DEPARTMENT OF TRANSPORTATION

COAST GUARD

MARINE CASUALTY REPORT

SS C. V. SEA WITCH - SS ESSO BRUSSELS (BELGIUM);
COLLISION AND FIRE IN NEW YORK HARBOR
ON 2 JUNE 1973 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 2 June 1973, the SS C. V. SEA WITCH lost steering control in New York harbor. The ship moved out of the channel and struck and penetrated the anchored Belgian tankship SS ESSO BRUSSELS which was loaded with crude oil. The 31,000 barrels of oil from three ruptured tanks ignited and the resulting fire engulfed both ships.

The master and two crewmembers died aboard the SEA WITCH. The master and ten crewmembers of the ESSO BRUSSELS died after abandoning ship, one crewmember died aboard ship, and one crewmember is missing. Some nearby beaches were polluted, and damage to the ships and cargo amounted to about $23 million.

The National Transportation Safety Board determines that the probable cause was a mechanical failure in the steering system of the SEA WITCH and the lack of adequate and timely action by the crew to control their ship after the failure occurred. The cause of the loss of steering was the deficient design of the system which did not provide "two separate and independent steering control systems" as required by 46 CFR 58.25. The cause of the fire, pollution, and deaths after the collision was that the typically designed bow of the SEA WITCH penetrated the hull of the ESSO BRUSSELS instead of absorbing the crash energy.

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COLLISION IN NEW YORK HARBOR ON 2 JUNE 1973 WITH
LOSS OF LIFE

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National Transportation Safety Board

Washington, D C 20594

SS C. V. SEA WITCH-SS ESSO BRUSSELS COLLISION AND FIRE NEW YORK HARBOR 2 JUNE 1973

ACTION BY THE NATIONAL TRANSPORTATION SAFETY BOARD

This casualty was investigated by a U.S. Coast Guard Marine Board of Investigation, which convened at New York City, N. Y., on 5 June 1973. A representative of the National Transportation Safety Board observed part of the proceedings. The National Transportation Safety Board has considered only those facts in the investigative record 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 2 June 1973, the SS C. V. SEA WITCH lost steering control in New York harbor. The ship moved out of the channel and struck and penetrated the anchored Belgian tankship SS ESSO BRUSSELS, which was loaded with crude oil. The 31,000 barrels of oil released from three ruptured tanks ignited and the resulting fire engulfed both ships.

The master and two crewmembers died aboard the SEA WITCH. The master and ten crewmembers of the ESSO BRUSSELS died after abandoning ship, one crewmember died aboard ship, and one crewmember is missing. Some nearby beaches were polluted, and damage to the ships and cargo amounted to about $23 million.

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ANALYSIS

This analysis is to be read in conjunction with the facts reported in the Marine Board investigative report.

Steering Gear Reliability

To insure that steering capability will not be lost, 46 CFR 58.25-50 requires that an alternate steering station on the after weather deck be provided, and that "components of the alternative steering control system shall be completely separate and independent of the pilothouse steering control system." Further, 46 CFR 58.25-55 requires that as a substitute for the alternate steering station, "two separate and independent steering control systems shall be provided for controlling the steering gear from the pilothouse."

The Coast Guard approved the SEA WITCH steering gear installation as complying with this latter option. However, the two control systems on the SEA WITCH were separate and independent only up to the two rotary hydraulic power units in the steering gear room. The outputs from these two units were connected by a roller chain. From that point on, the control was a single channel system through the shafting, the connecting universals, and the differential unit. The failure which precipitated this accident occurred in that portion of the steering system, so the failure could not be bypassed from the pilothouse.

In its review and approval of the SEA WITCH drawings, the Coast Guard did not fulfill the intent of the regulation by insuring that the control systems were completely "separate and independent" up to the power units. Although the Coast Guard officer who approved the drawings for this steering gear testified that this represented the most commonly approved installation, the Marine Board of Investigation questioned this practice. But the Commandant's Action asserts that the single system of linkage aft of the rotary hydraulic power units "meets the intent of duplicity of steering gear control."

The Safety Board questions the logic of this interpretation. The Board believes that a change in this interpretation would result in a significant improvement in the reliability of such steering gear installations which have already demonstrated their weaknesses. The Commandant's Action rejected a change in the interpretation,

but stated that "research is being started into possible requirements which may include additional reliability factors in steering systems." While such research might be desirable, this should not preclude or delay a more rational interpretation of the existing regulation.

Responsibility for the reliability of vital machinery aboard ship is shared by the ship operators and by the Coast Guard. In addition, the American Bureau of Shipping gathers information on the condition of such machinery during their periodic inspections. The Coast Guard checks annually that the rudder can be turned to its maximum angle port and starboard from either control station and that the rudder angle indicator is correctly aligned. But these efforts do not provide enough information about the reliability of the steering equipment.

The previous steering failures which occurred on the SEA WITCH and its sister ships are evidence of the low reliability of this steering system's design. These failures were not reported to the Coast Guard because the repair cost did not meet the minimum $1,500-cost criterion established by the Coast Guard. Also, the ship owners did not consider 33 USC 361, which requires reporting of material damage affecting the seaworthiness or efficiency of a vessel, applicable, particularly when the failures occurred in the open ocean. But a report on the loss of steerage from failure of any component within the system provides more important information than does an annual operational test of the rudder.

