DEPARTMENT OF TRANSPORTATION

COAST GUARD

MARINE CASUALTY REPORT

SS AFRICAN NEPTUNE: COLLISION WITH THE SIDNEY LANIER BRIDGE AT BRUNSWICK, GEORGIA ON 7 NOVEMBER 1972 WITH LOSS OF LIFE

U.S. COAST GUARD
MARINE BOARD OF INVESTIGATION REPORT
AND COMMANDANT'S ACTION

ACTION BY
NATIONAL TRANSPORTATION SAFETY BOARD

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16. Abstract

On the evening of November 7, 1972, the SS AFRICAN NEPTUNE departed the State Docks at Brunswick, Ga. About 13 minutes later, the ship struck the Sidney Lanier Bridge at a point about 350 feet south of the channel centerline. Three sections of the bridge and 10 vehicles waiting to pass over the span fell into the river. As a result, 10 persons died and 11 were injured, and the bridge, part of U.S. Route 17, was closed to highway traffic for about 6 months. Repair costs amounted to about $1,300,000. Damage to the ship was relatively minor.

This report contains the action taken by the National Transportation Safety Board in determining the probable cause of the casualty and in making recommendations to prevent its recurrence. The report also contains the Marine Board of Investigation report and the action taken by the Commandant, U.S. Coast Guard.

The National Transportation Safety Board determines that the probable cause of the collision of the SS AFRICAN NEPTUNE with the Sidney Lanier Bridge was (1) the failure of the helmsman to apply the correct rudder in response to two helm orders; (2) the failure of the third mate, master, and pilot to discover the first error; and (3) the delay by the third mate, master, and pilot in detecting the second error.

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SS AFRICAN NEPTUNE; COLLISION WITH THE SIDNEY LANIER
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WITH LOSS OF LIFE

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NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20591

SS AFRICAN NEPTUNE, BRUNSWICK, GEORGIA, 7 NOVEMBER 1972

This casualty was investigated by a U.S Coast Guard Board of Investigation convened at Savannah, Ga. on November 13, 1972. A representative of the National Transportation Safety Board observed the proceedings. The National Transportation Safety Board has considered only those facts in the investigative report which are pertinent to the Safety Board's statutory responsibility to determine the cause or probable cause of the casualty and to make recommendations.

SYNOPSIS

On the evening of November 7, 1972, the SS AFRICAN NEPTUNE departed the State Docks at Brunswick, Ga. and maneuvered into the Brunswick River which has a course of 112° outbound. About 13 minutes after departure, the ship struck the Sidney Lanier Bridge at a point about 350 feet south of the channel centerline. Three sections of the bridge and 10 vehicles waiting to pass over the span fell into the river. As a result, 10 persons died and 11 were injured, and the bridge, part of U.S. Route 17, was closed to highway traffic for about 6 months. Repair costs amounted to about $1,300,000. Damage to the ship was relatively minor.

The National Transportation Safety Board determines that the probable cause of the collision of the SS AFRICAN NEPTUNE with the Sidney Lanier Bridge was (1) the failure of the helmsman to apply the correct rudder in response to two helm orders; (2) the failure of the third mate, master, and pilot to discover the first error; and (3) the delay by the third mate, master, and pilot in detecting the second error.

Contributing to the collision were:

1. The assignment of additional duties to the third mate, which prevented him from continuously monitoring the helmsman during high-risk periods of maneuvering.

2. The lack of visibility of the rudder angle indicator and the rudder order indicator from the normal conning positions.

3. The attempt to maneuver the AFRICAN NEPTUNE through the bridge opening without stabilizing the ship on the channel line before passing the point where transit could be safely aborted.

Contributing to the loss of life was the location of the traffic-control devices on the bridge, which permitted vehicles on the portion of the bridge which could be struck by a ship.

ANALYSIS

Preventing Helm Error

To insure accuracy in carrying out helm orders, standard procedure requires the helmsman to repeat aloud the order received. The correct repeating of the order, however, does not preclude even experienced helmsmen from occasionally turning the steering wheel in the wrong direction. As a further safeguard, the helmsman also calls out the position of the rudder when it has reached the position ordered. As a final safeguard, the third mate is responsible for monitoring the helmsman during maneuvers in and out of restricted waters. This procedure was followed by the crew of the AFRICAN NEPTUNE as the ship progressed down the channel from the State Docks on the night of the accident.

The pilot and master also monitored the helmsman primarily by listening to his repetition of the helm order and comparing the anticipated ship response with the actual response. The time required for the ship machinery to operate and then to overcome the interia of the ship introduces a delay in this monitoring process. The first effect on the ship from a change in rudder position will be a change in angular acceleration. Because of the low value of this angular acceleration and the presence of vibrations, individual movements, and other distracting influences, the effect of angular acceleration cannot be used to monitor change in rudder position. The new angular velocities which result from the angular acceleration, however, can be quickly detected, particularly if the ship's bow is rotating against a distinctive background, such as the lighted Sidney Lanier Bridge. As the AFRICAN NEPTUNE approached the Sidney Lanier Bridge, the unexpected new angular velocity alerted the master and the pilot that something had gone wrong and prompted them to look at the rudder angle indicator. To check the indicator, the master had to come back into the wheelhouse, and the pilot had to step backward and look up. Neither the master nor the pilot could spot-check the rudder angle indicator from the position he had taken to perform his other duties.

Direct monitoring of the helmsman would eliminate this delay as well as prevent incorrect movements which require more time to correct than is available. However, the steering wheel on the AFRICAN NEPTUNE was a small black wheel that was nearly obscured by the helmsman. From most locations in the dark wheelhouse, it was very difficult to see which way the wheel was being turned or what rudder angle was being set. A rudder

order indicator was mounted on the steering stand but was recessed and could not be read except from very close to the steering stand. Thus, to fulfill his duty to monitor the helmsman, the third mate would have had to stay next to the steering stand. However, the third mate was also required to operate the engine order telegraph and maintain the bell book. Since two engine orders were given at about the same time as the last two helm orders, the third mate was involved in these other duties while the helmsman was operating the steering wheel. As a result, the third mate did not discover the helmsman's error in responding to the order to steer left 20° until the rudder angle indicator read about 10° right.

Thus, at a critical time, no one in the wheelhouse -- the master, the pilot or the third mate -- was monitoring the input to the steering control frequently enough to prevent an accident.

Error Initiation and Development

Figure 1 is a chart showing the heading of the AFRICAN NEPTUNE during the 3 minutes immediately before the collision. The data in Figure 1 were obtained by reading the headings on the ship's course recorder chart with a precision x-y reader. Because the thickness of the line on the ship's chart was significant in relation to the time scale, all readings were taken to the center of the line; heading was read to the closest 0.25°. The chart clock period, 0242 to 0245½, corresponds approximately to 0245 to 0248 on the wheelhouse and engineroom clocks. Although the exact time difference between the chart clock and wheelhouse clock cannot be determined, the sequence and duration of events affecting the ship's heading can be interpreted from the chart.

The pilot on the AFRICAN NEPTUNE testified that before he gave the last order for "left 20°," he had ordered "left 10°" and the ship had been swinging left satisfactorily. The sharply curved arc at point A in Figure 1 shows where the ship commenced swinging right in response to the helmsman's reverse application of the "left 20°" order. The arc at point B shows where the ship's heading reversed after the error was discovered and after full left rudder was applied. Because the rudder forces are changing throughout the period of rudder travel and because the ship's inertia precludes instantaneous changes in the ship's heading, it is difficult to locate precisely where the incorrect rudder application began in response to the "left 20°" order. However, the sharp curvature at A shows that the angular acceleration and, therefore, the right rudder forces were high at that time. The pilot stated that when he looked at the rudder angle indicator, it read 20° right. Thus, at about point A, the rudder probably had reached 20° right and the pilot discovered the error.

Point C identifies the end of the ship's last period of steady turn to the left before the collision. This steady turn to the left was produced by some left rudder application, probably 10°. The time interval between points C and A is about 34 seconds. Since it takes the rudder slightly less than 10 seconds to go from 10° left to 20° right, the

