

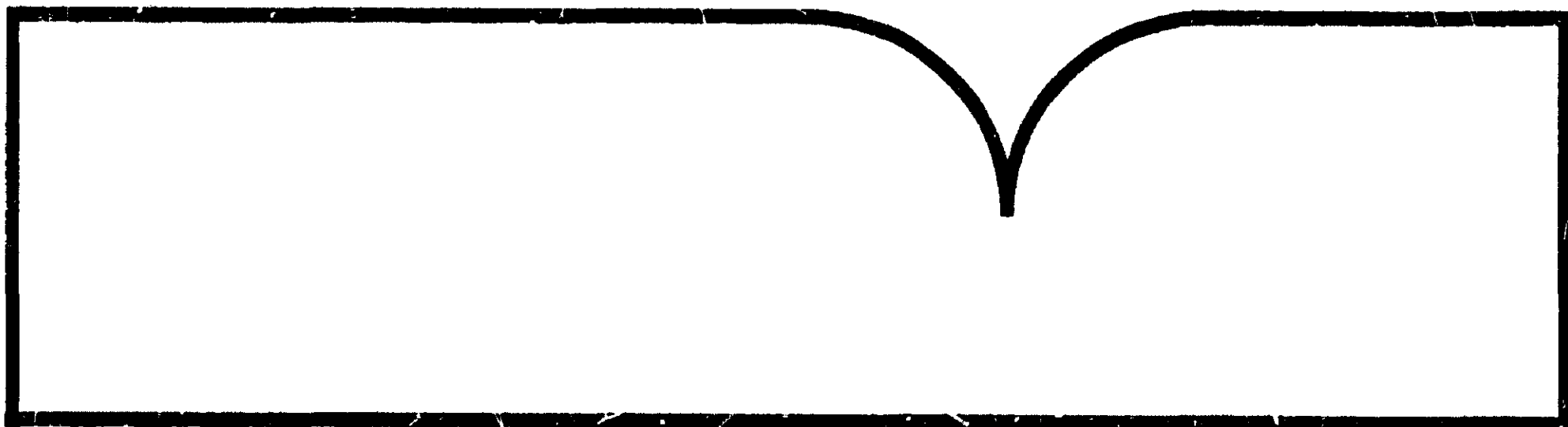


PB93-916402

National Transportation Safety Board Marine Accident Report
Collision of the U.S. Towboat Fremont and Tow with the
St. Vincent and the Grenadines-Registered Containership
Juraj Dalmatinac, Houston Ship Channel, December 21, 1992

(U.S.) National Transportation Safety Board, Washington, DC

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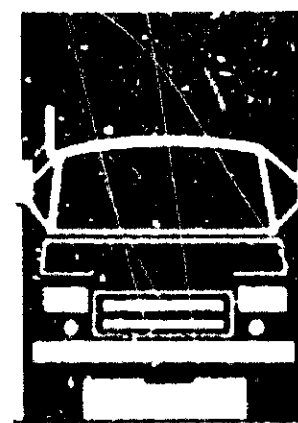
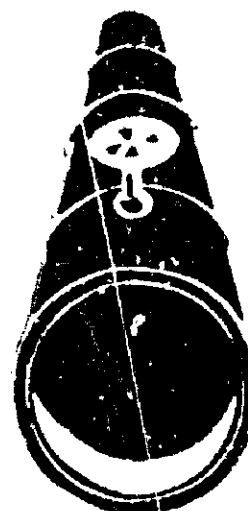
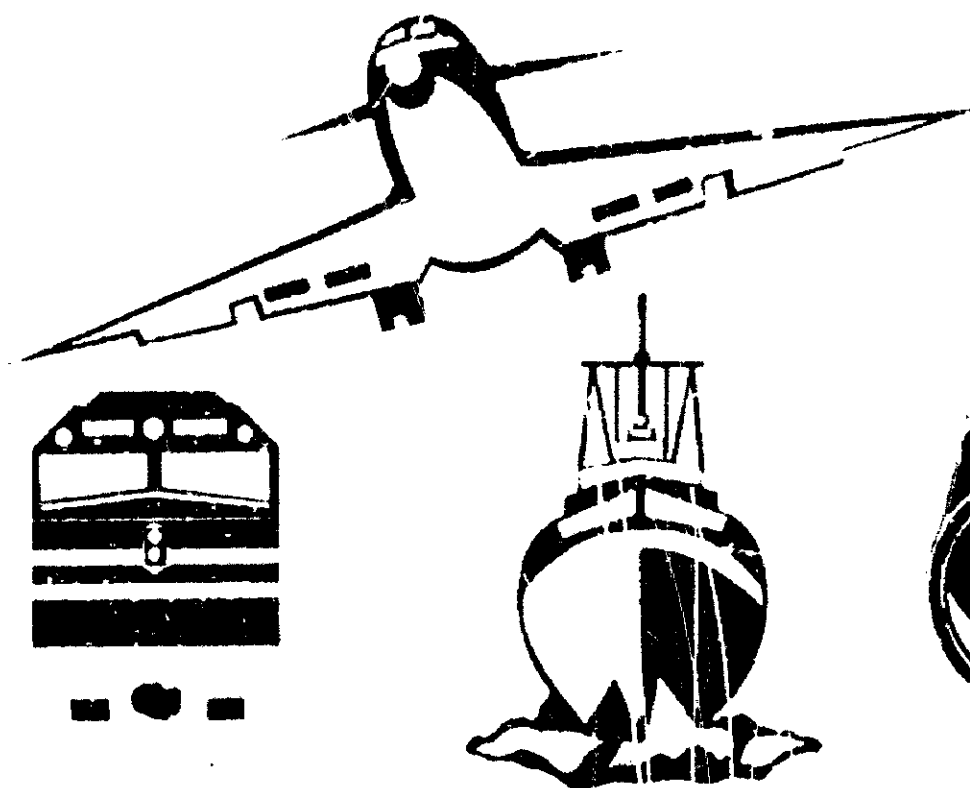
PB93-916402
NTSB/MAR-93/02

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594

MARINE ACCIDENT REPORT

**COLLISION OF THE U.S. TOWBOAT FREMONT AND TOW WITH
THE ST. VINCENT AND THE GRENADINES-REGISTERED
CONTAINERSHIP JURAJ DALMATINAC
HOUSTON SHIP CHANNEL
DECEMBER 21, 1992**



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Springfield, Virginia 22161

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable cause of accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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**NATIONAL TRANSPORTATION
SAFETY BOARD**

Washington, DC 20594

Marine Accident Report

**COLLISION OF THE U.S. TOWBOAT FREMONT AND TOW
WITH THE ST. VINCENT AND THE GRENADINES-REGISTERED
CONTAINERSHIP JURAJ DALMATINAC
HOUSTON SHIP CHANNEL
DECEMBER 21, 1992**

ADOPTED: DECEMBER 8, 1993

NOTATION 5991B

Abstract: On December 21, 1992, the St. Vincent and the Grenadines-registered containership JURAJ DALMATINAC collided with the tank barge DUVAL 2, which was being pushed by the U.S. towboat FREMONT, in the Houston Ship Channel, Galveston Bay. After the containership backed away from the DUVAL 2, the barge buckled and sank, spilling its cargo of molten sulphur into the waterway. Vessel damage from this accident totaled more than \$955,500; the estimated loss of commerce and area wharfage fees exceeded \$6 million.

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EXECUTIVE SUMMARY

About 2230 on December 21, 1992, the St. Vincent and the Grenadines-registered containership JURAJ DALMATINAC collided with the tank barge DUVAL 2, which was in tow of the U.S. towboat FREMONT, in the Houston Ship Channel, Galveston Bay. The bow of the JURAJ DALMATINAC penetrated the side and bottom hull of the barge, which buckled and sank when the containership backed away from it. When the DUVAL 2 buckled, both cargo tanks were breached, and the barge's cargo of molten sulphur spilled into the waterway.

The National Transportation Safety Board determines that the probable cause of the collision between the JURAJ DALMATINAC and the FREMONT tow was the failure by the ship's pilots and master to effectively use all available equipment and personnel to evaluate the developing situation so that they could take timely action to avoid the collision. Contributing to the cause of the collision was the FREMONT's lack of a compass, which could have afforded the tow operator the capability to maintain his tow on station outside the navigation channel.

As a result of its investigation of this accident, the Safety Board makes recommendations to the United States Coast Guard, Gantt Towing, the American Waterway Operators, Inc., the Harris County Board of Pilot Commissioners, and the American Pilots Association.

NATIONAL TRANSPORTATION SAFETY BOARD

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Marine Accident Report

**Collision of the U.S. Towboat FREMONT and Tow
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Houston Ship Channel
December 21, 1992**

INVESTIGATION

Following an accident narrative, this report will address the following major safety issues that the Safety Board identified as a result of its investigation: lack of a compass on towboats; inadequacy of bridge resource management on the JURAJ DALMATINAC, and failure of the JURAJ DALMATINAC's bridge watch to fully use the Automatic Radar Plotting Aids (ARPA) radar. This report also looks at the role of the Houston-Galveston VTS and the inadequacy of postaccident drug and alcohol testing procedures.

THE ACCIDENT

The FREMONT

At 1710, on December 21, 1992, the towboat FREMONT departed the Exxon Company sulphur dock at Baytown, Texas, with the tank barge DUVAL 2 in tow bound for the Pennzoil Company sulphur dock in Galveston, Texas (see figure 1). The DUVAL 2 was loaded with about 2,464 long tons of molten sulphur. The FREMONT had a typical three-man operating crew comprising a licensed operator and two deckhands. In addition to the regular crew, a contract tankerman, who had been hired to operate the cargo heater on the DUVAL 2, was on board the FREMONT.

Although weather was clear and calm when the FREMONT departed Baytown, the operator said that he anticipated that he would encounter restricted visibility during the voyage because the weather forecast had called for "patchy fog." As the FREMONT proceeded outbound in the Houston Ship Channel (HSC), it was about 1/8 mile behind another outbound

tow under the control of the towboat FAWN. The FREMONT operator said that as he began to make the turn in the channel at beacons 53 and 54, fog closed in, and he could no longer see the FAWN's towing lights ahead (see figure 2).