It is important to know the failure rate for this steering system. Since most steering gear failures currently are not reported to the Coast Guard, its data bank will imply a much higher reliability for those installations than actually exists. The current criteria for reporting casualties need to be revised to require the explicit reporting of any steering gear failure which affects or threatens control.

SEA WITCH's Trackline

When the SEA WITCH was about $1\frac{1}{4}$ miles from the Verrazano Bridge, the pilot changed course left from 167° True to 158° True. Since steerage was lost when the rudder was at 12° right, it is probable that the helmsman applied this right rudder to check the ship's left swing at the end of the course change, at which time the key slipped out of the keyway and disconnected the control linkage.

When the helmsman found that he had no rudder control, he called this to the attention of the third mate, who went to the steering stand and confirmed that something was wrong with the steering controls. The third mate then walked to the starboard door, called to the master and the pilot on the bridge wing, and told them of the loss of steerage.

The Safety Board determined the probable trackline of the SEA WITCH following the loss of steering control. (See Figure 1.) This trackline is based on the best available evidence including the estimated impact speed, the angle of collision, the effect of stopping and backing the engine, and the ship's latitude when the course was changed to 158° True. The plausability of various possible tracklines varies with the time interval that the SEA WITCH had no directional control. The most reasonable trackline constructed showed a duration of no directional control for $3\frac{1}{2}$ minutes. This would mean that steering control was lost at minute $38\frac{1}{2}$.

Although the ESSO BRUSSELS was a long ship, because of its location and alignment in the channel, it subtended a small angle when viewed from the SEA WITCH during most of this $3\frac{1}{2}$-minute period. In fact, it subtended an arc that grew only from 5° to 11° from minute $38\frac{1}{2}$ to minute 40; therefore, the ship appeared as a small object until about minute 40 when the subtended angle and, consequently, the ship's apparent size began to increase rapidly. The engine of the SEA WITCH was stopped at this time.

The relative bearing of the ESSO BRUSSELS' bridge remained constant about 19° off the starboard bow almost until minute 41. Although any constant relative bearing less than 90° on a stationary object will result in a spiral path that closes in on that object, the pilot and master on the bridge of the SEA WITCH probably believed that as long as the ship's bow did not point any closer to the tankship, the situation was not serious. It was not until a few seconds before minute 41 that the SEA WITCH's centerline crossed the tankship's stern. At minute 41, when the SEA WITCH was about $1\frac{1}{2}$ ship lengths from the tankship, the pilot backed the SEA WITCH's engine.

Evidently, during about the first $1\frac{1}{2}$ minutes after the loss of steering control, the indications of an impending collision developed slowly; when the indications began to develop rapidly, there was insufficient separation between the ships to avoid the collision.