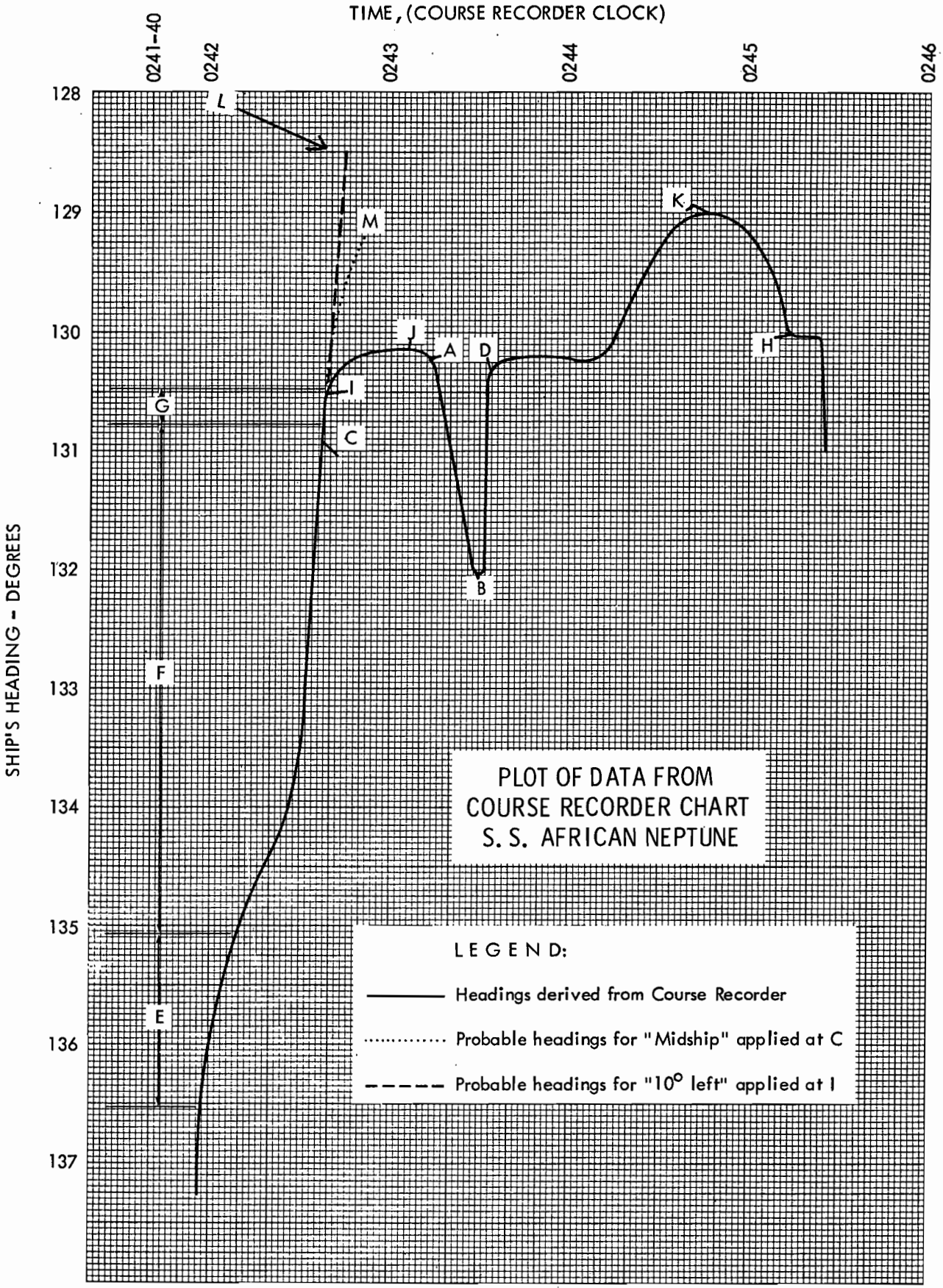
TIME, (COURSE RECORDER CLOCK)
0241-40
0242
0243
0244
0245
0246
SHIP'S HEADING - DEGREES
128
129
130
131
132
133
134
135
136
137
L
M
K
J
A
D
H
I
G
C
B
F
E
PLOT OF DATA FROM
COURSE RECORDER CHART
S. S. AFRICAN NEPTUNE
LEGEND:
Headings derived from Course Recorder
Probable headings for "Midship" applied at C
Probable headings for "10° left" applied at I

Figure 1

incorrect 20° right rudder application did not commence at point C. As further proof of this, the ship's response to a significant rudder reversal would have been more nearly like that represented from A to B to D, although not so peaked, and not gradual as shown from C to A. Therefore, the helmsman could not have gone directly from a correct left 10°, which was the prior order, to the incorrect right 20°.

The pilot recalled that prior to the last "left 10°" order, he gave several sequences of "left 10°" and, "midships" orders. Region E probably represents the result of one of the "midship" orders and region F probably represents one of the "left 10°" orders. Region G could also have resulted from another "midships" order. A subsequent "left 10°" order would have increased the ship's swing to the left again, as shown approximately by line L. If, however, the rudder had been kept amidship when the "left 10°" order was given, the ship's swing to the left would have decreased slowly, as shown approximately by line M. Instead, the ship's swing to the left decelerated rapidly and then essentially stopped before reaching point J. It therefore follows that some right rudder was applied in response to the last "left 10°" order, which probably was given at point I.

The flattening of the curve from I to A indicates, however, that this erroneously applied right rudder was not maintained. During this period, the ship continued to approach the bridge with what the pilot thought was 10° left rudder. At about point J, the pilot recognized the need to increase the ship's turning rate to the left and ordered "left 20°". Therefore, the time from the first failure to respond correctly to a left rudder order (point I) until the pilot recognized the need for a correction (point J) was about 27 seconds. A correct response to the final "left 20°" order probably would still have permitted a successful transit through the bridge opening. At the time of the "left 20°" order, the pilot was calling for nearly maximum settings on his controls (rudder and speed), and any significant increase in the ship's position error would have exceeded the ship's control capabilities. The significant increase in error did occur when the helmsman turned right in response to the "left 20°" order and the pilot failed to discover the error for about 6 seconds. The magnitude of the helmsman's error was magnified by the accompanying increase in propeller speed, which increased the forces on the wrongly positioned rudder. Even when the corrective left full rudder was applied, 22 more seconds (point A to point D) elapsed before the ship's right swing was reversed and the ship regained the heading at which the error was originally discovered. Based on this analysis of Figure 1, it must be concluded that the helmsman turned the rudder in the wrong direction twice, first at point I when left 10° was ordered and then at about point J when left 20° was ordered.

The third mate testified that the helmsman turned the steering wheel right 10° in response to the "left 10°" order which preceded the "left 20°" order. (The third mate recalled the latter as a "left 15°" order.) However, he also indicated that these orders were only separated by about 3 seconds, which is not substantiated by the 27-second interval shown in

Figure 1. If the turning error had been detected and corrected immediately as the third mate indicated, the peaked arc from points A to B would have occurred much closer to point I, and there would not have been the two separate indications of right rudder applications at points I and A. If the pilot and the master had been immediately made aware of this error, they would have anticipated the slowing of the ship's swing and could have compensated sooner by correcting the rudder. They furthermore would then have undoubtedly intensified the monitoring of the helmsman.

From the location of the point of impact with the bridge, the course recorder data can be combined with data on ship speed to produce the ship's track. Figure 2 has been compiled on the basis of estimated speeds of the vessel during the 3 minutes before the collision, with the assumption that at 0242 by the chart record, the ship was traveling at 7 knots. The effect of wind and current are considered negligible. The solid trackline indicates the path followed by the ship's bow. The events labeled along the solid line are spaced to show the position of the ship's bow. The crosshatched line indicates the position the bow would have followed if the last "left 10°" order had been properly executed and the ship's swing would have been as indicated by segment L in Figure 1. This crosshatched curve also assumes the pilot would have made no further adjustments, which is unlikely.

Emergency Response

When the steering error was discovered, the ship was on a heading of 130° and the section of the bridge directly ahead of the ship was about 900 feet away. The drawbridge was 850 feet away, alined on a channel line of 112°. At an assumed speed of 7 knots, any maneuver to aline the ship with the bridge opening would have had to have been accomplished in about 72 seconds. It took about 18 seconds to reverse the ship's swing from right to left. With full left rudder, the ship probably could have had enough time to reach a heading of 112°. However, because the ship's path was now to the right of the channel line, the ship still would not have been lined up with the bridge opening. It is highly probable that any attempt to reach the bridge opening with a hard left turn would have resulted in the ship's striking the tower which supported the southern end of the lift span. (See Figure 2.)

The AFRICAN NEPTUNE was not provided with information on turning-circle diameter, stopping distance, or other maneuvering data, other than a speed table. On December 18, 1968, the Safety Board recommended that the Coast Guard require vessels to have data regarding stopping and turning capability at different loading conditions posted in the pilothouse.[1/] A Notice of Proposed Rule Making was published on August 22, 1973, concerning such maneuvering data, but no regulations have yet been adopted. Data on a ship's advance would show whether a turning maneuver is likely to be

1/ National Transportation Safety Board, Study of Collisions of Radar-Equipped Merchant Ships and Preventive Recommendations.

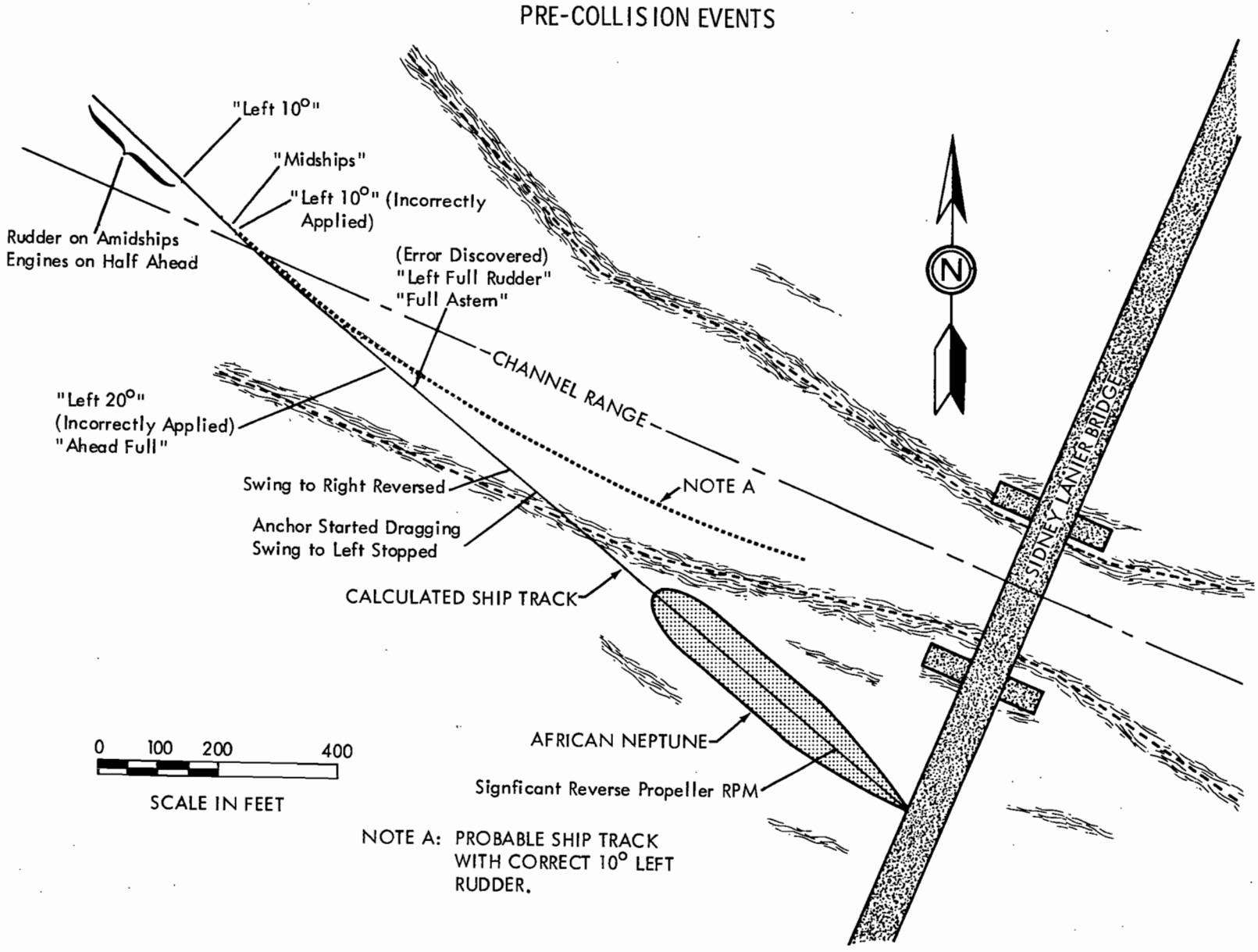
PRE-COLLISION EVENTS
"Left 10°"
"Midships"
"Left 10°" (Incorrectly Applied)
Rudder on Amidships
Engines on Half Ahead
(Error Discovered)
"Left Full Rudder"
"Full Astern"
CHANNEL RANGE
"Left 20°"
(Incorrectly Applied)
"Ahead Full"
Swing to Right Reversed
NOTE A
Anchor Started Dragging
Swing to Left Stopped
CALCULATED SHIP TRACK
SIDNEY LANIER BRIDGE
N
AFRICAN NEPTUNE
Signficant Reverse Propeller RPM
0 100 200 400
SCALE IN FEET
NOTE A: PROBABLE SHIP TRACK WITH CORRECT 10° LEFT RUDDER.