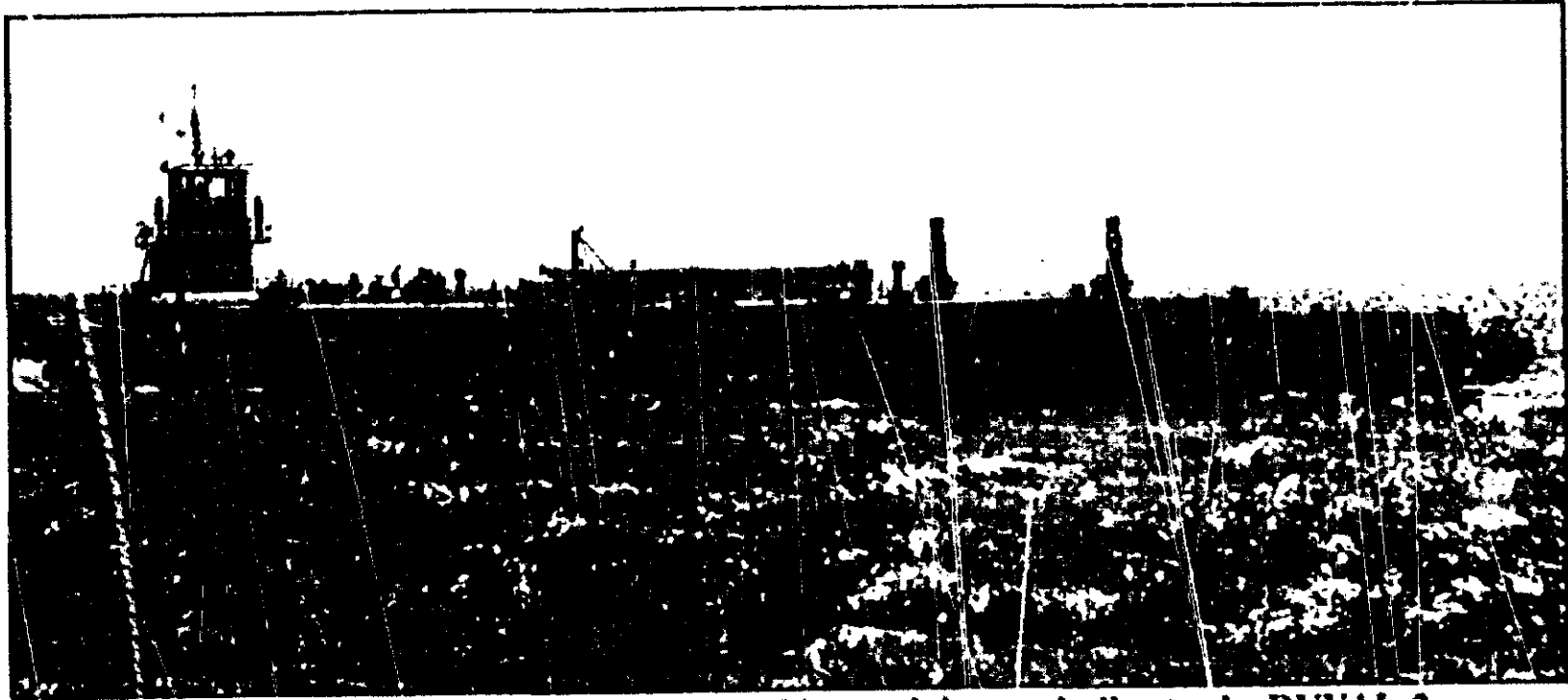


Figure 1. U. S. towboat FREMONT pushing tank barge similar to the DUVAL 2. The total length of the FREMONT-DUVAL 2 tow was 310 feet.

The FREMONT operator said that in accordance with his company's policy of not moving a tow when visibility is severely reduced, he pushed his tow to the outbound starboard side of the channel to stop and wait for visibility to improve. Steering by radar, he maneuvered the tow at slow speed toward buoy 51.

The operator said that in the dense fog, he was first able to see buoy 51 just as the bow of the barge passed it. Keeping buoy 51 in sight, he brought the tow to a complete stop next to it about 2145. He said that at this time the fog was so dense that he could barely make out the head of the tow, which was about 280 feet forward of the FREMONT's pilothouse.

The operator said that when he halted the tow's forward movement, the DUVAL 2's starboard side was touching buoy 51. The operator continued to twin screw¹ the engines, maneuvering the tow to align with the channel. He said that he oriented his tow to the channel by watching buoy 51 and by referencing buoy 52 and beacon 49 on radar. Buoy 52 was directly across the channel from buoy 51, about 800 feet away.² Beacon 49 was on the same side as

¹ A towboat term for operating twin-engine, twin-screw boats. To facilitate turning, one engine is operated in the ahead direction while the other engine is operated in the astern direction.

² On NOAA chart 11327, which shows the accident area, the distance between the charted position of buoy 51 and buoy 52 is 290 yards (870 feet). Because the buoys sit in water depths of about 15 feet and their securing chains are about 40 feet long, actual distance between the buoys at a given time is subject to minor variance.

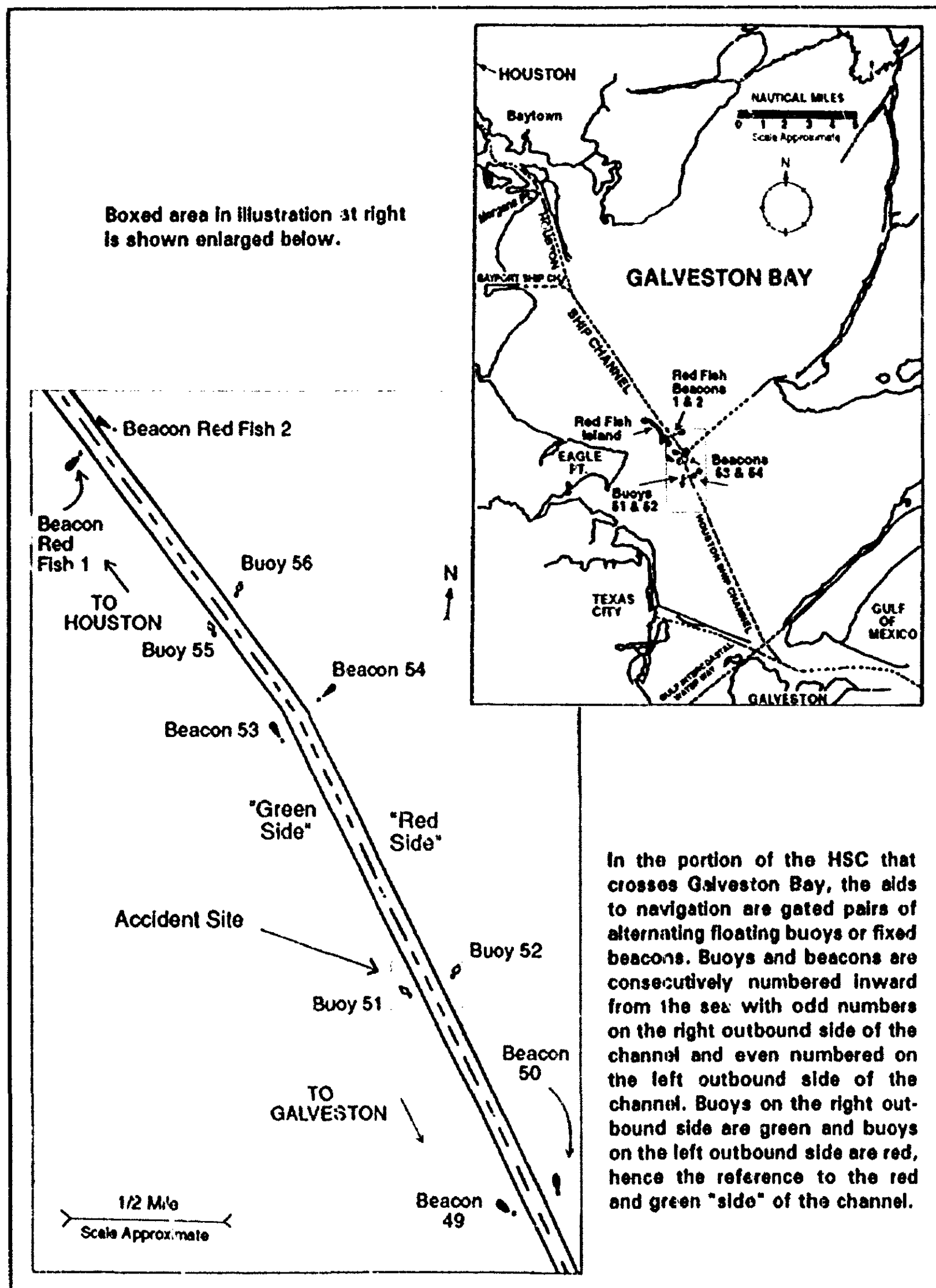


Figure 2. Galveston Bay, including accident site.

buoy 51, about 4,050 feet further down the channel.

The operator testified that he shined a spotlight several times toward buoy 52 but could not see it in the dense fog. He therefore established the heading of his tow by shining the spot light on buoy 51 and referring to radar, which was on the 2-mile scale. He estimated that the tow was 15° to the right of buoy 49. In this position, the stern of the tow was on the channel side of buoy 51 and the head of the tow was outside the green buoy line (see figure 3).

At 2200, the FREMONT operator radioed the U.S. Coast Guard Vessel Traffic Service (VTS),³ to report that he had stopped his tow near buoy 51 with "shut-out fog." He then waited for the visibility to clear. He testified that while he was pushed-in at the side of the channel, the tow floated freely and never touched the bottom. He maintained station by using the engines and rudders when necessary. He testified that although the relative position of the buoy to the tow varied somewhat, he was able to keep buoy 51 in sight and maintain station on it at all times.

The FREMONT operator testified that while he was keeping station on buoy 51, an unidentified outbound two-barge tow and an inbound light boat,⁴ the B.J. BARBER, passed within 300 feet of the FREMONT and did not present a problem to his tow. From recorded radio transmissions, the Safety Board determined that the B.J. BARBER passed the FREMONT about 2216. The B.J. BARBER's operator stated that he was able to see the DUVAL 2's outline and some of its lights, including a flashing light forward in the center of the barge and a red sidelight. He said he was unable to see the FREMONT, its spotlight, or any of its navigation lights.

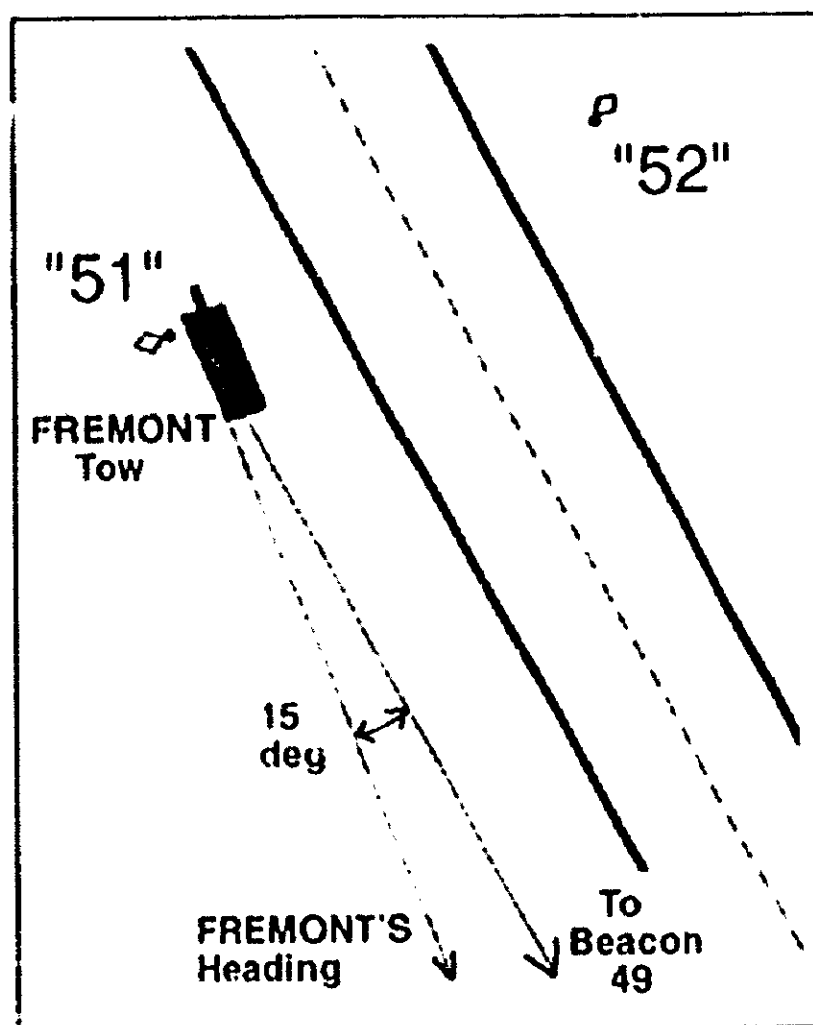


Figure 3. The position of the FREMONT at buoy 51 as described by the tow operator.

