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of the Marine Safety Council

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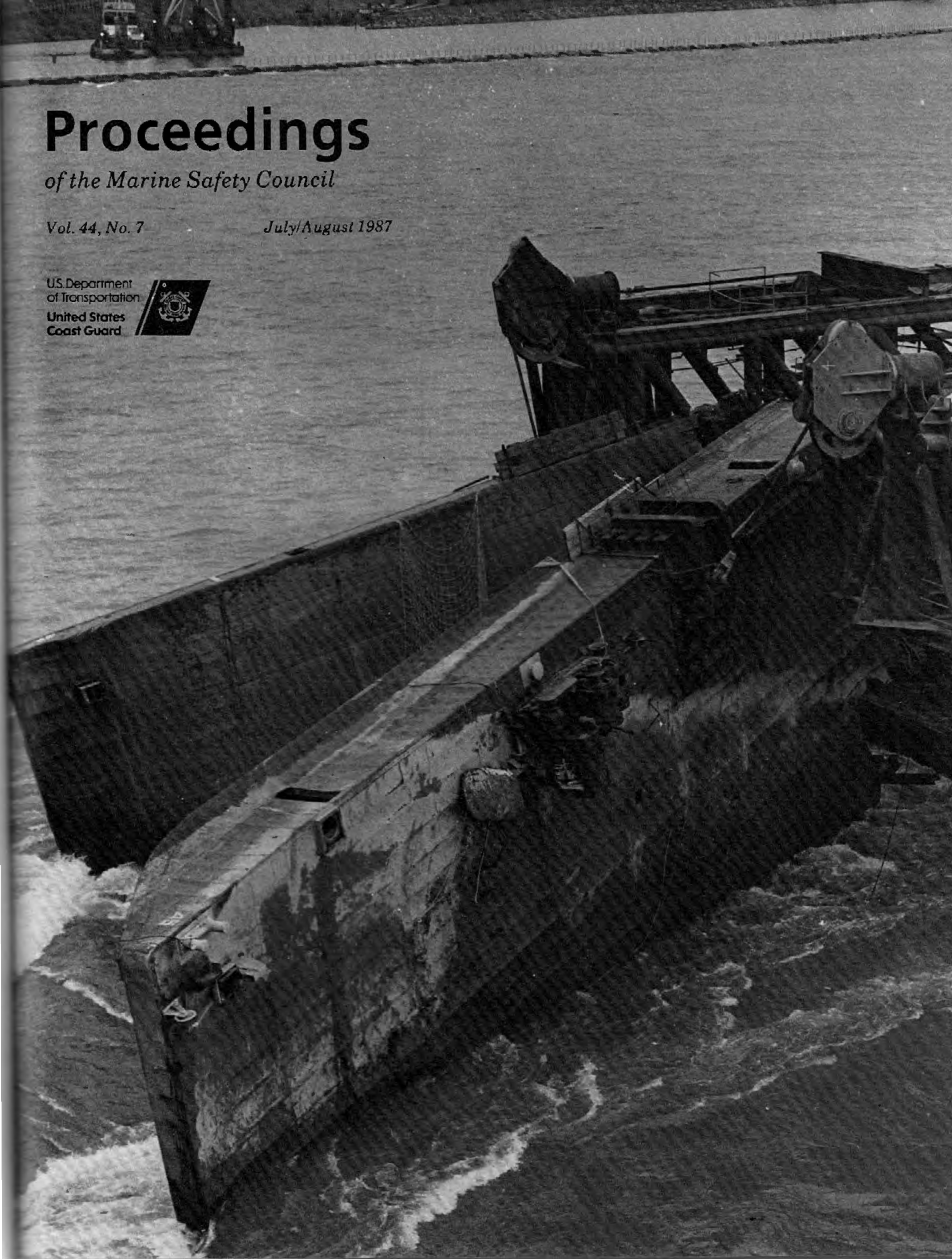

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July/August 1987 *Vol. 44, No. 7*

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When its tow sank, the Barge #45 became impaled on the Peace Bridge, a primary bridge between the United States and Canada. Months of planning and coordinating were needed before the barge could be safely removed. Here, the broken Barge #45 is carried by a lift barge to a dismantling site. (Photo courtesy of the U.S. Army Corps of Engineers, Buffalo District)

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The Fall and Rise of the Barge 45

LCDR Timothy G. M. Balunis

Marine safety duties, always interesting and challenging, require the best efforts from individuals and organizations to bring maritime emergencies to a successful end. A recent casualty on the Niagara River involving an ordinary barge and the Peace Bridge (located between Canada and the United States) resulted in many challenges for the Coast Guard in Buffalo, New York. Initially a port safety problem, the casualty also had the potential to become an environmental catastrophe for two countries. However, the accident also presented an opportunity for Coast Guard personnel from Marine Safety Office, Buffalo, and Group Buffalo to work with the Army Corps of Engineers, the U.S. Navy Supervisor of Salvage, and a commercial salvage company. These cooperative efforts were performed in severe weather conditions under close public scrutiny and presented a great test of stamina and professionalism for all involved.

The Casualty

On August 7, 1986, the tug **Ruth B** with **Barge #45** unsuccessfully attempted to navigate the Niagara River near Buffalo, New York. As a result, the tug sank, and the barge became impaled on the Peace Bridge. **Barge #45**, built in 1946, was a deck cargo barge of 175 feet in length and a beam of 40 feet. The 12-knot river current had smashed it broadside, amidships, against the fourth support pylon of the 100-foot high Peace Bridge, a primary land transport link connecting western New York State with Canada. The hull of the barge had folded around the granite, ice -breaking edge of the bridge support. Public parks at Fort Erie, Ontario, and Buffalo bordered the accident site, and many park visitors witnessed the casualty. Nearby boaters sprang into action and quickly removed the three persons on board **Barge #45**.

Murphy's Law: Two barges stuck on the Peace Bridge.
(Photo courtesy U.S. Army Corps of Engineers, Buffalo)

Coast Guard Group Buffalo immediately notified Marine Safety Office (MSO) Buffalo of this casualty and indicated that an unknown quantity of fuel was still on board both the tug and the barge. MSO Buffalo gave instructions that the **Ruth B**, grounded downstream out of the navigable channel, be marked by a temporary lighted aid to navigation and that a Notice to Mariners be broadcast. Essentially,

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the **Ruth B** was no longer a problem, but the barge continued to present serious threats.

Under Captain of the Port (COTP) authority, the MSO addressed the potentially disastrous port safety and environmental problems:

- Was the Peace Bridge structurally sound after suffering this blow?

- Many casual boaters considered the wrecked barge a new tourist attraction and flocked to see it. The currents raging around the barge and bridge structure were remarkably unpredictable and violent, endangering the recreational vessels.

- In an area known for daredevil feats of going over Niagara Falls in (or not in) a barrel, dangerous events such as "barge buzzing" or "barge jumping" could become popular.

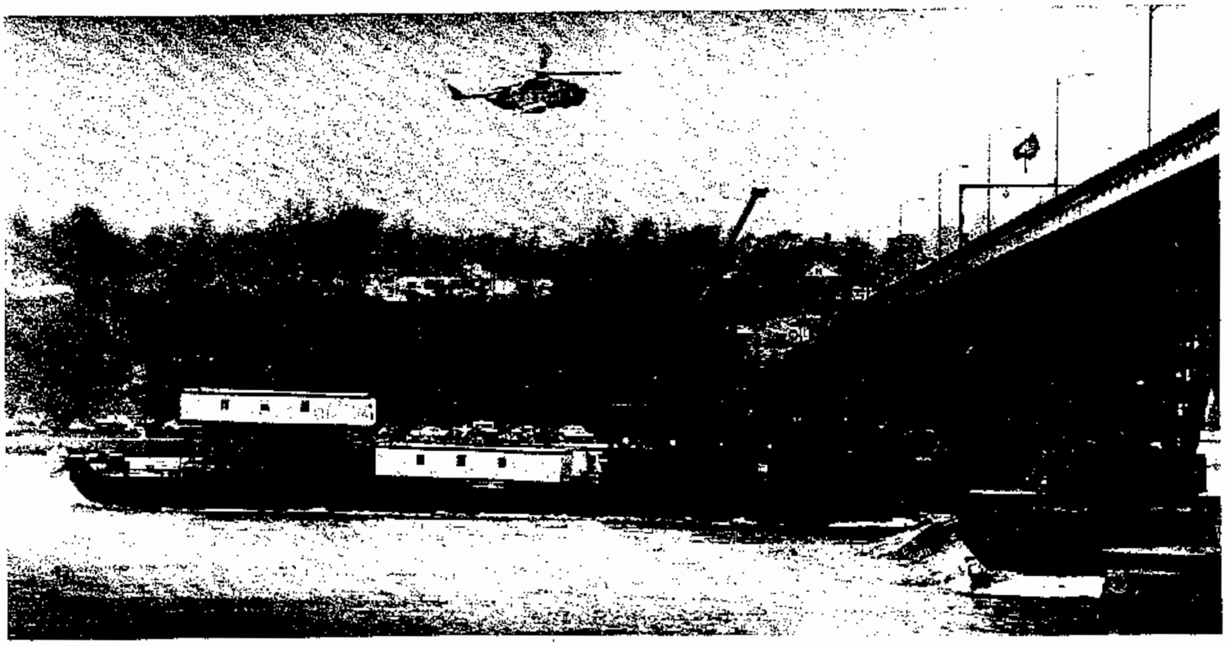
- The Army Corps of Engineers estimated that the barge was blocking about 10 percent of the Niagara River's flow area, amounting to about 5,000 cubic feet of water per second. It was believed that if the barge were left in place, the level of water in Lake Erie would rise 3 inches over a 2-year period.

