into which the Coast Guard conducted some level of investigation. This database is derived from information entered into the Coast Guard Marine Safety Information System (MSIS), which is the primary computer record of all Coast Guard marine safety activities. MSMS and MSIS are the main data sources for all inquiries regarding Coast Guard marine safety activities. (For a glossary of terms used in this section, please see Appendix C.)

Data on inland towing industry workforce size (used to determine fatality rates) comes from a model presented by Mercer Management Consulting, Inc., in its 1994 report to the American

[4] American Waterways Operators Responsible Carrier Program, p. I-2.

Waterways Operators.[5] The Mercer model predicts work force size based upon four variable inputs, segregated by vessel horsepower ranges:

1. Number of towing vessels in operation;
2. Average crew size per vessel;
3. Utilization rate of vessel;[6]
4. Number of occupied billets.[7]

Data on deck crew work force distribution by age and experience were compiled from a survey of seven inland towing companies representing a cross-section of the industry, from small fleet boats to large line-haul vessels.

Study Scope

The scope of the study was specifically limited to fatalities in the inland towing industry for the 10-year period from January 1, 1985, to December 31, 1994. The search criteria were as follows:

1. Fatalities occurring on vessels operating in the waters of the Second, Eighth and Ninth Coast Guard Districts -- essentially the Mississippi and Ohio River systems and the Gulf Intracoastal Waterway from Brownsville, Texas, to St. Marks, Florida. The study excluded the Great Lakes and their connecting waterways; the Gulf of Mexico; lakes, bays and sounds contiguous to the Gulf of Mexico; and other rivers and waterways on the East, West and Gulf coasts.

2. Fatalities of vessel crew members who were directly engaged in or associated with routine inland towing operations -- excluding fatalities of shoreside and facility personnel, contract workers and government employees.

3. Fatalities occurring on the job, but not as a result of natural causes, suicide or homicide.

4. Fatalities occurring on vessels directly associated with the inland towing industry. Specifically excluded were fatalities on vessels identified in the database as being used for recreational or other non-towing activities at the time of the fatality. The study also did not include fatalities on vessels used for dredging, salvage, construction or any other operation not directly tied to towing, or on barges certificated and in service as passenger vessels at the time of the fatality.

The above criteria yielded a total of 136 fatalities over the 10-year study period among personnel employed as crew members on vessels in the inland towing industry as defined above. The

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[5] Mercer, "Appendix D--Towing Industry Regional Employment Model," (Western Rivers, East Gulf, and West Gulf regional segments).

[6] Percentage of available hours per year that the vessel was in manned status.

[7] Defined as the number of crew employees per position needed to ensure a full crew complement, considering days off, vacations, watch rotations, etc.

physical record of each of these cases was examined in order to verify information, fill in missing data, address inconsistencies and develop lessons learned.

Data Limitations

Certain data limitations were inherent in this study and in the Coast Guard database. Since only the Western Rivers and Gulf Intracoastal Waterway portion of the inland segment of the towing industry was studied, "denominator" data (vessel activity levels, work force size, etc.) was difficult to establish. Usual sources such as the Bureau of Labor Statistics, the Census Bureau and the Army Corps of Engineers do not generally collect and segregate data by this specific industry segment; nor do they uniformly sort by region, vessel type and vessel use. In particular, the following limitations were encountered:

1. Difficulty in determining vessel activity levels (operational tempos) by vessel type, time of year, time of day, or by waterbody on a year-to-year basis. Such data would have allowed analysis of fatality trends in these categories.

2. Inability to determine industry work force employment levels on a year-to-year basis. The Mercer model provided a 1994 "snapshot" of the industry which was extended to the entire period of this study. Hence, the fatality rates among deck crew members and within the industry are averaged over the 10-year period. Year-to-year rate comparisons were not possible.

3. Inability to conduct root causal analysis based upon the data in the Coast Guard database. The database does a good job of outlining "what" happened and is useful for generating fatality profiles, but it does not explain "why" an event happened.

Given these limitations, the following general assumptions were applied to the analysis:

1. Vessel activity level (operational tempo) was constant from year to year.
2. Vessel activity level was evenly distributed over the course of the 24-hour day.
3. Vessel activity level was seasonally constant.
4. Industry employment was at a constant level over the 10-year study period.

Data Analysis

Fatality data was analyzed with respect to the following to determine trends or patterns:

1. Accident cause -- fall into water, struck by, trapped in vessel, jumped, etc.;
2. Accident type -- drown, trauma, smoke inhalation;
3. Casualty type -- vessel or personnel;
4. Crew member activity at time of accident;
5. Crew member age at time of accident;
6. Crew member position;
7. Crew member years of experience in the towing industry;

8. Personal flotation device use -- yes, no or unknown;
9. Time of day;
10. Time of year;
11. Vessel type -- towboat or barge;
12. Vessel operation at time of accident -- fleeting, transiting, mooring;
13. Vessel status -- underway or moored;
14. Waterbody;
15. Weather.

In general, given the assumptions noted earlier, there appeared to be minimal correlation between the incidence of fatality and time of day, time of year, vessel type and weather. Most fatalities occurred during routine operations, while the vessel was underway, in good weather, and were distributed fairly uniformly by time of day and year.

Fatalities were much more strongly correlated with age, experience level, crew position and crew member activity at the time of the fatality. In fact, crew position and crew activity were the most critical predictors of fatality in this data. Deck crew personnel falling into the water while moving on the vessel, handling lines or conducting maintenance constitute the highest percentage of fatalities over the study period.

The following tables and graphs summarize these findings. Fatalities were distributed among vessel types as follows:

Fatalities by Vessel Type

TOTAL FATALITIES 1985-1994 Vessel Type	Total	Percentage
TOWBOAT	80	59%
FREIGHT BARGE	48	35%
TANK BARGE	8	6%
Grand Total	136	100%

Source: USCG Marine Safety Management System database, USCG Headquarters (G-MOA-2)

Table 1

They occurred on the following waterbodies:[8]

Fatalities by Waterbody

Waterbody	Total Fatalities 1985-1994	Waterbody	Total Fatalities 1985-1994
ALABAMA RIVER	2	MERMENTAU RIVER	1
ALLEGHENY RIVER	1	MISSISSIPPI SOUND	3
ARKANSAS RIVER	2	MOBILE RIVER	4
BLACK WARRIOR RIVER	1	MONONGAHELA RIVER	3
CUMBERLAND RIVER	2	OHIO RIVER	21
GICW	6	PORT ALLEN ROUTE	2
HOUSTON SHIP CHNL	4	RED RIVER	2
ILLINOIS RIVER	5	SABINE/NECHES RIVER	1
KANAWHA RIVER	2	TENNESSEE RIVER	2
KASKASKIA RIVER	1	TOMBIGBEE RIVER	1
LAKE FERGUSON	1	UPPER MISS RIVER	14
LAKE PONTCHARTRAIN	2	YAZOO RIVER	1
LOWER MISS RIVER	50	UNKNOWN	1
MCKELLAR LAKE	1	**Grand Total**	136

Source: USCG Marine Safety Management System database, USCG Headquarters (G-MOA-2)

Table 2

Figures 1 and 2, following, show total fatalities by time of day, month and calendar quarter. Trendlines indicate relative trends over the course of the study period. As noted earlier, however, conclusions with respect to relative fatality rates are difficult to make because activity levels for time of day, year or calendar quarter were not known.

[8] No conclusion can be reached with respect to relative waterway risk, since activity levels for each waterway are not known.

Total Fatalities by Time of Day

Count of Hour Segment Hour of Day	Total
00-01	6
01-02	5
02-03	6
03-04	3
04-05	8
05-06	1
06-07	4
07-08	2
08-09	3
09-10	8
10-11	6
11-12	7
12-13	4
13-14	3
14-15	2
15-16	6
16-17	3
17-18	1
18-19	6
19-20	7
20-21	10
21-22	6
22-23	11
23-24	4
UNK	14
Grand Total	136

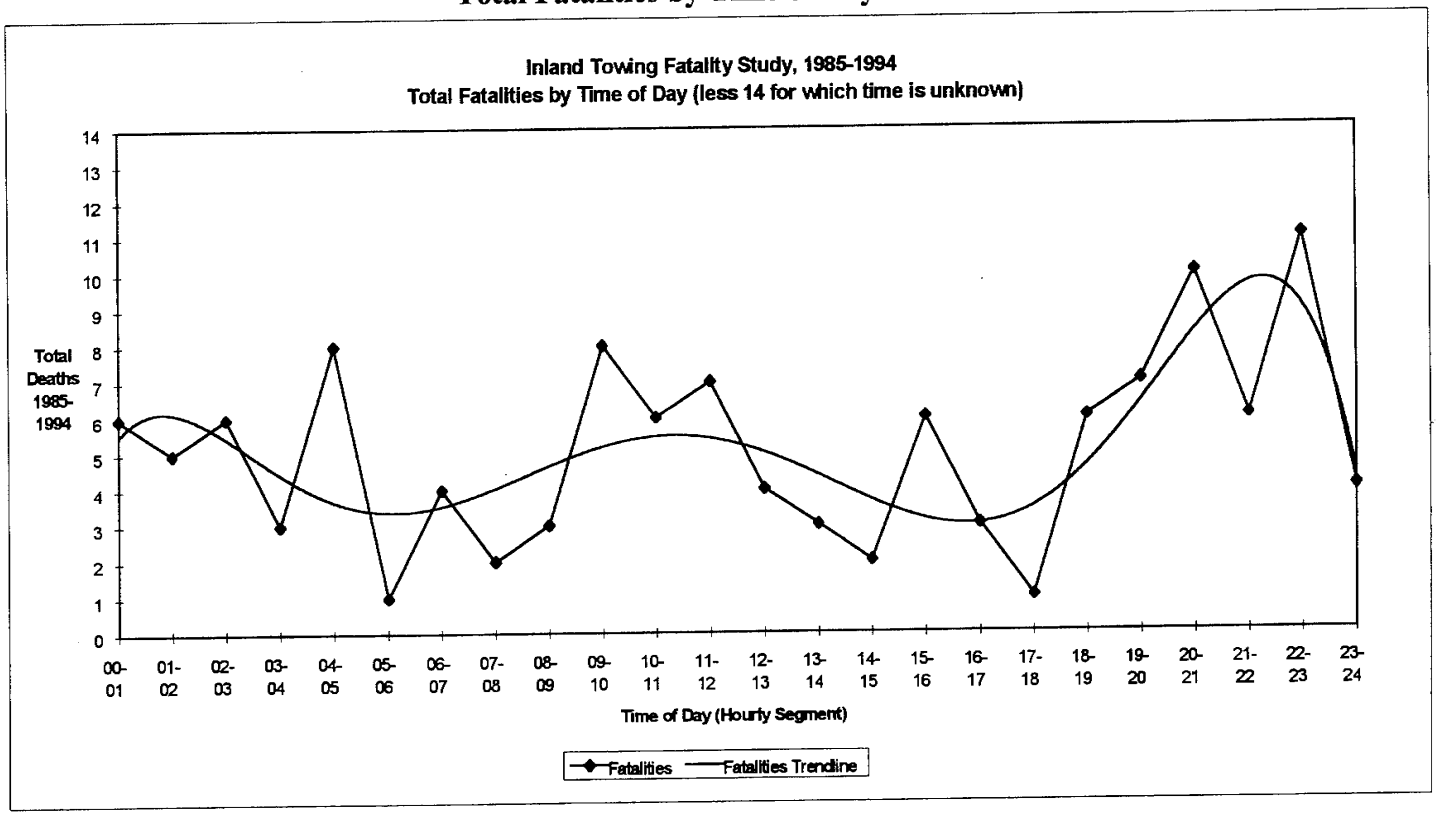
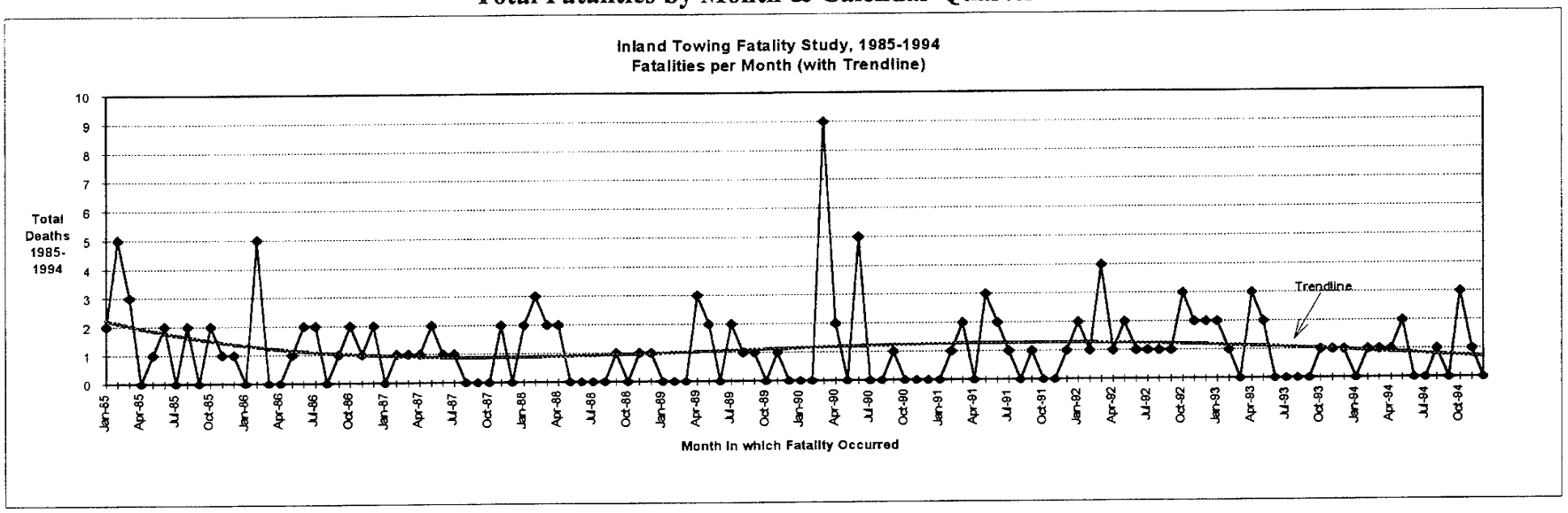


Figure 1

Total Fatalities by Month & Calendar Quarter



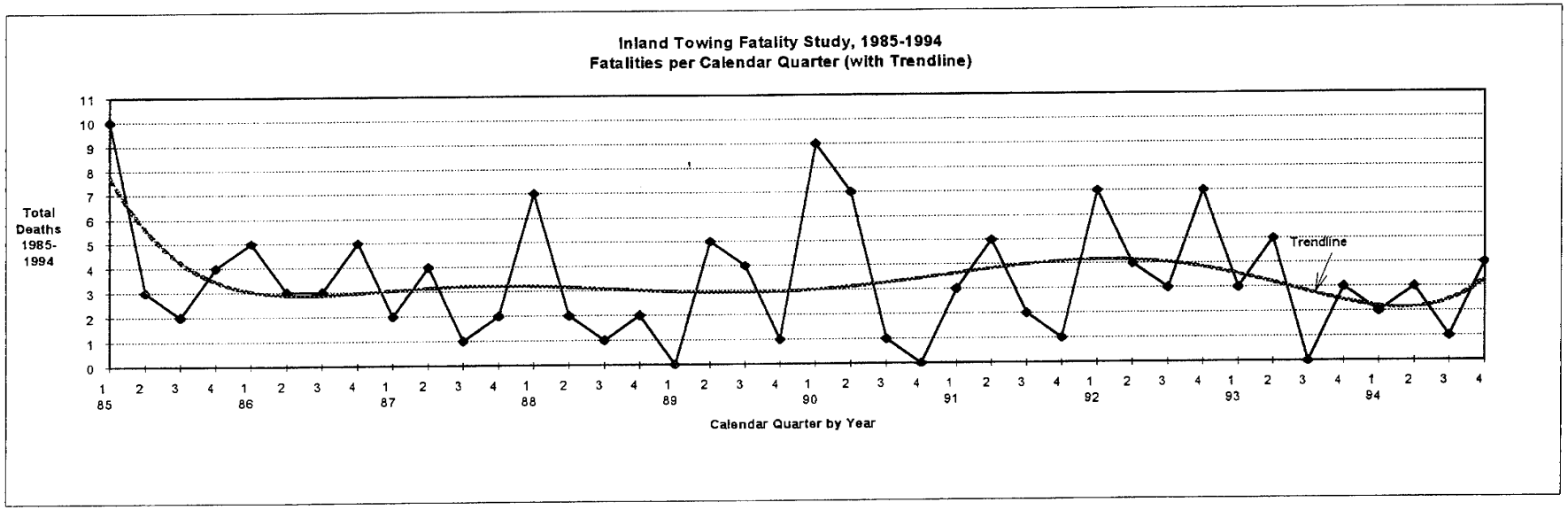


Figure 2

Fatalities by Crew Position & Cause

TOTAL FATALITIES 1985-1994	Position						
Cause	DECK CREW[9]	CAPT/PLT	ENGINEER	TANKERMAN	COOK	UNKNOWN	Grand Total
FALL INTO WATER	75	11	7	2	1	0	96
STRUCK BY	11	1	0	0	0	0	12
TRAPPED IN VESSEL	9	1	1	0	0	0	11
FALL, OTHER	5	0	0	0	0	0	5
JUMPED	1	3	0	0	1	0	5
UNKNOWN	1	1	0	1	0	2	5
ASPHYXIATION	0	1	0	0	0	0	1
EXPLOSION	1	0	0	0	0	0	1
Grand Total	103	18	8	3	2	2	136

Source: USCG Marine Safety Management System database, USCG Headquarters (G-MOA-2)

Table 3

Table 3 lists the distribution of fatalities by crew position and cause. Of note, personnel engaged in deck crew activities accounted for 103 of the 136 fatalities, or 76%. Seventy-five of these 103 deck crew deaths resulted from falls into the water. Thus, deck crew members falling into the water accounted for 55% of all inland towing industry fatalities recorded in the Coast Guard database during the 10-year period of study. Because of this, analysis was focused on these deck crew fatalities in the belief that by doing so, preventive measures could be developed which could be extended to other types of casualties. Moreover, reducing deck crew fatalities would substantially reduce the overall fatality rate in the inland towing industry.