³ The Houston-Galveston VTS operated by the U.S. Coast Guard is a vessel movement reporting system established under the authority of the Ports and Waterways Safety Act. From a continuously manned Vessel Traffic Center in Houston, operators monitor the entire HSC from the Galveston Sea Buoy to the Houston Turning Basin and disseminate marine traffic information to participating vessel operators via VHF-FM radio. The VTS acts not as a traffic control system but as a traffic advisory network. At the time of the accident, participation in the VTS was voluntary.

⁴ A light boat is a towboat operating without a tow.

Shortly after the B.J. BARBER passed, the FREMONT operator became aware of a radar contact above beacons 53 and 54, about 1 1/4 miles from the FREMONT. He testified that he watched on radar as the contact made the turn at beacons 53 and 54. He noted that the heading line⁵ on his radar screen was still to the right of the radar image that he believed was beacon 49. He looked at buoy 51 to verify that it was adjacent to the FREMONT's starboard bow and switched his radar to the 1-mile scale. He said that at this range setting, the approaching contact was just coming onto his radar screen. He continued watching the radar image of the contact's approach, which he described as first appearing to be off the centerline toward the red side and then appearing to cross the centerline to the green side. At this time, neither the operator nor anyone from the contact had attempted to establish radio communications with the other.

The FREMONT operator testified that he next switched the radar to the 1/2-mile range, noted the position of buoy 52 on radar, and sighted buoy 51 off the FREMONT's starboard quarter. When he looked back at the radar screen, he saw that the on-coming contact appeared to be headed directly toward the stern of his towboat.

About 2226, the FREMONT operator answered a radio call from the lead pilot of the approaching contact, a ship named the JURAJ DALMATINAC.⁶ He testified that he informed the ship's pilot that he had stopped his tow near buoy 51 and that his tow was 'sticking out of the channel.' The operator further testified that the content, tone, and manner of the pilot's message led him to believe that the pilot was not too concerned about the situation. Therefore, he stated, he did not think that collision was imminent.

At the time the radio contact was established, the FREMONT operator and the contract tankerman, who was also in the pilothouse at this time, were trying to sight the on-coming ship in the fog. The FREMONT operator said that he next felt the towboat ride up on a swell. He looked at the swing indicator⁷ and noted that the needle was indicating a port swing of 14 degrees per minute. About the same time, the contract tankerman announced, "There he is."

The operator of the FREMONT testified that he was first able to see the ship when it was about 30 to 35 degrees off the port side of the tow, seconds before it collided with the tow. He stated that he did not see any of the ship's navigation lights and that he could only see rows of lights from the ship's deckhouse. To try to avoid the collision, he immediately put the rudder hard right and placed the port engine throttle in the full ahead position and the starboard engine throttle in the full astern position to swing the barge's bow to the right. He said that he was

⁵ On the radar, an electronic bearing line that radiates from the center on the screen represents the vessel's heading.

⁶ The Coast Guard provided the Board with audiotapes containing transmissions pertinent to the accident. Safety Board laboratory personnel produced the transcript quoted in this report and shown in the appendix.

⁷ A gyroscopic device that measures the rate of turn in degrees per minute.

sounding the danger signal⁸ on the towboat's whistle when the collision occurred.

The JURAJ DALMATINAC

On December 21, 1993, the 633-foot-long JURAJ DALMATINAC was moored at city dock 8 in Houston, Texas (see figure 4). The vessel, which was loaded with miscellaneous break bulk and containerized cargo, was scheduled to sail at 1730 for China.

At 1715, two members of the Houston Pilots⁹ boarded the JURAJ DALMATINAC to pilot the vessel to sea. Because forward visibility from the ship's navigation bridge was restricted by deck-mounted cranes, the association required that two pilots be on the JURAJ DALMATINAC to maneuver the vessel safely in the winding upper portions of the HSC. According to the pilots in this accident, in a two-pilot scheme, one pilot acted as lead pilot, standing near the centerline and issuing all rudder and engine orders; the second pilot acted as the assisting pilot, walking freely about the navigation bridge to check the ship's side clearances as it passed piers and other structures in the waterway. The pilots involved in this accident testified that the assisting pilot had no specified duties or predesignated tasks other than checking clearances but did perform any functions that the lead pilot might request. The two pilots had worked together in a two-pilot scheme on previous transits of the HSC without incident.

Upon boarding the JURAJ DALMATINAC, the two pilots met with the vessel's master on the navigation bridge. During the pilot-master conference, the pilot who was to serve as the lead pilot first and the master discussed the vessel's particulars, its equipment, and the weather forecast, while the other pilot stood nearby and listened to the conversation. Neither pilot advised the master whether they had a predetermined point at which they would change roles.

The pilots walked around the pilothouse to familiarize themselves with the equipment layout, during which time they observed that the ship's two radar sets were operating properly. The starboard side radar was a conventional marine radar and the port side radar was an Automatic Radar Plotting Aids (ARPA)¹⁰ radar. The lead pilot requested that an anchor watch be placed on the bow to be available to drop anchors in an emergency. Although the pilot did not request a bow lookout, the master instructed the chief officer to go to the bow and serve not only as anchor watch but also as lookout. The chief officer maintained contact with the master by means of a hand-held radio.

⁸ At least five short and rapid blasts of the whistle.

⁹ In the HSC, State pilotage is compulsory for foreign vessels and U.S. vessels engaged in foreign commerce. The Governor of Texas commissions State pilots. The Houston Pilots is a voluntary association organized by the pilots for the purpose of performing administrative and business functions for members.

¹⁰ A computer-based device that processes radar signals and displays selected navigational information.

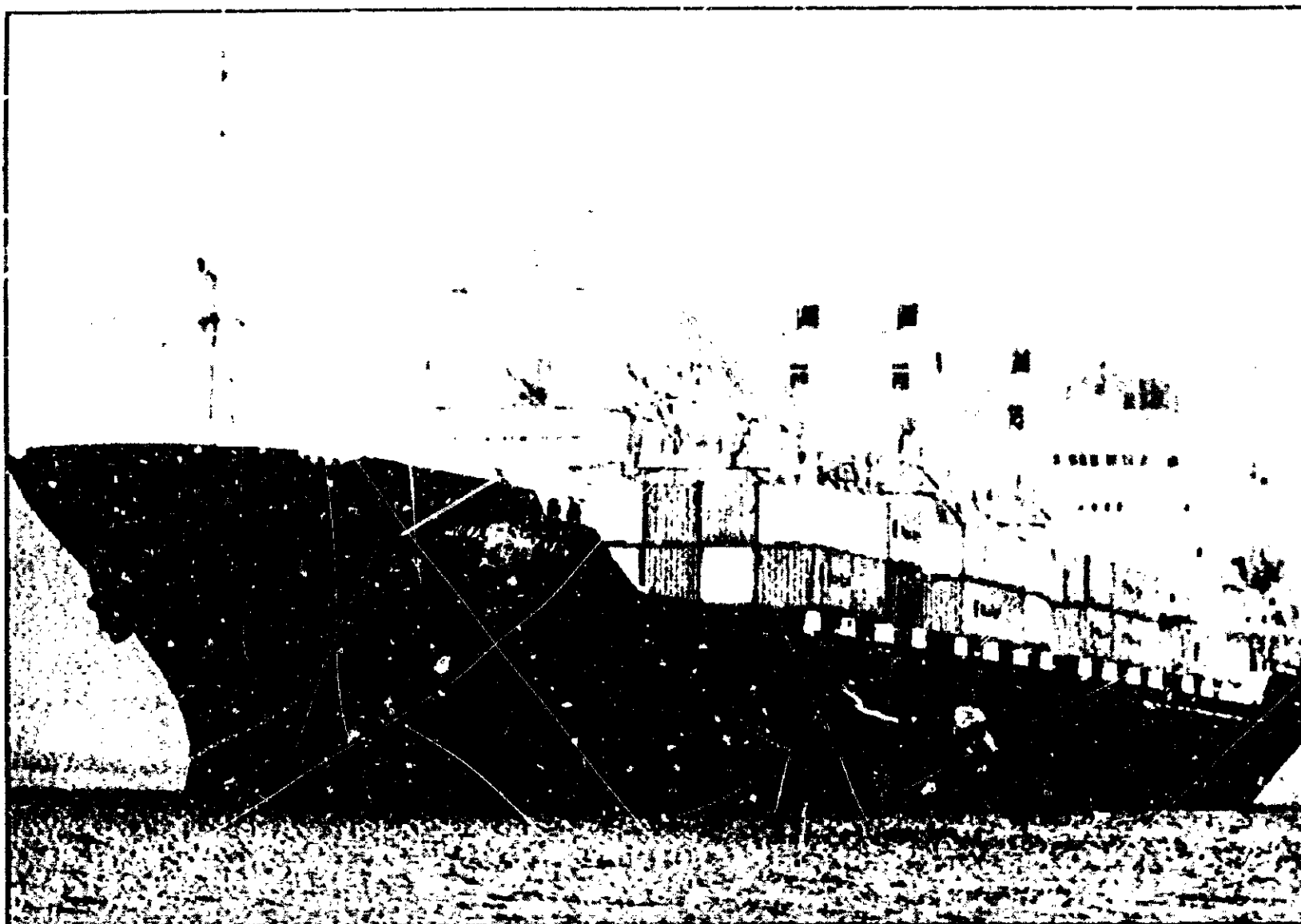


Figure 4. St. Vincent and the Grenadines-registered containership, JURAJ DALMATINAC.

By 1728, two tugs were made fast to the ship; at 1735, the lead pilot began to maneuver the ship away from the dock. Upon sailing, the vessel's draft was 27 feet forward and 32 feet aft. By 1757, the tugs were released and the JURAJ DALMATINAC began its outbound transit of the channel. Because fog was forecast, the Houston Pilots' had established one-way (outbound) ship traffic¹¹ in the HSC that night.