- If the barge were to break loose or break apart, boaters in the area and several drinking water intakes were endangered. But the most notable target was the International Railroad Bridge (just 1.3 miles downstream), which was crossed each day by more than 100 chemical tank cars.

Considering the grave threat posed by the barge, COTP Buffalo requested that Group Buffalo commence an urgent marine information broadcast warning mariners of the barge hazard. The COTP then established a safety zone in U.S. waters adjacent to and downstream from the barge. The COTP also began an aggressive effort to inform the public about this dangerous situation by filming videotapes showing the vicious current eddies around **Barge #45**. As a result, very few boaters approached the barge once the tapes were shown on television.

International Cooperation

Although the Coast Guard had undertaken safety measures to protect people



Coast Guard Marine Safety Office Buffalo enforces a safety zone during Operation Lift, the removal of Barge #45 from the Peace Bridge. *(Photo courtesy of B. Burr Lewis, Gannett Rochester Newspapers)* and property in the vicinity of **Barge #45**, the vessel was actually aground in Canada since it was straddling the invisible U.S.-Canada border line in the Niagara River. This condition limited the direct authority of COTP Buffalo, but it did make for an unusual opportunity to promote international relations.

The COTP determined that by definition (33 CFR 160.203), **Barge #45** created a hazardous condition in the port, to which the Canadian Coast Guard responded enthusiastically. Following planning sessions with the Peace Bridge Authority, the Army Corps of Engineers, and Canadian authorities, it was decided that the Royal Canadian Mounted Police and the Ontario Provincial Police would provide and enforce a complimentary restricted zone similar to the U.S. COTP safety zone.

The Army Corps of Engineers accepted the project of removing the barge from the port and contacted the U.S. Navy Supervisor of Salvage (SUPSALV) to obtain the renowned expertise of the Don Jon Marine Salvage Company, who developed an impressive, but expensive, plan for removing the barge. The $3.7-million price tag resulted from the anticipated difficulties with the swift river current and the conservative safety precautions that were followed for this large-scale job.

An anchor system, consisting of four steel pins 10 feet long and about 1-1/2 feet in diameter, would be set into the river bed securing an anchor barge in relatively calm waters 7,500 feet upstream from the Peace Bridge. A lift barge would be "lowered" downsteam to **Barge #45** at the Peace Bridge using winches on the anchor barge by means of two 3-1/2-inch cables. On the lift barge, two massive trusses would be used to support two other 3-1/2-inch cables connected to lifting saddles welded to the hull and deck of **Barge #45**. The barge would be lifted vertically, much like a lifeboat under lifting davits. Once up, the lift barge and the suspended **Barge #45** would be winched upstream to the anchor barge. Tugs would then take **Barge #45** to an interim site in the Port of Buffalo for subsequent dismantling.

The COTP exercised oversight of Operation Lift from the start. Additional safety zones were established to protect the public and the workmen throughout the operation. Group Buffalo provided safety zone enforcement resources and developed a secondary search and rescue plan. (The COTP had previously required the salvage contractor to provide a dedicated rescue boat throughout the entire procedure.) Additional Coast Guard involvement included the Coast Guard cutter **Neah Bay**, which provided all-weather radar surveillance of the safety zone and acted as a news media platform. Air Station Traverse City (Michigan) flew numerous helicopter sorties for safety zone enforcement, search and rescue, and eye-in-the-sky reconnaissance.

Numerous setbacks as well as adverse weather conditions seemed to intensify public interest in Operation Lift as the operation became more prolonged. Several 3-1/2-inch lifting cables broke, the winches failed, one of the steel rollers supporting a lift cable was severed, and the lift barge was mysteriously pinned under the Peace Bridge. These complications seemed to fire the public's imagination: songs were written about the barge; "Barge Buster" buttons, hats, and t-shirts were sold to commemorate it; barge burgers were sold to feed it; and the story was front-page news for 27 consecutive days in Buffalo. The high winds, low temperatures, and frequent precipitation did not diminish the size or interest of the sidewalk superintendents that gathered on both sides of the Niagara.

Success

Finally, on December 19, 1986, the barge was successfully lifted, folding on its own broken back in the process. As the barge was slowly dragged to a dismantling site in the Port of Buffalo, a moving safety zone of protective vessels surrounded the barge . Months of planning, coordinating, and hard work overcame many unforeseeable problems, and due to the cooperation of many entities, both U.S. and Canadian, this maritime obstruction was removed. ▮

Bridge Collision Accidents in St. Louis Harbor

CAPT James C. Card
and
LT Donald A. Hermanson

St. Louis Harbor is considered by many to be one of the more difficult areas for towboat navigation on the Upper Mississippi River. This difficulty stems from a combination of factors peculiar to the harbor, some of which demand the utmost control of the commercial vessel operator. The main problem appears to be the existence of four bridges within a 1.2-mile stretch of the river. These bridges, in the order encountered by downbound traffic, are shown in table 1.

Table 1

Bridge	River Mile
Martin Luther King	180.2
Eads	180.0
Poplar Street	179.2
MacArthur	179.0

In the early 1980s, the number of collisions with these bridges increased significantly. Concern over this problem and the associated hazards created as a result of these accidents has prompted this article.

Using data from 1971 through 1984, we have examined the collisions between commercial tows and the bridges listed in the table. By examining this data and looking for possible causes of these accidents, we hope that collisions in the St. Louis Harbor can be reduced or eliminated.

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LT Hermanson is an Investigating Officer at Coast Guard Marine Safety Office, San Francisco, California.

At the time this article was written, LT Hermanson was Senior Investigating Officer and CAPT Card was Captain of the Port, St. Louis.