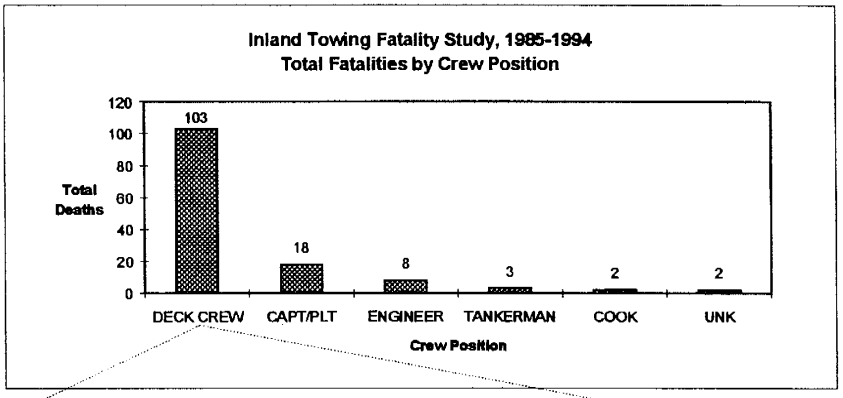
Figure 3 on the following page illustrates the point made earlier that crew position and crew activity were the most critical predictors of fatality.

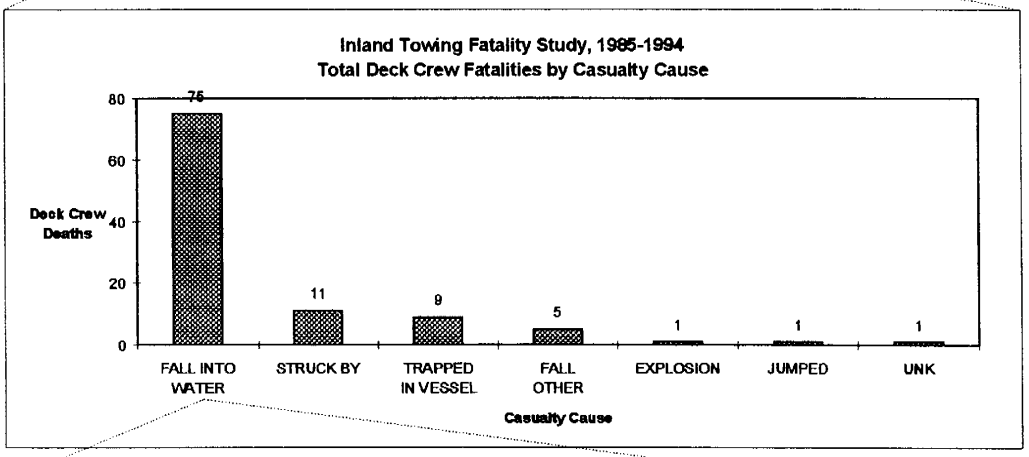
Each graph in the series follows from the one preceding it. The first depicts total fatalities by crew position. The second focuses on the causes of fatalities for just the 103 deck crew deaths. The third highlights the activities of the deck crew members who died subsequent to a fall into the water.

These graphs clearly show that deck crew personnel falling into the water while moving on the vessel, handling lines or conducting maintenance constitute the highest percentage of fatalities over the study period.

[9] Total includes two persons engaged in deck force activities at time of fatality, but not assigned as deck crew.

Fatalities by Position, Cause, & Activity





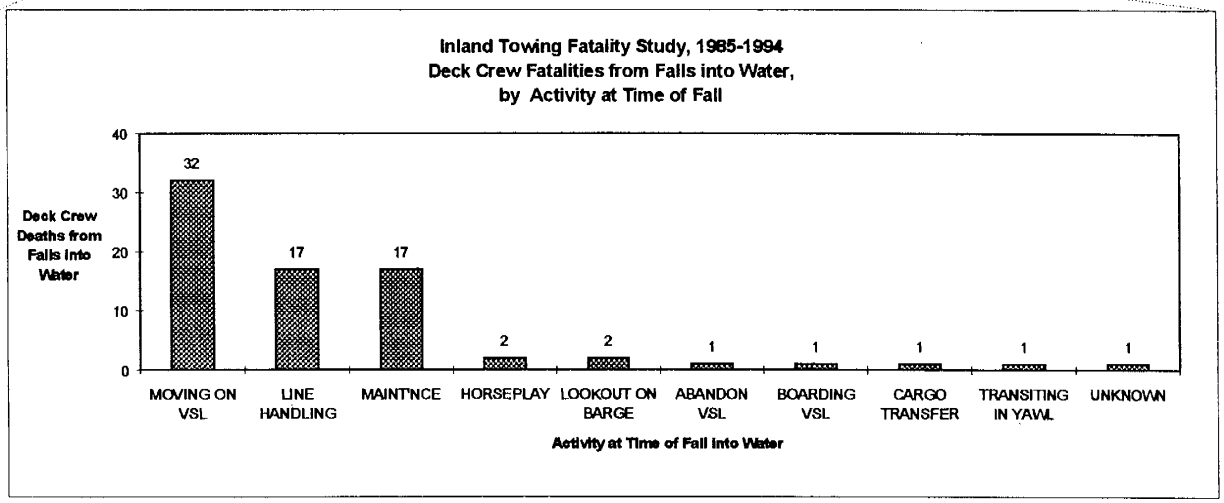


Figure 3

Overall deck crew fatalities and those from falls into water were further analyzed with respect to the following categories:

1. Casualty type
2. Time of day (in 2-hour segments)
3. Accident type
4. Weather condition
5. Vessel status
6. Experience level of deceased
7. PFD use
8. Time of day (day, night or twilight)
9. Age of deceased

The series of pie graphs which follow (Figures 4-12) shows the results of this analysis. Each series also includes a graph showing total fatalities as a point of reference. Since deck crew personnel comprise such a large percentage of the total fatalities (103 of 136), the graphs are quite similar within categories.

Most fatalities were not vessel-related, were evenly distributed by time of day, resulted from drownings, and occurred during good weather while underway. This provides further support to the finding that crew position, activity, experience and age are the most critical fatality predictors.