In addition to the pilots and the master, the navigation watch comprised a third officer and a helmsman. The lead pilot had the conn, issuing all rudder and engine orders that controlled the ship's movements. The master, who had overall command on the navigation bridge and responsibility for the vessel, could countermand any order from either pilot during the voyage. The third officer was responsible for executing and logging engine orders from the lead pilot and for ensuring that the helmsman executed helm orders properly.

About 2110, the JURAJ DALMATINAC arrived at Morgans Point. After the lead pilot completed the turn in the channel and steadied the ship on a course of 161° at an engine speed

¹¹ The one-way traffic restriction applied to ships only and did not impact the movement of other traffic, such as towboats and barges.

of SLOW AHEAD, he and the assisting pilot changed roles.¹² The pilot who assumed the role of assisting pilot at Morgans Point then advised the master of the lead pilot change. The new lead pilot radioed the VTS at 2114 to report that the JURAJ DALMATINAC had made the turn at Morgans Point. After receiving a traffic report, he ordered the ship's engine FULL AHEAD and maintained the JURAJ DALMATINAC in the center of the channel as he continued the outbound voyage.

About 2144, when the JURAJ DALMATINAC was about 9 miles above the accident site, the new lead pilot radioed the VTS to request the name of an outbound towboat that was immediately ahead of his ship. He requested the information so that he could call the towboat by name to arrange for a overtaking agreement with its operator. The lead pilot also asked the VTS operator for a vessel traffic report. The VTS operator informed the lead pilot that the towboat immediately ahead was the FILLY. The VTS operator also advised the JURAJ DALMATINAC lead pilot that four other tows were outbound ahead of the FILLY (one of which was the FREMONT), but did not identify all of the vessels by name.

As the ship approached Beacons Red Fish 1 and 2, about 1 9/10 miles from buoys 51 and 52, the lead pilot ordered the ship's engine speed reduced to HALF AHEAD because visibility had decreased to about 1/2 mile. The assisting pilot testified that when the JURAJ DALMATINAC was about 1 3/4 miles away from buoys 51 and 52, he noticed the presence of a contact on radar above buoys 51 and 52. He assumed that the contact was moving in an outbound direction and did not plot the contact or otherwise determine its true motion.

The master testified that he also became aware of a radar contact near buoys 51 and 52 when the JURAJ DALMATINAC was near beacons Red Fish 1 and 2. He said that the contact "just appeared at the edge of the radar screen," which at this time was set on the 1 1/2-mile range scale. He said the contact drew his attention because it appeared to block the entire channel. He stated that he discussed the contact with the lead pilot, who told him that the contact was two vessels, one inbound and one outbound, passing each other in the channel.

The master said that as he continued to watch the radar screen, the two contacts separated. He determined that one of the radar contacts (the FREMONT) was stationary or nearly stationary and lying parallel to the channel on the green side. He did not discuss his observations with either pilot.

As the JURAJ DALMATINAC approached the 10° turn to starboard at beacons 53 and 54, the assisting pilot announced that the radar screen showed an inbound and an outbound contact. The lead pilot looked at the radar, which had been switched to the 1 1/2-mile scale, and noted that the two contacts were about 3/4 mile away. He said that when the ship entered the

¹² Standard practices regarding where and when pilots should change roles do not exist. The location and time that two pilots change roles is based on individual preferences of the pilots involved. The pilots in this accident had changed roles at Morgan's Point during previous outbound transits of the channel.

turn, visibility seemed to decrease even more. Looking out the pilothouse window, he was still able to see beacons 53 and 54, which he used for reference to execute his turn.

After the helmsman completed the turn and steadied the ship on a course of 156°, the lead pilot ordered the engine speed reduced to SLOW AHEAD. The lead pilot testified that when the JURAJ DALMATINAC was out of the turn and steady on course, he sighted the inbound contact about 1/4 mile away and saw that it was a light boat (the B.J. BARBER). He testified that he then looked at the port radar and noted another contact about 3/4 mile ahead that he presumed to be a tow moving outbound on the green side of the channel. VTS transcripts of VHF-FM channel 13 transmissions show that the lead pilot attempted to establish communication with the operator of the detected vessel at 2223:46 and at 2225:09. During both radio calls, he addressed the unidentified vessel as "outbound traffic." The FREMONT operator, who was stopped at buoy 51, did not respond to either call from the JURAJ DALMATINAC's lead pilot.

In contrast to the lead pilot's recollection of events, the JURAJ DALMATINAC master testified that the ship passed the B.J. BARBER while making the turn at beacons 53 and 54. He stated that after passing the B.J. BARBER, he returned to the radar, where he observed that the second contact appeared to be lying parallel to the channel on the green side. He stated that when the contact was at a range of about 1/2 mile, it appeared to turn left 10 to 15° and hold position. He said that he did not mention his observation to either pilot because even though the contact had turned toward the center of the channel, it did not block the channel.

According to the ship's master, a short time later, the contact "started sharply turning to the left and [was] blocking the channel."¹³ The master said that he immediately informed the lead pilot. The master further stated that the lead pilot had already seen what was happening and had begun to issue rudder and engine commands.

The lead pilot testified that after his first two unsuccessful attempts to radio the outbound tow, he expected to sight the contact at any moment. He left the radar and walked to the starboard bridge wing, from which at 2226:23, he radioed, "Calling this outbound tow that's right ahead of the ship down here coming off 49/50...."¹⁴ The tow operator answered, "Fremont's stopped here at ... uh, 51/52, pushed outside the greens." About the same time, the lead pilot sighted the tow. He testified that about 30 seconds later, the operator of the FREMONT turned on a spotlight and illuminated buoy 51, which the lead pilot estimated was 45 feet from the tug's stern. The assisting pilot and the master each estimated the FREMONT's stern to be about 45 to 50 feet from the buoy.

¹³ The FREMONT operator's testimony indicated that the tow was not capable of turning as the master described.

¹⁴ If the FREMONT had been moving outbound, beacons 49 and 50 would have been the next set of aids to navigation that the tow encountered.

The lead pilot testified that he first sighted the towboat's two amber towing lights when the towboat was about 1/4 mile (about 1,500 feet) from the JURAJ DALMATINAC. He did not see any lights that would mark the towboat's tow or any sidelights. He stated that at this time, he did not doubt the ship was astern of a moving, outbound tow that was parallel to the channel because he knew the JURAJ DALMATINAC was parallel to the channel and because amber towing lights are only visible from astern.¹⁵ He said that if he had seen a red light, he would have known that the tow was not lying parallel to the channel line. He testified, "It looked good to me," and said he was not concerned about the developing situation.

The Collision

After transmitting, "...I'll swing it over out of your way," about 2227, the lead pilot ordered 20° port rudder to steer around the FREMONT and its tow. He testified that the helmsman executed the order properly and in a timely manner. The lead pilot testified that he ordered 20° "to give a buffer zone" between the ship and the tow, and not as a collision-avoidance measure. He said that he watched the 20°-rudder order take effect and the ship's bow swing away from the tow. About 2229, as he was ordering the rudder midships, the lead pilot said he heard a "crunch" as the ship struck the port side of the DUVAL 2.

The chief officer, who was serving as anchor watch on the ship's bow, sighted the FREMONT's amber towing lights about the same time as the bridge watch did. He testified that the towboat was ahead and to the right of the JURAJ DALMATINAC's bow, on a course parallel to the ship's. He radioed his sighting to the master. He testified that he was watching the FREMONT from the ship's bow when he suddenly saw a red light. He said he immediately became alarmed because he realized the vessel was in front of the ship. He radioed the master that the towboat had turned in front of the ship, whereupon the master ordered the chief officer to run from the bow. He was running aft along the port side of the ship and had reached the area between holds number 3 and 4 when he heard the noise of the collision.

The lead pilot testified that he initially thought the ship had merely sideswiped the tow. However, shortly after initial impact, the lead pilot looked at the tow and observed that the barge DUVAL 2 was across the JURAJ DALMATINAC's bow. The lead pilot then immediately ordered STOP followed by FULL ASTERN with the engine.

Postaccident Events

The JURAJ DALMATINAC's bow penetrated the DUVAL 2's side and bottom hull plating about 109 feet aft of the barge's bow, passing completely through the barge's No.2 port

¹⁵ Inland Navigation Rule 21 states that towing lights must be visible over an unbroken arc of the horizon of 135° and so fixed as to show the light 67.5° from right aft on each side of the vessel.

wing void tank and indenting the outboard plating of the port cylindrical cargo tank.

The collision caused the FREMONT to heel to starboard to such a degree that seawater flooded into the galley and engine room spaces through open main deck doors. Immediately after impact, the operator of the FREMONT tried to pull the barge away from the ship by pulling the port engine throttle to the full astern position so that both engines were operating full throttle astern. However, the starboard main engine, which had aspirated salt water, stalled. He said that about this time, the JURAJ DALMATINAC's forward movement stopped and he put the FREMONT's engine throttles into neutral.

As the JURAJ DALMATINAC backed away from the barge, the DUVAL 2 buckled transversely, with the bow and stern pointing upwards. When the barge buckled, both the port and starboard cargo tanks were breached and molten sulphur spilled into the waterway.

When the DUVAL 2 started to buckle, some wires connecting the barge to the FREMONT suddenly broke and the towboat abruptly righted itself. The operator was thrown onto the arm of the pilothouse chair and fell to the deck. He said that he was momentarily stunned but regained his feet after a few moments and resumed his position at the towboat's controls. The operator testified that he suffered minor internal injuries as a result of his fall.

In the meantime, the contract tankerman had left the FREMONT's pilothouse shortly after the collision and boarded the DUVAL 2 to check the machinery in the barge's generator room. When the barge buckled, he left the barge generator room and went to the barge's aft port corner to assist the deckhands in releasing the remaining wires that connected the barge to the towboat. After the wires were released, the operator maneuvered the FREMONT close to the barge, and the deckhands extended an aluminum ladder between the towboat and the barge to allow the contract tankerman to climb back aboard the FREMONT. The operator then maneuvered the towboat away from the sinking barge; at 2233, he radioed VTS to report the collision.

After the JURAJ DALMATINAC's lead pilot saw the towboat move away from the barge, he contacted the VTS operator and reported that the JURAJ DALMATINAC would anchor in the channel. The pilot then backed the ship about 1/4 mile away from the wreck and anchored in the center of the channel (see figure 5).

During its investigation, the Safety Board received conflicting testimony concerning the angle of impact between the JURAJ DALMATINAC and the FREMONT tow. Some witnesses testified that the angle of impact was close to 90°, while others testified that the angle of impact was between 30 and 35°. A Safety Board investigator examined the wreckage of the DUVAL 2 as it was removed from the waterway to determine the angle of impact. However, to remove the wreck from the waterway, salvors had to cut the barge into several pieces. The resulting damage from the salvage operation and the collision was so severe that the Board was unable to determine the angle of impact between the two vessels.