St. Louis Harbor

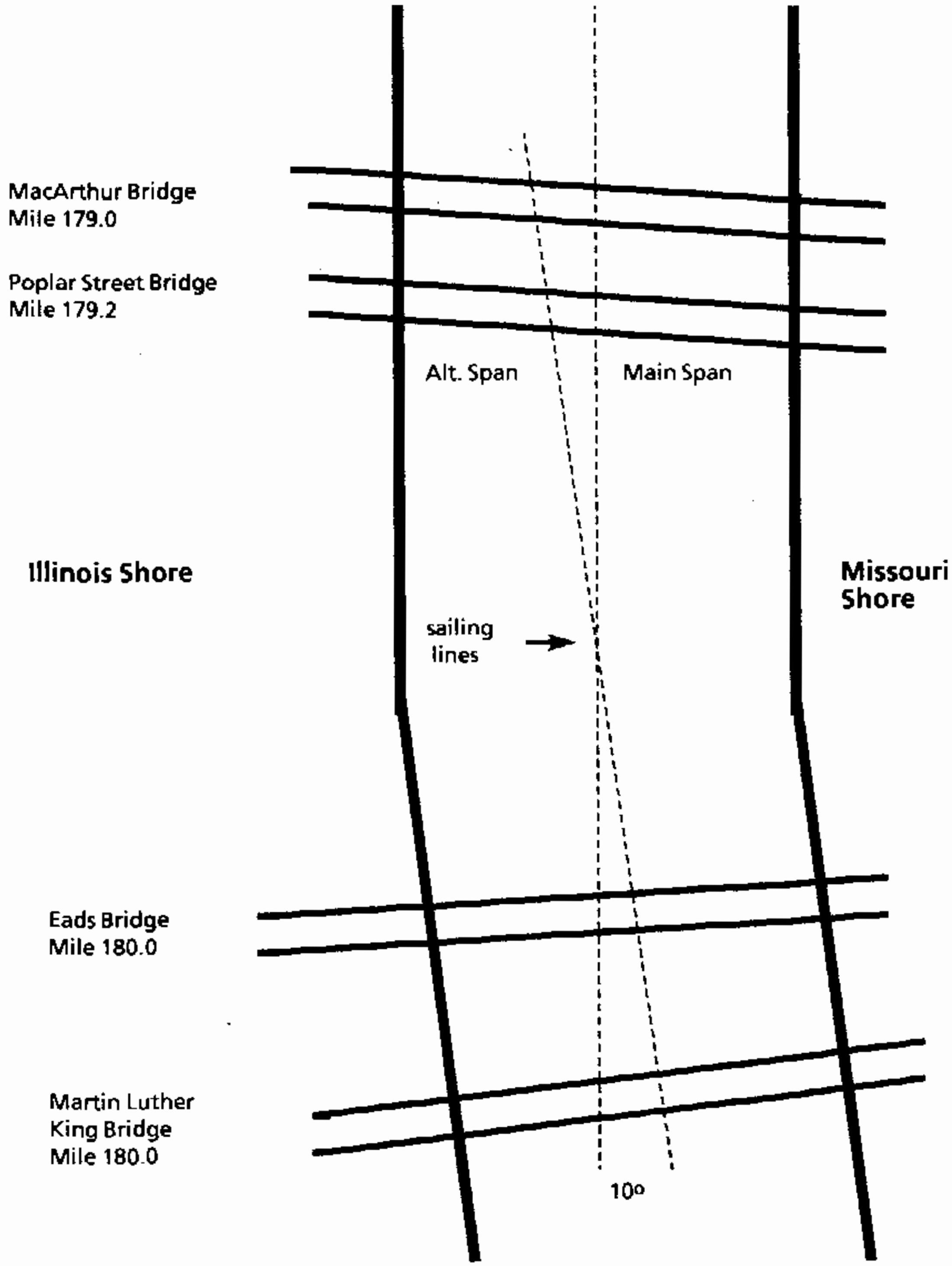
Four bridges cross the Upper Mississippi River in the St. Louis Harbor between Miles 180.2 and 179.0 A bend in the river from left to right (facing south) requires a course change of approximately 10 degrees between the Eads and Poplar Street Bridges. This bend is shown in figure 1.

Two other bridges are located further upriver. They are not targeted in this article, but it is important to mention them since they have an influence on navigation through the harbor. The Merchants Railroad Bridge is at Mile 183.2, just below the southern end of the Chain of Rocks Canal. Downriver from the Merchants Bridge is the McKinley Highway and Railroad Bridge at Mile 182.5.

The navigable portion of the harbor above the aforementioned bridges is largely pool water; that is, the stretch of river from Lock and Dam 26 at Mile 202.9 to the lower end of the Chain of Rocks Canal, Mile 184.1, contains currents of much less velocity than what would be encountered in the open river.

As might be expected in a river that runs through a major metropolitan area, there are a number of improvements on both banks of the Mississippi through this stretch. In particular, there are several moorings for commercial attractions along the Missouri shore between the Martin Luther King Bridge and the Poplar Street Bridge. On the Illinois shore, there are docking facilities and moorings for commercial vessel traffic (barges) between the Martin Luther King Bridge and the MacArthur Bridge.

Figure 1 **St. Louis Harbor Bridges**



A "Sample" Voyage

Let us now present a "mockup" of the elements of a southbound transit through the St. Louis Harbor. The scenario is a distillation of facts, figures, interview, and opinions of marine industry personnel, Coast Guard investigator, and others associated with river navigation and the harbor. Caution: This mockup is stated in the broadest of terms.

It is spring evening in St. Louis, and the Mississippi River is up. The St. Louis gage is showing 20 feet and rising. Traffic on the river is moderate to heavy as towing companies strive to meet commitments. The navigation lights are showing properly on the bridges. The decorative lights on the Eads Bridge are on. It is cloudy, but there is no rain. Visibility is good.

The vessel is a twin propeller, 3800 horsepower towboat. It is in good mechanical condition with all systems functioning properly. The vessel is pushing 11 loaded freight barges strung three wide with a notch in the head of the tow. The draft of the tow is 8 to 9 feet.

The operator is about 45 years old. He had been in the pilothouse for several years and is experienced with the St. Louis Harbor.

The tow is headed downbound approaching the Merchants Railroad Bridge. The throttle settings on both engines are one-half to two-thirds ahead. The trip through the Chain of Rocks Canal and Lock and Dam 27 were uneventful. The operator of the vessel has been on watch for over 3 hours. He knows that the river is up and he is a little concerned about getting through the bridges ahead. He has made this trip many times before and knows what conditions to expect.

As the tow clears the McKinley Bridge, the operator begins navigating his tow away from the Illinois shore. He aligns the stern of his vessel with the Venice Power Plant, Mile 182.3, and angles the head of his tow toward the right descending side of the navigation channel. He knows that the current "sets" to the left coming through the Martin Luther King and Eads Bridges and continues to set left during the approach to the Poplar Street Bridge.

About a mile above the Martin Luther King Bridge, the operator begins shaping his tow for passage through the main bridges. He aligns the front of his tow with the lights at the Peabody Coal Company, Mile 179.2, left descending bank in preparation for the passage. As the head of the tow approaches the Martin Luther King Bridge, the operator of the vessel begins a gradual (or slow) steer to the right. The slow steer induces a slight, clockwise twisting motion into the tow. The tow's port string is right of the channel center navigation lights on the Martin Luther King Bridge. The head of the tow is swinging gradually to the right and enters the main navigation span of the Eads Bridge between the dayboards marking the center and right side of the channel. The stern of the tow, including the towing vessel, is swinging to the left. The operator now puts both engines full ahead to shove out from the Eads Bridge. The pilot house on the vessel passes directly beneath the center dayboard on the Eads bridge. The increased engine power has aided the operator in stopping the swing of his tow. The vessel and tow have now cleared the Eads Bridge and are lined up with the main navigation span on the Poplar Street Bridge. The vessel operator eased the rudder between the Eads and Poplar Street Bridges and steers his tow through the main navigation spans of the Poplar Street and MacArthur Bridges. He reduces the vessel's throttle settings back to one-half to two-thirds. He has successfully transited the main bridges in the St. Louis Harbor.

Accident Study

To fully appreciate the expertise necessary to successfully navigate through the stretch of river examined in this study, several factors must be clarified (see table 2). Each factor will be analyzed for the part it may have played in a collision.

Vessel Traffic

During the period November 1971 to May 1985, 33 commercial tows collided with bridges in the St. Louis Harbor. Twenty-eight of these accidents occurred in the stretch of the river that includes the four bridges mentioned in table 1.

Generally, as traffic increases, the accident potential also increases. We looked for a relationship, if any, between cargo movement and casualty rate. Information from the Corps of Engineers showed that the tonnage moved through Lock and Dam 27, immediately above the St. Louis Harbor, has increased steadily since 1971, but no clear relationship between cargo movement and casualties is evident until 1981, when both increased. Since cargo tonnage

Table 2

Factors Involved in Collisions

Vessel traffic
River stage
Current
Time of day
Weather
Proximity of bridges
Bridge design
Aids to navigation and bridge lighting
Experience of vessel operator
Vessel horsepower and size of tow
Vessel's coure (upbound/downbound)
Cause of accident (operator error vs. material failure
Psychological considerations

transported has increased only slightly during that period, while casualties have increased substantially, we could not draw a conclusion between cargo movement and casualty rate.

River Stage

The U.S. Army Corps of Engineers furnished us with data concerning river stages in St. Louis at the time of these incidents. It was apparent immediately that a strong relationship existed between high water (defined for the purposes of this article as 20 feet or more) and bridge collisions. Of the 28 incidents involving the bridges, 21 occurred during high water. In general, accidents during high water occurred when river stages were 10 feet or more above average for the time of year.

