



**The United States
Coast Guard**



**The American Waterways
Operators**

May 21, 2003

MEMORANDUM

TO: AWO Board of Directors
Designated Representatives, AWO Carrier Members

FROM: Tom Allegretti, The American Waterways Operators
RADM Paul Pluta, U.S. Coast Guard

RE: Coast Guard-AWO Bridge Allision Work Group Report

We are pleased to enclose the Report of the Coast Guard-AWO Bridge Allision Work Group, formed by the Coast Guard-AWO Safety Partnership in the wake of fatal barge-bridge accidents at South Padre Island, Texas, in September 2001 and Webbers Falls, Oklahoma, in May 2002. The Work Group was established by the Safety Partnership's National Quality Steering Committee and functioned as a Quality Action Team as provided for in the Coast Guard-AWO Partnership Agreement of 1995. The Work Group examined Coast Guard casualty data on bridge allisions involving barges and towing vessels and attempted to answer the questions, "How often do bridge accidents involving barges and towing vessels occur? What causes them? What do we need to do to prevent them and ensure that public safety is not placed at risk?" This report attempts to provide some answers to those questions, based on a study of towing vessel bridge allisions over the ten-year period 1992-2001, led by a group of Coast Guard and towing industry experts, including active and former towing vessel captains.

Because formal government investigations into the Texas and Oklahoma casualties are continuing, the Work Group did not attempt to draw conclusions about the causes of those particular incidents. This report is meant not to preempt the forthcoming accident investigation results, but to serve as context for them. Together, we expect that all of these inputs – the Work Group report **and** the Coast Guard and National Transportation Safety Board investigation results, combined with feedback from Congress and other federal agencies – will serve as the basis for well targeted and effective actions by industry and government to address the challenge of towing vessel/bridge accidents and ensure the safety of the traveling public. Copies of the report are also being shared with the Towing Safety Advisory Committee and the Navigation Safety Advisory Council for consideration.

Your feedback is an important part of this process. We hope that you will take the time to read the report carefully and offer your comments, questions, and suggestions for improvement. If you have any questions about the report, please feel free to contact Jennifer Carpenter, AWO Senior Vice President-Government Affairs and Policy Analysis, at jcarpenter@vesselalliance.com, or Captain Mike Karr, Chief, Office of Investigations and Analysis, U.S. Coast Guard, at mkarr@comdt.uscg.mil.

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Report of the

**U.S. Coast Guard -
American Waterways Operators
Bridge Allision Work Group**

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A Product of the Coast Guard - AWO Safety Partnership

EXECUTIVE SUMMARY

Introduction

On May 26, 2002, a tow struck the I-40 highway bridge over the Arkansas River. The bridge collapsed, resulting in the tragic loss of the lives of 14 motorists. Under the auspices of the U.S. Coast Guard-American Waterways Operators (AWO) Safety Partnership, the Coast Guard and AWO convened a work group to investigate the prevalence and causes of bridge allisions involving barges and towing vessels and develop recommendations to prevent allisions and mitigate their consequences.¹ The group's work was **not** intended to address the I-40 accident itself, since that casualty is the subject of an ongoing investigation by the National Transportation Safety Board, which may result in additional recommendations for Coast Guard-industry action.

The Bridge Allision Work Group (“the Work Group,” or “the Group”) included members from both the Coast Guard and AWO member companies with expertise in towing operations and safety, including four active or former towing vessel captains. The Work Group also drew on subject-matter experts from the Coast Guard and the AWO staff. The Group used the principles of Risk-Based Decision Making (RBDM) to provide structure and discipline to its analysis.

Data Extract and Analysis

Data on all bridge allisions in which the primary event was either an allision or breakaway were extracted from the Coast Guard's databases. This resulted in a study database of 2,692 bridge allision cases involving towing vessels and barges in U.S. waters for the years 1992-2001. This number must be viewed in the context of the number of trips conducted by tugboats and towboats each year. Using data from the U.S. Army Corps of Engineers for the year 2000 (the most recent year for which published data is available) as a reference point, the Work Group calculated that bridge allisions occur at the rate of approximately 0.06%, or six allisions for every 10,000 towing vessel trips.

The Work Group divided the bridge allision cases into five severity classes. The table below gives the definitions of the classes and the number of cases in each:

Table 1: Severity Classes

Class	Definition	Count
0	Damage recorded as “None or Not Specified.”	1,702
1	Damage between \$1 and \$25,000.	610
2	Damage between \$25,001 and \$100,000.	220
3	Damage between \$100,001 and \$500,000.	99
4	One or more of: damage > \$500,000; loss of life > 0; injured > 0; missing > 0; oil spilled.	61

¹ An allision is a collision with a stationary object, such as a bridge or dock.

A statistical analysis of the entire study database was conducted. This provided the Work Group with information about the most frequently hit bridges, the bridges that sustained the most damage, and the bridges currently scheduled for alteration or removal under the Truman-Hobbs Act. Analyses of the allisions by vessel characteristics (e.g., length, horsepower, etc.), time of day of the accident, and occurrence of a pollution incident showed no correlations or patterns suggesting fruitful areas for further study.