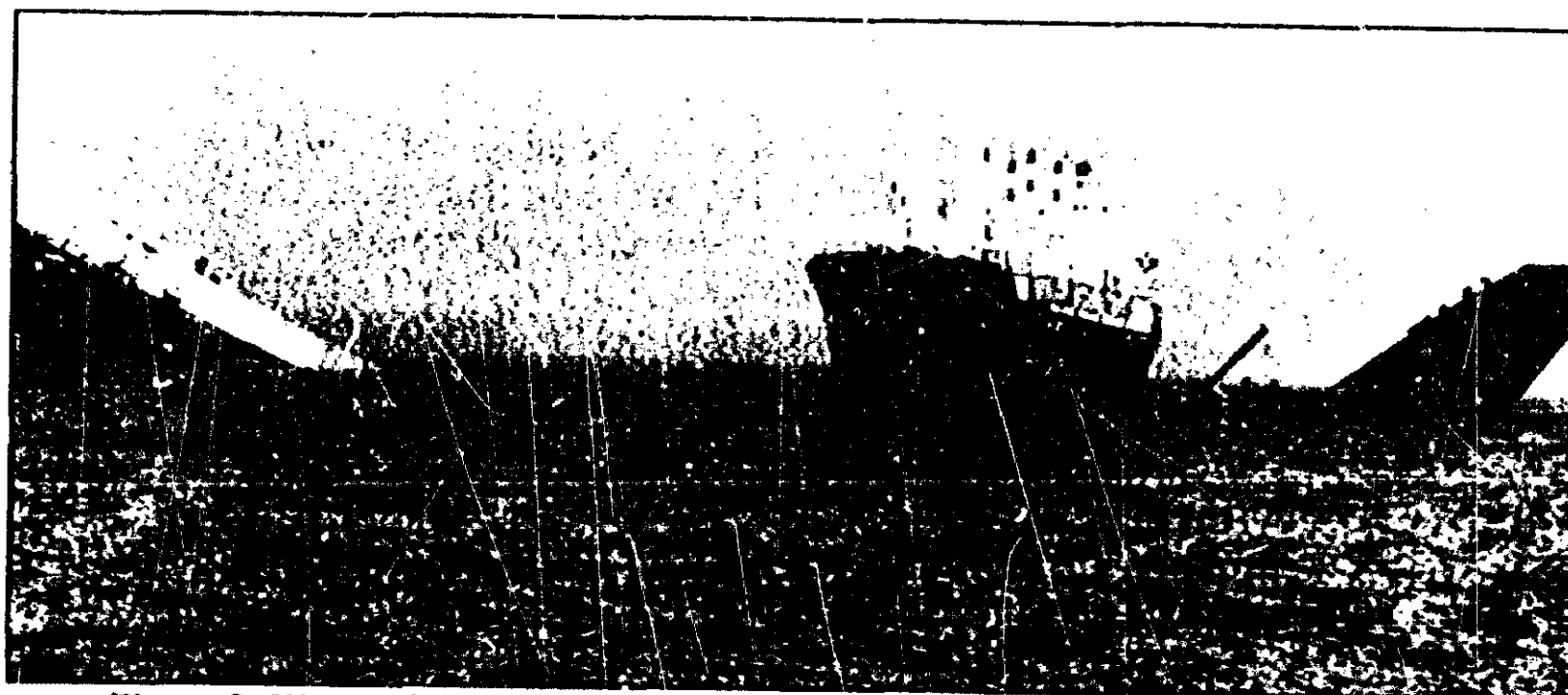


Figure 5. Wreck of the DUVAL 2; the JURAJ DALMATINAC is in the background.

Damage.--Vessel damage resulting from this accident is shown in the following table. As a result of this accident, the Houston channel was closed to all traffic for 3 days, forcing 15 outbound ships to remain in the Port of Houston or to anchor in the channel and 50 inbound ships to anchor in the Gulf of Mexico. Between December 25, 1992, and February 17, 1993, channel traffic was restricted to one-way movement because the sunken wreck of the DUVAL 2 blocked portions of the waterway. The Port of Houston lost an estimated \$100,000 in wharfage fees, and shipping lines lost an estimated \$6 million from delays.

Vessel	Type of Damage	Cost
FREMONT	Starboard main engine aspirated salt water and had to be rebuilt.	\$16,000
DUVAL 2	The barge and its cargo were destroyed.	Barge - \$750,000 Cargo - \$122,000
JURAJ DALMATINAC	Sustained minor dents and scrapes near forepeak tank and bulbous bow. Shell plating in the forepeak tank sustained one small puncture. Damage to the containership was not consistent with grounding.	\$67,500

Table 1. Type and damage cost by vessel.

Toxicology Testing.--Within 6 minutes of the collision, vessel personnel reported the accident to VTS personnel, who in turn, notified the duty investigating officer at the Coast Guard Marine Safety Office (MSO) in Galveston within the hour. About 1 1/4 hour after the accident, the investigating officer called the owner-representative for the FREMONT to obtain general vessel information and to ask about injuries. During their conversation, the investigating officer did not discuss drug testing.

About 0045 on December 22, about 2 1/4 hours after the accident, the investigating officer called the JURAJ DALMATINAC's local agent and asked that the bridge crew be tested for drugs. The officer later stated that he did not explicitly mention testing for alcohol.

The investigating officer was en route to investigate the accident within 2 1/2 hours of the collision when his vessel experienced an electrical fire and he was forced to return to his base port. In the meantime, an Coast Guard petty officer from MSO-Houston had called the JURAJ DALMATINAC's local agent and asked him to arrange for postaccident testing for the pilots and bridge crew. The petty officer also did not specify which drugs should be included in the screening.

Coast Guard investigating officials arrived aboard the FREMONT about 0500, at which time they were asked by company personnel who should be tested. They responded that all crewmembers should be drug tested. None of the parties discussed alcohol testing. The Coast Guard investigators transferred to the JURAJ DALMATINAC about 0730, at which time they stressed the need for drug testing to the pilots and to company officials who had since boarded the ship. The pilots responded that they felt they had a legal responsibility to stay with the ship and that they wanted an order from the Coast Guard to leave for drug testing. During the next 3 hours, the Coast Guard investigators again called the vessels' respective company agents concerning the drug tests.

Between 1230 and 1430 on December 22, about 14 to 16 hours after the accident, the two pilots and navigation watch of the JURAJ DALMATINAC provided urine specimens for drug testing; at 1700, about 18 hours after the accident, the contract tankerman and operating crew of the FREMONT provided urine specimens for drug testing. Subsequent analyses by National Institute on Drug Abuse-approved laboratories were negative for evidence of drug use. No one was directed to provide breath or blood samples for alcohol testing. In later interviews, the employers stated that they were unaware of the alcohol testing requirement.

SAFETY ISSUES

In the following section, the Safety Board describes factors that it was readily able to exclude as causal to the accident, how the accident happened, and a detailed analysis of each safety issue identified.

Exclusions

The Safety Board was able to rule out a number of possible causal factors in this accident. No actions or omissions on the part of the Coast Guard VTS caused the accident. Neither the FREMONT nor the JURAJ DALMATINAC suffered any steering gear or propulsion equipment failures. Based on testimony from the FREMONT operator and postaccident observations of Safety Board investigators, the Board determined that the FREMONT's radar probably did not malfunction. The JURAJ DALMATINAC's bridge watch standers executed engine or rudder orders properly. Postaccident drug screenings support the finding that drug use was not a factor.

Because no one was tested for alcohol, the Board could not conclusively assess whether alcohol use was a factor in this accident. However, Coast Guard personnel who arrived first on scene after the accident stated that they observed no visible indications of alcohol impairment among the vessel operating personnel.

The Accident

The Safety Board believes that in the dense fog between beacon 53 and buoy 51, the principals involved in this accident failed to accurately recognize that their vessels were out of position for a safe passing. According to the lead pilot of the JURAJ DALMATINAC, visibility was about 1/4 mile. The FREMONT operator testified that the range of visibility was even less, about 280 feet. After executing a turn at beacons 53 and 54 and a passing maneuver with an inbound vessel, the JURAJ DALMATINAC's lead pilot failed to maintain the ship on the centerline of the channel. While the FREMONT operator was attempting to maintain station, he was concentrating on buoy 51 to the extent that he failed to realize that his tow had pivoted around the buoy and into the deep-water area of the channel.

The Safety Board determined that nonavailability and nonuse of navigation equipment was a primary factor in this accident. The FREMONT was not outfitted with a compass. Lacking any other visual reference, the FREMONT operator became disoriented in the fog and allowed his tow to become misaligned. Aboard the JURAJ DALMATINAC, the pilots did not plot radar contacts on the conventional radar or use the anticollision tracking features of the ship's ARPA radar. The failure to use important equipment resources was an example of a greater systemic problem on the JURAJ DALMATINAC: the bridge watch did not practice effective bridge resource management in the conduct of their operation. The assisting pilot and the master failed to communicate essential information to the lead pilot that could have averted this accident.

Following a discussion of each of the safety issues that were causal or contributory to the accident, the Board discusses the role of the Houston-Galveston VTS and looks at the adequacy of postaccident drug and alcohol testing procedures.

Lack of a Compass on the FREMONT

In accordance with his company's policy concerning towing operations in fog, the FREMONT operator intentionally stopped his tow outside the outbound starboard side of the HSC. He said that when he positioned his tow at buoy 51, the stern of the towboat was about 10 feet from the buoy and the tow was heading 15° to the right of beacon 49. In other words, the head of the tow was pointing away from the channel. A U.S. Army Corps of Engineers area survey chart shows that had the tow had been in the position indicated by the operator, the DUVAL 2 would have been in water about 15 feet deep.

The Safety Board concludes that stopping his tow during conditions of dense fog was an appropriate course of action and that if the FREMONT tow had remained in its original orientation, the collision probably would not have taken place. However, subsequent events demonstrate that the FREMONT operator did not maintain his tow in a safe position outside of the channel. The JURAJ DALMATINAC's forward draft was 27 feet. To strike the barge in waters 15 feet deep, the ship would have had to run aground. Because the JURAJ DALMATINAC did not run aground, the tow could not have been positioned as the operator believed when the DUVAL 2 was struck by the ship. The Safety Board concludes that while attempting to maintain station near buoy 51 in the dense fog, the FREMONT operator allowed his tow to become misaligned and to swing into the channel where it was struck by the passing JURAJ DALMATINAC.

The Safety Board found that several factors adversely affected the operator's ability to keep his tow aligned with the channel, the most important of which was the lack of a compass.

Because of dense fog, the FREMONT operator only had one visual reference, buoy 51, with which he could try to determine his location and keep his tow aligned to the channel. Visual reference to a single floating object was not sufficient to establish alignment with the channel. The towboat could pivot completely around the buoy to any heading and still keep the same relative position to the buoy. He needed at least one additional point of reference, such as another visual object, a radar reference, or a compass bearing to determine his alignment.

Upon arriving at buoy 51, the FREMONT operator positioned the tow so that the radar heading line was about 15° to the right of a radar contact that he assumed was beacon 49. For the next 45 minutes, the operator maneuvered the engines to keep buoy 51 in his sight, periodically using his radar as a second reference to ensure that the tow was still on this heading. He testified that maintaining visual contact with the buoy was very important to him and that if he lost visual contact, he would have to move the tow further south to the next aid to navigation, beacon 49. The Safety Board concludes that the operator of the FREMONT concentrated so much on watching buoy 51 that he failed to give proper attention to the heading line on the radar and allowed the tow to swing into the channel.