Figure 2

successful in avoiding a collision.[2/] In deep waters, the class of ship to which the AFRICAN NEPTUNE belonged has an advance of about 2,000 feet at full sea speed. Although in shallow water and at full maneuvering speed, the AFRICAN NEPTUNE would have had a smaller advance, the 900 feet available ahead of the ship was undoubtedly insufficient for the ship to avoid hitting the bridge by turning hard right.

Although the pilot instinctively ordered "left full rudder" after he discovered the helmsman's error, he stated that he knew the ship could not be lined up with the bridge opening and his subsequent orders were intended to stop the ship as quickly as possible. Point D on Figure 1 indicates the probable point at which the starboard anchor was dropped and the ship's swing to the left stopped. The effects of the "full astern" order, however, were not so immediate. In sea trials, a sistership took 1½ minutes to go from 112 RPM ahead to 41 RPM astern in a scheduled crash stop test. The "full astern" order on the AFRICAN NEPTUNE probably took slightly less time, since the ship was traveling at 65 RPM ahead. Because the machinery operations required for reversal would not reduce the time in proportion to the initial propeller RPM, about 1 minute elapsed before significant backing power was produced. Since the backing of a right-handed propeller will cause the bow of a ship to move to the right, significant reverse propeller RPM was apparently reached at point K in Figure 1, about 1 minute 15 seconds after full astern was ordered. At point K, the slow swing to the left was stopped and the bow began swinging to the right. At about this time, the rudder was shifted from full left to full right, but, with the reverse flow over the propeller, the rudder shift produced no signif-- icant turning effect on the ship. The large rudder angle, however, did help to slow the ship. All the means for stopping the ship in the shortest distance were used.

At point H in Figure 1, the ship's right swing was interrupted abruptly. The engineer's bell log shows that a "stop" order was received at 2148½, which was probably immediately after the ship struck the bridge. The most reasonable correlation with the time scale of the course recorder confirms that the "stop" order was received a few seconds after the time indicated by point H. The sharp curvature at point H therefore indicates the collision.

Maneuvering through Bridge Opening

In coming out of Oglethorpe Bay into the Brunswick River, a ship has a very short run in which it can be alined with the opening in the Sidney Lanier Bridge. Because of its relatively large turning radius, a ship the size of the AFRICAN NEPTUNE must begin turning before it reaches the main channel. According to the pilot, it is not unusual for a ship still to be turning as it enters the bridge opening because "there are not too many ships that we are able to get straightened out before we go through that bridge." The pilot said, ".... we've had some close instances with the bridge." The master also evaluated the transit as a tough maneuver.

2/ The advance of a ship is the distance which the ship travels along its original course line from the time of putting the rudder hard over until the ship has turned 90°.

Minimizing the Risk

In conning a vessel, a pilot must evaluate many external forces acting on his ship, anticipate the probable ship response, make rudder and speed changes to be combined with external forces, compare the ship response with the desired ship position, and make additional rudder and speed changes to reduce discrepancies. This system relies on feedback to overcome two problems which confront the pilot, i.e., that the external forces are difficult to measure and that each ship responds differently at different loadings. However, such a "cut and try" system consumes time and distance before a ship can be brought onto the desired track. This is a continuous process, and as the pilot "gets the feel of the ship," he is able to correct error with more certainty and therefore is able to reduce the time needed to put the ship in the desired position.

As a ship approaches a bridge, there is a "decision point" beyond which transit cannot be aborted without the possibility of the ship's striking the bridge. Since the risk of collision increases suddenly between the decision point and the bridge, the decision point ought to be as close as possible to the bridge. Because the advance of a ship is normally much greater than the ship's stopping distance, the decision point should be based on aborting transit with a crash stop rather than with a full rudder turn. The speed of approach to the decision point should be the minimum speed consistent with maintaining maneuvering control. The pilot of the AFRICAN NEPTUNE recognized the decision point as the "point of no return" and the need for minimizing its distance from the bridge. However, no attempt was made to locate specifically the decision point as the AFRICAN NEPTUNE approached the bridge.

When a ship reaches the decision point, the pilot must determine whether to continue or abort the transit. The risk of collision can be minimized if the ship is on its intended trackline and all controls are functioning properly. In addition, as the ship approaches the decision point, the ship's movement should be as steady as possible. In this way, the minimum number of control mechanisms will need to be activated, which will minimize the probability of malfunction. Thus, a ship should not go "swinging through" a bridge on a curving trackline which requires frequent or large rudder changes. The AFRICAN NEPTUNE could have been alined in the channel on the navigation range through the bridge opening before the decision point was reached. To reduce further the risk of collision, the helmsman should have been continuously monitored after the ship passed the decision point. This monitoring should have included watching the steering stand rudder order indicator as well as the rudder angle indicator.

A presailing conference for planning maneuvers through high-risk areas can reduce the probability of an accident. The master can inform the pilot of significant ship-handling characteristics, including stopping distances for various speeds; the pilot can inform the master of

particular danger areas, planned and alternative maneuvers, and their respective risks. The master will then be able to participate in the risk-making decisions while there is time to evaluate the alternatives, not while the risks are developing. The decision point can be clearly identified, and all the conditions that must be met before the ship reaches that point can be specified. At such a conference, it should be made clear that monitoring duties such as observation of the helmsman should take precedence and not be interrupted for routine record keeping. If a presailing conference had been held aboard the AFRICAN NEPTUNE, it would have been evident that the ship could not be properly stabilized by the contemplated procedure before the ship reached the decision point. A less risky maneuver should then have been planned.

Some changes in wheelhouse instrumentation and procedures could help to prevent similar casualties. The limited visibility of the rudder angle indicator and rudder order indicator on the AFRICAN NEPTUNE discouraged spot-checking these instruments as a monitoring technique. The instruments should be relocated in a more suitable position, and additional instruments should be provided. In the exercise of its ship design approval authority, the Coast Guard should require that such instruments as rudder angle indicators and rudder order indicators fulfill their intended function.

The Maritime Administration has sponsored the design and installation of an experimental "integrated conning system" to develop a more reliable and precise control system for U.S. oceangoing ships. This system attempts to correct many deficiencies found in most current ship-control systems, including insufficient, imprecise, or poorly displayed information, lack of capability for predicting anticipated maneuvers, and time-consuming and distracting manual logging of data.[3/] If a system such as the integrated conning system is put into common use, standard procedures will have to be revised. For instance, audio tape recordings may have to be accepted in place of the presently required written logs.

The Coast Guard report recommends that the Board of Pilotage Commissioners for the Port of Brunswick adopt alternative operating procedures requiring large vessels to line up on the Sidney Lanier Bridge lift span opening before they pass a point of no return during outboard passage. The Board of Pilotage Commissioners, created by the Georgia legislature, has authority only over the State pilots who advise the ship masters. The board does not exercise authority over the ships. However, the Coast Guard, under authority of Title I of the the Ports and Waterways Safety Act of 1972 (Public Law 92-340), can require such an outbound procedure at this bridge.

The location and design of bridges over navigable waters greatly influence the risk of ship collisions and the magnitude of the losses

3/ At its present stage of development, this system would not have assured that the AFRICAN NEPTUNE could have avoided striking the Sidney Lanier Bridge.

in the event of a collision. Location and design are influenced by construction costs, load bearing capability of ground support, traffic patterns, safety, and many other factors. Some bridges which have proven to be very hazardous to navigation have been modified to reduce such collisions. An orderly procedure for alteration or relocation of bridges to eliminate unreasonable obstructions to navigation is provided in the "Truman-Hobbs Act" (33 USC 511-524).

The Coast Guard is presently responsible for reviewing the design and the location of bridges over navigable waterways. An environmental impact study is normally required to evaluate the effects of proposed bridges. If such a preplanning study also gave high priority to the safety implications of proposed bridges, the incidence of ship/bridge collisions would undoubtedly be reduced and fewer bridges would have to be altered in the future.