To investigate the causal factors behind the bridge allisions, a subset of the cases was produced consisting of all the cases in severity classes 3 and 4, plus a random sample of cases from the other classes. The subset was sent to teams of industry experts, each chaired by a Work Group member. A computer-based tool was used by the experts to categorize and assign causal factors to each case. This exercise returned detailed data on 459 cases.

The information contained in the Coast Guard casualty reports posed a significant challenge to the Work Group. Current Coast Guard standards for gathering casualty facts and information, especially human factors information, were incompatible with the intent of the Work Group to conduct a detailed analysis. In many cases, the detail necessary to determine precisely the causal factors of an allision was not available. Work Group members were therefore forced to rely on their own operational experience, judgment, and knowledge of a particular waterway in interpreting the limited information in the Coast Guard casualty reports and classifying allisions by mishap type and causal factor. With this admittedly significant caveat, the Group concluded that 90% of the cases were related to human performance (78% to pilot error and 12% to other operational errors). Only 5% were related to mechanical problems, and for the remaining 5% there was insufficient information to assign a cause. The Group's analysis of the performance-based cases showed that the predominant causal factor in bridge allisions was decision making error on the part of the towing vessel operator, which surfaced as a causal factor in 68% of the 435 sampled cases in which a mishap category could be identified. Significantly, this pattern was the same for cases across the range of severity classes, meaning that both high- and low-consequence cases exhibited the same causal factors.

Development of Recommendations

Based on this information, the Work Group focused on improving decision making in the wheelhouse. Cognitive models of the decision making process were developed and used to construct a systems model of the factors involved. Development of the systems model showed clearly that reducing the number of bridge allisions is a complex issue; there are no "silver bullets" or quick fixes. The Work Group identified leverage points in the model where changes could be made to reduce the frequency of bridge allisions or mitigate the consequences of allisions and generated a list of potential recommendations. A cost-benefit analysis was applied to the list. Based on the results of the cost-benefit exercise, the Group developed this five-point action plan:

1) The Coast Guard and AWO should initiate a joint program to implement the six prevention recommendations with the highest efficiency scores resulting from the cost-benefit analysis. These are:

- a) Identify vulnerable bridges where measures to prevent and/or mitigate allisions should be applied.

- b) Develop navigation best practices for transiting bridges vulnerable to allision.
- c) Train operators in the application of navigation best practices.
- d) Require route familiarization, posting, or a check-ride before an operator is permitted to navigate under a vulnerable bridge alone.
- e) Improve Coast Guard-industry information sharing on near misses.
- f) Require the implementation of Crew Endurance Management Systems (CEMS) throughout the towing industry as a means of improving decision making fitness.

2) The Coast Guard and AWO should use this report to accelerate the removal and alteration of bridges under the authority and procedures of the Truman-Hobbs Act. More than 900 bridge allisions – 34% of all allisions between 1992-2001 – occurred at bridges under order to be altered or on the Truman-Hobbs backlog priority list.

3) The costs and benefits of requiring additional protection for bridge piers should be given further consideration in the process of identifying vulnerable bridges as proposed in Recommendation #1 above. Targeting improved bridge protection measures on those bridges identified as most vulnerable to allision or to severe consequences should an allision occur may be a meaningful and cost-effective addition to the prevention recommendations offered here and should be given further study.

4) The Coast Guard Research and Development Center should use this report as a basis to consider future studies to explore combinations of the potential recommendations that can generate greater benefits acting together than indicated by their individual cost-benefit scores (i.e., a study of the non-linear dynamics of the causes of bridge allisions).

5) The Coast Guard should implement a special investigative effort for certain bridge allision incidents, over a specified period of time (three to five years). As part of this effort, the Coast Guard would conduct a thorough investigation of each bridge allision for which the preliminary investigation showed human factors issues as possible causal factors. Coast Guard and AWO analysts would regularly evaluate the data from these completed investigations and report their findings to the National Quality Steering Committee (QSC) of the Coast Guard-AWO Safety Partnership. This effort would provide future analysts with more detailed information than was available in most of the cases reviewed by the Work Group.

Conclusion

The core findings of the Work Group are as follows:

- 1) The human element, in particular decision making errors, is the predominant factor in bridge allisions. This does not mean that towing vessel operators are poor decision makers. Indeed, the fact that the overwhelming majority of bridge transits take place without incident – and that most bridge allisions that do occur result in no damage to people, property, or the environment – testifies to the skill and professionalism of towing vessel operators who do a difficult job under challenging conditions, with very little margin for error.
- 2) A myriad of factors contribute to the human factor-based errors, thus there is no “silver bullet” or “quick fix” for reducing bridge allisions.

- 3) The recommendations advocated by the Work Group involve a mix of industry and government action to reduce the occurrence of bridge allisions. However, the risk of bridge allisions cannot be reduced to zero. Thus, additional actions by transportation authorities are needed to remove hazardous bridges and improve protection standards for bridges so that consequences from a bridge allision are minimized.
- 4) These findings should be distributed to industry, government, and related parties by as many channels as possible.
- 5) Additional research may develop other recommendations.

The Work Group is confident that it thoroughly explored the information it had available and that its findings and recommendations will provide a solid foundation for future work to reduce the frequency of bridge allisions and minimize the consequences of those that do occur.