While he was preoccupied with buoy 51, the FREMONT operator may have mistaken the radar image of another navigation aid for beacon 49 when he referred to the radar screen and

aligned his tow differently than he intended. When the radar is set to the 2-mile scale, the arrangement of navigation aids near buoy 51 can appear on the radar scope to form a "false channel" at a quick glance (see figure 6). The alignment of buoy 51, beacon 50, and beacon 48 might be confused with the true channel line represented by buoy 51, beacon 49, and beacon 47. If the operator mistakenly aligned his tow with reference to beacon 50 instead of beacon 49, the tow initially would have been aligned almost parallel to rather than away from the channel.

As he passed the FREMONT, the B.J. BARBER operator noticed only the forward centerline and port side navigation lights of the DUVAL 2. He did not see any lights displayed by the FREMONT. If the FREMONT tow were angled into the channel, only the closest lights, those on the barge, would have been observable to the passing B.J. BARBER.

If the tow became misaligned to the extent that its head was inside the navigable channel, the flood tidal current may have affected its position. According to the pilot's testimony, tidal currents in the HSC follow the course of the dredged channel. At the time of the accident, the flood tidal current, which runs up the channel toward Houston, was about 1 knot.¹⁶ If the tow became even slightly angled toward the navigating channel, the tidal current would have acted against the starboard side of the FREMONT tow. The tidal current acting against the tow's starboard side may have caused it to slowly rotate counterclockwise without the operator's knowledge until the tow was partially in the deep-water navigating channel. If such a misalignment occurred, the forward half of the barge could have been in water depths of 27 feet or more, where the JURAJ DALMATINAC could strike the DUVAL 2 without running aground.

Had the FREMONT been equipped with a suitable magnetic compass, the operator would have been able to determine at a glance what his heading was and whether it had changed. If he had determined that the tow was misaligned, he could have used the compass to return it to its proper heading without having to rely on visual cues. The Safety Board concludes that if the FREMONT had been equipped with a properly functioning compass that the operator could have used to monitor the heading of the tow, this accident probably would have been avoided.

The FREMONT was 68 gross tons. The Coast Guard does not currently require towboats and tugs less than 1,600 gross tons to have a compass. In 1974, the Coast Guard published an Advanced Notice of Proposed Rule Making proposing that all U.S. and foreign vessels more than 150 gross tons be required to be outfitted with a magnetic compass. In the resulting Notice of Proposed Rule Making, which was published in 1976, the Coast Guard deleted the compass requirement, terming it to be "overly burdensome and unrealistic for small vessels." The Coast Guard stated that further study was needed to determine appropriate navigation equipment requirements for smaller vessels. To date, these further studies have not been conducted. The Safety Board does not consider the comparatively small cost of a marine magnetic compass overly burdensome and unrealistic for small vessels, and believes that the safety benefits accrued by such vessels having compasses is more than justified.

¹⁶ Based upon tidal current calculations for Red Fish, the closest tidal reference station to the accident site.

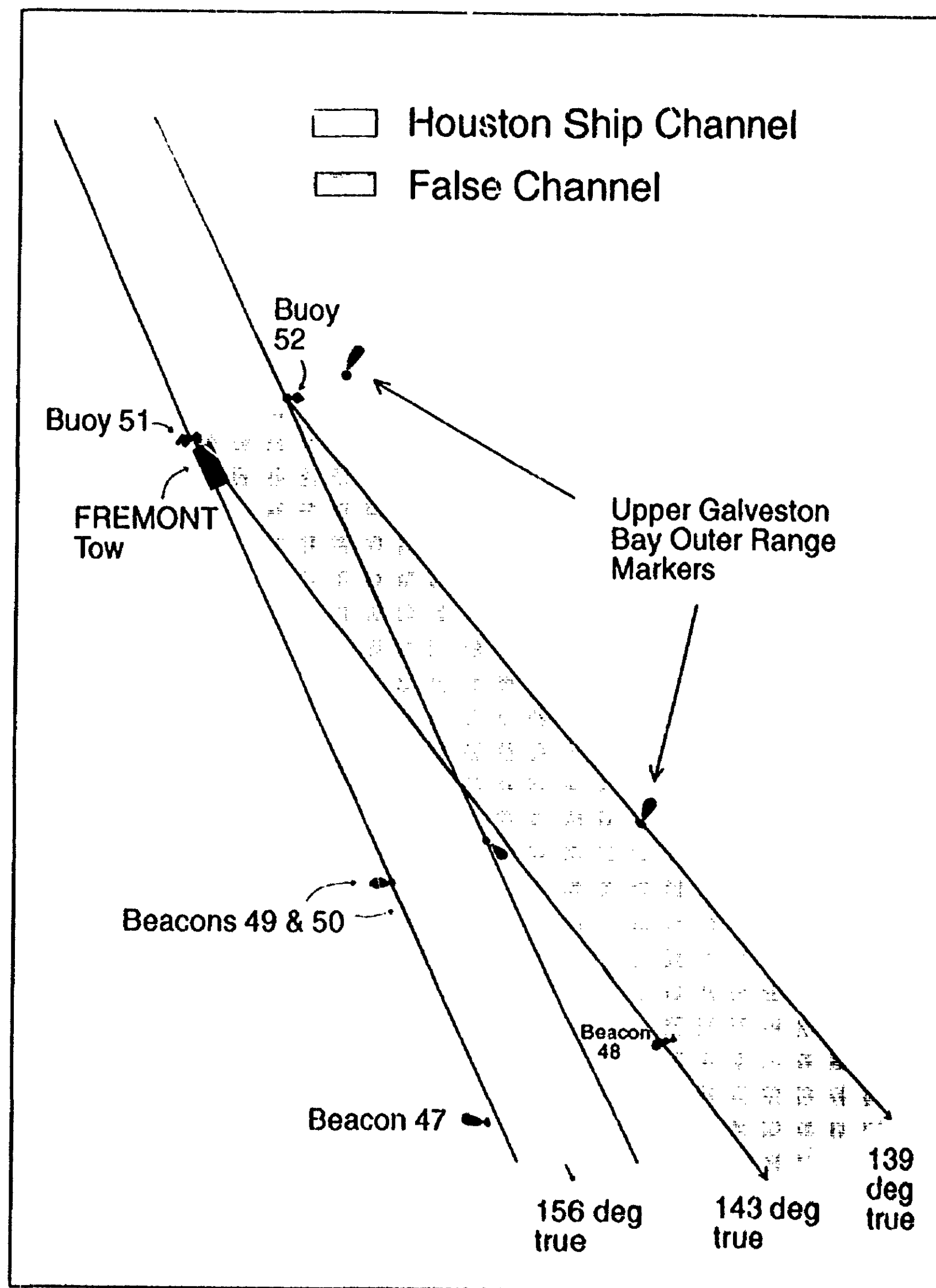


Figure 6. How navigation aids form "false channel" with respect to HSC.

The Safety Board believes that tugs and towboats, especially those operating in open waters, such as Galveston Bay, should be required to carry a magnetic compass. These tugs and towboats move barges carrying thousands of barrels of chemicals and petroleum products, which if spilled, can seriously threaten life and property. Such spills are usually caused by collisions and groundings. The Safety Board believes that the acquisition and use of a magnetic compass by towboat operators would reduce the threat of such accidents.

Inadequacy of Bridge Resource Management on the JURAJ DALMATINAC.

According to the JURAJ DALMATINAC's lead pilot and assisting pilot, the ship was on the channel centerline as it approached the FREMONT. From buoy 51, the channel centerline is about 400 feet. The JURAJ DALMATINAC's beam is 75 feet. If the ship had been on the centerline, its starboard side would have been about 360 feet from buoy 51.

The ships' two pilots and master testified that buoy 51 was no more than 50 feet from the FREMONT's stern when they first sighted the vessel. Even if the 310-foot-long tow had been perpendicular to the channel, the DUVAL 2 would have barely reached the ship and could not have been struck mid-length if the JURAJ DALMATINAC were on the channel centerline (see figure 7).

The Safety Board believes that the lead pilot allowed the JURAJ DALMATINAC to leave the centerline and move more than 100 feet to the right in the outbound side of the channel. He may have consciously allowed the ship to move to the right to allow more room for passing the inbound B. J. BARBER or he may have misjudged the turn at beacons 53 and 54 because of the limited visibility conditions. More likely, the latter was the case because he had no other visual cues to reference during the turn maneuver except beacons 53 and 54.

The lead pilot did not become aware of the position of the tow on radar until it was about 3/4 mile away. He thought that the tow was moving outbound and did not initiate avoidance action until after the FREMONT came into visual range, which he estimated to be about 1/4 mile in the dense fog. When the lead pilot sighted the tow, the JURAJ DALMATINAC may actually have been closer to the tow than the lead pilot estimated. According to testimony from the FREMONT operator, visibility

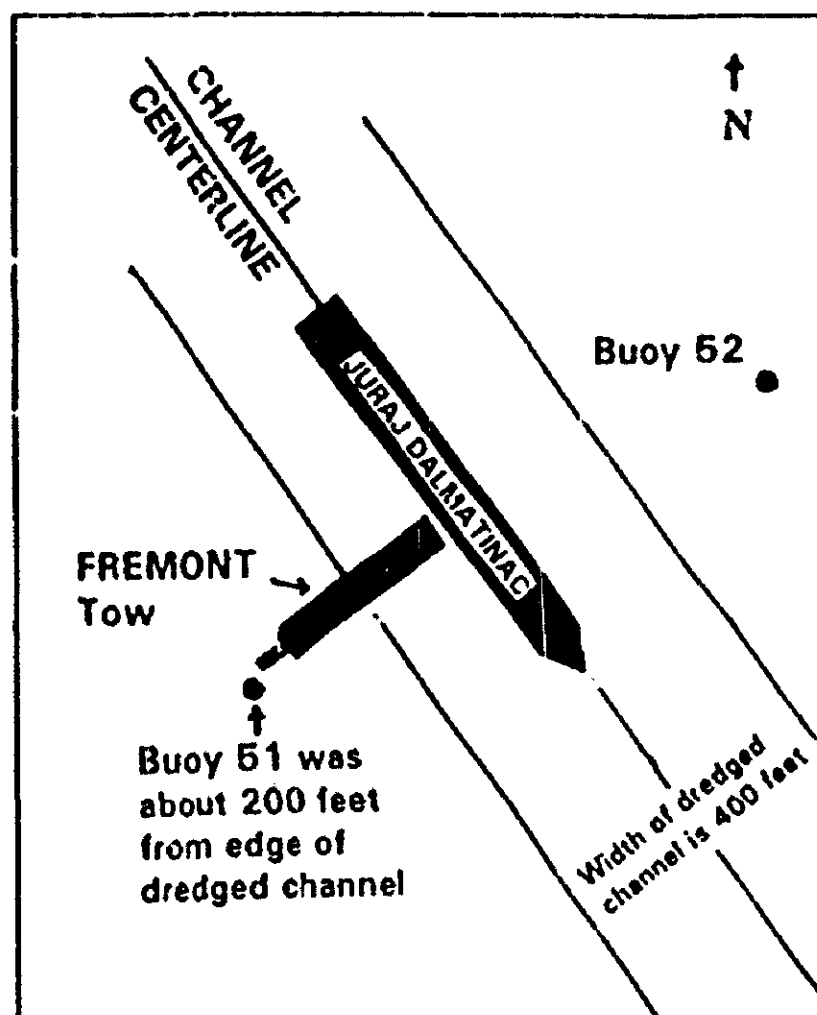


Figure 7. Above shows worst-case scenario in which the tow is perpendicular to channel.

was less than 300 feet. The Safety Board believes that the lead pilot waited too long before he initiated avoidance action and that the JURAJ DALMATINAC probably was too close to the FREMONT for the pilot to avoid collision when the tow entered visual range.