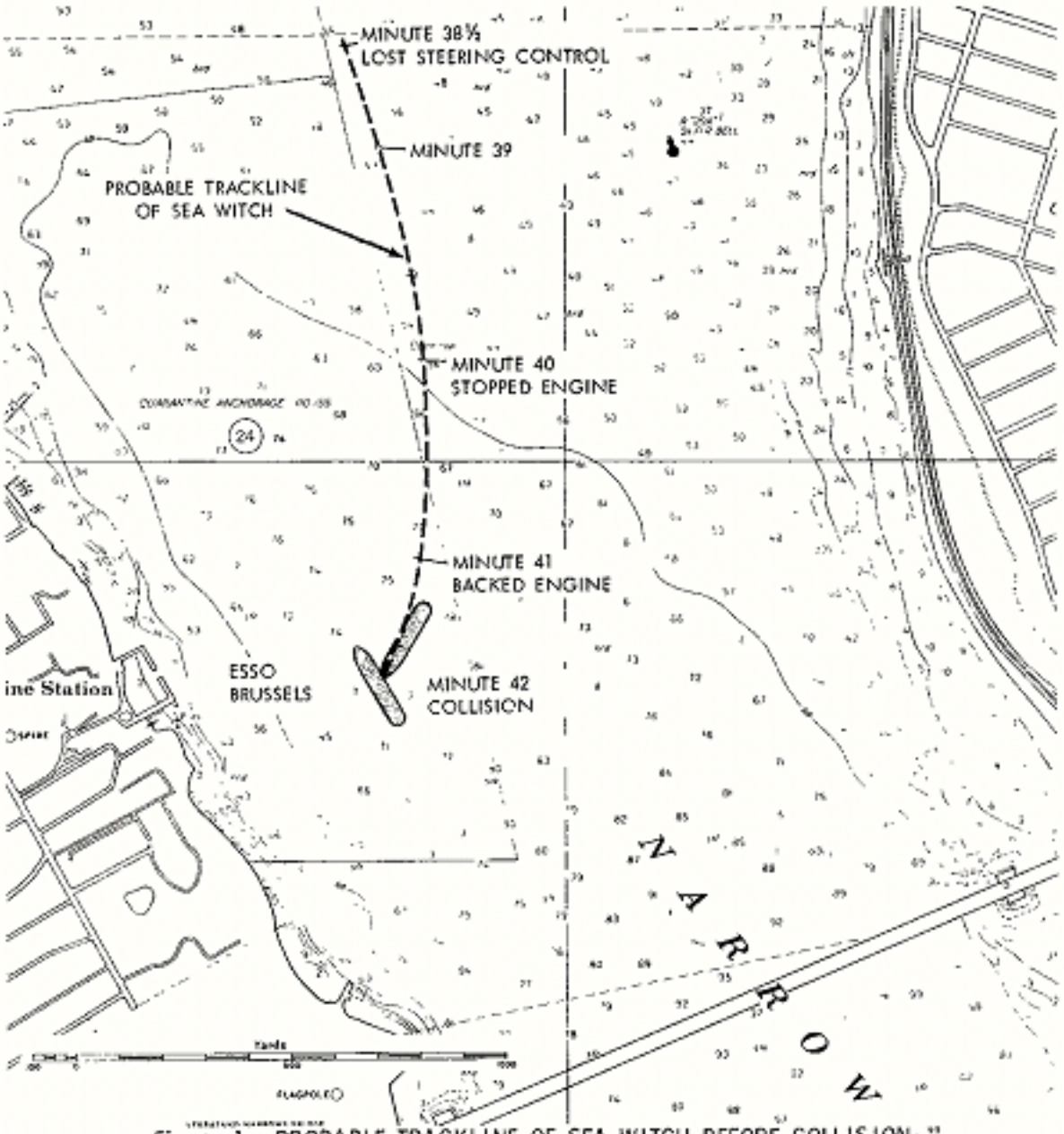


Figure 1. PROBABLE TRACKLINE OF SEA WITCH BEFORE COLLISION

When steering control is lost in confined water, the usual indications of impending collision are of little value since they may arrive too late. It is important under such circumstances that action be taken immediately to minimize a ship's speed, even if no danger is apparent.

Efforts to Restore Steering Control

Steering systems on ships are designed in anticipation of certain types of failures, and appropriate alarms and countermeasures are provided. The helmsman on the SEA WITCH detected a steering malfunction not because of any alarm or change in the indicator lights on the steering stand, but because he could not bring the ship to the desired heading. No one on the bridge had any clues about the malfunction to help them restore steering control in a hurry or to suggest whether the malfunction was correctable on the bridge.

Although they had no clues about the steering malfunction, they did have two procedures for emergency operation specified by the steering control equipment's manufacturer. The first procedure is to switch from the active to the alternate control circuits. The second procedure is to switch from the hand steering followup mode to the lever nonfollowup mode. One switch is involved in the first emergency procedure and two switches in the second. Both procedures can be completed in about 10 seconds.

The master of the SEA WITCH completed both emergency procedures. The alternate steering gear motor was placed in operation, and both emergency procedures probably were repeated with the alternate motor. This could have been accomplished in about another 15 seconds. However, the master reportedly continued to work at the steering control stand, apparently unaware that the switching of controls could not bypass the fault or that if the fault was in the bridge components, more time would be required to locate and repair it than was available. The master spent 2 minutes in this effort, despite several previous steering failures on the ship in which control could not be restored from the bridge.

The master's preoccupation with the bridge's steering control equipment probably had two important effects. First, from his position behind the steering stand, he could not observe the vessel's movement through the harbor. As a result, he could not perform

his primary duty of monitoring the ship's movement out of the channel, and as the person most knowledgeable about the ship's maneuvering characteristics, he could not make timely engine orders to reduce the risk of collision. Second, the pilot, who had little knowledge of the workings of the steering gear, probably expected that the master's efforts to restore steering control would succeed. So the pilot could have delayed the order to stop the engine. The pilot subsequently stated that until he stopped the engine, he was "... waiting for that rudder to catch, to break the swing."

Emergency Steering

The emergency steering station in the steering gear room on the SEA WITCH provided the means to disconnect immediately all control circuits from the bridge and to steer directly in response to orders relayed from the bridge. However, this station was normally not manned, and there was no emergency signal and procedure for manning it. If the station had been manned and put into operation, either control would have been restored immediately or it would have become obvious that switching circuits would not correct the situation. In either case, steering actions could have commenced immediately.

The manning of the emergency steering station is of no benefit when a ship's service generator fails, because most ships do not have an emergency generator of sufficient capacity to power the steering gear motor. The need for this emergency capability is particularly critical when both the main propulsion power and the ship's service electrical power are lost, as previously happened to the SEA WITCH in New York harbor. They are then unable to reduce their stopping distance by backing; their anchors' usefulness is reduced; and they cannot steer to avoid collisions or groundings. A steering gear system with alternate power from the emergency generator and a requirement for manning the emergency steering station in the harbor would provide a ship directional control until its speed drops sufficiently to reduce its damage capabilities.

Harbor Speed Selection

One of the most crucial factors which determine the chances of collision for a ship moving through a harbor is speed. However, the risk of collision because of a loss of steering control generally is not considered when a ship's harbor speed is chosen.