Casualty Type

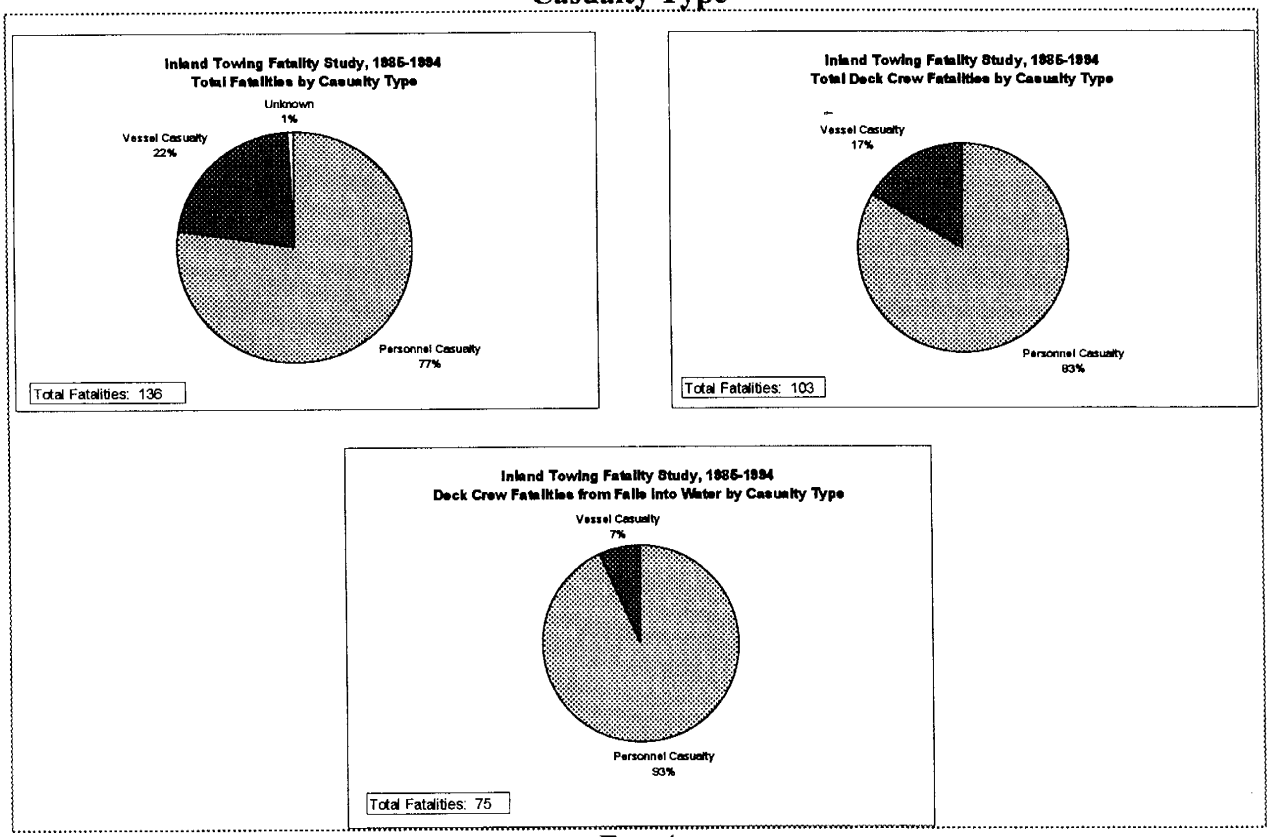


Figure 4

Time Category

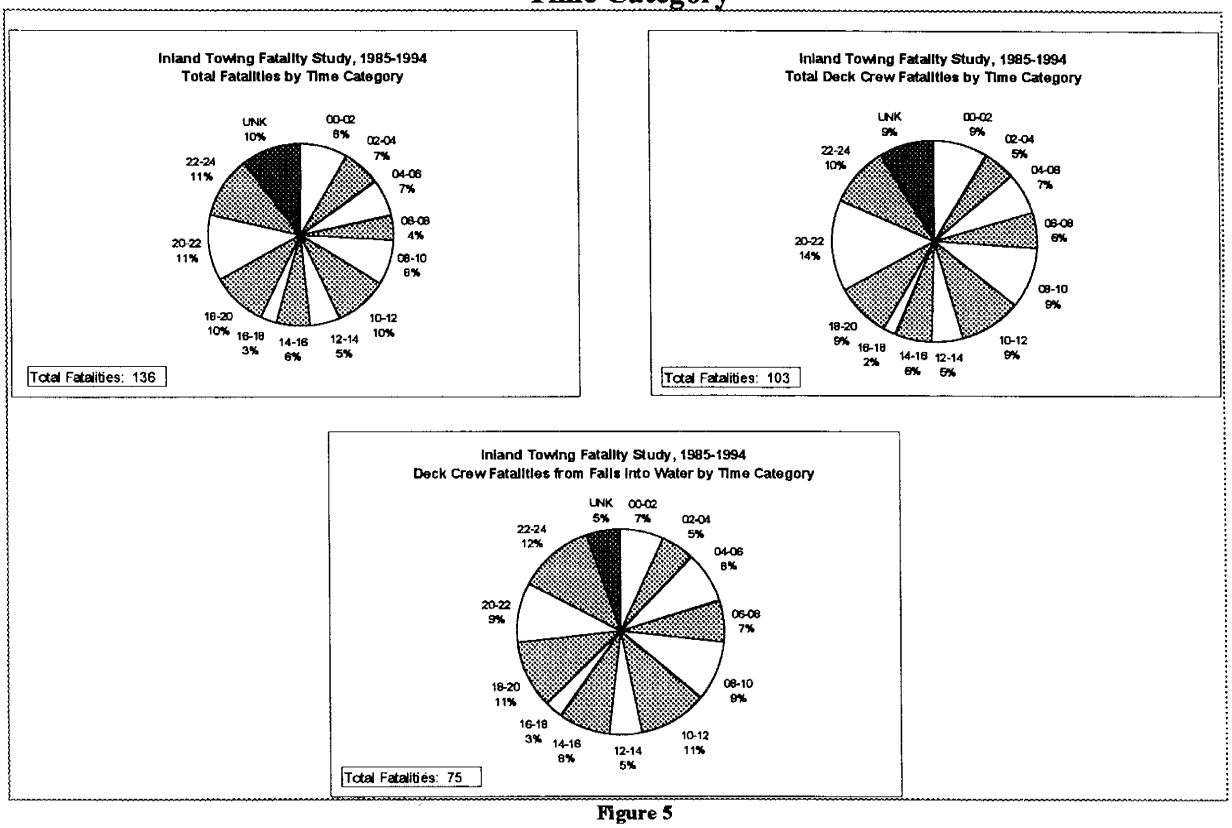


Figure 5

Accident Type

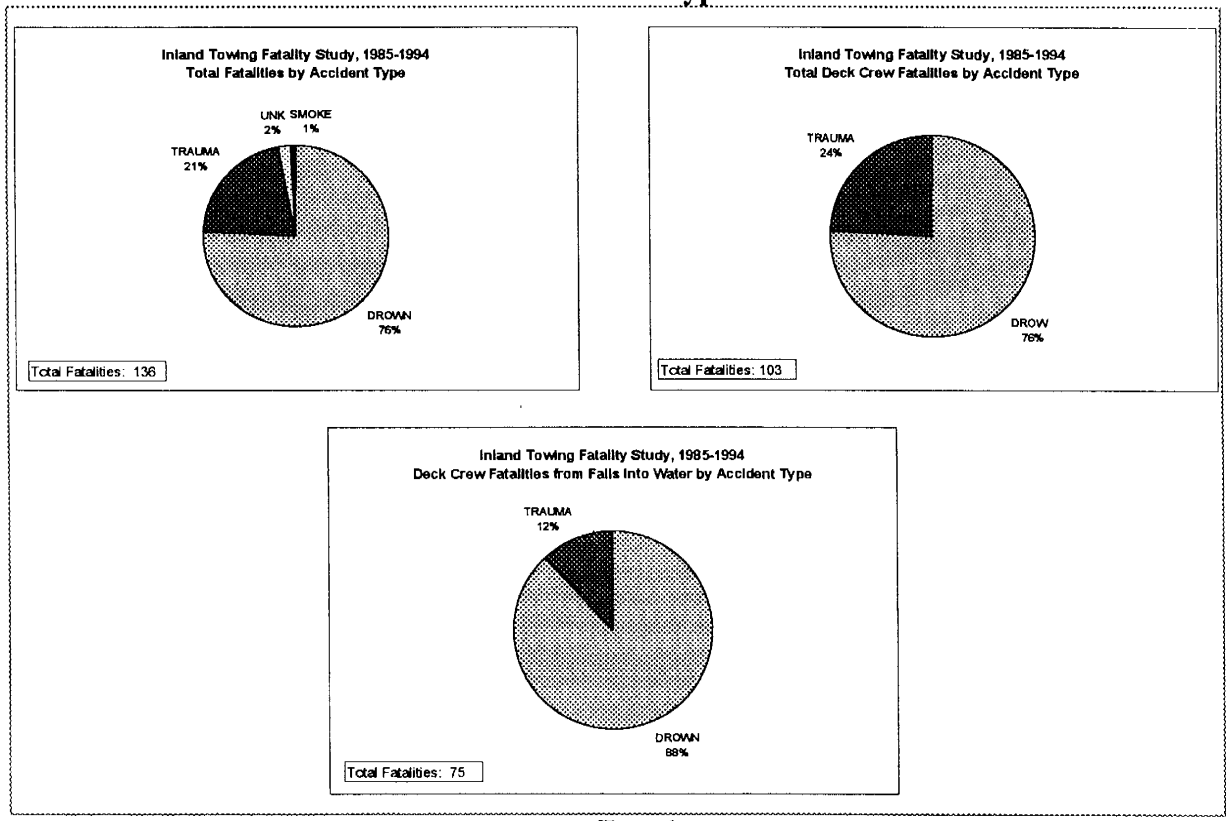


Figure 6

Weather Condition

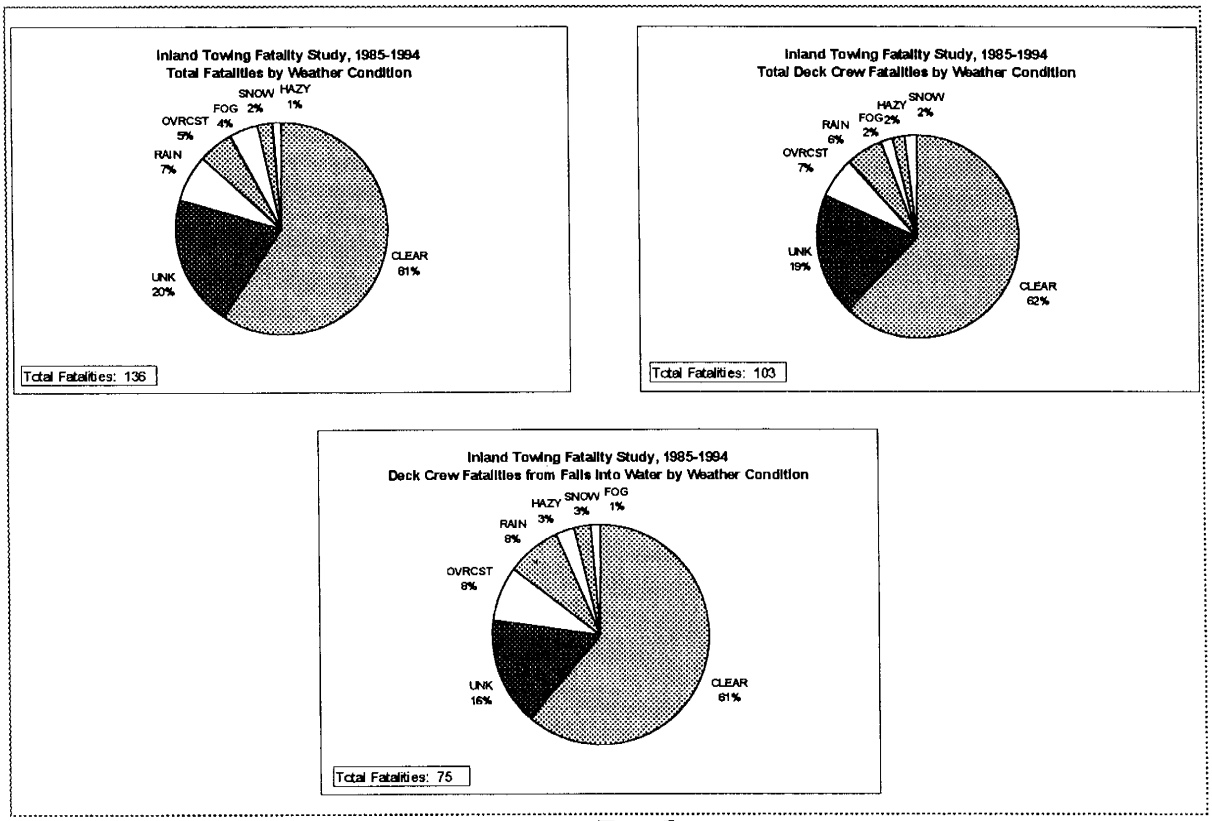


Figure 7

Vessel Status

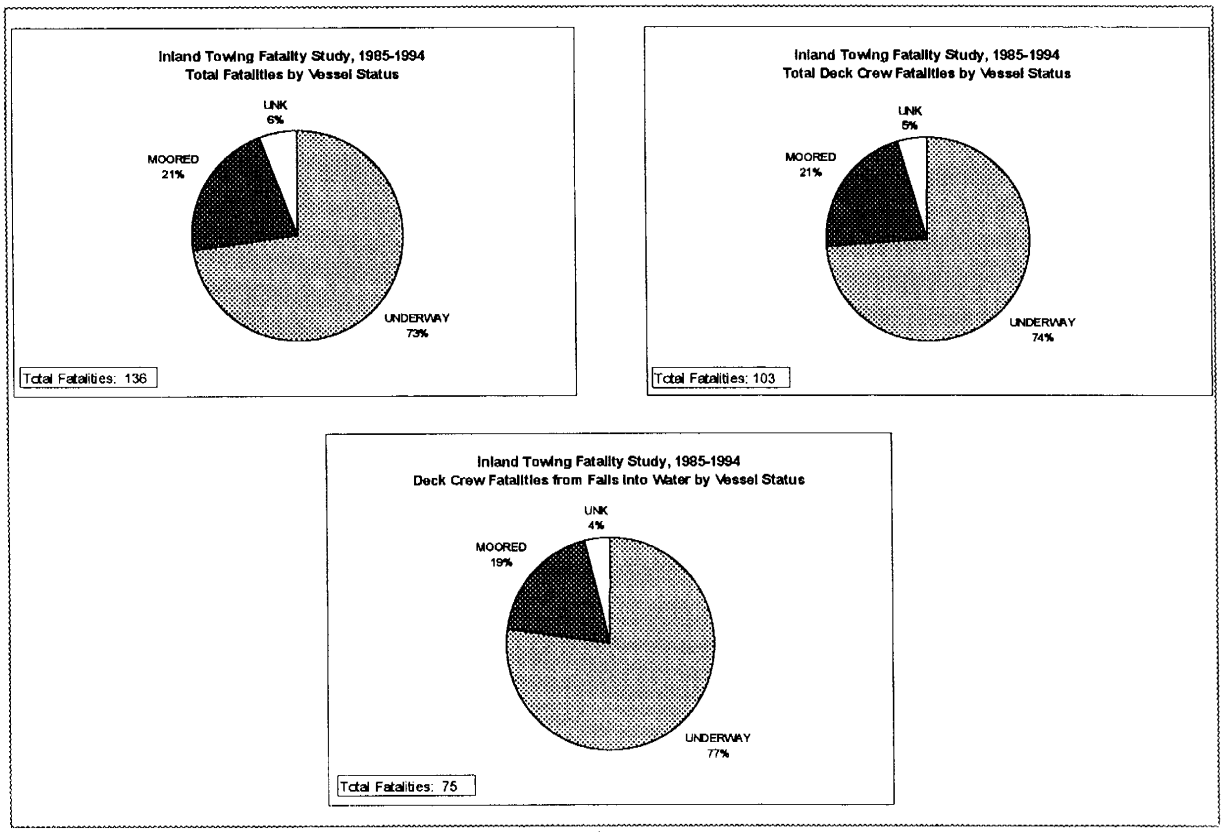


Figure 8

Experience Level

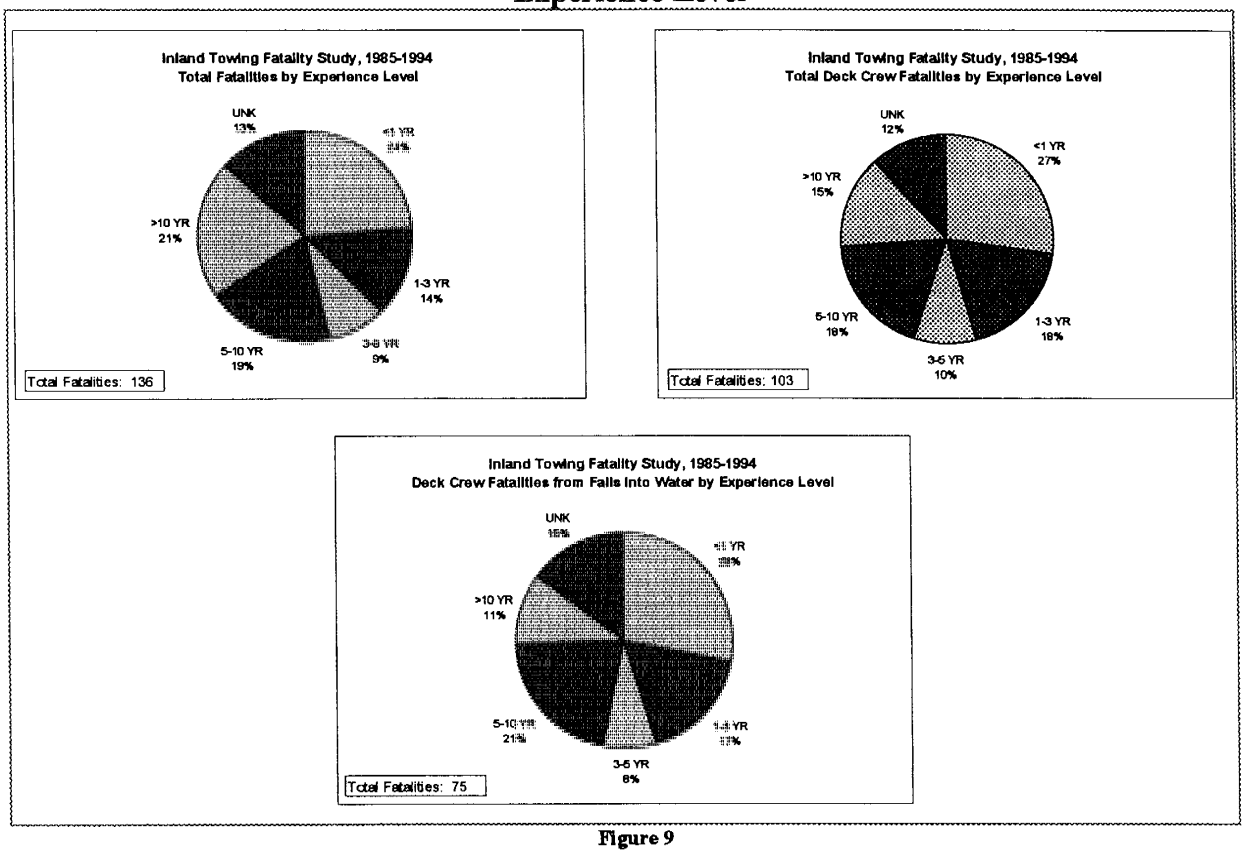


Figure 9

PFD Use

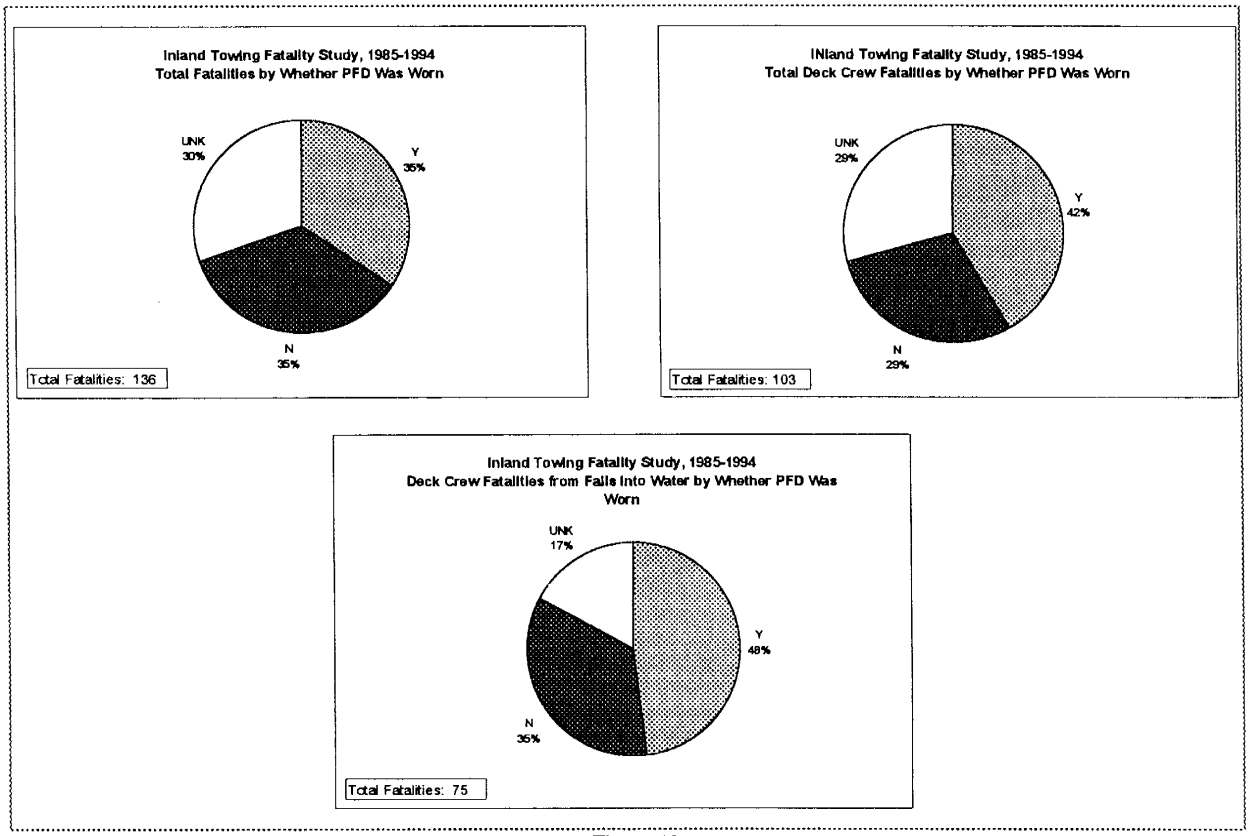


Figure 10

Time of Day

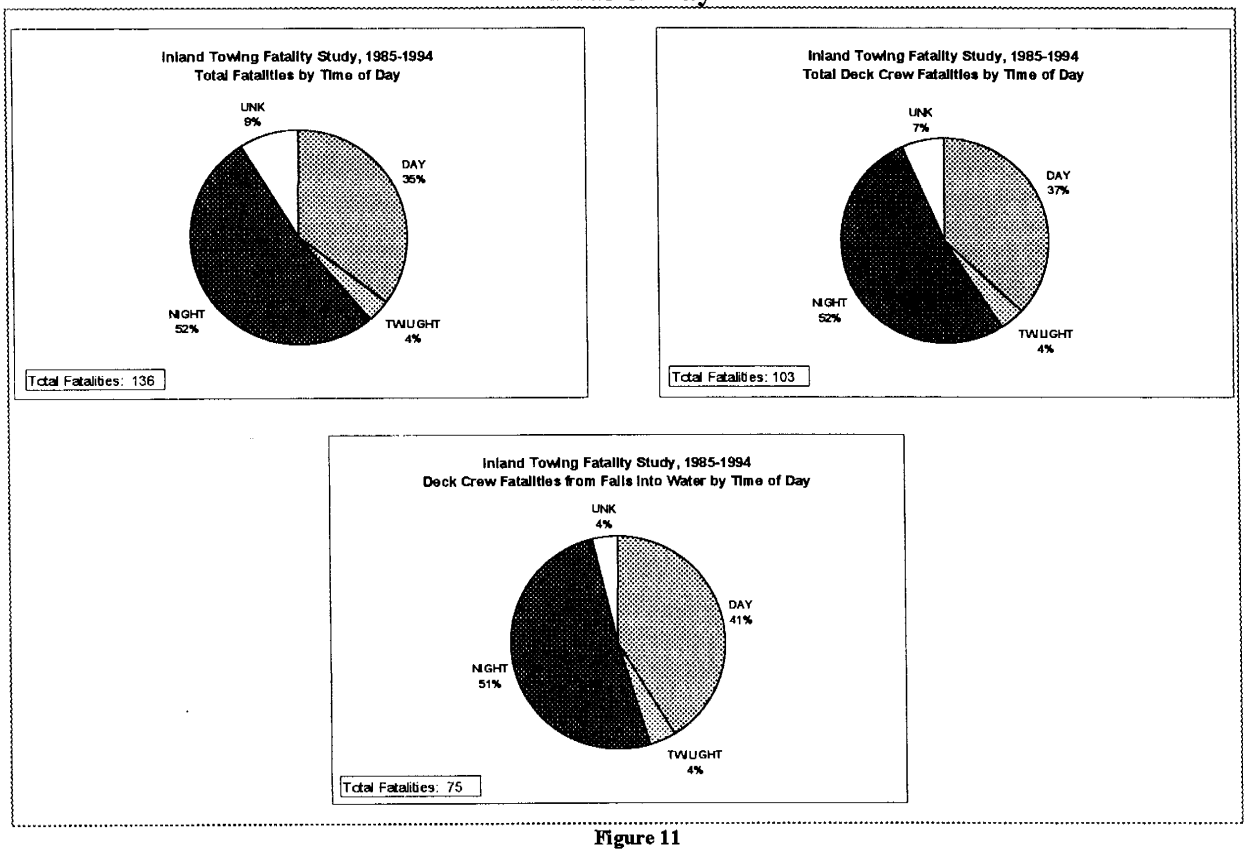


Figure 11

Age Category

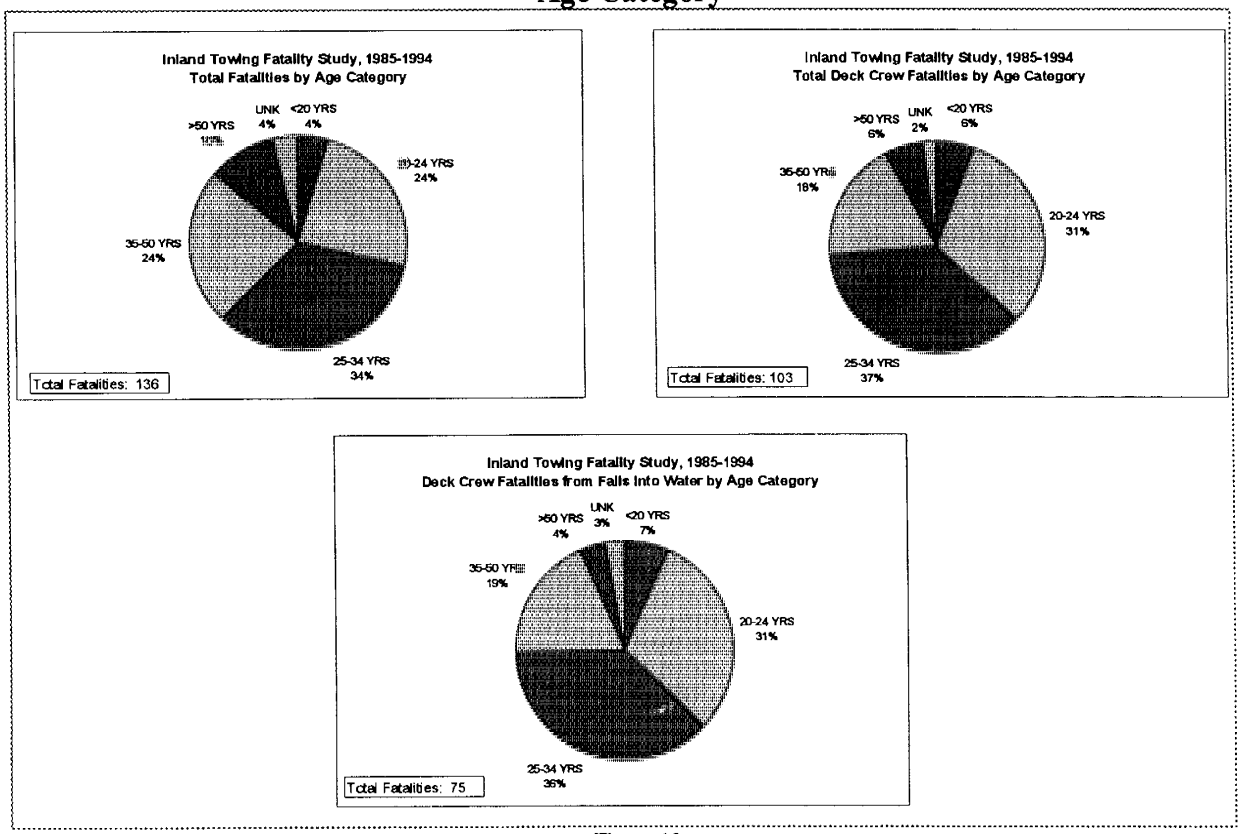


Figure 12

Fatality Rates

Annual fatality rate per 100,000 workers was used as a normalizing index to allow for comparison of fatality rates in the inland towing industry with rates in other industries and transportation modes, and to establish a baseline measure. Table 4 below gives annualized fatality rates, averaged over the 10-year study period, for the overall industry, for deck crew personnel and for other than deck crew personnel.

Fatality Rates: 1985-1994 (on average)	
Total Inland Towing Workforce: [10]	20,172
Total Fatalities, 1985-1994:[11]	136
Avg. Annual Fatalities per 100,000:[12]	68
Avg. Annual Deck Crew Fatalities per 100,000:[13]	88
Avg. Annual Fatalities per 100,000 for all other crew members (excluding deck crew):[14]	39

Table 4

As noted in table 4, the fatality rate for deck crew personnel was more than double the rate of all other crew positions combined.

The QAT segregated deck crew personnel by age and experience in order to determine more specific fatality rates within the deck crew population. This required three steps:

1. Segregate deck crew fatalities, 1985-1994, by age and experience levels;

2. Determine the distribution of the deck crew work force in the inland towing industry by age and experience levels;

3. Apply the distribution to the overall industry deck crew work force in order to provide a baseline for calculating fatality rates.

Step 1 followed from the analysis of casualty data in the Coast Guard database.

Step 2 was determined through a sample survey of seven inland towing companies representing a cross-section of the industry. The sample size totaled 794 employees classified as deck crew

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[10] Mercer Management Consulting Report.

[11] Source: USCG Marine Safety Management System database, USCG Headquarters (G-MOA-2)

[12] $\left(\frac{136}{10\,yrs} * 100{,}000\right) \div 20{,}172$ (rounded up to nearest whole number)

[13] Deck crew personnel figured at 58% of total workforce (20,172*58% = 11,700) -- from data published in the *Inland River Record*, 1994 edition. See Figures 15 & 16, following, for more detail.

[14] $\left(\frac{(136-103)}{10\,yrs} * 100{,}000\right) \div (20{,}172 - 11{,}700)$ (rounded up)

personnel. The QAT assumed that the distribution of deck crew by age and experience within the sample was the same as the distribution for the entire industry deck crew work force. The results of the survey are illustrated in figures 13 and 14 which follow. These figures clearly depict a young and inexperienced deck crew population.