Sufficiency of Operational Data for Accident Investigation

The reconstruction of precollision shipboard events is made extremely difficult by the lack of suitable automatically recorded data. The manual entries in the engine log and wheelhouse log normally are referenced to the nearest minute, which is too inaccurate to reflect the rapid sequence of events which occur before a collision. These records show orders but not the time progress of the engines or rudder in achieving the order. Furthermore, ship speed, which is an important parameter, is not recorded and is difficult to derive from the propeller speed when the ship is maneuvering. Even if a course recorder is installed on a ship, the time scale is so compressed that accuracy is sacrificed. Helm orders are not recorded and recollections of the exact orders and their sequence are often vague or conflicting. This problem may partially explain the confusion in the Coast Guard report, which shows about a 2-minute interval between the "left 10^{o}" and "left 20^{o}" orders despite the third mate's statement that the rudder was turned right on the "left 10^{o}" order.

The means for recording sufficient and accurate operational data are presently available. First, a multitrack voice recorder with a time reference track will provide specific information on helm orders and other audible communications. With proper security safeguards and some modification of the present regulations which require written logs, voice records could relieve the third mate of some of the writing duties that interfere with his more critical duties such as monitoring the helmsman in high-risk situations. The record of the engine orders maintained both in the wheelhouse and in the engineroom is merely internal administrative function, and the significant output, ship's speed, is not recorded. The ship's speed would be very useful to the conning officer in selecting maneuvering speed and would provide vital information in accident investigation. Some newer ships have propeller RPM recorders which print the time for each entry to a fraction of a minute. Although an improvement, this still does not provide sufficiently accurate information concerning the ship's speed through the

water. To obtain more accurate readability of the time scale in maneuvering situations, course recorders are available with an added high chart speed which can be turned on when needed.

Risk to Bystanders

The occupants of the vehicles on the bridge had approximately 1½ minutes to escape after the ship's whistle initially sounded. If the 25 persons on the portion that subsequently collapsed had understood the meaning of the whistle or the threat posed by the ship's movement at that time, they would have probably run more than the maximum distance of 300 feet sufficient to reach the portion of the bridge which did not collapse. Just before impact, some of the occupants did run for safety, but only three got beyond the collapsed portion. (See Figure 3.) The AFRICAN NEPTUNE, as viewed in darkness from the far side of the tall bridge, was largely obscured. Because of its relatively slow movement, the ship was not perceived as a danger by most of the vehicle occupants on the bridge, despite the continued blowing of the ship's whistle.

Since similar hazards exist on other bridges throughout the nation, the Safety Board recommended on December 12, 1972, that the Federal Highway Administration, the American Association of State Highway Officials, and the International Bridge, Tunnel and Turnpike Association:

> "Establish policies and standards to insure that standard traffic control devices (gate, signals, signs, and pavement markings) are installed on movable bridges at locations which will halt traffic on a section of the bridge that is not subject to impact by large marine vessels. Such positioning of warning systems will prevent vehicles from being on those portions of such bridges which may collapse when they are struck by a marine vessel. (Recommendation No. H-72-48)"

The Federal Highway Administration has adopted this recommendation in a Policy and Procedure Memorandum.

In addition to killing 10 people and injuring 11 others, the accident closed the bridge to traffic for 6 months. Repairs cost about $1.3 million. In the reconstruction of the bridge, a flexible traffic-control system which fully implemented the intent of the Safety Board's recommendation was installed.

Questions of Accident Causation not Reported

The reasons why the qualified and experienced helmsman on the AFRICAN NEPTUNE made the steering errors were not revealed in this investigation. The helmsman testified that he had followed orders exactly as received. Generally, the question of why people make errors has been refractory to the investigative process. Nevertheless, the problem is so important to all modes of transportation that efforts to obtain a better understanding of why and when such errors may occur need to be promoted. The Maritime Administration and Coast Guard are supporting the efforts of the Maritime

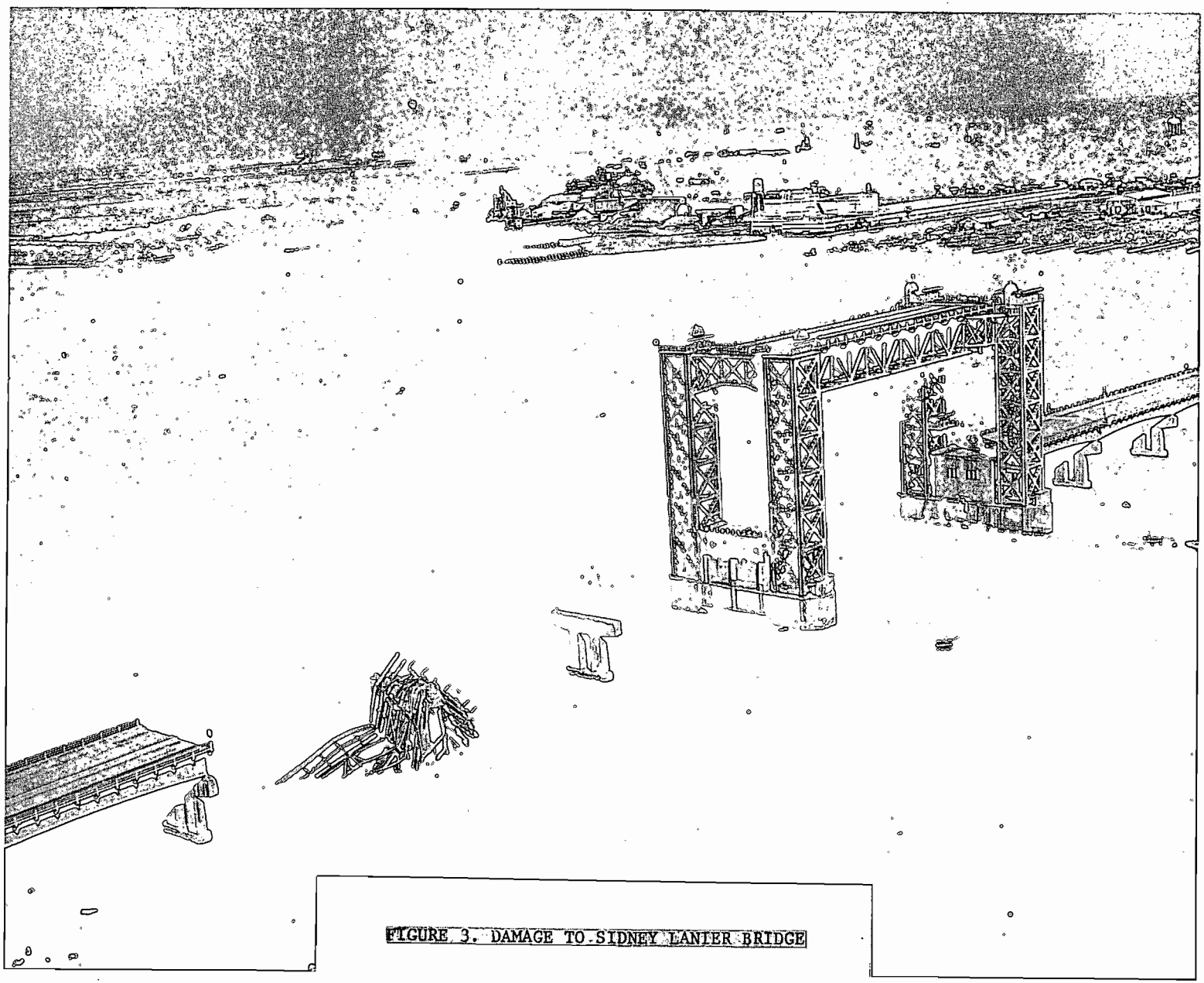

FIGURE 3. DAMAGE TO SIDNEY LANIER BRIDGE

Transportation Research Board and the National Maritime Research Center in one such effort by attempting to determine appropriate research efforts. In this case, it is known that the preceding helmsman conveyed to the relieving helmsman his opinion with obscenities, that those giving him orders ".... don't even know what they are doing." The record does not permit an evaluation of the relieving helmsman's reaction to the previous helmsman's removal, or to those giving the orders. Probing questions in this area, assisted by an audio record of the wheelhouse events, would assist in obtaining information concerning the underlying causes of errors. General studies of error frequency in the highway field show that personal concerns do affect driver error and behavior.

When the third mate discovered the second helm error, he gave the helmsman a hand signal to correct the error. This type of silent communications does not apprise the master and pilot of the helmsman's performance until any errors are significantly large that the wrong ship response is evident. The third mate may have chosen this signal to avoid further stress on the bridge following the earlier removal of another helmsman. However, the investigation did not establish whether this was the customary way to correct the helmsman or a unique occurrence.

The risk of collision associated with the approximately 7 knot approach speed of the AFRICAN NEPTUNE was not addressed in this investigation. The selection of optimum speed to minimize the risk of collision while maneuvering to pass through a narrow bridge opening may be too difficult to solve reliably due to the inaccuracy of input data, the complexity of the problem and the short time available for solution. The speed selection then becomes the pilot's judgment decision which cannot be analyzed. Until it becomes feasible to provide the pilot with immediate analytical predictive solutions as needed, the procedures recommended in this report can aid significantly in the selection of safer speeds. By comparing the stopping distances for different speed selections, the pilot can relate the sensitivity of his speed choice to its effect on the location of the decision point and thereby to its effect on risk of collision in the event of a malfunction.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the collision of the SS AFRICAN NEPTUNE with the Sidney Lanier Bridge was (1) the failure of the helmsman to apply the correct rudder in response to two helm orders; (2) the failure of the third mate, master, and pilot to discover the first error; and (3) the delay by the third mate, master, and pilot in detecting the second error.