If a ship looses steering control, there are two ways it can avoid collisions: A turning maneuver or a full-backing (stopping) maneuver. The speed of a ship determines which of these maneuvers will be more effective.

At lower speeds, a ship's stopping distance is less than its advance distance from a hard-over rudder turn. If such lower speeds in harbors are accepted, pilots will know that, in case of steering loss, their most effective maneuver will be to back full and that restoration of steering control probably will not offer any advantage. In this case, the risk of collision is no greater than is the risk with an operable steering system.

There is a minimum speed necessary for adequate control of a ship; this speed varies for each ship depending on environmental conditions and on the ship's loading. When ships travel below this minimum speed, tugs can be used to provide adequate control.

When ships proceed at full speed through a harbor, a turning maneuver is more effective than a stopping maneuver. This is because at full speed, a ship's stopping distance is greater than its advance distance in a hard turn. Even if the object in the path of the oncoming ship is at less than the advance distance, a hard-over rudder turn could steer the ship off track enough to avoid a collision. Consequently, most pilots have a strong preference for steering maneuvers rather than for stopping maneuvers in a potential collision situation. Pilots also have a preference for steering maneuvers if steering control has been lost, but they anticipate its immediate restoration. This causes a delay in stopping the ship.

Reliance on the Anchor

Even though higher speeds reduce the effectiveness of the stopping maneuver, customarily a ship's anchor is manned whenever the ship moves through a harbor. However, the value of placing two or three men at the anchor station is questionable when stopping maneuvers are secondary to turning maneuvers. Since the anchor has limited effectiveness until the ship has been slowed and may be dangerous if it is dropped above such speeds, the use of the anchor can reduce the ship's stopping distance by only a small percentage of the distance traveled with backing power alone. Backing the ship's engine a few seconds earlier will be more effective than will a later backing of the engine combined with dropping the anchor.

It is impossible to calculate the last moment in which the addition of the anchor to full backing would make the difference between collision or no collision. Therefore, it is difficult to justify the dependence placed on the anchor, because its effects are difficult to predict at the beginning of the emergency and because there is a reasonable chance that the anchor will not run. Further, since anchoring can be done only near the end of the avoidance maneuver, there is neither time nor distance to try anything else if it does not work.

Bow Design

The SEA WITCH penetrated about 40 feet into the hull of the ESSO BRUSSELS while suffering only about 20 feet of damage to its own bow. If the bow of the SEA WITCH had not penetrated the hull of the ESSO BRUSSELS, there would have been no fire, pollution, or loss of life.

A number of technical studies have been made to find ways to improve the collision resistance of tankship hull structures. A struck tankship absorbs a small amount of elastic and hydrodynamic energy between contact and hull rupture. Although the absorption of these two cannot be altered, it might be possible to increase the absorption of plastic energy, but the redesign effort would have to be extensive, because it would affect both sides of the hull almost for the entire length of the ship.

Traditional design and construction of bows has resulted in a rigid bow with axial strength exceeding normal operating requirements. However, collisions could be reduced in severity if the capability of ships' bows to inflict damage to other vessels were reduced. This could be done by reducing the bow's axial strength without interfering with the strength of the rest of the ship's hull or the ship's cargo-carrying capability.

An analysis was performed to determine the strength of the structures involved in this collision and to determine how the bow could be redesigned to produce a nonpenetrating bow. This analysis was performed for the Safety Board by [redacted] Inc., a firm specializing in marine systems' analysis and design. This firm has considerable experience in performing studies on the collision resistance of ships.

Calculations of the axial strength of the SEA WITCH's bow showed that it could exert a load of 5,000 tons at various stages of crushing before the bow collapses further. This load is about 2.5 times the maximum side resistance generated by a typical tankship of this size [1/] when its side shell ruptures. A nonpenetrating bow for the SEA WITCH, therefore, would require a reduction in its crippling strength of more than 2.5 times. A feasibility analysis was made to determine if this could be achieved, given the following practical requirements:

a. The crushing of the bow should not progress beyond the collision bulkhead or beyond 1/20 of the ship's length from the stem. This would have protected the SEA WITCH from flooding and would have prevented damage to its cargo.

b. To prevent rupture of the struck tankship, the maximum impact force of the SEA WITCH's bow must be less than the maximum potential resitance of the struck tankship's side shell. Both of these forces vary with the location of initial impact, the changing imprint of the contact area, and the structural design.

c. The hydrodynamic characteristics of the bow should remain essentially unchanged.

d. The strength of the bow structure to meet all other operational requirements should not be degraded.

George C. Sharp, Inc., considered two collision situations: First, a collision impact between the struck ship's web frames, and second, a collision impact centered on a web frame.