Step 3, which is illustrated by figures 15 and 16, applied the sample distribution to the overall deck crew work force and determined fatality rates for various age and experience levels of deck crew personnel in the inland towing industry. The deck crew workforce was determined from the Mercer model and the *Inland River Record.*

Figures 15 and 16 show that deck crew personnel under 25 years of age and with less than one year experience suffered fatalities at significantly higher rates than other age and experience categories.

[*Note*: The fatality rates for deck crew personnel are annualized 10-year averages based upon extrapolated data. As such, they should be viewed as estimates and not exact numbers. They are only relative indicators of inland towing industry safety, and will be particularly useful as baseline measures for follow-up studies, assuming the same statistical methodology is used.]

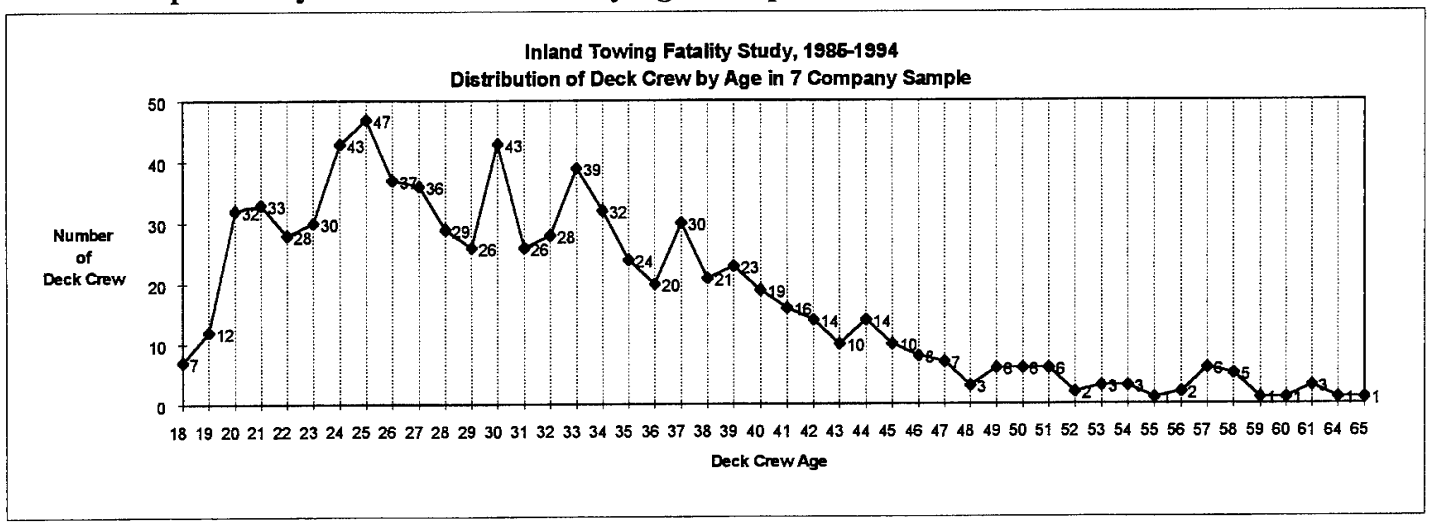
Sample Survey Actual Distribution by Age & Experience

Summary Statistics
for 7 Company Sample

Age	
Mean	31.9
Standard Error	0.3
Median	30.0
Mode	25.0
Standard Deviation	9.1
Sample Variance	83.1
Kurtosis	0.6
Skewness	0.9
Range	47
Minimum	18
Maximum	65
Sum	25,328
Sample Size	794
Confidence Level(95.0%)	0.6

Years Experience	
Mean	5.4
Standard Error	0.2
Median	3.0
Mode	0.0
Standard Deviation	6.9
Sample Variance	47.9
Kurtosis	3.3
Skewness	1.8
Range	39
Minimum	0
Maximum	39
Sum	4,258
Sample Size	794
Confidence Level(95.0%)	0.5

Source: AWO/USCG Inland Towing Fatality Study industry survey



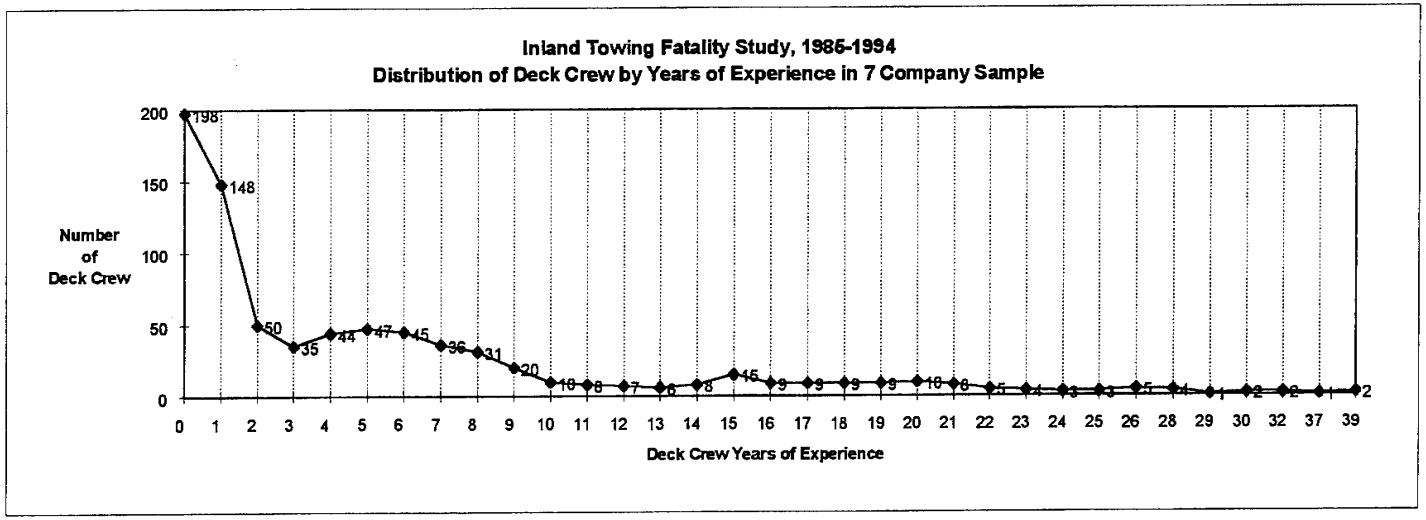


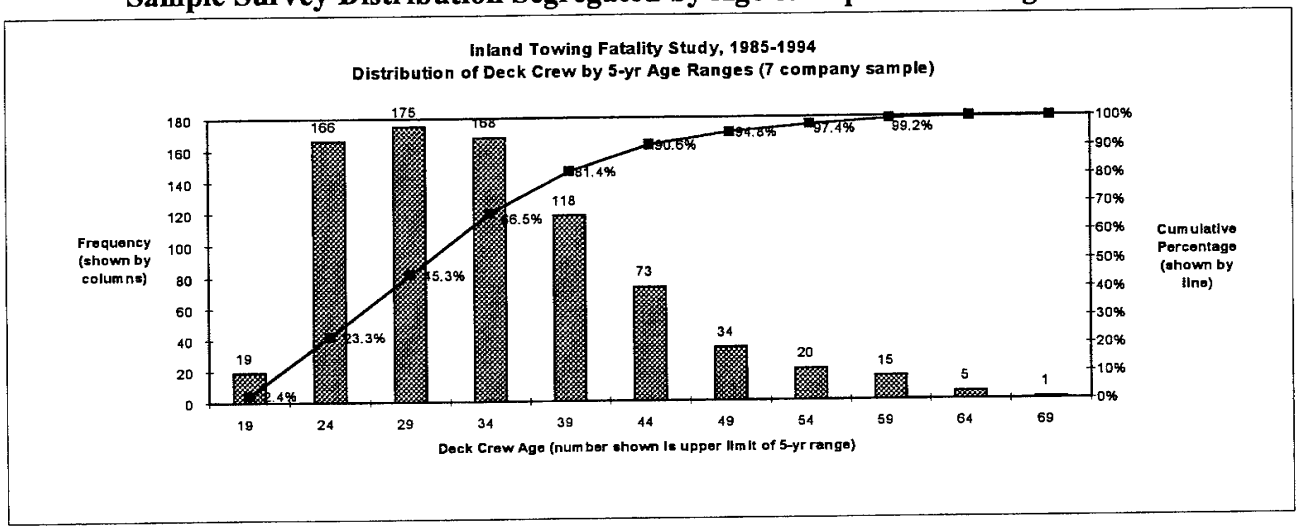
Figure 13

Sample Survey Distribution Segregated by Age & Experience Ranges

Summary Statistics
for 7 Company Sample

Age		
5 yr increments	*#*	*Cumulative %*
19	19	2.4%
24	166	23.3%
29	175	45.3%
34	168	66.5%
39	118	81.4%
44	73	90.6%
49	34	94.8%
54	20	97.4%
59	15	99.2%
64	5	99.9%
69	1	100.0%

Source: AWO/USCG Inland Towing Fatality Study industry survey



Years Experience		
2 yr increments	*#*	*Cumulative %*
1	346	43.6%
3	85	54.3%
5	91	65.7%
7	81	75.9%
9	51	82.4%
11	18	84.6%
13	13	86.3%
15	23	89.2%
17	18	91.4%
19	18	93.7%
21	18	96.0%
23	9	97.1%
25	6	97.9%
27	5	98.5%
29	5	99.1%
31	2	99.4%
33	2	99.6%
35	0	99.6%
37	1	99.7%
39	2	100.0%
41	0	100.0%

Source: AWO/USCG Inland Towing Fatality Study industry survey

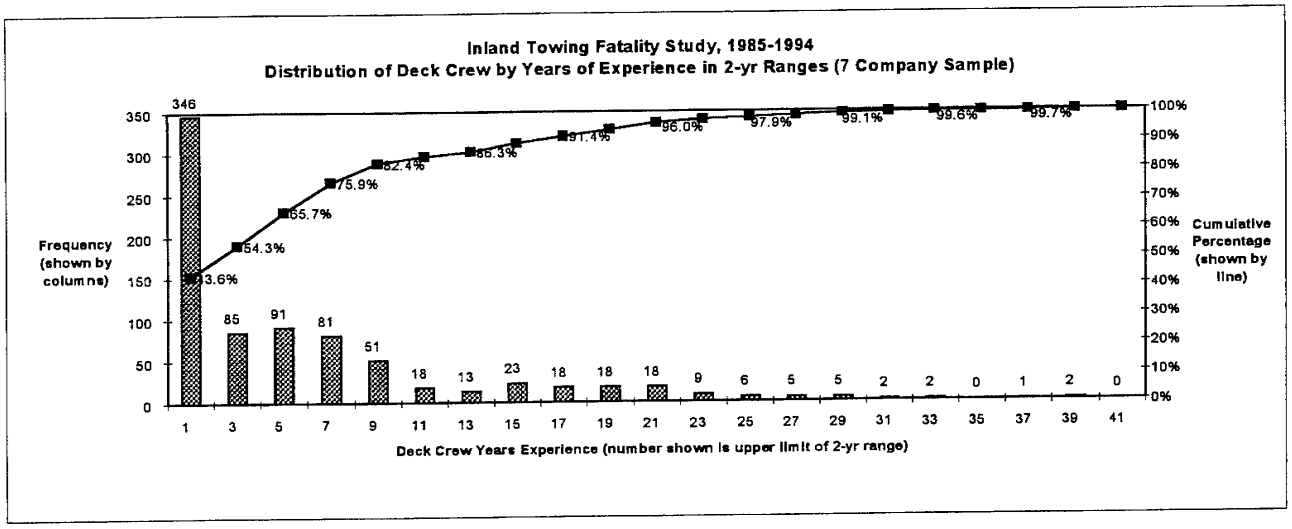


Figure 14

Deck Crew Personnel Annual Fatality Rates per 100,000 Employees (by Age Category)

Deck Crew Age Range	Deck Crew Distribution in 7 Company Sample	Deck Crew Distribution by Percentage	Total Industry Deck Crew Workforce[1]	Total Industry Deck Crew Fatalities, 1985-1994 [2]	Annual Deck Crew Fatalities per 100,000 workers [3]
< 20 YRS	19	2.4%	280	6	214
20-24 YRS	166	20.9%	2,446	32	131
25-29 YRS	175	22.0%	2,579	18	70
30-34 YRS	168	21.2%	2,476	20	81
35-39 YRS	118	14.9%	1,739	12	69
40-44 YRS	73	9.2%	1,076	3	28
45-49 YRS	34	4.3%	501	4	80
50-54 YRS	20	2.5%	295	3	102
55-59 YRS	15	1.9%	221	3	136
60-64 YRS	5	0.6%	74	0	0
65-69 YRS	1	0.1%	15	0	0
Unknown				2	
Totals:	794	100%	11,700	103	88

Total Inland Towing Workforce: 20,172

Source: Mercer Mgt Consulting Report, "Evaluation of Casualty Incidents for the U.S. Towing Industry 1981-1990," Appendix D--"Towing Industry Regional Employment Model" dtd 5/16/94

Deck Crew Workforce Factor: 0.58

Source: Inland River Record, 1994 edition

Total Deck Crew Workforce: 11,700

[1] Assumption: Distribution of Deck Crew in workforce = Distribution in 7 company sample.