Contributing to the collision were:

1. The assignment of additional duties to the third mate, which prevented him from continuously monitoring the helmsman during high-risk periods of maneuvering.

2. The lack of visibility of the rudder angle indicator and the rudder order indicator from the normal conning positions.

3. The attempt to maneuver the AFRICAN NEPTUNE through the bridge opening without stabilizing the ship on the channel line before passing the point where transit could be safely aborted.

Contributing to the loss of life was the location of the traffic-control devices on the bridge, which permitted vehicles on the portion of the bridge which could be struck by a ship.

RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Coast Guard require that ocean-going vessels be alined with any channel bridge opening before the vessels reach a point equal to the ship's stopping distance from the bridge. (Recommendation No. M-74-14)

2. The Coast Guard require that every master of an ocean-going vessel inform himself of the pilot's plan to maneuver his ship in or out of a harbor and that the master determine, with the pilot's assistance, the critical aspects of the maneuver, including the pilot's plan for emergencies. The master should then be required to instruct his crew to insure that high-risk tasks receive priority. (Recommendation No. M-74-15)

3. The Coast Guard expedite the issuance of regulations requiring that all ocean-going vessels be provided with stopping distances and turning radii for various speeds and loading conditions. (Recommendation No. M-74-16)

4. The Coast Guard, in approving ship designs, require better visibility of the rudder order indicator and rudder angle indicator from all conning positions. (Recommendation No. M-74-17)

5. The Maritime Administration, in developing an advanced "integrated conning system:"

    a. Display rudder order and rudder angle postions so as to be visible from all conning positions.

    b. Provide an expanded scale on the course recorder for use during in-port maneuvering.

c. Upgrade the quality of the audio-recorder and add a time reference trace.

d. Provide automatic recording of propeller RPM and ship's speed. (Recommendation No. M-74-18)

6. The Coast Guard, in processing applications for highway, railroad, or pipeline bridge construction, require a safety impact study as well as the environmental impact study. Lift span bridges with narrow openings, supports in relatively deep water, and locations near curved channels should be considered relatively hazardous. (Recommendation No. M-74-19)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

Adopted this 22nd day of May 1974:

John H. Reed, Chairman

Francis H. McAdams, Member

Louis M. Thayer, Member

Isabel A. Burgess, Member

William R. Haley, Member

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (GMVI-3/83)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE:

5943/AFRICAN NEPTUNE
A-7 Bd
18 MAY 1973

Commandant's Action

on

The Marine Board of Investigation convened to investigate circumstances surrounding the collision of the SS AFRICAN NEPTUNE with the Sidney Lanier Highway Bridge at Brunswick, Georgia on 7 November 1972 with loss of life

1. The record of the Marine Board of Investigation convened to investigate subject casualty has been reviewed; and the record, including the Findings of Fact, Conclusions and Recommendations is approved subject to the following comments and the final determination of the cause by the National Transportation Safety Board.

REMARKS

1. Concurring with the Marine Board of Investigation it is considered that the primary cause of the casualty was that the helmsman erroneously applied right rudder instead of the left rudder ordered by the pilot at a critical point in the approach of the ship to the passage throught the bridge opening.

2. The failure of the third mate in not detecting the incorrect application of the rudder in time to prevent creating an irreversible situation is considered to have been a contributing cause of the casualty. While the Board may have determined that there is no actionable negligence, poor judgement was displayed by the mate in his determination that recording the bell was of more importance than checking the correct application of the helm. This goes to show again the importance of reliable helmsmen, the relay of helm orders, and a safety observer to make certain that helm orders are properly executed.

ACTION CONCERNING THE RECOMMENDATIONS

1. The recommendation that vehicular traffic control gates on the Sidney Lanier Bridge be relocated to such points on the roadway which would provide a margin of safety for vehicles and their occupants should a similar accident occur is concurred with. Copies of this report will be forwarded to the Federal Highway Administration and the Georgia Department of Transportation for consideration of the adoption of this recommendation. The National Transportation Safety Board issued their Safety Recommendation H-72-48 on 12 December 1972 as a result of this casualty and recommended to the Federal Highway Administration that they establish policies and standards to protect vehicles on portions of bridges that might collapse if struck by a marine vessel.

2. A copy of this report will be provided to the Board of Pilotage Commissioners for the port of Brunswick, Georgia. It is recommended that they adopt an alternative operating procedure that will require large vessels to line up on the Sidney Lanier Bridge lift span opening before passing a point of no return during outbound passage.

3. The recommendation to refer Darling C. Woodall, Z-228495, helmsman, to investigation under the Suspension and Revocation Proceedings, R.S. 4450, as amended, is concurred with.

C. R. Bender

C. R. BENDER

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
COMMANDANT (GMVI-3)
U. S. COAST GUARD
WASHINGTON, D. C. 20590

5943/AFRICAN NEPTUNE
MARINE BOARD
2 March 1973

From: Marine Board of Investigation
To: Commandant (GMVI)

Subj: SS AFRICAN NEPTUNE, Official Number 290485, collision with the Sidney Lanier Highway Bridge with loss of life on 7 November 1972 at Brunswick, Georgia

FINDINGS OF FACT

1. At about 2149 (+5 Zone Time) on 7 November 1972, the outbound freight ship AFRICAN NEPTUNE collided with the Sidney Lanier Highway Bridge (U.S. Route 17) at a point about 250 feet south of the bridge's southernmost lift span tower. Upon impact, three sections of the bridge roadway south of the span collapsed and fell into the waters of the Brunswick River at a point where the depth of water was about 30 feet. There were ten vehicles carrying a total of 24 persons stopped on two of the three sections which collapsed. Ten of these persons lost their lives as a result of this accident. Eight were hospitalized, three were treated and released at a local hospital, and three escaped unhurt. There were no deaths nor injuries on board the AFRICAN NEPTUNE. Damage to the vessel was confined to the bulwarks and various structures on the foc'sle head and to the anchor windlass.

2. Vessel Data is as follows:

Name:	AFRICAN NEPTUNE
Official Number:	290485
Service:	Freight
Gross Tons:	11309
Net Tons:	6809
Length:	543.3
Breadth:	75.1
Depth:	29.1

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Propulsion:	Steam Turbine
Horsepower:	16500
Home port:	New York, N. Y.
Owners/Operators:	Farrell Lines, Inc. 1 Whitehall Street New York, N. Y. 10004
Year Built:	1963
Place Built:	Pascagoula, Miss.
Last Inspection for Certification:	
Date:	23 February 1971
Place:	New York, N. Y.
Last Inspection:	Midperiod
Date:	24 March 1972
Place:	New York, N. Y.
Vessel Document:	Permanent Certificate of Registry No. 56 issued at New York, N. Y., on 28 February 1972.
Master:	Frank Stanejko 2340 North Avenue Bridgeport, Conn. 06604
USCG License:	No. 423636; Master, Oceans Unlimited, Radar Observer.
Seaman's Document:	BK-274688
Joined Vessel:	Signed on as Master of the AFRICAN NEPTUNE at New York, N. Y., on 11 September 1972.

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Pilot:	Edwin R. Fendig, Jr. 216 Davenwood Drive St. Simons Island, Ga. 31522
State License:	By Board of Pilot Commissioners, St. Simons and St. Andrews Bars, Brunswick, Ga., ltr 25 July 1964; for the bar of St. Simons and Turtle River and the bar of St. Andrews and Satilla River.
USCG License:	No. 407387. First Class Pilot of Steam and Motor Vessels of any gross tons between St. Simons Bar and Brunswick, Ga. harbor.
Crew:	The crew of the AFRICAN NEPTUNE were signed on Foreign Shipping Articles at New York, N. Y., on 6 September 1972 for a period of 12 months.

3. Record of deaths and injuries:

a. Deaths:

1. James F. Robinson, Age 58
1747 Danese Street, Jacksonville, Fla.

2. Lorene Vinson, Age 37
125 Fell Street, Savannah, Ga.

3. Veronica Vinson, Age 10
125 Fell Street, Savannah, Ga.

4. Arthur L. Johns, Age 2
605 Stephenson Street, Waycross, Ga.

5. Delia C. Johns, Age 64
605 Stephenson Street, Waycross, Ga.

6. Kelly L. Johns, Sr., Age 23
605 Stephenson Street, Waycross, Ga.

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7. Kelly L. Johns, Jr., Age 3
605 Stephenson Street, Waycross, Ga.

8. Charles E. Rooks, Age 28
Box 288, Floral City, Fla.

9. Dr. James W. Pinkham, Age 38
3896 Richardson Road, Independence, Ky.

10. Yolanda G. Thomas, Age 18
10 Albert-Andrews Terrace, Brunswick, Ga.

b. Admitted to Glynn Brunswick Memorial Hospital:

1. Brenda Whalen, Age 23
4219 Dixie Highway, Erlanger, Ky.

2. Lynne H. Rooks, Age 24
Box 288, Floral City, Fla.

3. Dr. Kenneth R. Estes, Age 43
4122 Dixie Highway, Erlanger, Ky.

4. Bunny Vinson, Age 41
125 Fell Street, Savannah, Ga.

5. Betty Ann Johns, Age 21
605 Stephenson Street, Waycross, Ga.

6. Albert C. Donal, Age 36
2223 Florey Land, Montgomeryville, Pa.

7. Mary C. Donal, Age 21
2223 Florey Land, Montgomeryville, Pa.

8. Karen White, Age 26
31 Sanders Drive, Boone, Ky.

c. Treated at Glynn Brunswick Memorial Hospital and released:

1. McKinley Sharpe, Age 29
2106 Lee Street, Brunswick, Ga.

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2. Charles O. Denny, Age 44
Box 95, Cross Junction, Va.