Current

Adding to the navigation difficulties of the downbound operator is a set in the current, encountered immediately above the Martin Luther King Bridge, which runs from the Missouri shore toward the Illinois shore. This set is much more pronounced when the St. Louis gage reading exceeds 20 feet. The photo shown on the next page, taken when ice was present in the river, illustrates this set.

Time of Day

Seventeen of the 28 accidents mentioned in this article occurred at night. Ten of the 13 accidents at the Poplar Street Bridge occurred at night. Of the 17 accidents, lighting was a common complaint of the vessel operator involved. Lights from shoreside activities as well as lights on mooring cells and docks appeared to increase the likelihood of an operator's confusing navigation light configurations on the bridges.

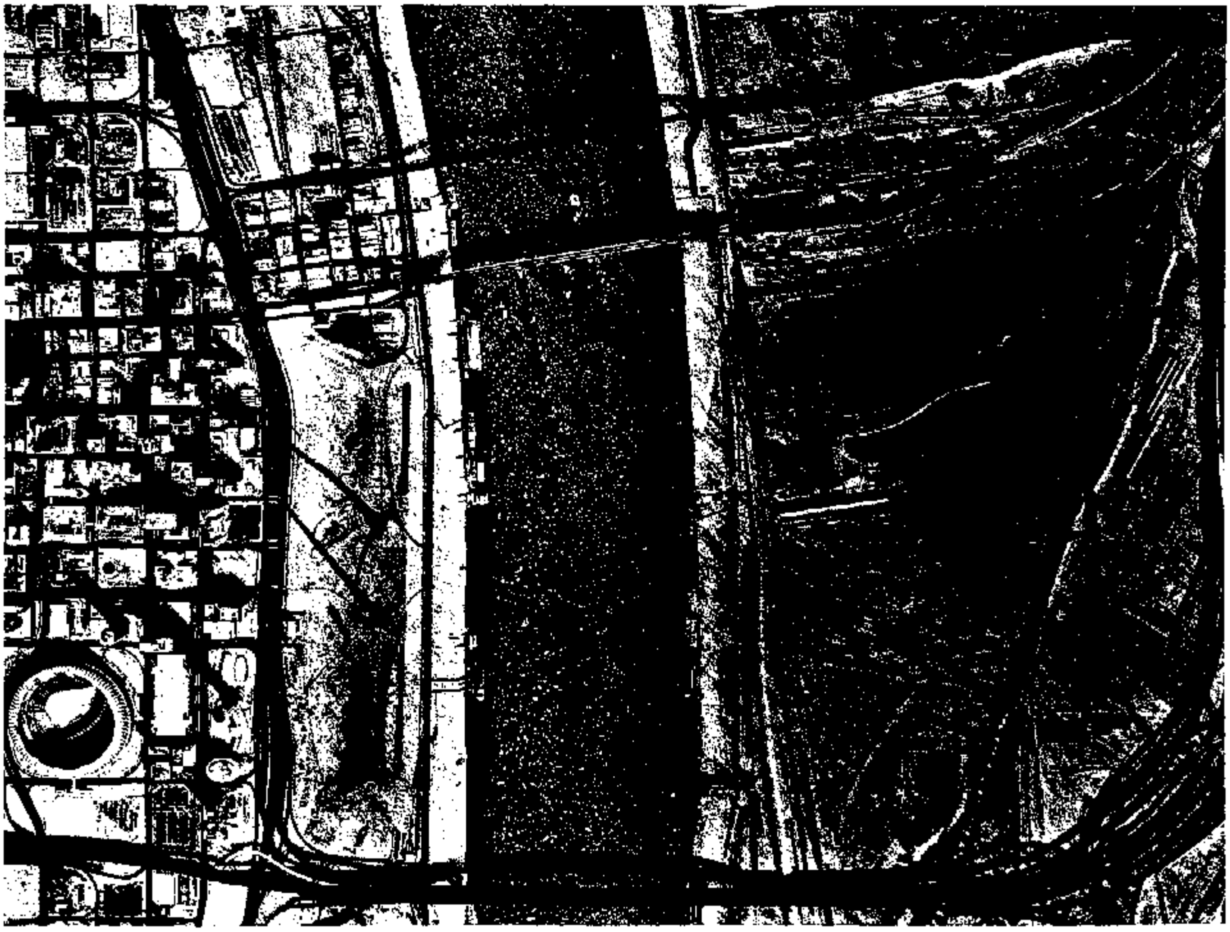
Weather

Eighteen collisions occurred when conditions of visibility were good. Nine collisions occurred during circumstances of reduced visibility due to rain, snow, fog, or smoke. Weather conditions for the remaining one casualty were unknown.

Proximity of Bridges

The main bridges in this study are, as mentioned earlier, located in a 1.2-mile stretch of the Upper Mississippi River. The Martin Luther King Bridge is located two-tenths of a mile upriver of the Eads Bridge, and the Poplar Street Bridge is located two-tenths of a mile upriver of the MacArthur Bridge. There is a separation of eight-tenths of a mile between the Eads and Poplar Street Bridges. Greater appreciation of the distances between these bridges can be realized when they are expressed in terms of the length of a typical tow. For example, utilizing a common tow length of 1200 feet, two-tenths of a mile is equal to 0.9 tow length. Eight-tenths of a mile is equal to 3.5 tow lengths.

During conditions of high water, it is common for a vessel operator to negotiate



This aerial view of ice in the Mississippi River illustrates the set in the current immediately above the Martin Luther King Bridge. *(Photo courtesy of U.S. Army Corps of Engineers, St. Louis)*

passage of the St. Louis bridges with engines at one-half to full ahead. This is done to overcome the effects of the set" of the current. At the approaches to the Martin Luther King and Eads Bridges, sufficient headway is critical to avoid being set toward the Illinois shore. The set continues to the left in the stretch of river between the Eads and Poplar Street Bridges. The speed of the vessel, then, must be greater than the speed of the current to attain appropriate rudder response and allow the operator to steer his vessel. vessels normally navigate at 8 to 12 miles per hour through the Martin Luther King, Eads, and Poplar Street Bridges. These speeds allow little time (4 to 6 minutes) for course correction once the vessel and tow have reached the Martin Luther King Bridge because the remaining three bridges are located inside the distance required for the vessel to stop.

The majority of the collisions occurred to the left of center of the navigable channel. All but four of the accidents involved downbound tows. Typically, the operator of the vessel did not have his tow properly aligned for passage through the Poplar Street Bridge and attempted to stop. In the time elapsed between the vessel's transition from headway to sternway, the vessel and tow struck the Illinois pier of the Poplar Street Bridge.

Bridge Design

Three of the four bridges involved are of conventional design and are no more of a factor than are bridges of similar design over the Western River system. By conventional, we mean bridges with their supporting framework built into or over their decks. The design of these bridges is such that each contains support structures, or piers, located in the navigable waterway. The effect of these piers is to divide the channel producing an alternate and main (preferred) channel under each bridge.

Of particular concern in this area is the Eads bridge, Mile 180.0. The bridge, completed in 1874, is supported by steel arches. This form of construction makes navigation under the bridge more difficult, since less vertical clearance is available near the sides of the navigation spans. Additionally, the Eads Bridge blocks the towboat operator's view of the Poplar Street Bridge. the problem is aggravated by high water. The vertical clearance under the center of the main navigation span is 88.6 feet when the St. Louis river gage reads zero. The pilothouse height of many modern towboats exceeds 50 feet. Thus, when the St. Louis gage reads 20 feet an operator may have less than 15 feet of clearance above the center of his pilothouse if he passes directly under the center of the navigation span. In six of the collisions involved in this article, the river stage exceeded 30 feet; flood stage in St. Louis. The Eads Bridge, while posing a very real physical barrier, also presents a psychological problem to mariners approaching it.

Aids to Navigation and Bridge Lighting

Vessels operators have frequently complained about lights on shore and docks while transiting the main bridges in the St. Louis Harbor. The operators' complaint was that the lights surrounding the harbor make it difficult to observe the navigation lights on the bridges. In particular, the lights from facilities south of the main bridges, lights on the road surfaces of the bridges, and lights on docks and mooring cells on the Illinois shore appear to be the primary concern of the vessel operator since it is these lights that compose the background of the navigation lights on the main bridges.