[2] Source: U.S. Coast Guard Marine Safety Management System.

[3] Determined as follows: { [(Deck Crew Fatalities 1985-1994 / 10 yrs) * 100,000] / Total Deck Crew Workforce}

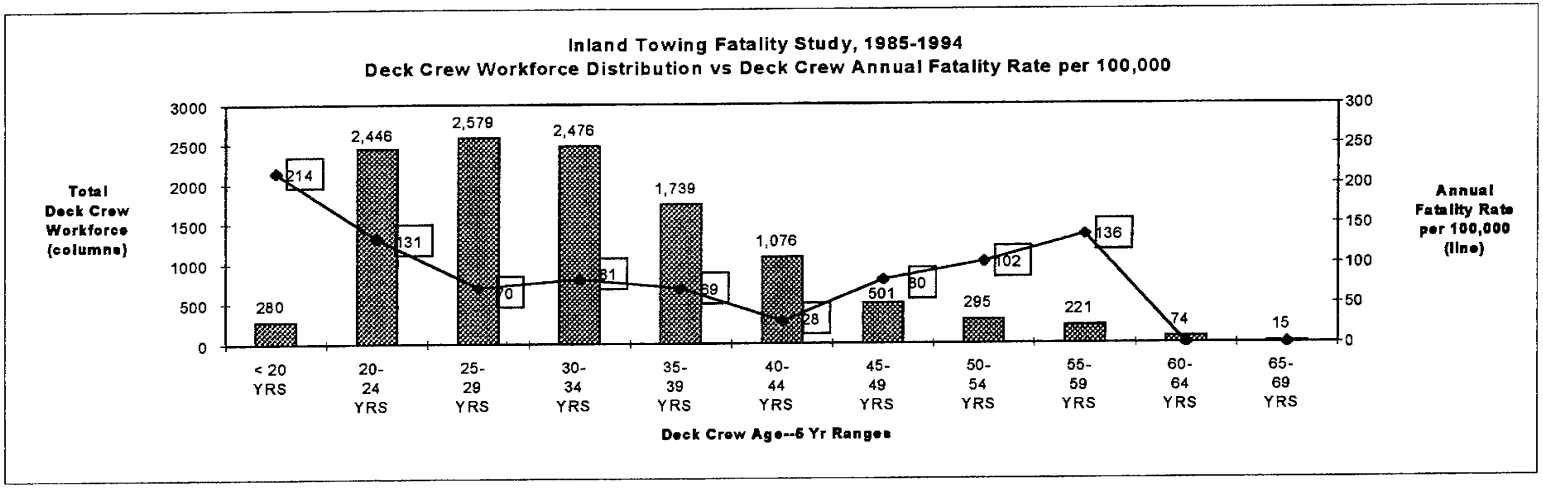


Figure 15

Deck Crew Personnel Annual Fatality Rates per 100,000 Employees (by Experience Level)

Deck Crew Experience Range	Deck Crew Distribution in 7 Company Sample	Deck Crew Distribution by Percentage	Total Industry Deck Crew Workforce [1]	Total Industry Deck Crew Fatalities, 1985-1994 [2]	Annual Deck Crew Fatalities per 100,000 workers [3]
<1 YR	198	24.9%	2,918	28	96
1-3 YR	198	24.9%	2,918	19	65
3-5 YR	79	9.9%	1,164	10	86
5-10 YR	189	23.8%	2,785	19	68
>10 YR	130	16.4%	1,916	15	78
UNK		0.0%		12	
Totals:	794	100.0%	11,700	103	88

Total Inland Towing Workforce: 20,172

Source: Mercer Mgt Consulting Report, "Evaluation of Casualty Incidents for the U.S. Towing Industry 1981-1990," Appendix D--"Towing Industry Regional Employment Model" dtd 5/16/94

Deck Crew Workforce Factor: 0.58

Source: Inland River Record, 1994 edition

Total Deck Crew Workforce: 11,700

[1] Assumption: Distribution of Deck Crew in workforce = Distribution in 7 company sample.

[2] Source: U.S. Coast Guard Marine Safety Management System.

[3] Determined as follows: { [(Deck Crew Fatalities 1985-1994 / 10 yrs) * 100,000] / Total Deck Crew Workforce}

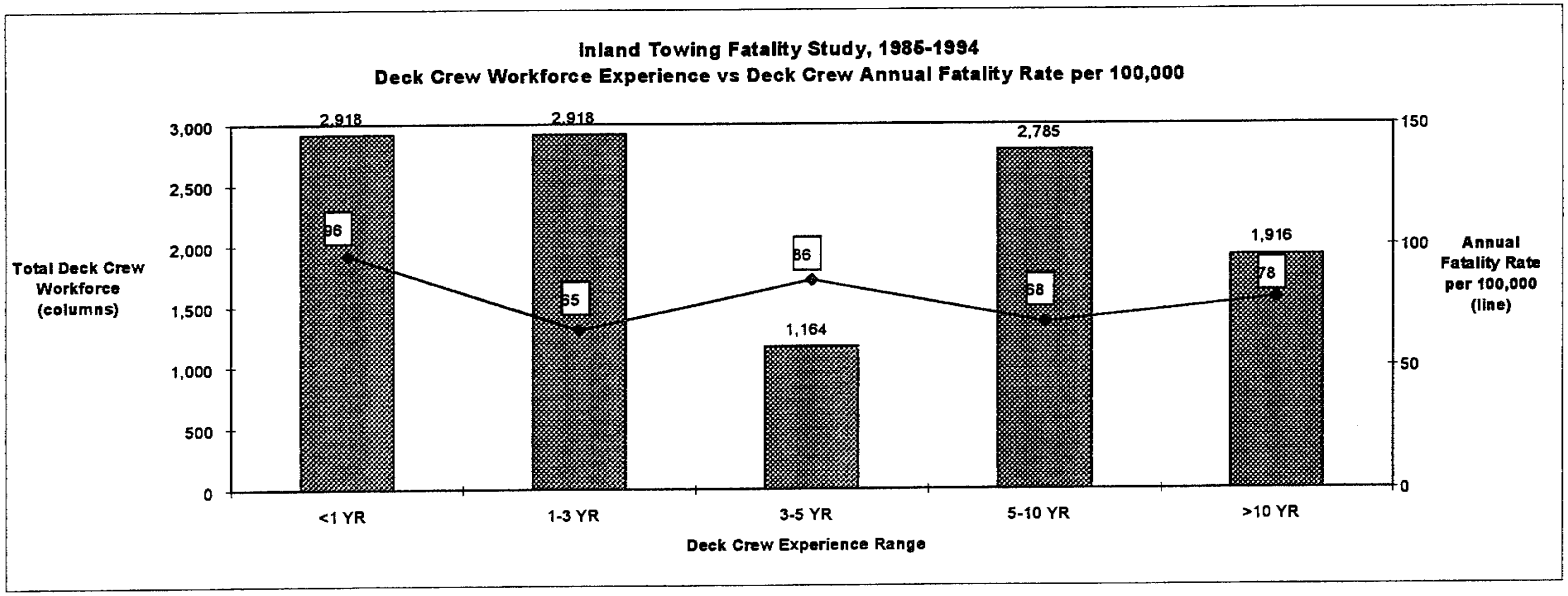


Figure 16

Analysis of Case Studies

While the QAT's quantitative analysis of Coast Guard and Corps of Engineers casualty data enabled the team to develop a profile of the circumstances and conditions in which fall overboard incidents and resultant fatalities most often occur, neither the amount nor the type of information contained in the agencies' casualty investigation reports was sufficient to conduct a comprehensive analysis of the causes of fall overboard incidents. This difficulty was exacerbated by the fact that nearly 50 percent of fall overboard fatalities were unobserved by other crewmembers, leaving no surviving eyewitness who could be interviewed regarding the circumstances and causes of the casualty. (Fall overboard situations which do not result in fatality or require a crewmember to receive medical attention beyond first aid -- incidents which might shed further light on the causes of fall overboard incidents -- need not be reported to the Coast Guard under existing casualty reporting regulations found at 46 CFR Part 4.)

To address this important gap in its analysis, the QAT augmented its quantitative analysis with a review of 19 fall overboard case studies (some of which resulted in fatalities and some of which did not) provided by team members. This review enabled the QAT not only to validate the trends uncovered by its quantitative analysis against a sampling of actual cases, but, because team members were personally familiar with the facts surrounding these incidents, and because a number of the cases were "near-miss" incidents in which the surviving victim could be interviewed directly, to conduct a rudimentary causal analysis as well. While not a true root-cause analysis, this review enabled the team to identify a short list of key causal factors which surfaced most prominently in the fall overboard cases under review.

In conducting this analysis, the QAT attempted to limit its conclusions to those which could be supported by direct empirical evidence as contained in the case study or as provided by individuals with firsthand knowledge of the incident. This approach was intended to bring a measure of discipline to the analysis and to avoid inferring conclusions not based on direct evidence. As a result, the QAT believes that the resultant list of key causal factors, while clearly not exhaustive, can be considered a reliable portrayal of factors which played a prominent role in the cross-section of cases reviewed. At the same time, the QAT recognizes that other, less apparent, factors may also have contributed to these casualties and that other factors not identified in this analysis may contribute to fall overboard incidents in the inland towing industry as well. This is particularly true with respect to human factors such as distraction, fatigue, etc., which are difficult to isolate through traditional casualty investigation and reporting procedures.

The seven cases which follow represent a cross-section of the 19 cases reviewed by the QAT and have been formatted to facilitate comparison with the trends identified in the quantitative analysis section above. These summaries do not contain all of the information available to the QAT in the conduct of its analysis. Information on the remaining 12 cases is contained in Appendix D.

FALL OVERBOARD CASE STUDY 1:

Linehaul Boat Engaged in Tow Work

Time/Month:	7:00 a.m., February	***Weather***:	Clear/cold/good visibility
Ohio River:	Normal operating conditions	***Deckhand:***	Under 20 years of age; One to three years experience

Description of Incident:

Rearranging tow at a fleet after picking up barges but prior to departure. Tow was configured with 15 barges: 3 wide by 5 long, 10 loads and 5 empties; empties made up port string.

Subject deckhand and supervisor (leadman) were adjusting wires on center string, port side coupling. While pulling on wire in tandem, with subject deckhand positioned behind the leadman, subject deckhand fell backward off loaded barge and into the river through an opening made by a rake-to-rake coupling on the adjacent empty string of barges in tow.

Causal Factors:

- Violation of company policy: working with back to water.
- Situational awareness: opening in barges near work area.
- Lack of planning/pre-briefing: failure to review task at hand, identify hazards.
- Poor supervision: failure to assess hazard and proceed with safe work practice.

FALL OVERBOARD CASE STUDY 2:

Sounding Fuel While Linehaul Boat Lays By

Time/Month:	4:30 a.m., February	***Weather***:	Clear at towboat; fog ahead in river
L. Miss River:	Normal operating conditions	***Asst. Engineer***	25-34 years of age; New to company and industry

Description of Incident:

Linehaul boat was stopped waiting for traffic to clear in fogged-in portion of the river ahead. Engines were engaged in reverse in order to hold position.

Subject assistant engineer, a new employee, was assigned to sound the number 3 port and starboard fuel tanks during the midnight watch. Working alone, the subject assistant engineer was last seen gauging the number 3 port side fuel tank. Access to the fuel tank gauging port is on the main towboat deck between a winch used to adjust a tow face wire and the chock used to direct the face wire out to the tow, creating both close quarters for working and a significant tripping hazard. Chains used to protect crewmembers from falls overboard in this area were not in place.

Subject assistant engineer was noted as missing when the chief engineer came on watch at 5:30 a.m. A search of the boat disclosed that a flashlight, sounding tape, and a pair of hearing protectors were missing from the engineroom, but subject assistant engineer was not found.

Subsequent investigation suggests that subject assistant engineer, while working alone, possibly without life vest, fell overboard, was swept under the barges in tow, and drowned.

Causal Factors:

- No orientation/training: employee had no industry experience and had worked a total of three days during which no safety training had occurred.
- Failure to use available safety equipment: safety chains on main deck of towboat were not properly placed to prevent falling overboard; mate saw subject assistant engineer on main deck working without PFD.
- Situational awareness: employee failed to identify combined hazards of darkness and potential for tripping over face wires while working in restricted, unprotected area.

FALL OVERBOARD CASE STUDY 3:
Fleet Boat Crew Change

Time/Month:	5:00 p.m., April	***Weather:***	Clear/dusk
L. Miss River:	Normal operating conditions	***Pilot:***	35 to 50 years of age Over 10 years experience

Description of Incident:

Pilot had landed fleet boat at office barge for crew change following a day of work in the fleet.

In crossing from fleet boat to office barge, pilot had to step up on to office barge deck; there was about a 2' difference in elevation.

While pilot was wearing appropriate safety gear, his hands were full, with a day bag in one hand and paperwork for the office in the other.

Upon jumping up onto the office barge deck, the pilot slipped on the wet surface, lost balance and fell back into the river between the fleet boat and the office barge.

Causal Factors:

- Lack of planning for routine task: hands full.
- Situational awareness: wet, uneven surfaces.
- Taking short cuts: not taking time to disembark safely.

FALL OVERBOARD CASE STUDY 4:

Handling Material on Fleet Boat

Time/Month:	9:00 p.m., March	***Weather:***	Dark/rain
L. Miss River:	High water	***Deckhand:***	Under 20 years of age Less than one year experience

Description of Incident:

Subject deckhand, wearing appropriate safety gear, was positioned on boat fleet deck. The fleet deck of this boat consisted of grating and superstructure which connected the top of the boat push knees with the second level of the boat. Such fleet decks are common on fleet boats and provide easy access to empty barges when making/breaking tow.

Subject deckhand was engaged in handing deck tools down from fleet deck to another deckhand located on the main boat deck. As subject deckhand began handing a particularly heavy tool down, the person who was to receive the tool became distracted and looked away. Subject deckhand could not stop forward momentum, lost balance, and fell from fleet deck into water.

Causal Factors:

- Lack of communication.
- Situational awareness: inattention to task at hand.

FALL OVERBOARD CASE STUDY 5:

Checking Tow on Linehaul Boat Underway

Time/Month:	6:30 p.m., December	***Weather:***	Clear/dark/full moon
L. Miss River:	Normal operating conditions	***Deckhand:***	25-34 years of age 1-3 years experience

Description of Incident:

Underway, northbound, with tow of 42 barges configured seven long by six wide with 20 loads and 22 empties. Tow had loads grouped four wide by five long surrounded by empties on port and starboard string and two tiers of empties across head of tow.

Subject deckhand was acting as "temporary" leadman as part of an appraisal process resulting in permanent promotion to leadman.

After coming on watch, subject deckhand, along with new, inexperienced deckhand, proceeded on to tow to perform a routine check of wires, barge wing tanks, and navigation lights. Subject deckhand first received permission of captain on watch in wheelhouse, in accordance with company policy. New deckhand had been assigned to boat 12 days earlier; subject deckhand arrived on boat the previous day.

In accordance with company policy, the two proceeded to check barges as a team. Both had flashlights and safety gear; the leadman had a radio. However, at a point mid-tow, subject leadman instructed new deckhand to remain on the loaded portion of the tow while subject deckhand proceeded up a ladder to empties on the head of tow. After several minutes, new deckhand became concerned and checked head of tow. Subject deckhand could not be found, so captain signaled general alarm, called boats in the area for assistance and a search of boat, tow, and river began.

Subject deckhand was not found immediately; however, remains were found several months later. Investigation revealed the electric cord connected to the center flashing amber navigation light to be disturbed as if subject deckhand had tripped over the cord, and fell off head of tow.