3. Doris Smith, Age 14
41 Dixie Highway, Brunswick, Ga.

d. Uninjured:

1. Charles M. Wells, Jr., Age 18
2204 Oriole Road, Brunswick, Ga.

2. Hank Staley, Age 17
2730 Oriole Road, Brunswick, Ga.

3. Duke Smith, Age 16
4021 Riverside Drive, Brunswick, Ga.

4. Weather conditions at the time of the collision were: Sky overcast, ceiling 400 feet, visibility slightly more than one mile. The wind was southwesterly at about 8 Knots. The air temperature was approximately 70°F., and the water temperature was approximately 66°F. The barometer was 29.85 inches of mercury and falling. The predicted time of slack before ebb from the Tidal Current Tables off the Quarantine Dock in the Brunswick River (31°07'N, 81°28'W) C&GS Chart No. 447, was 2143 on 7 November 1972. The Quarantine Dock is approximately one mile downstream of the Sidney Lanier Bridge. The U. S. Army Corps of Engineers Tidal Gauge, located less than one mile upstream of the Sidney Lanier Bridge, recorded high water at 2112 on 7 November 1972.

5. The AFRICAN NEPTUNE was equipped with radar. At the time of the collision the radar was in operation, but was not used. The AFRICAN NEPTUNE was also equipped with a course recorder.

6. The AFRICAN NEPTUNE moored at 1012, 7 November 1972, head downstream, port side to Berth No. 3 at the State Docks. The berth is parallel to the eastern bank of a narrow tidal river called Oglethorpe Bay (C&GS Chart No. 447). From Berth No. 3, Oglethorpe Bay flows downstream about 1-1/8 miles in a southeasterly direction to a junction with the Turtle River. The two rivers there become the Brunswick River. The Brunswick River then flows east southeastward under the Sidney Lanier Bridge which is about 400 yards to seaward of the junction.

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Two locally owned tugs, the SAMSON, O.N. 264395, and the MALUCO I, O.N. 264394, provided assistance in turning and mooring the AFRICAN NEPTUNE at her berth. Edwin R. Fendig, Jr., a State licensed branch pilot who served as bar pilot and docking master upon the arrival of the vessel at the port of Brunswick, departed the AFRICAN NEPTUNE at 1013, 7 November 1972.

7. At about 1300, on 7 November 1972, two gangs of longshoremen commenced loading 420 long tons of cargo in Number 1 and Number 6 holds. By about 2100 on that day, they had completed loading the cargo. During the day the crew of the AFRICAN NEPTUNE maintained sea watches. At 2100, the steering and navigational gear was tested satisfactorily. The engine room and pilot house clocks were synchronized. The vessel was in light condition and trimmed by the stern. The draft was 19'00" forward, 22'02" aft, and 20'07" mean. The maximum loaded mean draft of the AFRICAN NEPTUNE is 30'10".

8. The following table compares the maneuvering speeds with the regular speeds in terms of the engine order telegraph propeller speed in revolutions per minute (RPM) and speed in Knots:

MANEUVERING SPEED TABLE

BASED ON ZERO SLIP - PROPELLER PITCH - 21.67 FEET

AHEAD	R.P.M.	APPROXIMATE SPEED
DEAD SLOW	10	2.1 KNOTS
SLOW	25	5.3 KNOTS
HALF	40	8.5 KNOTS
FULL	65	13.9 KNOTS
ASTERN	R.P.M.	
DEAD SLOW	10	
SLOW	20	

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HALF	40
FULL	60

9. Pilot Fendig returned aboard the AFRICAN NEPTUNE at about 2118. With him was Pilot Eugene Lawrence Gray, a State licensed branch pilot who also holds a U. S. Coast Guard issued First Class Pilot's License (Number 385801) from the Brunswick bar to the port. Pilots Gray and Fendig are the only pilots actively serving on their State licenses as branch pilots for the port of Brunswick. Pilot Fendig, the senior pilot, had prior to 7 November 1972, completed an estimated 700 trips on ocean going vessels while serving as a branch pilot. Gray had served as branch pilot on about 350 trips. Pilot Fendig also serves as docking pilot for the port of Brunswick. On those trips during which Pilot Gray serves as branch pilot, Pilot Fendig, as docking pilot, usually controls the maneuvering of the vessel while it is in close proximity to its assigned berth. Under those circumstances, and on those occasions, Pilot Gray remains on the bridge of the vessel but does not give maneuvering orders.

10. At about 2124, 7 November 1972, preparatory to sailing, the AFRICAN NEPTUNE's gangway was taken in. Pilot Fendig and the Master, Frank Stanejko, were on the bridge of the ship. At the helm was one of the 8-12 watch Able Seamen, Charles L. Williams, Z-208360-D2. Third Mate Donald L. Rominger, U. S. Coast Guard License No. 370920, Z-262408, was the mate on watch. The fifth person on the bridge was Pilot Gray who was waiting to relieve the docking pilot, Fendig. On the foc'sle head in charge of line handling and the anchors was Chief Mate Folke K. Johansson, U. S. Coast Guard License No. 457243, Z-891694. With him was the ship's carpenter, Bernard J. Clark, Z-617706. The Second Mate, Gilbert McKay, U. S. Coast Guard License No. 403271, Z-271710, was on the stern in charge of line handling. Other members of the 8-12 deck watch and other deck crewmembers were assigned to line handling duties. Third Assistant Engineer Edgar R. Snedeker, U. S. Coast Guard License No. 328990, Z-123700, was the engineer on watch. Getting underway, Mr. Snedeker's position was in the Fire Room. The First Assistant Engineer, Paul W. Samolchuk, U. S. Coast Guard License No. 419446, Z-1201211, was at the throttle; the Chief Engineer,

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Roland A. Walton, U. S. Coast Guard License No. 408371, BK-295876-C1, was also in the engine room.

11. Pilot Fendig ordered the SAMSON placed head to and perpendicular to the side of the AFRICAN NEPTUNE near the starboard bow. Pilot Fendig then ordered the tug to go ahead at the same time as the AFRICAN NEPTUNE's engines were ordered, "SLOW ASTERN". The effect was to push the bow of the AFRICAN NEPTUNE against the wharf and move the stern to starboard. At about 2136, the last line was off the dock.

12. At about 2137, the docking pilot then maneuvered the AFRICAN NEPTUNE laterally a short distance into the channel using both the tug and the ship's engines. As the AFRICAN NEPTUNE began to make headway, Pilot Fendig considered the efforts of the tug SAMSON ineffective. He decided to release the tug and to maneuver the vessel clear of the dock and around several barges moored downstream using only the ship's rudder and engine. At about 2139, the engines were ordered, "AHEAD FULL", and the rudder put, "HARD RIGHT", and soon thereafter the tug SAMSON was cast off. The ship gained speed and the right rudder caused the bow to swing right and away from the barges. As the AFRICAN NEPTUNE drew close abeam of the barges, the helm was shifted from hard right to hard left. At about 2141, as the ship's stern passed the barges, the pilot ordered the engine, "SLOW AHEAD".

13. The Master and docking pilot were on the port wing of the bridge during most of the undocking maneuver. As the AFRICAN NEPTUNE passed the barges, the Master was not satisfied with the way the helmsman applied the pilot's orders. At about 2141, the Master ordered the mate of the watch, Mr. Rominger, to have the helmsman relieved. Mr. Rominger passed the word to the Second Mate on deck to have the other 8-12 Able Seaman, Darling Carroll Woodall, Z-228495, proceed to the bridge to relieve the helmsman, Williams.

14. From the period that the vessel was abeam of its former berth at the State Docks to the time that the AFRICAN NEPTUNE's stern passed the moored barges, the ship had traveled about 1,000 feet. Its head was being directed to swing slowly to the right. At that point, the AFRICAN NEPTUNE was situated in the channel about midway between the center and the east

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side. After considering the ship's position and progress down the channel, Pilot Fendig, the senior pilot, decided that he would remain in control of the maneuvering of the vessel until it passed the Sidney Lanier Bridge.

15. At about 2143, the AFRICAN NEPTUNE radioed the Sidney Lanier Bridge operator, Mr. Roscoe Tanner, of the vessel's intention to pass under the lift span. When Mr. Tanner observed the vessel proceeding down the channel, he initiated procedures to lift the span. The bridge operator noted that he could see all the barriers, warning lights, and other protective devices working properly. At that time the shore line on both sides of the bridge was visible. After the warning gates had closed, traffic on the span was halted and cars approaching the gates began to stop behind them. Having lifted the span, Mr. Tanner noted that as the span reached the top, the red lights which mark the center of the span, one marking the upstream and one marking the downstream approach to the bridge, had properly switched to green. He was satisfied that the bridge was ready for the vessel's passage.

16. At about 2143, Pilot Fendig ordered the engine, "HALF AHEAD". Moments later he ordered the helm, "LEFT, TEN DEGREES" to start his left turn towards the lift span passage of the Sidney Lanier Bridge. By this time the AFRICAN NEPTUNE had moved to the right side of the channel and was heading about 180°T. The ship was nearly abeam of Andrews Island Spit Light (Light List No. 485, Light List, Volume II, Atlantic and Gulf Coasts, 1972, CG-160) as indicated on C&GS Chart No. 447. The AFRICAN NEPTUNE then commenced a slow swing to the left. After noting the vessel swinging to the left, Pilot Fendig ordered, "RUDDER AMIDSHIPS". At approximately this time, Able Seaman Woodall relieved Able Seaman Williams at the wheel. Williams uttered an obscenity upon his relief which was directed generally towards the Master and the pilot. The Master and the pilot denied hearing the comment and the pilot stated that he was unaware that the helm had been relieved. After the rudder amidships order, Pilot Fendig in noting more of a swing to the left than he wanted, ordered the rudder, "RIGHT, TEN DEGREES", to check the swing. Seconds later, he ordered, "RUDDER AMIDSHIPS". Shortly thereafter, at about 2144, Pilot Fendig again ordered the rudder, "LEFT, TEN DEGREES".