By successive design changes with intermediate calculations to determine crippling strength at various bow crushing intervals, the firm demonstrated that it was feasible to design a nonpenetrating bow. They determined that the following design characteristics would permit a nonpenetrating bow:

1/ Because detailed structural drawings of the ESSO BRUSSELS were not available, calculations were made on a tankship of similar length and capacity, which is representative of vessels of this size.

a. The stem plate scantlings should not exceed those of the side shell.

b. The stem plate's radius should be enlarged to about 18 inches. This would not increase the ship's resistance if the waterline entrance angles are retained.

c. All flats in the peak should be eliminated where possible. Floors can replace flats as shell supporting members, floor separation can be increased, and intermediate frames can be added.

d. Decks and flats can be prebuckled. This reduces the postbuckling crushing force to about 60 percent of the critical buckling force. Depressions can be drained into scuppers and bridged over by grating.

e. Breast hooks should be minimized and should not back up the radiused portion of the stem plate.

f. The bulbous bow should project as little as possible and be ring-stiffened rather than girder-supported.

g. The heavy shell plating under the hawse pipe bolsters, which protect against the abrasive action of the anchors, must be eliminated. It can be replaced by half-round fenders cut from pipe and placed vertically.

(See Figure 2 for an isometric view of the original SEA WITCH's bow design and Figure 3 for the design of the nonpenetrating bow. To increase clarity, some of the redesigned features, such as the increased stem radius and the prebuckled decks, are not shown in Figure 3.)

In order to limit bow crushing to 1/20 of the ship's length, it was necessary to determine the limiting striking velocity which would allow the bow to absorb all of the ship's kinetic energy within that distance. For the SEA WITCH in the fully loaded condition, the limiting striking velocity was determined to be about 6.8 knots. The SEA WITCH struck the ESSO BRUSSELS at about 5 knots. If the SEA WITCH had had this nonpenetrating bow, it would have lacked