Causal Factors:

- Violation of company policy: failure to work as a team.
- Situational awareness: electrical wires on head of tow are potential tripping hazard. With full moon, subject deckhand may have stepped into shadow without checking area with flashlight first.
- Inattention to task at hand: when inventorying personal effects, material present suggested subject deckhand was experiencing significant financial difficulties. Perhaps this contributed to state of inattentiveness.

FALL OVERBOARD CASE STUDY 6:

Linehaul Boat Repositioning Fleet Light Before Departing Fleet

Time/Month:	6:15 p.m., January	***Weather:***	Clear/cold
Ohio River:	Normal operating conditions	***Deckhand:***	25-34 years of age 1-3 years experience

Description of Incident:

A linehaul boat had completed facing up to its tow of barges in a fleet and was ready to depart. Prior to departure, the captain directed the leadman to reposition a fleet light from the tow back onto a barge that was to remain in the fleet. Since the departing tow consisted of loaded barges and the barges left in the fleet were empty, there was a considerable height difference between barge deck surfaces. In fact, the leadman could not reach high enough to place the fleet light onto the empty barge.

As a result, the leadman directed the subject deckhand working the tow at the time to step up on the knee of the leadman in order to place the fleet light. While the two were performing this task, the adjacent barges separated and the subject deckhand fell into the river.

Causal Factors:

- Failure to use safety equipment: a ladder was available for use.

- Poor supervision: leadman directed an unsafe act.
- Taking short cuts: in addition to not using ladder, did not secure adjacent barges in order to prevent separation.

FALL OVERBOARD CASE STUDY 7:
Linehaul Boat Engaged in Locking Operations

Time/Month:	11:00 a.m., May	***Weather:***	Rain/good visibility
U. Miss River:	High river/high current	***Deckhand:***	25-34 years of age 6-10 years experience

Description of Incident:

Locking downbound with a mixed tow of loaded dry cargo barges and empty liquid barges. The subject deckhand, wearing appropriate safety gear, was assigned to work the starboard stern of the tow while locking. The starboard stern barge was a loaded covered barge, decks were free of loose or spilled cargo.

Because of the odd configuration of the tow, the lock wall pins did not match up well with barge fittings, so the subject deckhand worked off a quarter kevel. In addition, over 100' of lock line was positioned on the starboard stern of the tow. This is more than generally needed for the task to be performed.

While subject deckhand walked back to the boat after securing the stern barge to the lock wall, the remaining unused lock line, which was now behind the subject deckhand, began falling off the stern barge. Before subject deckhand reached the boat, the lock line struck him in the feet, knocking him overboard.

Causal Factors:

- Situational awareness: deckhand was walking in confined area, along edge of barge, with potential tripping hazard present.
- Lack of planning: deckhand did not secure line in walk/work area in a way to prevent line from falling off barge.

Conclusions

Based on its review of the relevant literature and the quantitative and causal analyses described above, the QAT reached the following conclusions regarding crew fatalities in the inland towing industry.

1. During the 10-year period 1985-1994, there were 136 inland towing vessel employee fatalities, generating an annualized average fatality rate of 68 per 100,000 employees.

2. Vessel employees classified as deck crew suffered a fatality rate more than twice that of all other towing vessel crewmembers (88/100,000 employees vs. 39/100,000 employees).

3. Only 22%, or 30, inland towing vessel crew fatalities resulted from vessel casualties (i.e., collisions, fires, capsizings, etc.).

4. Of the 106 fatalities not resulting from vessel casualties, 83%, or 87 fatalities resulted from falls overboard.

5. Of all towing vessel crew classifications, deck crewmembers suffered the highest number of fatalities from falls overboard.

6. Deck crewmembers under 25 years of age experienced significantly higher fatality rates than other crewmembers. The fatality rate for crewmembers under 20 years old was higher than that of any other age group, at 214 deaths per 100,000 workers.

7. Deck crewmembers with less than one year of experience incurred the highest fatality rate of any other experience level, at 96 deaths per 100,000 workers.

8. Based on Coast Guard casualty data, falls overboard, resulting in fatality, tend to occur:
   a) In roughly equal numbers from both towing vessels and barges;
   b) Generally during clear weather;
   c) At any time, night or day;
   d) While the vessel is underway;
   e) While performing routine tasks (e.g., line handling, deck maintenance, moving on vessels.)

9. Only seven fatalities during the 10-year study period occurred during locking operations.

10. The QAT attempted to evaluate whether the use of personal flotation devices (PFDs) reduced the incidence of fatality in fall overboard accidents, but found that the data was inconclusive. Although more than one-third of the crewmembers suffering fatalities were reported to have been wearing a PFD at the time of the fall into the water, there is no information available to identify those instances where a crewmember was recovered

safely, and hence not reported as a casualty. No conclusion was possible concerning the question as to whether PFDs increased survivability when a fall overboard did occur.

11. The towing vessel environment is a dynamic workplace with inherent hazards, the most prominent among them being the need for crewmembers to regularly perform routine tasks in close proximity to the edge of a boat or barge.

12. Coast Guard and Corps of Engineers casualty data is adequate to develop a profile of conditions and circumstances surrounding fatalities resulting from falls overboard, but does not allow for in-depth analysis of the causes of fall overboard incidents and fatalities.

13. Based on the empirical evidence available through the QAT's review of company-provided fall overboard case studies, recurring causal factors contributing to fall overboard incidents in the inland towing industry include:

- Lack of orientation/training, including skill assessment
- Lack of planning/pre-brief for routine maneuvers, including clear assignment of responsibilities
- Violation of company policies and procedures, including
  - Safe work practices;
  - Buddy system/teamwork;
  - Communication procedures; and,
  - Fouled work area.
- Absence of company policy/procedures, including
  - Teamwork/buddy system; and,
  - Communication.
- Lack of supervision/poor supervision
  - Lack of awareness of deck activity or personnel location;
  - Poor planning or coordination of taskings; and,
  - Inadequate guidance or direction.
- Lack of adequate communication
  - Inadequate means of communication or failure to use available means of communication; and,
  - Failure to understand signal or communication.
- Taking shortcuts
  - Rushed;
  - Failure to recognize hazard or risk; and,
  - Taking poorly calculated risk.

- Safety chains; and,
- PFDs.

- Situational awareness
  - Failure to recognize hazards in the workplace;
  - Inattention to task at hand; and,
  - Uncertainty of task in relation to other events.

Recommendations

The QAT believes that the incidence of towing vessel crew fatalities can be reduced through a four-part program encompassing prevention measures, collection and dissemination of lessons learned, improved investigation and data collection techniques, and regular assessment of towing industry performance over time using the fatality rate model developed in this study. Reflecting the cooperative ethos on which the Coast Guard-AWO Safety Partnership is based, the QAT's recommendations emphasize primarily non-regulatory solutions. Corporate and industry responsibility remains the first line of defense to ensure a safe marine environment and vessel workplace, and joint Coast Guard-industry action in facilitating company efforts should further reduce the risk of towing vessel crew fatalities. To that end, the QAT's recommendations include:

Prevention

1. Barge and towing companies should develop and implement a fall overboard prevention program as part of an overall company safety management program (e.g., the AWO Responsible Carrier Program). At a minimum, developing and implementing a company fall overboard prevention program should include the following steps:

    - Formulate and implement fall prevention work procedures consistent with vessel mission, crew complement, and geographic area of operation. Procedures should emphasize teamwork, communication, and safe work practices.

    - Ensure that all crewmembers receive initial and recurrent training in such procedures.

    - Assign responsibility for ensuring compliance with procedures to on-board supervision.

    - Enforce fall overboard prevention policies and consider the use of counseling, recurrent training, and discipline in the enforcement process.

    - Investigate all fall overboard incidents to determine what happened and how such incidents could be prevented in the future.

    - Inform all employees of fall overboard incidents and use lessons learned as part of a recurrent training program.

    - Modify fall prevention procedures as necessary based on investigation of fall overboard incidents.

2. Specific actions were considered to moderate inherent workplace risks associated with deck activities on towboats and their tows. However, the great diversity of inland towing operations and equipment precludes universal application of such recommendations. Therefore, barge and towing companies should examine the "best practices" referenced in

Appendix E and consider incorporating into their company fall overboard prevention programs those measures appropriate to the company's mission and area of operation.

3. AWO should add to its Responsible Carrier Program a requirement for company fall overboard prevention programs.

Lessons Learned

1. AWO should publicize the findings and recommendations of the Towing Vessel Crew Fatalities QAT through the *AWO Letter*, sector committee meetings, regional meetings, and the Interregion Safety Committee. Copies of the QAT report should be provided to all AWO members in the Inland Dry and Inland Liquid sectors.

2. The Coast Guard should publicize the findings and recommendations of the Towing Vessel Crew Fatalities QAT through all appropriate vehicles, including the *Marine Safety Newsletter* and local and district-level Industry Days.

3. The Coast Guard and AWO should make fall overboard prevention a focus of the "Prevention Through People" implementation program and a key objective for 1997.

4. The AWO Interregion Safety Committee should establish an information-sharing and retrieval mechanism to share lessons learned on fall overboard prevention and should consider how lessons learned could be shared with the Coast Guard to facilitate the mutual agency-industry objective of fall overboard prevention. (In this regard, the QAT notes that "near-miss" scenarios can serve as a particularly useful source of timely, substantive information on fall overboard incidents and prevention methods.)

5. The AWO Interregion Safety Committee should analyze lessons learned on fall overboard prevention and identify appropriate additions or modifications to company fall overboard prevention programs.

Investigation and Data Collection

1. In concert with the marine industry, the Coast Guard should revise its casualty reporting requirements and procedures for analyzing casualty information to better determine essential elements in the causal chains leading to a casualty.

2. Government and industry databases should be expanded or linked to include "exposure" data (e.g., vessel population, work force size, number of transits, etc.) to permit consistent measures of safety performance in the industry as a whole and in key industry segments.

3. The Coast Guard should consider amending the casualty reporting criteria at 46 CFR Part 4 to include all fall overboard incidents, including those falls overboard which do not result in injury or death. Lessons learned from such incidents would provide a better understanding of

the causes of falls overboard and help the industry and the Coast Guard to identify and refine appropriate prevention measures.

4. Both industry and government organizations should improve investigator training and database design to better document human performance in the marine workplace.

Performance Measurement

AWO should compile annually a fatality incident rate for towing vessel crewmembers based on an index of fatalities per 100,000 employees. This index should be generated using the algorithm developed by Mercer Management Consulting and described in the Statistical Methodology and Analysis section of the QAT report.

Subjects for Further Analysis

AWO and the Coast Guard should consider the following issues as potential subjects for further examination and analysis:

- Factors influencing survivability following a fall overboard incident;
- Use of the QAT report as a template for analysis of fatalities in other segments of the barge and towing industry; and,
- Development of a means to measure the impact that fall prevention programs, policies, and procedures have on vessel crew fatality rates.

Epilogue

In the course of investigating and reporting on inland towing vessel crew fatalities, the QAT expended a considerable amount of effort not only in gathering and analyzing accurate data, but also in ensuring that our conclusions and recommendations were adequately supported by that data.

We leave the reader with a thought on safety that occurred to all who worked on this project: that the safety "culture" of a company, or perhaps of the industry as a whole, may be playing a significant role in the results and trends reported here.

The fact that falls overboard have persisted as the major cause of fatality in the inland towing industry seems to suggest a pervasive and sustaining view about safety when working in and around barges and towboats. Perhaps such activities are so commonplace and, in fact, necessary, that the seriousness of the hazard has been consistently underestimated by vessel employees and shoreside management alike. In every case, those who fell over the side were near the deck edge -- a frequent and routine situation in the industry. Repeatedly, the individuals appeared to have done something which in hindsight was unsafe, unnecessary, unwitting or at odds with established practices and policies. In searching for the root cause of fall overboard incidents, the QAT inferred that despite training and safety programs intended to minimize risks, some other process was working at odds with those efforts.

We are profoundly struck by the fact that young, inexperienced deckhands incur fatal injuries at significantly higher rates than any other age/experience group in the towing industry work force. This is true despite higher standards for marine employment today (e.g., drug and alcohol testing), as well as a general industry effort toward enhanced safety training. The persistence of fatalities in this group over the years points to attitudinal elements of human performance at all levels that deserve specific attention if any recommendations to reduce the incidence of falls overboard are to have effect.

Perhaps the fundamental issue at hand is the safety "culture" of the industry. What is the real message sent to employees when speed or efficiency is a top concern, or when employees are not held accountable for failure to follow safety procedures? The industry concentrates on safety training for new employees, but may be unwittingly bypassing more senior employees. The risk is that senior employees may not "buy into" company safety programs because they perceive that other concerns have a higher priority. Moreover, do senior employees take calculated, unsafe risks that are being mimicked by new employees who are less able to deal with such risk-taking? If so, why? Does this result in new employees learning by example to disregard the lessons of their training because they see that in the "real world," senior co-workers do not follow all the safety rules, or that safety is not truly the first priority of the company? The result is a "cultural bias" which may tend to supersede safety programs.

This is the essence of a safety "culture." All employees must buy into safety and it must be the number one priority of the company, in word and deed. Onboard and shoreside employees alike must practice and live safety every day. We often hear complaints that safety rules "slow you

down" and take too much time. Yet the reality is that safety is the foundation upon which the success of the industry is built.

The high probability of these "cultural" effects will require the special attention of management to change attitudes and to revise supervisory approaches. It is the QAT's collective recommendation that companies assess the state of their respective safety cultures, and implement culture counter-measures, as necessary, as a beginning step to higher levels of overall safety, and specifically with respect to fall overboard prevention.

APPENDICES

APPENDIX A:

QUALITY ACTION TEAM CHARTER

to examine

TOWING VESSEL CREW FATALITIES

PURPOSE

This charter provides procedures, authority, and guidance for a Quality Action Team(QAT) to conduct a comprehensive and detailed examination and assessment of towing vessel crew fatalities. The National Quality Steering Committee(QSC) chose to examine towing vessel crew fatalities on the basis of a recommendation from the Report of the Coast Guard–AWO Quality Action Team completed on July 14, 1995. The QAT formed its report and made recommendations based on the two organizations' common goals of enhanced marine safety and environmental protection.

ASSIGNED PROJECT

The Towing Vessel Crew Fatalities QAT is chartered by the AWO/USCG National QSC to investigate the following issues of concern and to compile a list of proposed recommendations for consideration by the National QSC. The QAT will specifically review the following areas:

- Circumstances and causes of crew fatalities, including;
  - the operating environment and role of the human element,
  - training,
  - experience,
  - management controls and business practices,
  - equipment standards in risk management, and
  - industry implemented management programs which are successfully reducing risk;
- Impacts and costs of the recommended actions; and
- Other areas the QAT finds important to achieve the goals stated above.

STRUCTURE

The Towing Vessel Crew Fatalities QAT shall consist of the following individuals. QAT Leaders are designated below. Other necessary team roles and responsibilities will be determined by the members during the course of their activities.

Quality Action Team:

- ♦ Team Leaders: Mr. Steve Frasher, Midland Enterprises
  CAPT Scott Cooper, CGHQ
- ♦ Team Members: Mr. Glenn Hotz, ACBL
  Mr. John Joeckel, Ashland Petroleum
  Mr. Bob O'Neil, National Marine
  Mr. Gale Rhodes, Indiana–Michigan Power Co.
  CDR Pierce Guyer, 2nd CG District
  LCDR Tim Mann, MSD Baton Rouge, LA
  LCDR Don Darcy, CGHQ
  LCDR William McHenry, CG RTC Yorktown, VA
  LT Wyman Briggs, CGHQ

♦ Team facilitator: A team facilitator will be assigned from the cadre of TQM facilitators within either the Office of Marine Safety, Security and Environmental Protection or AWO.

Guidance Team: National QSC

QAT DELIVERABLES

Recognizing that there are many different Total Quality Management(TQM) process improvement models in use in the Coast Guard and in industry(e.g. the Crosby method, the Demming method etc.), no particular quality method is prescribed. The Towing Vessel Crew Fatalities QAT may employ any process which it is most comfortable with to identify the root causes of the problem and to identify appropriate process improvements. At a minimum, the process should include the following steps(derived from the July 14, 1995 "Report of the Coast Guard–AWO Quality Action Team"):

♦ Define the scope of the problem or process improvement needed(e.g., determine the baseline, validate the results of the Coast Guard and Mercer Management Studies), utilizing statistical data, case studies etc., as available;

♦ Analyze the data/identify root causes of the problem;

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

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

QAT DELIVERABLES(cont.)

- Refine proposed solutions as necessary; and
- Develop an implementation plan for submittal to the National QSC.

The Towing Vessel Crew Fatalities QAT has the latitude to develop a format for 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 improvement and recommend a means by which to communicate the recommended improvement to the target group.

RESOURCES

Towing Vessel Crew Fatalities QAT members were selected for their analytical knowledge and experience dealing with the towing industry. The QAT is expected to draw on their talents to access resources, conduct research and analyze all information available to them. The QAT may wish to seek assistance from other individuals or agencies(e.g. U.S. Army Corps of Engineers).