In a related matter, the Eads Bridge poses a situation where the vessel operator must contend with decorative lights on the bridge itself. The decorative lights follow the curves of the bridge's three arches. The complaint here is that when these lights are turned on, it is difficult for the operator to see beyond the bridge and downriver. As the river rises the situation is aggravated: the decorative lights tend to line up with the operator's field of vision and increase the glare. To counteract the effect, a meanings of extinguishing these lights from the pilothouse of a vessel is available. Briefly, a photoelectric switch can be tripped by using the vessel's searchlight, or the lights can be extinguished by personnel at Lock and Dam 27. This arrangement gives rise to other problems, however. First, the operator cannot fully concentrate on shaping up his tow for the bridges since he must concern himself with shutting off the lights. Second if the photoelectric cell doesn't trip and shut the lights off, the operator must use precious time in calling Lock and Dam 27 to get the lights off before he reaches the bridges.

It is interesting to note that some operators said the Eads Bridge's lights were beneficial in that the clearly defined the bridge's arches and helped in steer through the bridge.

Experience of Vessel Operator

Twenty of the 28 collisions were attributable to operator error. The operators who had accidents were an average of 43 years old, had approximately 14 years of experience in the wheelhouse of towboats, and had about 7 years of experience operating through the St. Louis Harbor. Their local experience ranged from none to 30 years. All were licensed by the Coast Guard as "Operator of Uninspected Towing Vessels (OUTV). Four also had first class pilots' licenses or a masters license for river towing vessels. However, many of the operators with OUTV licenses had enough trips through the area (experience) to qualify them for a first class pilot's license. An important consideration regarding operator experience, however, is one of "recency." Of those operators interviewed, some had not been through the harbor in several months. In one case, the operator had not been through the harbor in 2 years.

Cause of Accident -- Operator Error vs. Material Failure

Six of the 28 accidents studied were attributable to material failure; 22 were caused by operator error. Material failure is usually beyond the control of the vessel operator, although an aggressive preventive maintenance program will spot problems and correct them before they create an accident. It is evident that the majority of the accidents (71 percent) were caused by operator error. See table 3 for a complete list of causes.

Vessel Horsepower and Size of Tow

Vessel horsepower ranged from 730 to 6700. Barge tows ranged from 3 to 17. The average horsepower per barge was 334.

Table 3

Summary of Collision Causes

Vessel	Cause of Accident
1	OE - misjudged current/wind
2	OE - misjudged current
3	OE - underpowered
4	OE - lookout failed to watch
5	MF - steering
6	OE - misjudged current
7	OE - misjudged current
8	MF - steering failure
9	OE - underpowered
10	OE - misjudged current
11	OE - failed to align tow
12	OE - failed to align tow
13	MF - steering failure
14	OE - misjudged current
15	OE - misjudged current
16	OE - misjudged current
17	OE - misjudged current
18	MF - steering failure
19	OE - did not determine current set
20	MF - faulty weld
21	MF - coupling broke
22	OE - misjudged current
23	OE - misjudged current
24	OE - misjudged current
25	OE - misjudged current
26	OE - insufficient knowledge of harbor
27	OE - failed to align tow
28	OE - misjudged current

OE = Operator Error
MF = Material Failure

Vessel Course

Only four accidents occurred when vessel were navigating upbound (north). Twenty-four accidents occurred during southbound passage of the tows. Southbound tows navigate *with* the current through the St. Louis Harbor and therefore at faster speeds than northbound tows. It is necessary for the southbound vessel to "outrun" the current to maintain rudder control and, ultimately, the maneuverabilty of the tow.

Psychological Considerations

In 1969, a towboat operator was killed when his pilothouse struck the steel supporting structure of the Eads Bridge. One operator whose tow recently struck the Poplar Street Bridge stated that it is not uncommon for operators to worry about the Eads Bridge from the time they depart Minneapolis/St. Paul, Minnesota, when downbound, a distance of over 650 miles. Several other operators have stated that no one navigates through the St. Louis Harbor without giving a "healthy" respect to the bridges.

Conclusion

In its efforts to monitor and reduce collisions in the St. Louis Harbor, the Coast Guard consulted river pilots, industry associations, St. Louis authorities, the Army Corps of Engineers, the National Transportation Safety Board, and others to develop a list of possible corrective measures. These measures included changing navigational light configurations on the affected bridges; adding special, low luminescent panels to better mark the Poplar Street Bridge; adding navigational ranges and buoys to formalize the "marks" being used by experienced towboat operators; providing information describing St. Louis Harbor and present river conditions to downbound tows at lock 27; and modeling navigation through St. Louis Harbor on the Coast Guard's maneuvering simulator so changes could be studied. Most of the corrective measures have been implemented with positive results. The bridge collision accident rate in the past 2 years has been greatly reduced. While the physical changes to the system were needed, perhaps the most important factor in reducing accidents was the public discussion of the problems where all the involved parties focused on the issues. By publicizing the problems and including the entire marine community in the decisions, all could rightly take credit for "fixing the problem." A negative situation was turned into a positive, problem-solving effort. Vessel operators gladly participated in the discussions and were eager to pass along the harbor changes along with the "right way to make it through the bridges in St. Louis."

Unseaworthy Barge Owner Pleads Guilty

LCDR Christopher Walter

In December 1986, a barge owner was indicted by a federal grand jury in Norfolk for violating Title 46 United States Code (USC) 10908. 46 USC 10908 (recodified from 46 USC 658 in 1983) reads:

> *A person that knowingly sends or attempts to send, or that is party to sending or attempting to send, a vessel of the United States to sea, in an unseaworthy state that is likely to endanger the life of an individual, shall be fined not more than $1,000, imprisoned for not more than 5 years, or both.*

The barge owner sent an uninspected tank barge from Norfolk to Belhaven, North Carolina in December 1984 and from Norfolk to Seaford, Delaware, also in December, while it was unseaworthy. On the latter trip, the barge started to sink and pull the tug underwater. The tug's crew unsuccessfully tried to pump it out and grounded it to keep it from sinking. When the barge was salvaged and hauled out of the water, four holes were found in the starboard bilge knuckle, and water was weeping from the bottom under heavy marine growth. A surveyor was able to push an inspection hammer through the wasted bottom. The barge's shell plating, from the 1-foot waterline down, was severely wasted and had numerous set-in areas. For more information on the casualty, see the June 1986 issue of *Proceedings* magazine, page 130.

Unseaworthiness

Seaworthiness means a reasonable fitness to perform or do the work at hand. In civil cases, a presumption of unseaworthiness is raised when a properly loaded, properly towed barge sinks in good weather for no apparent reason. See *Consolidated Grain & Barge Company v. Marcona Conveyor Corporation*, 716 F.2d 1077, 1985 A.M.C. 117 (5th Cir. 1983).

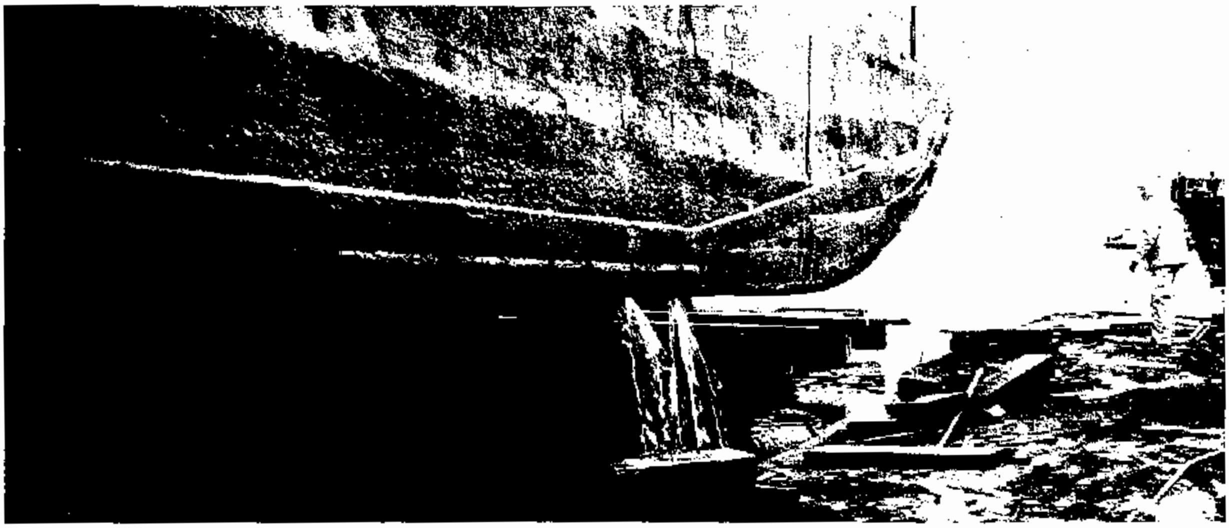
In the criminal case, the presumption of unseaworthiness was not needed. The barge was surveyed twice for the owner and hauled out for repairs in the 5 months between its purchase and its sinking. It was surveyed by two insurance investigators after the casualty, and the crew knew about the owner's makeshift repairs to control flooding before the barge was sent from Norfolk to Seaford. Eyewitness accounts of the surveyors, the tug's crew, and yard repair personnel clearly show that this barge was not fit to leave the dock.