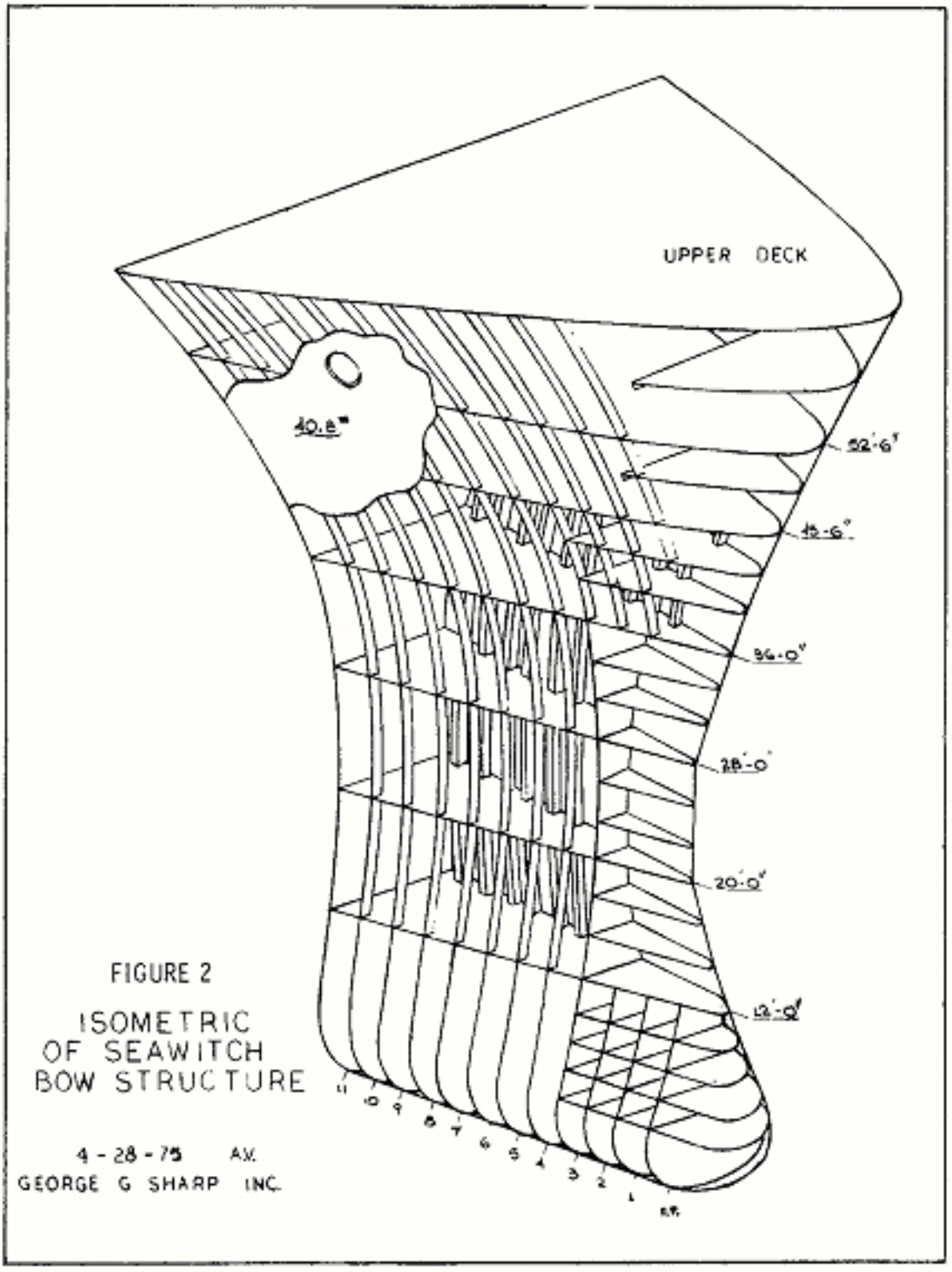
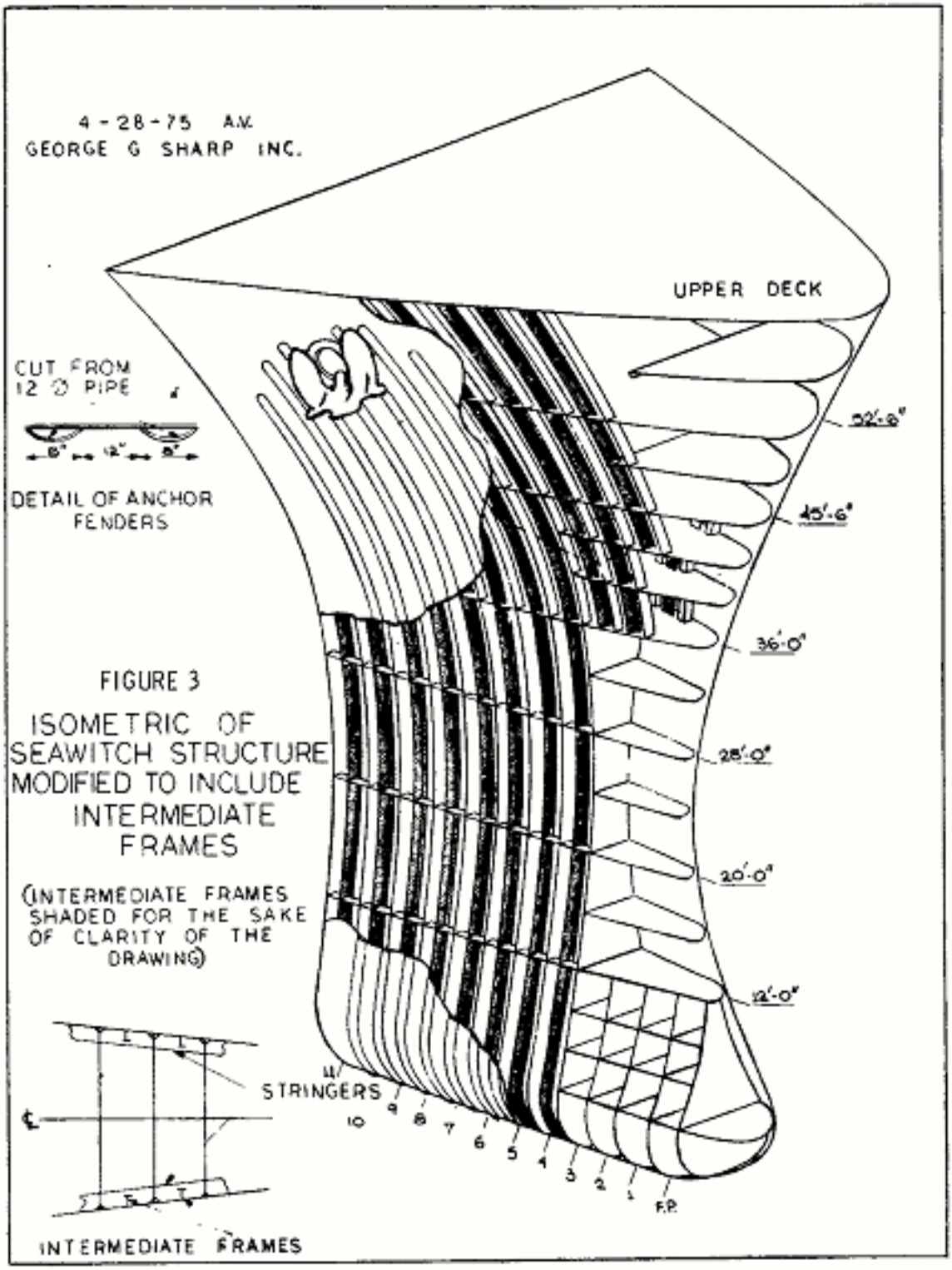


FIGURE 2

ISOMETRIC
OF SEAWITCH
BOW STRUCTURE

4 - 28 - 75 A.V.
GEORGE G SHARP INC.


4 - 28 - 75 A.V.
GEORGE G SHARP INC.
UPPER DECK
CUT FROM
12 ∅ PIPE
DETAIL OF ANCHOR
FENDERS
32'-0"
45'-6"
36'-0"
28'-0"
20'-0"
12'-0"
FIGURE 3
ISOMETRIC OF
SEAWITCH STRUCTURE
MODIFIED TO INCLUDE
INTERMEDIATE
FRAMES
(INTERMEDIATE FRAMES
SHADED FOR THE SAKE
OF CLARITY OF THE
DRAWING)
4/
STRINGERS
10
9
8
7
6
5
4
3
2
1
F.P.
INTERMEDIATE FRAMES

the axial strength to penetrate the side of the ESSO BRUSSELS, and the bow could have absorbed the energy without damage to the SEA WITCH's collision bulkhead.