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17. Each of the pilot's rudder orders were audible in the pilot house. Each rudder order was repeated by the helmsman as it was given, and each repeat was heard by personnel in the pilot house. Orders to the engine were similarly repeated by the mate on watch. Helmsman Woodall audibly repeated the "LEFT, TEN DEGREES" rudder order given by the pilot at about 2144.

18. After continuing the left swing towards the bridge passage for about 3 minutes, the ship crossed the Brunswick Point Cut Range about 300 feet downstream of the junction of the Brunswick Harbor Range (Light List Nos. 483 & 484) and the Brunswick Point Cut Range (Light List Nos. 479 & 480) (C&GS Chart No. 447). At this time the heading of the ship was about 145°T, and the AFRICAN NEPTUNE had passed the point in her approach to the Sidney Lanier Bridge, which in the opinion of the pilot, was the "point of no return". This "point of no return" marks the position of the vessel in relationship to the bridge where the vessel is committed to continue.

19. At about 2146, Pilot Fendig ordered the engine, "FULL AHEAD" to improve rudder response. About this time, he also ordered the rudder, "LEFT, TWENTY DEGREES". Helmsman Woodall audibly repeated this order. The master had stationed himself on the starboard wing of the bridge to watch the vessel's passage by the south lift tower of the Sidney Lanier Bridge. Pilot Gray and Pilot Fendig were looking ahead through an open pilot house window to the left of the vessel's centerline. The mate, who was at his usual position in the starboard side of the pilot house, repeated the "FULL AHEAD" engine order and entered the order in the deck bell book at "2145+".

20. A short time after the pilot gave the left twenty degrees rudder order, the mate routinely checked the rudder angle indicator and observed the indicator about Right 10 Degrees and moving further to the right. The mate immediately approached Helmsman Woodall, tapped him on the arm and indicated to the helmsman by twirling his finger in a counter-clockwise direction to turn his wheel to the left. The helmsman accepted this as an order and began to turn the wheel to the left. At about this time, both pilots Fendig and Gray noted the vessel's head hesitate in it's swing to the left. Both pilots stepped

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back from the pilot house windows to check the rudder angle indicator on the forward bulkhead. Pilot Fendig saw it was reading about Right 20 Degrees and immediately ordered the rudder, "HARD LEFT", and the engine, "FULL ASTERN" at about 2147. Pilot Gray looked at the indicator and watched it swing past Right 20 Degrees and toward Right 25 Degrees. The Master also noted that the vessel's swing to the left had hesitated and he immediately proceeded into the pilot house. Helmsman Woodall had started turning the wheel to the left by the time that Pilot Fendig ordered the rudder, "HARD LEFT".

21. To notify the engineroom of the emergency nature of the FULL ASTERN engine order, the Master "jingled" the engine order telegraph several times, by repositioning the telegraph from FULL ASTERN to AHEAD to FULL ASTERN again. At about the same time that he jingled the full astern bells, the starboard anchor was dropped. About three shots or 45 fathoms of anchor chain went out the hawse pipe before the brake was applied. With the ship making headway, the chain continued to pay out, finally fetching up with about seven shots out of the hawse pipe.

22. The AFRICAN NEPTUNE's engines responded to the FULL ASTERN bell almost immediately. At about the same time, Pilot Fendig commenced sounding the ship's steam whistle in short rapid blasts. At about 2148, Pilot Gray ordered, "HARD RIGHT". By that time, the AFRICAN NEPTUNE had slowed it's forward progress to no more than one or two Knots. Observing that a collision was imminent, Chief Mate Johansson and Carpenter Clark left the foc'sle head and started aft to safety.

23. At about 2149, the top of the AFRICAN NEPTUNE's forward foc'sle head bulwarks passed under the walkway on the upstream side of the Sidney Lanier Bridge and struck the bridge's steel structural member. The point of impact was slightly south of midway between two bridge piers about 250 feet south of the southernmost lift span tower. Three sections of the bridge collapsed and the vessel sustained minor damage to the bow.

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24. Upon impact with the bridge, the AFRICAN NEPTUNE's engine was stopped. Immediately after the collision, its engine was again ordered FULL ASTERN. At 2149-1/2 that order was reduced to HALF ASTERN and at 2151 to SLOW ASTERN. The brake on the port anchor windlass was damaged by the bridge structure on impact with the result that the port anchor let go at the point of collision. Personnel on the AFRICAN NEPTUNE heard shouts from persons who had been on the Sidney Lanier Bridge. Five ring buoys were thrown into the water from the AFRICAN NEPTUNE. At 2152, the ABANDON SHIP alarm on the AFRICAN NEPTUNE was sounded for the purpose of mustering the boat crew for rescue operations. The Master and Pilot Fendig, concerned that the AFRICAN NEPTUNE would drift back on the structure of the Sidney Lanier Bridge, prepared to position the vessel port side to and parallel with the Sidney Lanier Bridge. It was determined that the safest place for the AFRICAN NEPTUNE would be for it to be situated against the protective fender system located just upstream of the two lift span towers. Pilot Gray joined crewmembers in the starboard lifeboat which was being launched to rescue the persons from the Sidney Lanier Bridge structure and from the water. The starboard lifeboat was launched and away before 2200.

25. After the warning gates and barriers had closed stopping highway traffic on the Sidney Lanier Bridge, and the lift span had been raised to allow the passage of the AFRICAN NEPTUNE under that portion of the bridge, several occupants of the vehicles stopped in the northbound lane, had left their vehicles and gone to the upstream side of the bridge walkway to watch the approach of the ship. One of these, Mr. Charles M. Wells, Jr., realizing that the AFRICAN NEPTUNE was going to collide with the bridge, shouted a warning to two of his friends and then ran for safety towards the south end of the bridge where his friends followed him.

26. Upon impact, the section of the bridge roadway struck by the AFRICAN NEPTUNE toppled sidewards and downwards towards the east, collapsed, and fell into the waters of the Brunswick River. The following vehicles stopped on that section fell into the river with the roadway:

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Vehicle Operated By	Vehicle Description
(1) Charles O. Denny	1967 International Tractor/Trailer
(2) James F. Robinson	1972 Mack Tractor/Trailer
(3) Kelly L. Johns, Jr.	1965 Ford
(4) Bunny Vinson	1956 Oldsmobile
(5) Albert C. Donal	1972 Chevrolet

27. The section of roadway just north of the section which had been struck also collapsed and dropped into the water. No vehicles were on that section. The section of roadway just south of the section which was struck by the AFRICAN NEPTUNE was the last to collapse. Vehicles on that section were as follows:

Vehicle Operated By	Vehicle Description
(1) Charles M. Wells, Jr.	1972 Ford
(2) Hank Staley	1966 Chevrolet
(3) Charles Rooks	1971 Dodge
(4) McKinley Sharpe	1966 Pontiac
(5) James W. Pinkham	1972 Chrysler

28. The bridge operator, Mr. Roscoe Tanner, located in the bridge tender house on the north lift tower, saw the ship cut into the bridge roadway and telephoned the City of Brunswick Police Department for assistance. After other immediate calls for assistance, various harbor craft, including the tug SAMSON and the starboard lifeboat from the AFRICAN NEPTUNE, were in the vicinity of the wreckage within minutes and others were on their way. The pilot boat was called from it's station at the mouth of St. Simons Sound. At about 2150, Coast Guard Station, St. Simons Island, received word of the collision and dispatched

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two 40 foot patrol boats to the scene. At 2205, CG-40486 was underway arriving on scene at 2245; CG-40595 was underway at 2210 and was on scene at 2255. The Station notified the Coast Guard Air Station, Savannah, Georgia at 2203, and the Seventh Coast Guard District Rescue Coordination Center at 2204. Two HH-52A helicopters were dispatched by the Coast Guard Air Station, Savannah, Georgia; CG-1385 departed Savannah at 2212 and CG-1424 departed Savannah at 2239. Civil Defense units in Glynn County, the Georgia Fish and Game Commission, the Georgia Highway Patrol, the Brunswick Police, and the Brunswick Rescue Squad units all responded promptly. A number of private citizens assisted in the search for survivors. Additional Coast Guard units arrived on the scene on the morning of 8 November 1972.

29. Twenty-four (24) persons had been occupants of vehicles stopped on the collapsed portions of the Sidney Lanier Bridge. At least three of these ran to safety on the undamaged portion of the bridge. As the sections collapsed some of the structural steel bent across the concrete piers. Several persons were able to cling to this damaged structure, others fell into the water. Ten lost their lives. Two were rescued by the ship's lifeboat. The remaining survivors were rescued by harbor craft. There were no personal flotation devices on the highway bridge. The search operations continued into the following day but failed to locate any additional survivors. The remains of the deceased were recovered from waters of the Brunswick River during the next several days. The last body was recovered from a submerged vehicle on 12 November 1972. The port of Brunswick was closed to shipping at about 2250, 7 November 1972, and was reopened at 0936, 8 November 1972.

30. At about 2154, on 7 November 1972, both ship's anchors were heaved up and at 2225, the AFRICAN NEPTUNE was maneuvered adjacent to the Bridge. Two tugs, the LIBERTY, O.N. 501746, and the SAMSON, O.N. 264395, were made fast to the upstream side of the ship. The tug LIBERTY was calling at the port of Brunswick and is not homeported there. At 2250, a small electrical fire occurred on the foc'sle of the AFRICAN NEPTUNE, but was immediately extinguished. At about 0325, 8 November 1972, the AFRICAN NEPTUNE got underway with the assistance of the tugs on a flood current and proceeded to the port of Brunswick. The ship was moored starboard side to the Lanier Berth in Brunswick at about 0512.

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On 8 November 1972, temporary repairs to the AFRICAN NEPTUNE's anchor windlass were completed. The concrete and steel debris which had fallen from the Sidney Lanier Bridge was removed from the foc'sle in the port of Brunswick. The vessel then proceeded to Savannah to discharge cargo and to effect permanent repairs.