The Safety Board believes that the actions by the JURAJ DALMATINAC's pilots and master demonstrated inadequate bridge resource management. Conceptually, bridge resource management involves achieving a safe and efficient operation by effectively using all resources, including people, equipment, and procedures. Timely communication among members of the bridge watch, delegation and coordination of tasks among watchstanders, and full use of available equipment resources is paramount to effective bridge resource management.

By virtue of their respective authority and responsibilities, communication between the master and pilot is essential. When two pilots are employed in the navigation bridge, as was the case on the JURAJ DALMATINAC, interaction among bridge personnel becomes more complicated and good communication becomes even more important. During the 10 minutes before the accident, the assisting pilot, the master, and the lead pilot each had a different perspective of the navigation situation that they failed to adequately confirm or communicate to other members of the bridge watch.

The assisting pilot testified that he first noticed the radar contact (the FREMONT) when it was at a range of about 1-3/4 miles. He said that he assumed the contact was making way and did not systematically watch or plot the contact to determine its speed.

The master testified that he became aware of the contact on radar when the contact was at a range of about 1 1/2 miles. He said that he continued to watch the contact on radar and determined that it was stopped parallel to the green side of the channel but that he did not advise either pilot of his observations. Only when the JURAJ DALMATINAC had closed to within 1/2 mile of the contact and the radar contact appeared to the master to turn sharply into the channel did he mention the radar contact to the lead pilot.

The lead pilot testified that he became aware of the contact when the assisting pilot announced that an inbound target and an outbound tow were ahead of them, at a range of about 3/4 mile. He said that he watched the targets on radar and that after the ship passed the B. J. BARBER, he went to the starboard bridge wing, from where he expected to be able to sight the other vessel. He stated that he expected the tow to be moving "like the FILLY"¹⁷ and that it would be a routine overtaking situation. He said that he continued to think that the contact was moving outbound when he sighted the towboat's towing lights and did not see its sidelights. The fact that the lead pilot saw only the towboat's towing lights does indicate a stern aspect. However, the towing lights do not confirm whether the vessel is moving. Moreover, the arc of visibility of towing lights is such that the vessel could have been angled as much as 67.5° into

¹⁷ The M/V FILLY was an outbound towboat that the JURAJ DALMATINAC had overtaken a few miles up the channel.

the channel before the port sidelight would become visible to someone approaching from astern. The lead pilot persisted in believing that the FREMONT was moving outbound until about 2 minutes before the collision, when the towboat operator radioed that he was stopped at "51/52, pushed outside the greens."

The lead pilot's interpretation of the situation is an example of *confirmation bias* or *reality construction*, which sociologist Charles Perrow describes in his chapter on marine accidents in *Normal Accidents: Living With High Risk Technologies*.¹⁸ This is the tendency of a person to find information that confirms a hypothesis and to ignore conflicting data; such bias often can be dispelled only when another person intervenes with contradictory information. In this case, had the master immediately advised the lead pilot of the presence of a radar contact that appeared to be stationary, the lead pilot could have adjusted speed to assess the situation or changed course sooner to provide a wider margin of safety when passing the FREMONT. Either action probably would have averted the collision.

The lead pilot would have learned that the FREMONT was stopped had the assisting pilot plotted the contact's course and speed when he first noticed it on radar (at a range of about 1-3/4 miles) and notified the lead pilot of his results. This accident demonstrates that the roles of the individuals who are responsible for the safe navigation of vessels need to be clearly defined for effective bridge resource management. The pilot who was serving in an assisting capacity at the time of collision testified that the roles of the two pilots "are not spelled out anywhere." Both pilots involved in this accident described the working arrangement as an informal one in which the assisting pilot responded to the lead pilot's specific requests.

The Safety Board believes that an unstructured, essentially reactive mode of delegating and coordinating task assignments hampers a pilot's ability to maintain proactive situational awareness. If the lead pilot had asked that the assisting pilot, who was a certified radar observer, plot all radar contacts encountered in the channel, the lead pilot would have learned earlier that the FREMONT was stationary. However, the lead pilot did not request that the assisting pilot perform such a task, and the assisting pilot did not take the initiative to do so on his own.

The Houston Pilots routinely assigns two pilots to vessels such as the JURAJ DALMATINAC because their structural configurations obstruct visibility to the extent that the capabilities of a single pilot to maneuver the vessel are exceeded. The association recognizes the potential hazard to safety and has addressed it by providing additional manpower. The Safety Board acknowledges the association's proactive effort. However, the Board believes that the association's solution is inadequate because pilots do not have guidelines to follow when executing a two-pilot scheme. The Safety Board concludes that the Harris County Board of Pilot

¹⁸Perrow, C., Chapter 6, "Marine Accidents," *Normal Accidents: Living With High Risk Technologies*, Harper Collins Publishers, 1984.

Commissioners¹⁹ should prepare guidelines for members of the Houston Pilots to use when they are working in a two-pilot scheme.

The Safety Board further concludes that the circumstances of this accident reinforce the finding that licensed deck watch officers, including Federal and State pilots, need to receive training in bridge resource management, a practice that is fully supported by the Board of Trustees of the American Pilots' Association (APA). At its October 5, 1993, Trustees' meeting, the president of the APA stated that bridge resource management "...is in keeping with the APA's missions of promoting safety, ... and maintaining the high standards of the pilotage profession in the United States." The APA's Trustees recommended that all member pilots take a course in bridge resource management and refresher courses every 3 years. The Trustees called for pilot associations to provide bridge resource management courses for their members and trainees and for licensing authorities to require bridge resource management training as a prerequisite for receiving and renewing a pilot license.

The Safety Board has identified the need for licensed deck officers to receive bridge resource training in numerous prior accident reports and studies. Of the five "open" safety recommendations made to the Coast Guard regarding bridge resource management, three specifically address the need for training. On March 14, 1991, as a result of its investigation of the grounding of the tankship WORLD PRODIGY,²⁰ the Safety Board issued the following safety recommendation to the Coast Guard:

M-91-6

Require bridge resource management training for all deck watch officers of U.S.-flag vessels of more than 1,600 gross tons.

The Coast Guard responded to this recommendation on January 16, 1992, stating that it anticipated issuing an Advance Notice of Proposed Rulemaking after reviewing the studies mandated by the Oil Pollution Act of 1990. On March 11, 1992, the Safety Board classified Safety Recommendation M-91-6 "Open--Acceptable Response."

On June 25, 1993, as a result of its investigation of the RMS QUEEN ELIZABETH 2 grounding,²¹ the Safety Board issued the following safety recommendations to the Coast Guard:

¹⁹ The agency that regulates the Houston Pilots.

²⁰ Marine Accident Report--Grounding of the Greek Tankship WORLD PRODIGY off the Coast of Rhode Island, June 23, 1989 (NTSB/MAR-91/01).

²¹ Marine Accident Report--Grounding of the United Kingdom Passenger Vessel RMS QUEEN ELIZABETH 2 Near Cuttyhunk Island, Vineyard Sound, Massachusetts, August 7, 1992 (NTSB/MAR-93/01).

M-93-19

Propose to the International Maritime Organization that the masters, deck officers, and pilots of ocean-going ships be required to successfully complete initial and recurrent training in bridge resource management.

M-93-20

Require that all applicants for an original or the renewal of a Federal pilot and deck officer license for vessels of more than 1,600 gross tons successfully complete a course in bridge resource management.

On September 27, 1993, the Coast Guard responded that it partially concurred with Safety Recommendation M-93-19, stating:

The United States will propose that IMO agree in principle to requiring masters and deck officers on seagoing ships to complete initial and recurrent training in bridge resource management. However, the Coast Guard views pilot qualifications as a matter for port State regulation.

In its October 1993 reply, the Safety Board encouraged the Coast Guard to actively promote the International Maritime Organization's (IMO's) acceptance of Safety Recommendation M-93-19 and classified the recommendation "Open--Acceptable Alternate Response," pending the outcome of the Coast Guard's efforts.

In its September 1993 correspondence, the Coast Guard concurred with Safety Recommendation M-93-20, stating that it would initiate a rulemaking project to implement the recommended requirements for the original issue of and the renewal of a Federal pilot and deck officer license for vessels of more than 1,600 gross tons. As a result, the Safety Board classified Safety Recommendation M-93-20 "Open--Acceptable Response."

Failure by the JURAJ DALMATINAC Bridge Watch to Use the ARPA Radar

The JURAJ DALMATINAC bridge watch failed to use an important equipment resource that would have afforded them the capability to determine the status of the FREMONT early enough to avoid the collision. The JURAJ DALMATINAC was equipped with an ARPA radar, a computer-based electronic device that processes radar signals and displays selected navigational information. The ARPA radar has several features that aid in navigation safety. One of the most useful is a tracking feature. When a member of the navigation watch positions an electronic cursor over a radar contact and presses a button, the ARPA radar "acquires" the contact and automatically tracks it. The radar system provides digital readouts of the target's true course and speed, its closest point of approach (CPA), and length of time to CPA. Moreover, the radar

system continuously updates the status of the contact while tracking it.

If the bridge watch of the JURAJ DALMATINAC had used the ARPA features of the radar in this accident, the FREMONT could have been identified as a stationary target within one minute of steady state tracking, before the JURAJ DALMATINAC had travelled about two ship lengths.²² Given the information that the impending contact was stationary, the lead pilot would have realized that he not only had less time to take avoidance action, but also that the vessel he was approaching could not maneuver out of the way.

The Safety Board is aware of arguments that the ARPA radar is not really well suited for navigation in restricted waters, such as a narrow channel, because of the system's proximity alarm feature, which sounds an alarm on the navigation bridge whenever the radar detects a contact within a preset distance of the ship. Nonadvocates point out that the alarm sounds continually when a ship is performing routine maneuvers in pilotage waters, such as when the ship passes close to other ships and to navigation aids. The Safety Board notes that this feature can easily be turned off without affecting the operation of other ARPA features.

The Coast Guard issued regulations requiring that vessels of a certain tonnage and carrying certain dangerous cargo in U.S. navigable waters be fitted with ARPA radars following Presidential oil antipollution initiatives in 1977 and the Port and Tanker Safety Act of 1978. Current Federal requirements, which were published in 1984 and identify which vessels are required to carry ARPA radars, are contained in 33 Code of Federal Regulations (CFR) 164.38.