This means that if the bow had been designed only for the necessary axial strength, the penetration, consequent fatalities, and property loss would not have occurred. The SEA WITCH bow design was typical; nevertheless, its unnecessary strength contributed to the accident's severity and could be corrected by engineering design and development.

The design features which produce a nonpenetrating bow do not appear to create any operational difficulties. The plating panels at the bow are proportioned in size so that the stresses from slamming are not increased. The lateral stiffness of the bow is not reduced and may even be increased because of the prebuckling of the decks and flats. The bending moment and shear stress values at the collision bulkhead are low, so even after the reduction in scantlings, the shear stresses in the side shell remain low. Assuming the SEA WITCH were equipped with the nonpenetrating bow, if it shipped 7 feet of green seas on its bow and this dynamic load was added to its static load, the shear stress in the side shell would remain moderate. The peak hydrodynamic pressure on the bow, whether at 16 knots against steep 25-foot waves or hove to in 70-foot waves, is insufficient to cause crushing of the redesigned bow. However, any head-on striking of piers would cause the ship to sustain much more damage than it does with its present bow. But since ship operators are responsible both for damage to the pier and to the ship, the damage costs borne by the ship interests probably will not increase significantly. The replacement of a bow is preferable to the catastrophic losses from fire and pollution that are possible with the standard bow.

This study was extended to determine the feasibility of producing a similar nonpenetrating bow for a tankship about the size of the ESSO BRUSSELS. This task was easier because the bows of most tankships have less rake and larger radii. The study showed that such a bow was feasible for the ESSO BRUSSELS, but more engineering testing and development will be required. Many of the calculations will need to be ascertained or confirmed by hydrodynamic and structural model tests.

The effectiveness of nonpenetrating bows in collisions will depend on long term development and on the widespread implementation of these bows.

Postaccident Plans

The Safety Board concurs with the planned Coast Guard actions concerning the change to combination fire nozzles with shutoff capability at the nozzle, the review of the suitability of hand cranked lifeboat engines, the research into general container safety requirements, and the review of methods to prevent the propagation of smoke through shipboard spaces. The Safety Board also concurs with the Coast Guard actions for improving the Intergovernmental Maritime Consultative Organization (IMCO) standard for lifeboat disengaging apparatus and with the relocation of the emergency equipment, including the oxygen breathing apparatus.

Although the Coast Guard's planned research into possible requirements to improve steering gear reliability might be highly desirable, known improvements which can produce immediate benefits should not be deferred. Assuring that there are truly "two separate and independent steering control systems...for controlling the steering gear from the pilothouse" is one such improvement.

In three previous major casualty reports,[2/] the Safety Board has recommended to the Coast Guard that it require each life preserver to be equipped with a battery-powered light. The Marine Board of Investigation in this casualty has repeated the recommendation. The progress on implementation has been exceedingly slow.

In March 1972, the Safety Board recommended[3/] that the Coast Guard, the U. S. Army Corps of Engineers, and the Office of

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2/ National Transportation Safety Board, "SS PANOCEANIC FAITH Foundering with Loss of Life North Pacific Ocean, 9 October 1967," 1 July 1969; National Transportation Safety Board, "F/V FENWICK ISLAND Capsizing in Atlantic Ocean, December 7, 1968," 18 February 1970; National Transportation Safety Board, "M/V THERESA F. Capsizing in Gulf of Mexico on 9 January 1969," 31 March 1971.

3/ National Transportation Safety Board, "Analysis of the Safety of Transportation of Hazardous Materials on the Navigable Waters of the United States," NTSB-MSS-72-2, 22 May 1972.

Emergency Preparedness jointly prepare emergency contingency plans to respond to catastrophic accidents involving hazardous materials for those waterways which carry large quantities of these materials. The Coast Guard reply of November 7, 1972, concurred with this recommendation. Since a formalized plan was described in the Safety Board recommendation, this recommendation, which has now been repeated by the Marine Board of Investigation, should have been acted upon. Further, the Commandant's current response concerning the use of conferences, seminars, and critiques for this purpose is not responsive to the original Safety Board recommendation.

The collision between the SEA WITCH and the ESSO BRUSSELS demonstrated a lack of coordination and communication among the many diverse rescue and firefighting units, particularly during the early critical hours of this disaster. Although the Coast Guard reportedly has prepared an emergency contingency plan in the event of a liquefied natural gas (LNG) or liquefied petroleum gas (LPG) ship accident, there is no similar plan for a major petroleum tankship accident.

The Safety Board has pointed out the need for a multitrack voice recorder with a time reference track that will provide information on helm orders and other audible communications in the investigation of a ship accident.[4/] The Marine Board of Investigation also has recognized this need with one of its recommendations. The Commandant's Action disagrees with the need for such equipment on the basis that few vessel casualties kill everyone immediately concerned or all those persons who are witnesses to the accident. However, the Action does acknowledge that "the tragic loss of the master and the officer on the bridge of the SS C. V. SEA WITCH at the time of the collision, seriously hampers any attempt to accurately reconstruct the events and conversations which preceded the collision." This statement of the Commandant supports the need for such equipment. There is a need for such equipment not only because of the loss of vital witnesses, but also because the knowledge and recollection of facts by witnesses is often poor.