The barge was deliberately grounded at this location to keep it from sinking. *(Photo courtesy of the author)*

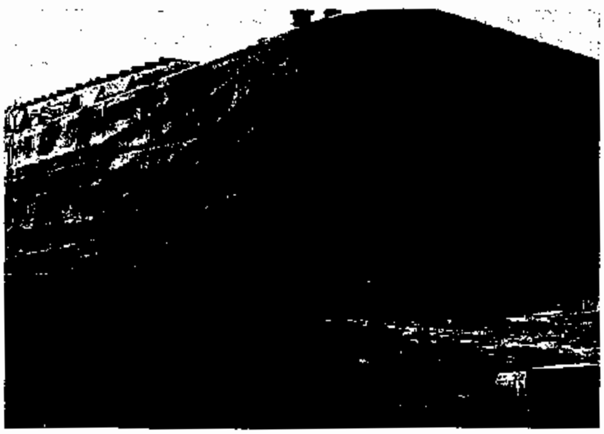
Where Does the Law Apply?

The definition of "sea" covers not only the high seas, but also bays, inlets, and rivers as high up as the tide ebbs and flows. This barge did not venture out onto the ocean on December 6 and December 10. Its route was on the

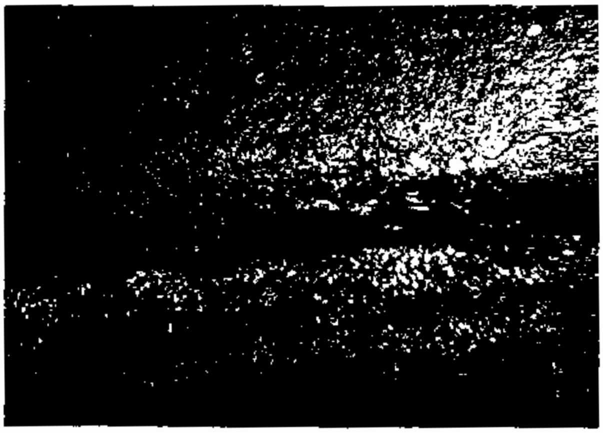
LCDR Walter is Chief of the Investigations Department, U.S. Coast Guard Marine Safety Office, Hampton Roads, Virginia.



Water drains from the wing tank after the barge was salvaged and hauled out. *(Photo courtesy of the author)*



Starboard view of the barge after salvage. *(Photo courtesy of the author)*



Note holes and severe pitting in the barge's starboard bilge knuckle. *(Photo courtesy of the author)*

southern branch of the Elizabeth River and Intracoastal Waterway on one trip and the Chesapeake Bay on the other, waters subject to the tide's ebb and flow. This definition is important to barge owners and tug captains since it brings them within the criminal jurisdiction of 46 USC 10908 if their barges are unseaworthy.

Holding the Owner Accountable

A criminal conviction was sought to hold the barge owner accountable. The tug captain's license was suspended for 9 months for his part in the accident, but a similar action could not be brought against the owner who didn't properly maintain the barge and who was ultimately responsible for its condition. The barge is not subject to the Coast Guard inspection laws. 46 USC 10908 does not have civil penalties for sending unseaworthy vessels to sea. The only corrective measure that could be directed toward the owner was criminal prosecution.

The Sentencing

On February 18, 1987, the barge owner pled guilty to a lesser charge of operating a vessel in a grossly negligent manner that endangered life, limb, or property (46 USC 2302(b)). He was fined appropriately.

Lessons from Casualties

Are You Sure That's a Work Vest?

LCDR William M. Riley

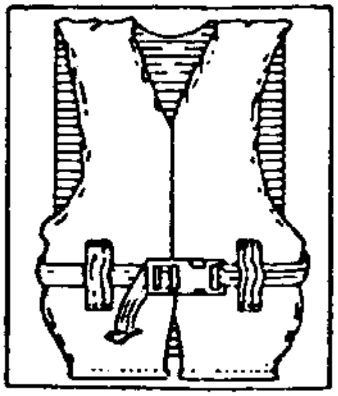
A Coast Guard-approved Type III personal flotation device (PFD) is not the same as a work vest.

A work vest is one of several varieties of Coast Guard-approved Type V PFDs. Work vests are made of materials which meet the same standards for strength and durability as those used in life preservers (Type I PFDs). Work vests provide a minimum buoyant force of 17.5 pounds. Work vests may be carried in addition to the required life preservers on all commercial vessels. Work vests are intended to be comfortable to wear while performing manual labor on deck or over the side, while providing protection in case of a fall overboard. Because of its intended use, a work vest does not have to be capable of being donned within 1 minute.

A Type III PFD may be made of materials which meet the lower standards for strength and durability allowed for a recreational boating PFD. Type III PFDs provide a minimum buoyant force of only 15.5 pounds. A Type III PFD must be capable of being donned within 1 minute. Type III PFDs were originally conceived as recreational boating devices, but they may be carried as the required PFDs on uninspected commercial vessels less than 40 feet in length, not carrying passengers for hire.

Neither a work vest nor a Type III PFD is required to turn an unconscious wearer face up in the water.

Because some small commercial vessels may use Type III PFDs as their only required PFDs, some manufacturers have obtained dual approval for their devices as both work vests and Type III PFDs, allowing one product to be sold in two distinct markets. These devices will bear two approval numbers, one beginning with "160.053/" for work vest use, and one beginning with"160.064/" for Type III use. Other manufacturers have chosen to market a plain Type III device with some of the appearance features of the work vest, for "industrial" use. These devices bear only a "160.064/" approval number and are not allowed on larger commercial vessels even as optional equipment.



Flotation Aid
Type III PFD

A recent fatal casualty aboard a large uninspected towing vessel and its fleet of barges revealed that the vessel personnel were unaware of the difference between Type III PFDs and work vests. The witnesses referred to the device in question as a "Type III work vest." Examination of the remaining devices on board established they they were only Type III PFDs and not approved as work vests. It is unknown whether the subtle differences in performance between the types of devices would have saved the victim's life in this case, but it is clear that confusion existed.

As always, our advice is to read the label to see whether the device you are buying -- or using -- is the proper one for the job.

LCDR Riley is a Staff Engineer in the Coast Guard's Survival Systems Branch, Merchant Vessel Inspection and Documentation Division, Office of Marine Safety, Security and Environmental Protection.

PERFORMANCE CHARACTERISTICS OF COAST GUARD-APPROVED PFDs

Type PFD	Floatability	Minimum Buoyancy	Advantages	Disadvantages	Environment
TYPE I	Will float majority of people face-up even if unconscious.	22 pounds (Adult)	Excellent performance. Suitable for rough water.	Very bulky and cumbersome.	Offshore, open water, coastal cruising.
TYPE II	Some wearers may not float face-up if unconscious.	15.5 pounds (Adult)	Good flotation and low cost.	Uncomfortable. Not suitable for rough water or cold water.	Inland water or where rescue will be quick.
TYPE III	May take active participation to float wearer in upright position.	15.5 pounds (Adult)	Comfortable and stylish. Allows wearer to swim. Useful in water-skiing, small boat sailing, etc.	Not suitable for rough or cold water.	Inland water or where rescue will be quick.
TYPE IV	A broad category for devices designed to be thrown.	16.5 pounds for ring buoy. 18 pounds for cushions.	Throwable.	Cannot be worn.	In areas where there are boats and rescue will quick.
TYPE V HYBRID (Required to be worn)	Inflated - provides either Type I, II, or III performance. Deflated - may not float some people.	22 pounds when fully inflated (Adult) 7.5 pounds deflated (Adult)	Very comfortable and stylish. May provide better flotation than Type II or III.	Higher cost. Requires attentive maintenance.	Depends on equivalent flotation performance (i.e., Type I, Type II, or Type III).
TYPE V SPECIAL	A Type V PFD is approved for restricted uses or activities such as board-sailing, commercial whitewater rafting, etc. The label on the PFD indicates whether a particular design can be used in a special application, what restrictions or limitations apply, and its equivalent flotation performance type.				