The JURAJ DALMATINAC's master stated that he knew how to use the ARPA radar; both pilots in this accident said that they did not know how to use it. In the current regulations, the Coast Guard recognizes the ARPA as a time and labor saving device that can contribute positively to protecting the environment, particularly in waters in which geographic or other conditions do not force vessels to make repeated course changes. Current regulations do not require that any crewmember know how to use the ARPA radar.

The Safety Board finds it incredible that regulations require that vessels be equipped with a proven, effective piece of collision-avoidance equipment yet do not require that anyone know how to use it. The Safety Board believes that navigation officers, including pilots, should know how to use state-of-the-art navigation equipment, especially the equipment on vessels that they may be required to navigate. If the pilots in this accident had been familiar with the features of the ARPA radar, they could have used or requested that another member of the bridge watch use the device to determine the status of contacts and keep them apprised during transit of the channel. The Safety Board concludes that the ARPA radar was a valuable bridge resource that the master and pilots of the JURAJ DALMATINAC failed to use.

²² Performance standards for ARPA radar are in Appendix A to 33 CFR 164.38.

VTIS Procedures

To arrange for an overtaking agreement with an outbound tow ahead of him, the lead pilot of the JURAJ DALMATINAC radioed the VTS operator at 2144, requesting a traffic report, when the ship was about 9 miles from the accident site and a little more than 7 miles from the next VTS reporting point near Redfish 1 and 2. About 16 minutes later, the FREMONT operator radioed the VTS to report that he had stopped his tow near buoy 51.

When the ship arrived at the Red Fish reporting point, the lead pilot did not call the VTS. At the time of the accident, participation in the Houston-Galveston VTS was voluntary. Therefore, the failure of the JURAJ DALMATINAC's lead pilot to report at the Red Fish reporting point was not a violation of any law or regulation. However, had the ship's lead pilot called the VTS at the Red Fish reporting point, the VTS operator probably would have advised him that the FREMONT was stopped near buoy 51. With this information, the lead pilot would have had sufficient time and distance to maneuver safely past the FREMONT.

The Coast Guard is now upgrading the Houston-Galveston VTS system's surveillance and tracking capabilities by adding a radar installation at Eagle Point and acquiring more low-light video cameras and new vessel tracking computer hardware and software. Under the Oil Pollution Act of 1990, participation in the Houston-Galveston VTS will become mandatory by mid-1994.

Moreover, the Coast Guard is developing an enhanced VTS project called Vessel Traffic Services 2000. The enhanced VTS system will use standard digital cartographic and imaging techniques to correlate and process data from multiple sources, such as radar and closed circuit television, in order to identify hazardous conditions. The new system will also allow the Coast Guard to "use data transmission techniques to relieve overcrowding of the VHF-FM maritime band," reducing voice communication to the extent possible.

The Safety Board anticipates that upgrading the VTS will increase the VTS center's ability to monitor vessel traffic in the HSC and that mandatory participation may help prevent accidents like the collision between the JURAJ DALMATINAC and the FREMONT tow. Moreover, the VTS 2000 should enable the VTS to take a more proactive role in increasing the safety of navigation in the HSC. With the help of computer software and advanced data transmission techniques, the VTS operator will immediately be able to update vessel positions and notify vessel operators of developing situations that affect their safe navigation rather than passively waiting for a vessel to reach a reporting point before relaying important navigation information.

Adequacy of Postaccident Testing for Drugs and Alcohol

Title 33 CFR Part 95 and 46 CFR Parts 4 and 16 set forth regulations regarding chemical testing for drug and alcohol use while operating vessels. Title 33 CFR Part 95.035 empowers law enforcement officers, including Coast Guard officers, and marine employers to direct an

individual involved in a marine casualty to be tested. In this accident, the Coast Guard did not direct any individuals to undergo testing. Coast Guard officials did provide some limited information to the employers about testing requirements, but failed to mention alcohol testing. Title 46 CFR Part 4.06 assigns the marine employer the primary responsibility for having individual(s) involved in an accident tested for evidence of drug and alcohol use. Title 46 CFR Part 16 details the requirements and standards for chemical testing in a variety of circumstances, including involvement in a serious marine incident.

The Safety Board believes that delays of up to 18 hours in sample collection were excessive. Current Federal regulations (46 CFR 4.06-10) require that an individual provide appropriate specimens only "as soon as practicable." The Safety Board, however, has investigated several other marine accidents in which delays in collecting specimens for drug and alcohol testing were excessive. The Board has recommended 4 hours as the maximum time allowed for obtaining specimens. A recent Board report²³ recounts the history of those accidents and the Board's prior recommendation regarding the importance of timeliness in collecting postaccident samples for drug and alcohol testing.

The Safety Board is concerned about the lack of awareness professed by the marine employers regarding postaccident alcohol testing. The Board concludes that the problem may be due in part to the employers unfamiliarity with applicable Federal regulations and in part to the terminology in the regulations. Title 46 CFR Part 16, is entitled *Chemical Testing*, a title which may fail to convey to the reader that the section is about testing not just for drugs but for alcohol as well (46 CFR 16.105). Subpart B of Part 16 describes five different circumstances in which a chemical test is required, four of which are routine occurrences requiring tests only for dangerous drugs.²⁴ The fifth case, involvement in a serious marine incident, is the only circumstance in which an individual must be tested for alcohol as well as dangerous drugs. Because serious marine incidents are infrequent, it is not surprising that marine employers might respond as they do in all other testing situations and require that their employees be tested only for drugs.

The Safety Board has addressed the need for improved postaccident drug and alcohol testing procedures, in particular the need for Coast Guard boarding officers to improve their procedures for informing marine employers of their responsibility to conduct toxicological testing after an accident. As a result of its 1992 investigation of the grounding of the QUEEN ELIZABETH 2, the Board recommended that the Coast Guard:

M-93-24

Provide guidelines to boarding officers investigating marine accidents about

²³ Marine Accident Report--Grounding of the United Kingdom Passenger Vessel RMS QUEEN ELIZABETH 2 near Cuttyhunk Island Vineyard Sound, Massachusetts, August 7, 1992 (NTSB/MAR-93-01).

²⁴ Marine employers can require routine drug tests for pre-employment, for periodic physical examinations, at random, and if reasonable cause or suspicion warrants.

informing marine employers of their responsibility to conduct toxicological testing and on providing assistance when necessary (such as providing sampling kits and making arrangements for testing with local approved laboratories).

The Coast Guard responded to this recommendation on September 27, 1993, stating that it concurred and would revise existing guidelines to provide the recommended information. The Safety Board is pleased that the Coast Guard concurs and, pending publication of the revised guidelines, has classified Safety Recommendation M-93-24 "Open--Acceptable Response."

CONCLUSIONS

Findings

1. If the FREMONT had been equipped with a compass, the operator could have monitored the heading of the tow and kept the tow out of the channel.
2. Inadequate bridge resource management by JURAJ DALMATINAC's pilots and master led to their failure to take early, substantial action to avoid the FREMONT tow.
3. The lead pilot could have been alerted sooner that the FREMONT was stopped and could have taken earlier avoidance action if the assisting pilot or another member of the bridge crew had been assigned to plot or systematically observe all closing radar contacts.
4. Had the JURAJ DALMATINAC's master informed the lead pilot that the radar contact (FREMONT) was stopped, the lead pilot would have had more time to assess the risk of collision with the FREMONT.
5. Although the FREMONT operator had misaligned his tow and was partially obstructing the navigable channel immediately before the collision, the JURAJ DALMATINAC had sufficient room to pass safely.
6. Had the JURAJ DALMATINAC's bridge watch used the tracking features of the Automatic Radar Plotting Aids radar, they could have been alerted that they were approaching a stationary, rather than a moving, radar contact.
7. Had the JURAJ DALMATINAC's lead pilot reported to the Vessel Traffic Service at the Red Fish reporting point, he probably would have been informed that the FREMONT was stopped at buoy 51 and would have had sufficient time to maneuver safely past the tow.
8. Although there was no evidence of alcohol use, the Safety Board could not definitively determine whether alcohol was a factor in this accident because postaccident alcohol testing was not performed.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the collision between the JURAJ DALMATINAC and the FREMONT tow was the failure by the ship's pilots and master to effectively use all available equipment and personnel to evaluate the developing situation so that they could take timely action to avoid the collision. Contributing to the cause of the collision was the FREMONT's lack of a compass, which could have afforded the tow operator the capability to maintain his tow on station outside the navigation channel.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board makes the following recommendations:

To the U.S. Coast Guard --

Require that commercial tugs and towboats operating on the navigable waters of the United States be equipped with a suitable compass. (Class II, Priority Action) (M-93-41)

Require that all licensed deck officers who serve on board vessels equipped with Automatic Radar Plotting Aids be certified in their use. (Class II, Priority Action) (M-93-42)

Require that all First Class Pilots who serve on board vessels equipped with Automatic Radar Plotting Aids (ARPAs) become knowledgeable in the operation of ARPA systems. (Class II, Priority Action) (M-93-43)

Recommend to the International Maritime Organization's Committee for Standards of Training, Certification, and Watchkeeping that deck officers on vessels equipped with Automatic Radar Plotting Aids be required to be certified in their use. (Class II, Priority Action) (M-93-44)

To Gantt Towing --

Provide all company towboats with a suitable compass. (Class II, Priority Action) (M-93-45)

To the American Waterway Operators, Inc.--

Recommend that member companies operating tugs and towboats on the navigable waters of the United States equip their vessels with suitable compasses. (Class II, Priority Action) (M-93-46)

To the Harris County Board of Pilot Commissioners --

Establish written recommended guidelines for members of the Houston Pilots to follow when they are working in a two-pilot scheme. (Class II, Priority Action) (M-93-47)

Encourage members of the Houston Pilots to become knowledgeable in the operation of Automatic Radar Plotting Aids. (Class II, Priority Action) (M-93-48)

To the American Pilots' Association --

Encourage member pilot associations to recommend that their members become knowledgeable in the operation of Automatic Radar Plotting Aids. (Class II, Priority Action) (M-93-49)

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December 8, 1993

APPENDIX
EXCERPTS FROM TAPES OF VTS TRANSMISSIONS

Time & Source	Transmission
2223:46 JURAJ DALMATINAC	76 calling outbound.
2225:09 JURAJ DALMATINAC	***** outbound traffic.
2226:23 JURAJ DALMATINAC	Calling this outbound tow that's right ahead of the ship down here coming off 49/50.
2226:33 FREMONT	Fremont's stopped here at uh, 51/52, pushed outside the greens.
2226:38 JURAJ DALMATINAC	OK, I'm right on your stern here, Captain. You don't, you look like you're sticking out in the channel pretty good, let me swing her over.
2226:46 FREMONT	Well I got this 51 right here by the push knees o my boat Cap, my barge is sticking out.
2226:52 JURAJ DALMATINAC	OK, lemme swing her over here.
2226:56 FREMONT	Let me drive on it a little bit, get a little further out but ah, I'm right, my light's on that 51.
2227:01 JURAJ DALMATINAC	Yeah I know that, Cap, but your boat's out in the ... channel, I'll, I'll swing it over out of your way. Yea, we're gonna....
2229:05 JURAJ DALMATINAC	Got this ship going full astern, Captain.

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