The AWO "Evaluation of Casualty Incidents for the U.S. Towing Industry 1981–1990" prepared by Mercer Management Consulting, Inc. and "Towing Vessel Occupational Safety Study", prepared by Coast Guard Headquarters Planning Staff in June 1994 are documents available for use. In addition to using AWO and Coast Guard casualty data, either raw or developed, the QAT may obtain more precise information by contacting individual company officials and Marine Safety Office personnel. Safety Manager and Investigating Officer interviews may be helpful to determine root causes of death investigations. The Guidance Team will assist the QAT with coordinating support needed from both AWO and Coast Guard.

The QAT shall begin work immediately so that an Interim Report on the Towing Vessel Crew Fatalities QAT Study may be available for the March 6, 1996 National QSC meeting. The report should consist of a brief written synopsis of the major emphasis of the work completed, particularly challenging or notable events, a forecast of upcoming work, and whether targets for completion can be met. The team's leaders will orally present the interim report to the QSC.

The Final Report should be submitted to the National QSC for review prior to the August 7, 1996 meeting.

The QAT must evaluate time and location of meetings for the group. Meetings may be held as often as necessary to complete the task. However, as good fiscal stewards, its necessary to ensure meetings are called when conference calls and other means of electronic communication will not suffice. Meetings should be held in locations which will spread the financial and time obligations among the participants.

AUTHORITY TO ACT

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

J.C. Card
Rear Admiral, U.S. Coast Guard
Chief, Office of Marine Safety,
Security and Environment
Protection

November 7, 1995
Date

Thomas A. Allegretti
President
American Waterways
Operators

November 8, 1995
Date

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Revised List of QAT Participants

The Towing Vessel Crew Fatalities Quality Action Team added somewhat to its membership during the course of its work. Similarly, some members of the QAT were not able to participate in the process through its completion. The revised list of QAT members includes the following:

Team Leaders:	Mr. Steve Frasher, Midland Enterprises CAPT Scott Cooper, CGHQ
Team Members:	Mr. Glenn Hotz, American Commercial Barge Line Co. Mr. John Joeckel, Ashland Petroleum Mr. Bob O'Neil, National Marine Mr. Gale Rhodes, Indiana-Michigan Power Co. CDR Pierce Guyer, Second CG District LCDR Tim Mann, MSD Baton Rouge, LA LCDR Don Darcy, CGHQ LCDR Peter Neffenger, CGHQ CDR Bob Segovis, CGHQ LT Wyman Briggs, CGHQ Mr. Michael Kidby, US Army Corps of Engineers Mr. Edmond Rogers, US Army Corps of Engineers Mr. Ron Riberich, Tennessee Valley Authority Mr. Bob Cockrel, Tennessee Valley Authority
Team Facilitator:	LCDR Julie Gahn, CGHQ

APPENDIX B:

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APPENDIX C:

GLOSSARY OF TERMS

ACCIDENT TYPE:	The nature of the casualty
Drown:	Drowned as a result of falling into water
Smoke:	Smoke inhalation
Trauma:	Massive injury
Unk:	Unknown
ACTIVITY:	The general activity of the deceased at the time of the fatality
AGE CATEGORY:	Age category of deceased at time of fatality
CASUALTY CAUSE:	The reported event which resulted in the fatality
Asphyxiation:	Does not include drowing deaths
Explosion:	Self-explanatory
Fall into Water:	Self-explanatory
Fall Other:	A fall other than into the water (such as into open hopper)
Jumped:	Deliberately entered the water (such as to abandon vessel)
Struck By:	Hit by object, crushed between vessels or between moorings and vessel, hit by propellers, etc.
Trapped in Vessel:	Unable to escape sinking vessel
CREW POSITION:	The deceased's reported role on the vessel at time of fatality
Capt/Plt:	Captain or Pilot
Deck Crew:	All designations for deck hands or unlicensed mates
Engineer:	All persons whose duties were described as Chief Engineer
Tankerman:	Persons with Merchant Mariner's Documents and identified as engaged in bulk liquid transfer operations at time of fatality
Cook:	All persons designated as a cook or steward
EXPERIENCE LEVEL:	Overall experience in the inland towing industry
TIME OF DAY:	Day, night or twilight
VESSEL STATUS:	Whether the vessel was underway or moored at time of the fatality
WATERBODY:	The river or other waterway on which the fatality occurred
WEATHER CONDITION:	Weather, in broad terms, at time of the fatality
WORK FORCE:	An estimate of the total number of people employed as crew members on vessels in service in the inland towing industry as defined in this study
UNK:	Unknown

Appendix.gar

APPENDIX D:

CASE 1

Time/Month:	6:00 a.m., June	***Weather:***	Clear/good visibility
L. Miss. River:	Normal operating conditions	***Deckhand:***	25-34 years of age One to three years experience

Description of Incident:

Crew and boat were engaged in making final adjustments to wires in tow prior to departure from fleet. Tow had 15 barges including six loads and nine empties configured three wide, five long. Tow adjustments were made by moving towboat progressively from stern tier to bow tier along the starboard side of the tow. At each coupling, a capstan line is deployed to a fitting on the center string. When the capstan line at each station is tightened, the strings of barges are pulled together. Once this is accomplished, two members of the deck crew tighten corresponding barge wires in order to give strength and stability to the final tow configuration.

In this case, subject deckhand untied boat from tow, stepped down on boat bow deck and radioed to captain that the boat could proceed to the next coupling. Mate and another deckhand were walking on tow ahead of boat to that next coupling with their backs to subject deckhand. Subject deckhand took position on boat out of sight of captain and captain engaged boat to proceed alongside tow. Therefore, no crewmember had subject deckhand in sight as boat moved. Once boat arrived at next work station, subject deckhand did not appear to tie boat to tow. General alarm was sounded; deckhand remained missing. Boat deck area where deckhand was last seen was clear of all slip/trip hazards. Safety chain on boat deck perimeter was down in location where subject deckhand was traversing between boat and tow. Subject deckhand's body was found in river two hours later, dead from crushing injuries. Subject wore PFD, safety boots, hat and clothes appropriate for work being performed.

Contributing factors: Subject deckhand was 6'2" tall, weighed 285 lbs. Over the past year, he had gained 100 lbs. Subject was also found to be wearing a knee brace under clothing on left knee. No crew members were aware of his use of this brace. Overweight condition, possible weakness of knee could have resulted in loss of balance when performing squatting/standing maneuvers required of the tasks assigned at the time.

CASE 2

Time/Month:	2:00 a.m., March	***Weather:***	Clear/good visibility
Tennessee River:	Normal operating conditions	***Mate:***	25-34 years of age Six to ten years experience

Description of Incident: The towboat was in the process of facing up to two empty barges in its tow below the lock. These barges were secured against cells designed and constructed to tie barges off to because most tows engage in multiple lockings at this particular lock. The barges secured to the cell were configured as "strung out" end-to-end (as opposed to side-by-side). Three crew members were deployed during this multiple lock operation: a mate, a leadman, and a deckhand. Activities occurring simultaneously were: A deckhand was completing the face-up of the towboat to the barges by tightening (using a winch) the starboard face wire (a port face wire had previously been tightened); the mate (after releasing a head line on the string) was walking to the head of the tow on the port gunnel to position himself for assisting entry into the lock chamber. The leadman was positioned at the coupling between barges. As the starboard face wire was being tightened, the string of barges slid to port, toward the cells, and struck a cell. The resulting bump caused the mate to fall into the water.

CASE 3

Time/Month:	12:00 noon, November	***Weather:***	Clear/good visibility
L. Miss. River:	Normal operating conditions	***Deckhand:***	20-24 years of age One to three years experience

Description of Incident: Boat had just entered lock with two hands on deck at bow. After stopping tow for tie off in lock, experienced deckhand stayed on head while the other deckhand went to stern to tie tow and monitor lines during lock up. Deckhand on stern decided to put lock line on wall pin above the shoulder height wall pin. To accomplish this he had to extend himself upward and outward. There was about a 2' gap between the tow and the lockwall. Deckhand lost his balance and fell between the tow and lockwall. Deckhand died two days later. The barge he was working from was a 300' x 54' tank barge with non-skid paint on the gunnel. There was no debris on the gunnel and the surface was dry.

CASE 4

Time/Month:	2:00 a.m., March	*Weather:*	Clear/good visibility
L. Miss. River:	Normal operating conditions	*Deckhand:*	20-24 years of age Less than one year experience

Description of Incident:

Deckhand was working on a tug mooring barges in a fleet. He had just completed tying off a hopper barge. The deckhand was working alone on the bow of two barges. The operator of the fleet tug was watching the deckhand from the tug and had illuminated the area using the tug's spot light pointed at an adjacent barge. When the deckhand had finished tying off the hopper barge he was positioned on the raked barge. He stood up and turned toward the bow. Now facing forward, he fell or stepped off the bow. No tripping hazards were in the immediate area. The deckhand did not appear to slip. There was no loose debris on deck. The tug was in stationary position and there was no bump. The crewman disappeared beneath a barge and surfaced about five minutes later further downstream. He was seen face down on the surface of the water. He did not respond to calls. Before help could reach him he again disappeared beneath the bow of another barge. He surfaced about one hour later and was recovered with no vital signs.

The activity level was low. The deckhand was wearing a work vest PFD, and steel toed work boots. He had a portable radio in a carrying belt. He may have had a flashlight. He had 90 days experience on the job. He was on day 14 of a 14-day stint of 12-hour shifts (seven days 0600 to 1800, then seven nights 1800 to 0600, then seven days off). The deckhand was living on the tug 24 hours a day for at least 50% of the 14-day period, but working 12-hour shifts. He had been working approximately eight hours at the time of the accident. He was physically fit with no known physical or mental impairments or known personal mental distractions. He was under the supervision of the tug operator who was on the tug. He had been given 14 days of on-the-job training with a "senior" deckhand before assuming an independent watch. The employing company gives all employees a general safety manual and employees watch three general safety videos. The fleet boats were normally crewed with one deckhand and one operator on duty.

CASE 5

Time/Month:	11:00 p.m., March	*Weather:*	Clear/good visibility
L. Miss. River: *(Canal)*	Normal operating conditions	*Deckhand:*	25-34 years of age Less than one year experience

Description of Incident: Deckhand was standing outboard of the starboard pushing knee as tug approached moored barge. Tug was approaching barge starboard bow to starboard bow. When tug was within a few feet of barge, pilot of tug pivoted tug to starboard and bow of tug ran under rake of barge. Deckhand was pinned between towing knee and barge rake. Deckhand was crushed. Pilot was not aware of location of deckhand at final approach. Deckhand was not informed that tug was going to turn to starboard. Tug had hand-held radios available, but deckhand was not carrying one at the time of the accident. Deckhand's watches were six on, six off. He was on hour five of a watch to end at 0000. Deckhand slept on the tug when not on watch. Deckhand had been employed at the company for one month, though it was reported that he had experience in the industry. All training was OJT. There was no written deckhand training program. Deckhand was in good health and physically fit with no known physical or mental impairments or known personal mental distractions. He was under the supervision of the tug pilot, who was in the wheelhouse.

CASE 6

Time/Month:	2:00 p.m., March	*Weather:*	Clear/cold/good visibility
L. Miss. River:	Normal operating conditions	*Deckhand:*	*35*-50 years of age One to three years experience

Description of Incident: Fleet tug was moving three empty barges alongside a row of empty barges to build a northbound tow. As the barges were being slid into position, the lead deckhand was sent forward by the tug pilot to tie a head wire. The three barge tow caught a notch while sliding into position. The resulting jolt was felt by the second deckhand but he did not lose his balance. Two barges broke loose. The tug pilot called for the leadman, but received no reply. The second deckhand was sent forward to investigate, but could not find the leadman. The tug pilot and second deckhand began looking for the leadman, including shifting barges around in the fleet. The leadman's work vest was found. The leadman remains missing. The lead deckhand had been employed by the company for two years and 10 months. He had previous experience in the barge fleeting industry. He was physically fit with no known physical or mental impairments or known personal mental distractions. He was under the supervision of the tug operator, who was on the tug. All fleet boats work an eight and four shift (four days 0500 to

1700, then four nights 1700 to 0500, then four days off). No personnel are allowed to sleep on tug during their daily 12-hour off period. The tug was manned by a pilot, lead deckhand, and deckhand. The leadman was on his fourth day and had been on the job about nine hours before the accident. The company's safety program for deckhands included giving all employees a copy of the *Deckhand's Manual*, company safety rules, watching general safety videos, and weekly safety meetings. It is a company policy that employees wear a PFD when on deck of the tug and when on barges. Company provided personal protective equipment for deckhands is gloves, safety shoes, and flashlight or "bull eye" (hat-mounted light). There are no written procedures for deckhand activities. There is no company requirement for deckhands to work in pairs.

CASE 7

Time/Month:	4:00 p.m., April	***Weather:***	Clear/good visibility
Intracoastal Canal:	Low water	***Deckhand:***	25-34 years of age Less than one year experience

Description of Incident: Tow was on the canal west, four barges in tow. The stern barge was a loaded coal barge. Unfacing the tow, one deckhand was on each side of the face wire taking the wire off of the bitt. The deckhand toward the center of the barge lost his grip and dropped the face wire. The deckhand toward the outside of the barge held on and lost his footing because of excessive coal on the deck. He tried to hold onto the wire. He fell down on the deck and rolled over the side into the water. The deckhand was immediately picked up with no injuries. Deckhand had been on watch four hours and was well rested.

CASE 8

Time/Month:	11:00 p.m., August	***Weather:***	Clear/good visibility
Intracoastal Canal:	Low water	***Deckhand:***	20-24 years of age Four to five years experience

Description of Incident: The tow had just transited a pass in the sound and the deckhand was sent out on tow to inspect rigging and tighten if necessary. The seas were running between 2-1/2 to three feet. On the head of the tow, the deckhand started to tighten a ratchet. The waves caused the barges to loosen the wires and caused the ratchet to surge toward the deckhand, striking him in the chest. The deckhand stood up in a dazed condition and fell overboard. The captain of the vessel spotted the deckhand because of the reflective

tape on his PFD. The deckhand was pulled up on the boat and given CPR successfully. The Coast Guard was given Loran readings which greatly expedited helicopter pick-up. The Loran is standard equipment on company Mississippi Sound boats. The deckhand had a flashlight, but no radio at the time of the incident.

CASE 9

Time/Month:	4:00 p.m., April	***Weather:***	Clear/good visibility
Kanawha River:	Normal operating conditions	***Deckhand:***	25-34 years of age Six to ten years experience

Description of Incident: The crew of a towboat was on the head of 10 standard, loaded barges getting ready to use a 2" lock line to check the tow down into Winfield Lock. The mate, deck engineer and deckhand were all on the head barge. The deckhand was to step from the head barge to the lock wall to lead the eye of the line down the wall. As he tried to step across the 2-1/2 foot to three foot gap between the tow and lock wall, he stepped on the wall and slid into the river. The deckhand suffered no injury and required no treatment. (The other deckhand hurt his back pulling the deckhand out of the water and up onto the barge).

CASE 10

Time/Month:	11:00 a.m., February	***Weather:***	Clear/good visibility
Kanawha River:	Normal operating conditions	***Deckhand:***	25-34 years of age Four to five years experience

Description of Incident: A deckhand on the forward watch was catching a line on a cell to tie off 10 standard, loaded barges, waiting for a lock turn above Winfield Lock, Mile 32. As he threw the 2" lock line from the barge to the cell, he lost his balance and fell into the river. The deckhand swam to the cell and held onto the cell until the watchman ran out the three barge lengths to help him. No injury suffered, no treatment required.

CASE 11

Time/Month:	10:00 p.m., February	***Weather:***	Clear/good visibility
Kanawha River:	Normal operating conditions	***Deckhand:***	25-34 years of age Six to ten years experience

Description of Incident: The crew was in the process of removing lines, tools, etc., from a tow of empty jumbo barges at a coal dock at Mile 40. The towknees of the boat were up against the empty barges. The deckhand picked up a 75' x 2" lashing, put it on his shoulder and with his free hand picked up a tow speaker. As he walked from the barge to the top of the towknees, he bumped into the jackstaff and lost his balance. Instead of falling eight feet onto the head of the boat, he pushed himself out towards the river. He fell into the water. The watchman and deck engineer who were working with him immediately threw him a line and pulled him onto the boat. No injury, no treatment.

CASE 12

Time/Month:	9:00 p.m., December	***Weather:***	Clear/cold/good visibility
Ohio River:	Normal operating conditions	***Deckhand:***	25-34 years of age Six to ten years experience

Description of Incident: The crew was making up a tow of 15 loaded coal barges at a coal dock, Mile 948. The crew was wiring in the loads as they were brought to them by the coal terminal tug. The deckhand was walking to the box end (stern) of the jumbo loaded tow to get the wires ready to wire in the next load, when he slipped on the ice-covered box end and slid into the river. The crew immediately pulled him out of the river and helped him into a warm shower. He put on dry clothes and returned to work one-half hour later. No injury, no treatment.