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New Publications

U.S. Naval Institute Announces New Magazine

The U.S. Naval Institute (USNI) recently announced that they will begin publishing a new magazine that will be totally devoted to naval and maritime history. The new magazine will be called *Naval History*.

According to Jim Barber, Executive Director of USNI, "The popularity of history articles published in our Proceedings, and the popularity of the two history supplements already published, were among the deciding factor in launching *Naval History*."

The new magazine will include first-person accounts of historical events along with analyses and new perspectives on naval events.

The Naval Institute will begin publishing *Naval History* on a quarterly basis in 1988. For more information, contact Fred Rainbow at (301) 268-6110.

Licensing Exam Study Guide

The third edition of James and Plant's *Study Guide to the Multiple-Choice Examinations for Chief Mate and Master* has recently been published by Cornell Maritime Press.

Originally issued in 1976 and now updated for the second time, the *Study Guide* is a companion volume to that for third and second mates, also by Captain Richard James and Richard Plant.

In addition to basic information about U.S. Coast Guard examination administration, procedures, grading, notification, etc., the study guide poses nearly 1,400 questions (and supplies the answers) grouped by topic. Pages from appropriate tables have been included at the ends of the various sections as needed. It also lists materials which are allowed in the exam room and has a study bibliography for ocean license candidates.

The *Study Guide* can be ordered directly from Cornell Maritime Press, P.O. Box 456, Centreville, MD 21617. The price is $32.00.

Cavitating Propellers

The Maritime Administration has announced the availability of two technical reports on efforts to develop a relatively simple mathematical model for predicting the characteristics of cavitating propellers. The research was conducted by the Virginia Polytechnic Institute and State University under MARAD's University Research Program.

The first report, "Analysis and Extension of Theory for Predicting Propeller Field Pressures and Blade Forces Due to Cavitation," describes the theoretical analysis for prediction of field pressure and blade forces for a transient cavitating propeller in a ship wake. Two models for the representation of sectional blade loading were considered, and the one which assumed an unsteady angle of attack but not unsteady camber was determined to be the proper representation for the approach used.

The second report, "Propeller Cavitation Program User's Manual," is a programmer's manual for the computer program predicting field pressures and blade forces on a cavitating propeller. The manual discusses the program operation as well as the various numerical techniques that are used. It also contains the results of a sample calculation and a program listing.

Copies of the reports may be obtained form the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The order numbers and prices are, respectively, PB87-171575/AS, $13.95; and (programmer's manual) PB87-171583/AS, $13.95.

Note for Proceedings Readers

This issue of the magazine is published for the months of July and August. We will resume publication with our September 1987 issue.

Chemical of the Month

Richard W. Sanders

Ethyl Chloride

Ethyl chloride, CH_3CH_2Cl, is a colorless liquid which boils at 12.4°C (54.3°F). It possesses a nonirritant, ethereal odor and a pleasant taste. Ethyl chloride is flammable and burns with a green-edged flame, producing hydrogen chloride fumes. The principal use for this chemical is in manufacturing tetraethyllead (TEL), the antiknock additive found in regular gas. Additionally, ethyl chloride serves as a solvent, refrigerant, and a local and general anesthetic.

Ethyl chloride was originally manufactured as an anesthetic and refrigerant. Annual output did not exceed more than a few hundred metric tons in any of the producing countries. When tetraethyllead manufacturing began in the United States in 1922, ethyl chloride became a large-volume chemical. Since ethyl chloride is essentially an automotive chemical, its pattern of increased production is linked with the growth of the automobile industry. Preceding World War II, annual output exceeded 23,000 tons, of which only 230 to 275 tons was used for purposes other than manufacturing TEL. Currently, 90 percent of the ethyl chloride produced is used to make TEL. Since the number of cars that use leaded gasoline is decreasing, and there is no significant secondary market, the demand for ethyl chloride is expected to decrease.

The principal danger of ethyl chloride in the workplace is its anesthetic property. Slight symptoms of poisoning will appear if an individual is exposed to 13,000 parts per million (ppm) of the chemical in air. Four inhalations of the gas at 20,000 ppm will cause dizziness and slight abdominal cramps. Drunkeness and loss of coordination resulting from exposure may lead to inept operation of equipment and possible injuries. Recovery after exposure often entails an unpleasant "hangover" period.

Acute exposure to ethyl chloride causes fluid buildup in the lungs and damage to internal organs, including the liver, kidneys, and brain. It is very soluble in blood, which prolongs its elimination from the body, but it does not appear that ethyl chloride is metabolized to any significant degree. Because ethyl chloride is suspected to be a human carcinogen, current exposure levels are limited to 1,000 ppm.

Since ethyl chloride is a gas at normal room temperatures, if large amounts of the liquid are spilled on the skin, evaporation may cause rapid cooling and possibly frostbite. Contaminated areas should not be rubbed as frostbitten areas can be seriously damaged by this action. Instead, if ethyl chloride contacts the skin or eyes, the affected areas should be flushed with plent of water. A person who has breathed large amounts of the vapor should be exposed to fresh air and then given oxygen. If breathing has stopped, artificial respiration must be performed.

In the event of an ethyl chloride leak, all ignition sources should be removed and the area ventilated. The flow of gas or liquid should be stopped, and exposed containers and the shutoff should be doused with water. If ethyl chloride ignites, flashbacks along the vapor trail and explosions in enclosed areas are possible, so workers should stay upwind and use a water spray to "knock down" the vapor. Workers should wear protective goggles and a self-contained breathing apparatus, and as a further safety measure, they should also be doused with water. Once contained, the fire should be allowed to burn itself out.

For cargo compatibility, the U.S. Coast Guard classifies ethyl chloride as a halogenated hydrocarbon under Part 150, Subchapter O,

Richard W. Sanders was a First-Class Cadet at the Coast Guard Academy at the time this article was written. It was written under the direction of LCDR J. J. Kichner for a class in hazardous materials transportation.

Title 46 of the Code of Federal Regulations. The Department of Transportation regulates the chemical as a flammable liquid in accordance with Part 172, Subchapter C, Title 49 CFR. The Environmental Protection Agency includes ethyl chloride as a hazardous waste in Title 40, Subchapter D of the CFR. The International Maritime Organization considers ethyl chloride a Class 2.0 chemical.

Chemical Name
ethyl chloride

Formula
CH_3CH_2Cl

Synonyms
chloroethane, choroethyl, hydrochloric ether, kelene, monochloroethane, narcotile

Physical Properties
boiling point: 12.4°C (54.3°F)
freezing point: -138.3°C (-216.9°F)
vapor pressure:
20°C (68°F) = 1011.1 mmHg
100°C (212°F) = 8738.2 mmHg

Threshold Limit Values
time-weighted average:
1000 ppm 6 mg/liter
acute toxicity (2-hr. LC_{50}):
57600 ppm 152 mg/liter

Flammability Limits in Air
lower flammability limit: 3.8% vol.
upper flammability limit: 15.4% vol.

Combustion Properties
flash point: -50°C (cc); -43°C (oc)

Densities
liquid (water = 1): 1.3798 (0°C)
vapor (air = 1): 2.23

UN Number: 1037
CHRIS Code: ECL
Cargo Compatibility Group: 36
(Halongenated Hydrocarbons)

Nautical Queries

The following items are examples of questions included in the Third Mate through Master examinations and the Third Assistant Engineer through Chief Engineer examinations:

Engineer

1. A bus bar is 3 inches wide and 0.375 inches thick. What size of round conductor in circular mils is necesary to carry the same current as the bus bar? (Note: The area of a circular mil is equal to 0.7854 of a square mil.)