31. The AFRICAN NEPTUNE's pilot house is equipped with two electric steering stands. These are located several feet apart, side by side near the centerline of the AFRICAN NEPTUNE, in such a position so that the helmsman faces forward when steering. The AFRICAN NEPTUNE's steering wheels are about waist high in height, about 14 inches in diameter, and rotate in a vertical plane. On each steering stand is located an illuminated mechanical indicator which displays the direction and amount of steering engine order applied by the helmsman turning the wheel. This indicator is graduated in 10° intervals from 0° amidships to 30° left and right. The indicator shows the mechanical position of the steering wheel, but not necessarily the actual position of the rudder. The port steering stand was in use on the evening of 7 November 1972. The rudder's position with respect to the centerline of the ship is displayed by the illuminated electric rudder angle indicator, located on the forward bulkhead of the pilot house, near the centerline of the ship, and above the level of the tops of the pilot house windows. This indicator is graduated by degrees from 0° at amidships to 35° left and right.

32. In the port of Brunswick, orders to the helm of a merchant vessel are usually given as rudder angle orders. When compass orders are given, the helmsman on the AFRICAN NEPTUNE directs his attention to the gyro compass repeater located immediately above and forward of his steering stand. The wheel is turned with little physical effort on the part of the helmsman by rotating the steering wheel to the left, counter-clockwise, or to the right, clockwise, the required number of rotations so that the mechanical indicator on the binnacle shows the direction and amount of steering order applied to the rudder mechanism. The helmsman may look up from his mechanical indicator to the electric rudder angle indicator on the pilot house bulkhead, and may rotate the steering wheel as necessary to attain the angle ordered. It takes about 13 seconds for the rudder to move from amidships to hard right at 35° (or hard left at 35°) or hard right to

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amidships.

33. The engine order telegraph on the AFRICAN NEPTUNE is located about 5 feet to the right of the starboard steering stand. Usually, the mate on watch stands behind the engine order telegraph while the vessel is maneuvering in pilot waters. After applying an engine order to the telegraph the mate proceeds from the telegraph to a small table near the starboard bridge wing door, where he records the time of the order and the nature of the order in the deck bell book. In addition to this specific function, the mate on watch supervises the helmsman, with special attention being paid to the application of the orders to the helm.

34. For the ten-year period preceding the collision, approximately 130 to 140 vessels a year have passed through the Sidney Lanier Bridge lift span opening. Branch pilots in the port of Brunswick have established procedures by which outbound ocean-going vessels may be maneuvered from Oglethorpe Bay, to the Brunswick River, and through the lift span passage of the Sidney Lanier Bridge. These procedures may vary slightly depending upon the heading of the vessel at its berth and upon other factors such as wind and current. The usual procedure for vessels similar to the AFRICAN NEPTUNE, moored as it was at Berth No. 3 with its bow downstream, at slack water, would be the same as the one used by Pilot Fendig on 7 November 1972. Various rudder and engine orders are used to control the left swing from the Lower Reach of Oglethorpe Bay (162°T) to the Brunswick Point Cut Range (113°T). Large ocean-going vessels approaching the Sidney Lanier Bridge in the same way as the AFRICAN NEPTUNE did prior to the collision are not usually lined up with the lift span opening and the Brunswick Point Cut Range until after they pass the "point of no return". It is not unusual for vessels passing through the lift span opening to be carrying left rudder and to still be swinging slowly left. The pilot attempts to delay "point of no return" to minimize the distance and time during which a failure of a shipboard system could cause a collision. The amount of the delay is dependent upon factors such as wind and current, vessel's draft and trim, as well as upon the minimum speed necessary to give effect to the vessel's rudder. Tugs are seldom used to assist vessels through the lift span opening. One of the bridge operators, has seen tugs alongside vessels passing under the lift span, but does not know if they were assisting the vessels or not. Two tugs, the MALUCO I, O.N.

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264394, 400 H.P., and the SAMSON, O.N. 264395, 400 H.P., are available in the port of Brunswick to assist ocean-going vessels. On at least one previous occasion, it was necessary to anchor an outbound foreign flag vessel upstream of the Sidney Lanier Bridge because the vessel was not lining up properly with the lift span passage.

35. Public hearings were held by the U. S. Army Corps of Engineers in 1947 prior to the construction of the Sidney Lanier lift bridge. The matter of the bridge being an obstruction to navigation was discussed and considered in depth. The bridge, which was opened to highway traffic in 1957, spans the Brunswick River at a point where the river is about 1250 yards wide. The 250 foot lift span which crosses the channel is raised to allow vessels to transit the bridge beneath the span. The vertical clearance at mean low water when the lift span is down is 24 feet. The vertical clearance at mean low water when the span is raised is 139 feet. The bridge has a four lane concrete roadway supported by continuous steel structures resting on reinforced concrete piers extending downward to the river bottom. The piers are located at 150 foot intervals across the approaches to the lift span. The continuous steel structure is separated at every third pier, at 450 foot intervals, by expansion joints. The three sections of the Sidney Lanier Bridge which collapsed upon the impact of the collision comprised the first continuous steel structure south of the southernmost lift tower. The vehicle warning gates on the Sidney Lanier Bridge are positioned over the first piers north and south of the lift towers.

36. Lights on the Sidney Lanier Bridge and all navigational aids in the vicinity of the Sidney Lanier Bridge were functioning properly at the time of the collision. There were no mechanical failures on board the AFRICAN NEPTUNE or on the Sidney Lanier Bridge.

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CONCLUSIONS

1. The primary cause of the collision was that the helmsman incorrectly applied right rudder instead of left rudder, as the pilot had ordered, at a critical point in the approach of the ship towards the passage through the bridge's lift span opening. As a result, the ship did not follow the usual track line contemplated by its experienced pilot as the pilot maneuvered the vessel with customary rudder and engine orders.

The lapse in time between the incorrect application of rudder and the time it was detected was a contributing cause of the collision. Another contributory factor was that the AFRICAN NEPTUNE, due to the channel configuration had to approach the lift span opening in a continuous left turn maneuver. An additional contributing factor was the substantial speed required to maintain steerageway thereby causing the AFRICAN NEPTUNE to pass the "point of no return" at a considerable distance from the Sidney Lanier Bridge lift span opening.

2. There is no evidence that any material failure on board the AFRICAN NEPTUNE or on the Sidney Lanier Bridge caused or contributed to the cause of the collision.

3. There is evidence that the failure of the helmsman to apply rudder as ordered was negligence contributing to the cause of the collision. (This has been communicated to the Commander, Seventh Coast Guard District for further investigation). There is no evidence of misconduct, negligence, inattention to duty, incompetence, or willful violation of law or regulation, on the part of any other person licensed or certificated by the Coast Guard warranting action under the Suspension and Revocation Proceedings of R. S. 4450, as amended. The rudder and engine orders given by Pilot Fendig, who was serving under the authority of his State license, were those typically used by the branch pilots in the port of Brunswick to maneuver vessels similar to the AFRICAN NEPTUNE in size, horsepower, and loaded condition, under similar conditions of wind and current. The master found no fault with the orders of the pilot and did not assume direct control of the maneuvering of the AFRICAN NEPTUNE as it made its approach to the bridge. There is no evidence that Third Mate Rominger failed to carry out his specific functions as

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mate on watch. He was recording a "FULL AHEAD" engine order in the deck bell book in the usual manner at about the same time that the helmsman applied the incorrect rudder. This diverted his attention from continuous supervision of the helmsman and may have caused him to be momentarily away from his position behind the engine order telegraph. Shortly after, upon routinely checking the helmsman, Mr. Rominger discovered the rudder angle indicator was about 10° right and was moving further to the right. He then promptly brought the application of the wrong rudder angle to the helmsman's attention. The helmsman then turned the wheel LEFT, TWENTY DEGREES without further reference to the pilot, thus indicating he recognized his own error. The period of time during which the AFRICAN NEPTUNE was actually under the influence of an incorrect rudder order was sufficient to allow the creation of an irreversible situation which resulted in the collision of the AFRICAN NEPTUNE with the Sidney Lanier Bridge.

4. Loss of life would have been prevented if vehicular traffic had been halted on the portion of the Sidney Lanier Bridge which was not damaged in the collision.

The collision might have been prevented if:

a. The rudder order had been applied properly.

b. The incorrect application had been detected sooner. There was no means by which the pilot could be alerted to the mis-application of his rudder (or engine) order. There was no record kept of orders given to the helmsman.

c. The "point of no return" had been delayed by utilizing one or more tugs of sufficient capabilities to assist the AFRICAN NEPTUNE to line up with the lift span opening of the Sidney Lanier Bridge.

5943/AFRICAN NEPTUNE
MARINE BOARD
2 March 1973

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RECOMMENDATIONS

1. That the vehicular traffic control gates on the Sidney Lanier Bridge be relocated to such points on the roadway which would provide a margin of safety for the vehicles and their occupants should a similar accident occur, and that copies of this report be forwarded to the Federal Highway Administration and to the Georgia Department of Transportation for consideration of the adoption of this recommendation.

2. That a copy of this report be forwarded to the Board of Pilotage Commissioners for the port of Brunswick concerning the adoption of an alternative which would allow large vessels to line up with the Sidney Lanier Bridge lift span opening before passing a "point of no return" when being piloted outbound from Oglethorpe Bay.

3. That further investigation under the Suspension and Revocation Proceedings under R.S. 4450, as amended, be initiated in the case of Darling C. Woodall, Z-228495, concerning his part in the casualty.

JAMES W. MOREAU
Rear Admiral, U. S. Coast Guard
Chairman

FREDERICK W. FOLGER
Captain, U. S. Coast Guard
Member

FORREST E. STEWART
Captain, U. S. Coast Guard
Member

ROBERT F. BENNETT
Commander, U. S. Coast Guard
Member and Recorder