Best prac.doc

APPENDIX E:

BEST PRACTICES

Because this study concludes that falling overboard, whether from a boat or barge, accounts for a significant majority of towing vessel crew fatalities, the QAT decided to include a list of "Best Practices" currently employed or under examination by inland towing companies to reduce the incidence of falls overboard.

Some of the practices listed below require modifications to boats and/or barges; others involve safety gear and corporate safety policies. Some of the fall prevention ideas presented here have never been successfully implemented, but their inclusion in this report is intended to enlighten the reader to a wide range of fall prevention ideas for potential inclusion in a company fall overboard prevention program.

PAINTING HAZARDOUS AREAS

Vessel Borders: Painting the perimeter of barges and towing vessels a white or yellow color aids in the identification of these hazardous areas, particularly in poor lighting situations.

Towing Vessel Walkways: Applying non-skid material to boat walkways helps establish good footing, particularly during inclement weather.

Barge Work Areas: Some companies paint deck tripping hazards such as buttons, timberheads, kevels, and hatch covers. Others paint a simple vertical stripe on coamings as an indicator of hatch cover locations. Such markings can be an aid in identifying tripping hazards during periods of darkness or poor visibility. However, companies which engage in these practices also take care not to paint surfaces where lines are normally worked (e.g., timberhead trunks), in order to prevent lines from binding.

RAILINGS/CHAINS

Towing Vessels: Installing chains on the main decks of towing vessels reduces exposure to falling overboard when walking or working on a main deck. Permanently applied handrails for stairways and upper decks also protect employees from falling from those levels.

Barges: At least one company has studied the application and use of handrails on its fleet of hopper barges. In this company's experience, the complications railings create in handling lines/wires when vessel employees are engaged in barge-to-barge operations (such as tow make-up/break-up) and barge-to-structure operations (such as locking and docking) outweigh the singular safety goal of fall restraint. Indeed, railings on barges, under certain operating scenarios, could introduce significant hazards into the workplace.

FALL RESTRAINT DEVICES

One company studied the application of fall restraint devices for deck employees while engaged in normal activities such as setting head gear/sounders, tow work, and locking.

The restraint devices were essentially composed of a full body harness, a retractable lifeline (affixed to the employee's back), and a hook for attachment to a permanent fitting on a barge.

Seventy employees tested this device while working on six linehaul boats during a 10-month period.

Essentially, the safety block locked up more frequently than anticipated and routine tasks involving crossing from barge to barge (such as picking up or dropping barges) became virtually impossible. Also, during locking operations, the safety block tended to lock up suddenly when a crewmember attempted to throw wraps of line onto deck fittings.

One situation in which such devices might be used successfully is in restraining falls when setting head gear and sounders. This company is continuing fall-restraint device development directed toward that specific work requirement.

LADDERS

Many companies employ the use of ladders in daily routines requiring movement between surfaces at differing elevations such as between loaded and empty barges.

One company has designed an innovative ladder that is lightweight, easy to carry, and attaches itself securely to the barge to be climbed upon. A drawing of this device is included in this report as Exhibit I at the end of this section.

SAFETY RULES

One company has formulated a man-overboard prevention program designed to make employees aware of falling hazards as well as providing rules aimed at eliminating the falling hazard altogether. These rules are also included in this section as Exhibit II.

SAFETY APPAREL

Companies stress the use of safety apparel such as billed caps (to reduce the glare of sun and searchlights), personal flotation devices (PFDs), eye protection, and safety footwear appropriate to the weather and task to be performed. Many companies employ walkie-talkies as a means of communication when a crewmember is out on tow. This not only improves communication, but enhances the "buddy system" among crew members.

OTHER SAFETY IDEAS

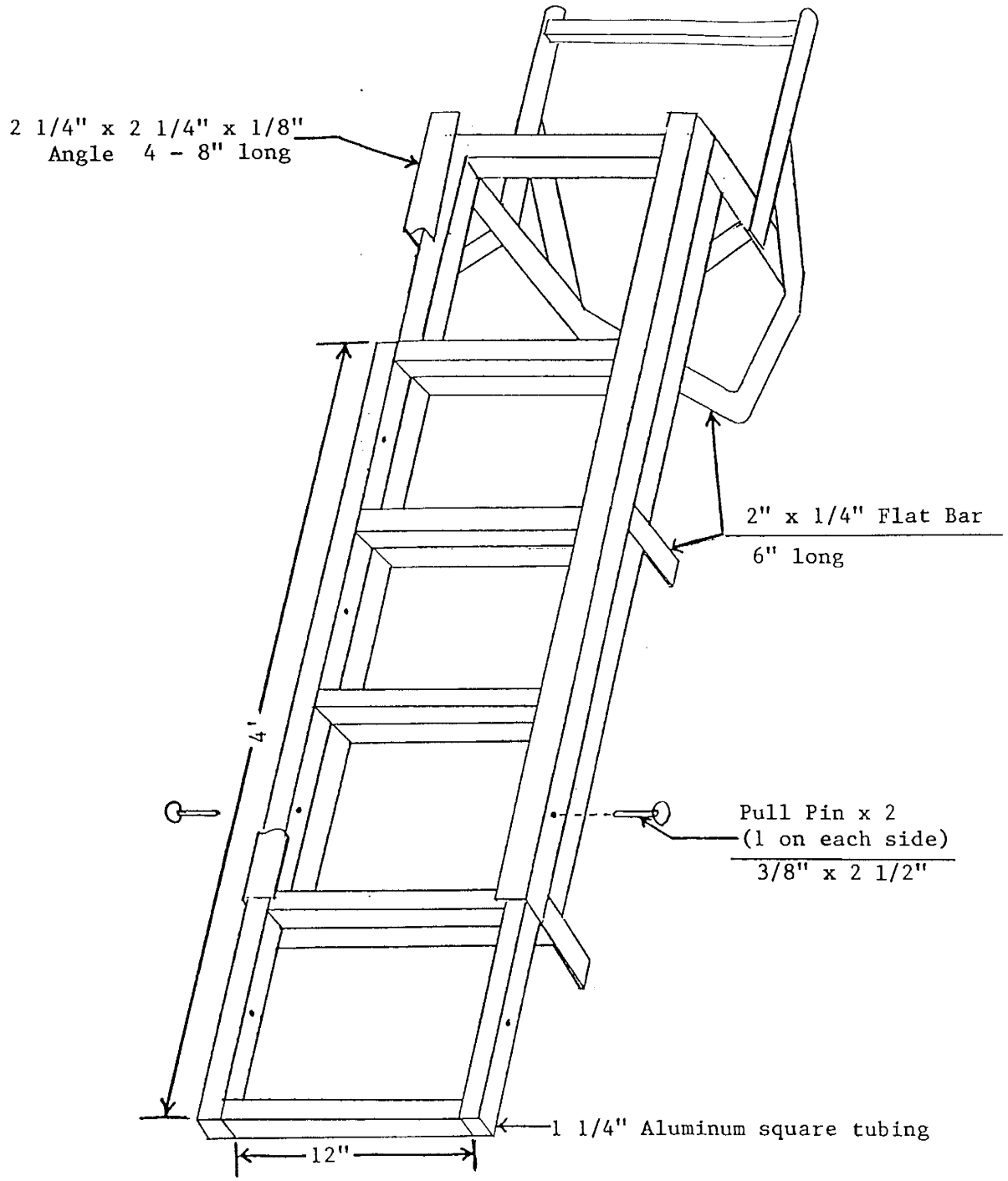
Boats: Companies have modified the interiors of boats so that movement throughout the boat can be accomplished without going outside onto a main or secondary deck.

Barges: Barge owners report the following barge design modifications aimed at reducing fall overboard hazards:

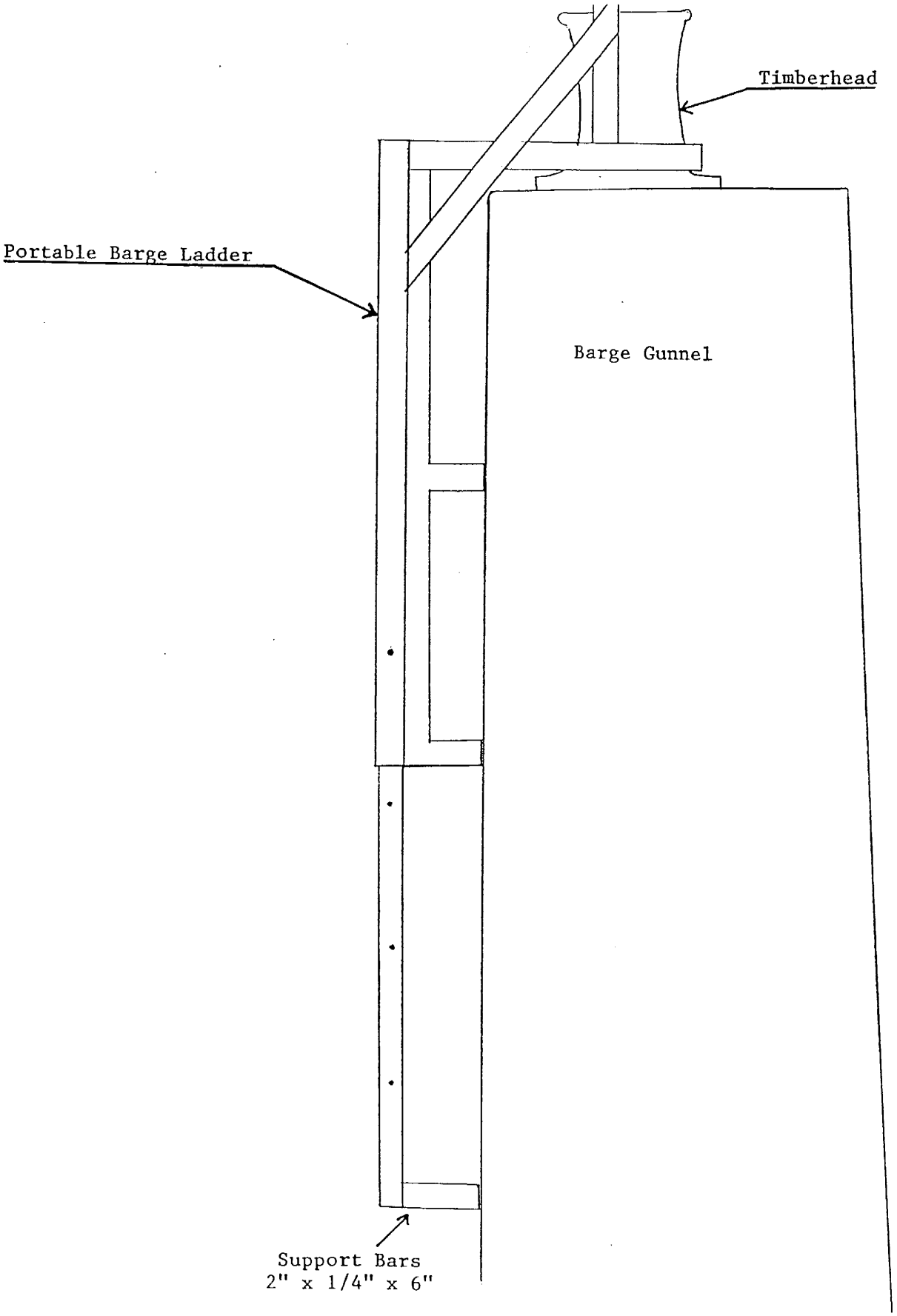
- Wider gunnels
- Non-skid walkways on barges
- Reducing tripping hazards on decks by moving fittings closer to barge edge
- Raising barge coaming heights to 30"
- Flush-mounted hatch covers
- Piping systems installed in dry cargo barges so that pumping any wing tank can be accomplished from the end of the barge instead of middle walkways

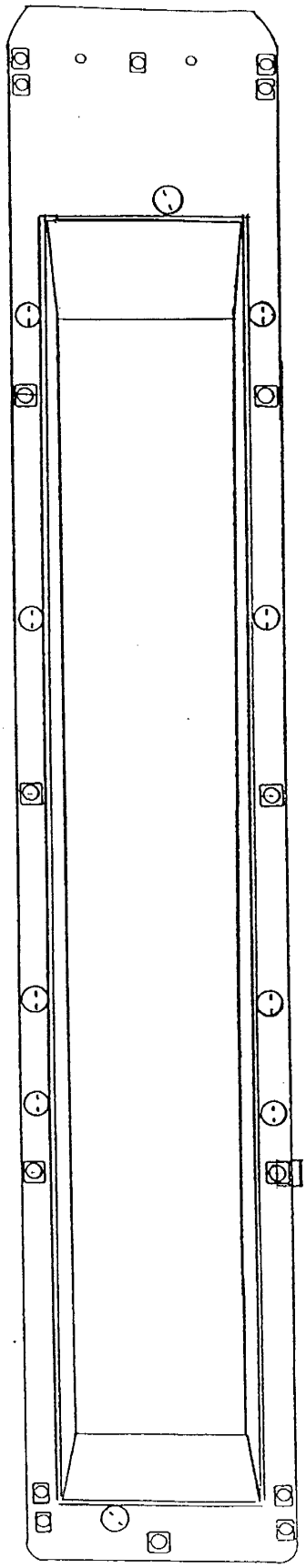
Clearly these solutions do not apply to all barges, all operating areas, or all company/customer service relationships; they are not a panacea for fall prevention. Companies and their employees need to implement programs that best fit the risks inherent in their own operations.

Exhibit I



Note: All square tubing is 6061 aluminum and is welded with 4043


Timberhead
Portable Barge Ladder
Barge Gunnel
Support Bars
2" x 1/4" x 6"



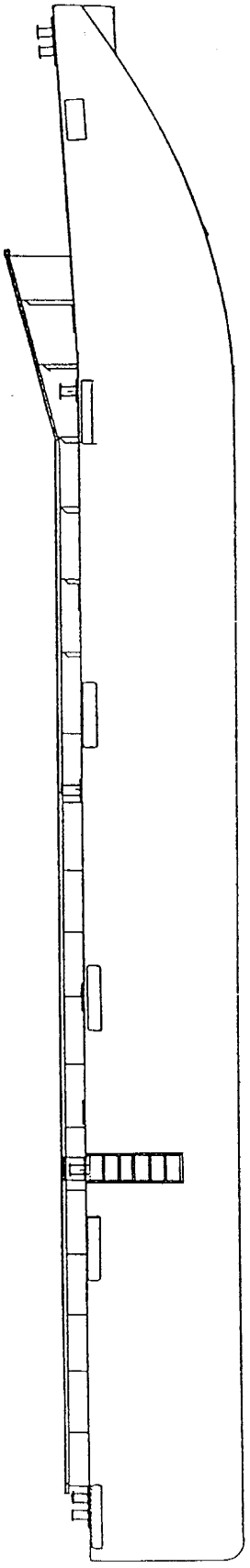


Exhibit II

FALL OVERBOARD PREVENTION RULES AND PRACTICES

Before Going on Tow:

1. Establish a game plan. Do not go on tow unless you have a specific task to perform.
2. Receive authorization from the wheelhouse before going on tow.
3. Discuss known hazards such as notches, duck ponds, poor walking conditions, and current weather conditions with the previous watch.
4. Perform a radio check. If at night, check flashlight as well.
5. Have proper work gear and personal protection equipment on hand and in safe working order. In particular, insure that work boots are securely tied and soles are in good condition.
6. Use the "BUDDY" system at all times. Identify your buddy and then maintain visual or voice/radio contact at all times when outside the vessel. In some circumstances, your buddy could be the person on watch in the wheelhouse.

Rules/Practices While on Tow:

1. Maintain frequent radio contact with the wheelhouse.
2. Don't walk on an open gunnel or the head of a tow unless absolutely necessary.
3. Avoid working and standing with your back to the water.
4. Position ratchets so they may be tightened inboard.
5. Be aware of and communicate potential bump hazards to co-workers.
6. Be aware of and communicate location of notches, duck ponds, or any other like hazards on tow.
7. Check all shadows before walking into them.
8. When departing locks and landings, all persons on tow should meet at a predetermined location so all can be accounted for, and so all can return to the boat together.
9. When head gear is being placed or adjusted, headway should be stopped if possible, or at the very least, slowed as much as possible in order to maintain steerage.

Upon Return From Tow:

1. Inform the wheelhouse that you have returned to the boat and of your location.
2. Record all unusual hazards and conditions so they may be communicated to the next watch.

General Rules and Ongoing Practices:

1. Contact wheelhouse to turn on the guard lights before going on the main deck at night.
2. Make sure all guard chains are hooked up at all times, except when persons are boarding or departing along side and when taking on groceries and/or supplies.
3. Keep all work areas, especially the head of tows, neat so as to reduce as many trip hazards as possible.
4. Keep spilled and loose cargo cleaned up. Shovel, clean and salt icy walkways.
5. Cover duck ponds with figure 8 lines to block the hole.
6. Don't throw a bucket overboard into the current to get water for priming pumps. Use water from a wing tank or go back to the boat for water.
7. Replace face wires, wing wires, and stationary wires that have severe kinks and twists as soon as practical.
8. When in locks or landings, make sure barges are flat and stopped before climbing lock ladders or disembarking position.
9. Don't attempt to climb lock walls or ladders while carrying gear; use a handyline.