A. 1,125,000 circular mils
B. 1,250,000 circular mils
C. 1,432,000 circular mils
D. 1,547,000 circular mils

Reference: NAVPERS 10546, *Electrician's Mate 3 & 2*

2. Increasing the valve tappet clearance of a diesel engine intake valve will cause the valve to open ________.

A. earlier and remain open longer
B. earlier and have greater lift
C. later and have less duration
D. later and have greater lift

Reference: Maleev, *Diesel Engine Operation and Maintenance*

3. When checking the oil level in an R-12 compressor, the most accurate reading is obtained ________.

A. immediately after purging
B. immediately after charging
C. after being secured for 3 hours with the sump heater secured
D. immediately after shutdown after a prolonged period of operation

Reference: Nelson, *Commercial and Industrial Refrigeration*

4. When a diesel engine is equipped with a hydraulic starting system that operates at pressures of 150 psi or more, Coast Guard regulations require that the hydraulic fluid shall _________.

A. have a viscosity index number greater than 100
B. have a flash point of not greater than 200°F
C. have a flash point of not les than 315°F
D. be oxidation-resistant and nontoxic

Reference: 46 CFR 58.30-10

5. What action should you take if the fires start sputtering while steaming under steady conditions?

A. Start the standby fuel oil service pump.
B. Increase fuel oil pressure.
C. Shift fuel strainers.
D. Shift suction to another tank.

Reference: Maleev, *Diesel Engine Operation and Maintenance*

Deck

1. You are downbound on the Ohio River locking through Greenup. The chamber has been emptied and the lower gates are open. You hear one short blast of the whistle from the lock. You should _________.

A. leave the lock
B. hold up until another tow enters the adjacent lock
C. tie off to the guide wall until the river is clear of traffic
D. hold in the lock chamber due to a malfunction with the gate

Reference: 33 CFR 207.300

2. If a vessel lists to the port side, the center of buoyancy will

A. move to port.
B. move to starboard.
C. move directly down.
D. stay in the same position.

Reference: Saubier, *Marine Cargo Operations*

3. In order to detect rot in manila lines, you should

A. feel the surface of the line for broken fibers.
B. measure the reduction in circumference of the line.
C. observe any mildew on the outer surface.
D. open the strands and examine the color of the inner fibers.

Reference: Cornell and Hoffman, *American Merchant Seaman's Manual*

4. The amount of freeboard which a ship possesses has a tremendous effect on its

A. initial stability.
B. free surface.
C. permeability.
D. stability at large angles of inclination.

Reference: LaDage, *Stability and Trim for the Ship's Officer*

5. A towing light is

A. shown at the bow.
B. white in color.
C. shown in addition to the sternlight.
D. an all-around light.

Reference: International Rules, Rule 24; COMDTINST M16672.2A

Answers

Engineer
1-C; 2-C; 3-D; 4-C; 5-D
Deck
1-A; 2-A; 3-d; 4-D; 5-C

If you have any questions concerning "Nautical Queries," please contact Commanding Officer, U.S. Coast Guard Institute (mvp), P.O. Substation 18, Oklahoma City, Oklahoma 73169; telephone (405) 686-4417.

Keynotes

Final Rules

CGD 87-015, Delegation of Authority To Measure Vessels (May 1)

This action delegates authority to perform certain functions concerning the measurement of U.S. vessels and the issuance of tonnage measurement certificates. Recent legislation authorized the Coast Guard to delegate these functions to the private sector. The Coast Guard has determined that such a delegation would be in the best interest of the federal government and the public. At this time, the Coast Guard is delegating to the American Bureau of Shipping the authority to perform U.S. formal tonnage measurement services for commercial, recreational, and public non-combatant vessels that are required or eligible to be documented as vessels of the United States.

CGD 87-008a, Civil Penalty Procedures (May 11)

This rule revises the procedures followed in processing civil penalty cases for violations of the various law enforced by the Coast Guard. The revisions were made necessary by the realignment of the Coast Guard districts and internal reorganization. Incident to the revisions required by organizational changes, the requirement for a second copy of a petition to reopen a hearing is eliminated and the timeframe for action on appeals is modified. These changes conform the rules to the reorganized Coast Guard structure.

CGD 85-098, Boating Safety; Fuel System Standard

This rule amends the Fuel System Standard in Subpart J of Part 183, Title 33 CFR, by requiring that gasoline fuel hose installed in new recreational boats be tested under SAE Standard J1527DEC85 instead of SAE Standard J30C. The increasing level of aromatics in gasoline and the use of alcohols in gasoline have raised safety questions over the permeation rates and longevity of hose meeting SAE Standard J30C. The purpose of these amendments is to specify four grades of fuel hose that are more resistant to alcohol permeation. This rule becomes effective November 23, 1987.

Notice of Study; Request for Public Comment

CGD 87-029, Report to Congress on the Coast Guard Auxiliary (May 7)

The Coast Guard Authorization Act of 1986 (Public Law 99-640) requires the Coast Guard to submit a report to Congress on the overall performance and effectiveness of the Coast Guard Auxiliary. This notice invites comments and views from interested persons in the maritime community on the topics required to be covered in the report. The report may include recommendations by the Coast Guard for legislative and administrative actions necessary to correct deficiencies and maintain the Auxiliary at optimum strength and effectiveness. Written comments must be received on or before July 6, 1987.

Termination of Approval Notice

CGD 87-027, Equipment, Construction, and Materials; Termination of Approval Notice

This notice contains a listing of Coast Guard approvals terminated between 1 September 1985 and 31 March 1987, as well as approvals terminated prior to 1 September 1985 which have not been published previously. These terminated approvals were for safety equipment and materials required by regulation to be used on certain merchant vessels and recreational boats, and also in Outer Continental Shelf activities. This listing updates the information published in the 1 September 1985 edition of the Coast Guard publication, "Equipment Lists."

Notice of Public Meeting

CGD 87-034, Great Lakes Pilotage Review; Open Meeting

A number of issues have been raised this past year concerning Great Lakes pilotage. Great Lakes pilotage was last studied in depth during 1972. In view of the concerns expressed and the fact that the current study is 15 years old, the Department of Transportation has initiated a review of Great Lakes pilotage. The review, to be conducted by a multi-agency working group, will take the form of an update of the 1972 study and the 1973 policy statement that resulted from that study's findings. The Coast Guard will take the lead on this review. A public meeting is planned for the purpose of announcing the initiation of a Great Lakes Pilotage Review, to request input, and to receive any comments and recommendations concerning Great Lakes pilotage that individuals may have at this time. Issues of particular interest include trans-lake pilotage, port pilotage, pilotage costs, "B" certificates, salty-lakers, target pilot compensation, pilot workload standards, and the appropriate roles of the public and private sectors. The public meeting will be held on June 24, 1987, at the Hollenden House, 610 Superior Avenue, Cleveland, Ohio. It will begin at 10:00 a.m. and end at 4:00 p.m. or sooner if all speakers have been heard. Comments should be mailed to Commandant (G-CMC/21) (CGD 87-034), U.S. Coast Guard, Washington, DC 20593-0001.

Maritime Notes

Toxic Marine Paint

Legislation to halt the sale of marine paints laced with organotins like the toxic chemical tributylin (TBT) was recently introduced by House Merchant Marine and Fisheries Committee Chairman Walter B. Jones (D-NC).

TBT is an effective anti-foulant. Anti-foulant paints restrict the growth of marine organisms on boat hulls, thus decreasing the frequency of bottom-scraping and increasing fuel efficiency by reducing drag. Organotin-based paints are very popular anti-foulants and come in two forms: free associated and copolymer. TBT is simply stirred into free associated paints while it is chemically bonded to the paint molecules in copolymer paints. Free associated paints release TBT into the water at a higher rate and require more frequent reapplications to remain effective (every 1 to 3 years as opposed to every 6 or 7 years).

Approximately 70 percent of all oceangoing commercial vessels use a copolymer paint. In recreational boating, 10 percent of U.S. vessels use free associated and 20 percent use copolymer. (The bulk of the other use copper-based paint.)

If passed, the Jones bill, H.R. 2210, will effectively eliminate free associated organotin paints from the marketplace by prohibiting use of paints which exceed a release rate of 5.0 micrograms per square centimeter. The bill also bans the use of any compound containing organotin purchased for addition to paints.

U.S. Department
of Transportation

**United States
Coast Guard**

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