4/ National Transportation Safety Board, "SS AFRICAN NEPTUNE: Collision with the Sidney Lanier Bridge at Brunswick, Georgia on 7 November 1972 with Loss of Life," USCG/NTSB-MAR-74-4, July 22, 1974.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause was a mechanical failure in the steering system of the SEA WITCH and the lack of adequate and timely action by the crew to control their ship after the failure occurred. The cause of the loss of steering was the deficient design of the system which did not provide "two separate and independent steering control systems" as required by 46 CFR 58.25. The cause of the fire, pollution, and deaths after the collision was that the typically designed bow of the SEA WITCH penetrated the hull of the ESSO BRUSSELS instead of absorbing the crash energy.

RECOMMENDATIONS

As a result of its analysis of this accident, the National Transportation Safety Board made 10 recommendations to the Commandant, U. S. Coast Guard. (See Appendix.)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

[redacted]
[redacted]
Acting Chairman

[redacted]
[redacted]
Member

[redacted]
[redacted]
Member

[redacted], Members, filed the following concurring and dissenting statement.

December 17, 1975

[redacted] Members, concurring and dissenting:

In our opinion, the cause of the accident is more accurately and clearly stated by the Commandant and the Marine Board of Investigation, and it should have been affirmed by the Board with the following exception:

The loss of steering could have been averted if the Coast Guard had not approved a steering system which did not meet the requirements of 46 CFR 58.25 for two separate and independent steering control systems.

Further, we do not agree, based on this record, that the design of the SEA WITCH's bow should be cited as a causal factor of the fire, pollution, and deaths following the collision. The factors which contributed to the foregoing were (1) failure of the Master and Pilot to take timely action to stop the vessel; (2) failure of the Master to utilize the emergency steering procedures; (3) the speed of the SEA WITCH, approximately 15.5 knots over the bottom just prior to impact; and (4) the inability to drop the port anchor. The design of the SEA WITCH's bow had absolutely no bearing on the cause of this accident.

It may be that if the SEA WITCH's bow had been of a different design with less axial strength, the severity of the impact may have been less; however, this is pure speculation of a highly controversial subject, and not supported by the facts of this investigation. There are no facts to support the contention that the design of the bow was deficient, inadequate, or a hazard. The Board, in our opinion, when determining the cause of a marine accident which it did not investigate, must confine its findings and determination of cause upon the record compiled by the Coast Guard. If that record is inadequate or deficient, then the Board should order the Coast Guard to reopen the record for the receipt of new and additional evidence which could then be evaluated not only by the Coast Guard but by the Parties to the Investigation.

In this case, the Board has gone outside the record and employed a private consultant to evaluate a causal factor. Such procedure is irregular and beyond the Board's statutory authority in this instance. The employment of a consultant was authorized by a 3-2 vote of the Board. [McAdams and Haley dissenting.]

If indeed the design of the SEA WITCH's bow was a causal factor, the Board should have ordered the Coast Guard to reopen the investigation and explore and evaluate whether the axial strength of the SEA WITCH's bow exceeded the normal operating requirements. If this procedure had been

followed, the Board would have been able to intelligently weigh all of the factors with respect to bow design. The Board has placed itself in the position of accepting the opinion of one expert -- an opinion which has not been tested since it was not part of the record of the investigation; the views of other marine design experts have not been considered; and the Coast Guard, responsible for the investigation, has not been given the opportunity to evaluate all of the evidence.

Despite the foregoing, the proper procedure to be followed in this case -- if the Board believed that a redesign of ships' bows was required in the interest of marine safety -- would have been for the Board to have made a separate and independent recommendation to the Coast Guard and submitted the report of the consultant in support of the recommendation that further research and analysis of this matter should be conducted.

[redacted]
Member

[redacted]
Member

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

APPENDIX

Forwarded to:

Admiral Owen W. Siler
Commandant
U.S. Coast Guard
Washington, D.C. 20590

SAFETY RECOMMENDATION(S)

M-76-1 thru 10

In 2 June 1973, the outbound SS C.V. SEA WITCH lost steering control in New York harbor and struck the anchored tankship SS ESSO BRUSSELS. The ensuing fire caused 16 deaths, one injury, and extensive property damage. In addition, nearby beaches were polluted.

The investigation of the collision showed that a mechanical failure had occurred in the steering control system. Federal regulation 46 CFR 58.25-55 requires that two separate and independent steering control systems shall be provided for controlling the steering gear from the pilothouse when the alternative steering means is not located on the after weather deck. The Coast Guard approved the steering system on the SEA WITCH even though it had two separate and independent control systems only up to the two rotary hydraulic power units in the steering gear room. From that point on, the control was a single channel system. It was in this section that the failure occurred.

Although this mechanical failure in the steering control system could not be bypassed from the bridge, the emergency steering station in the steering gear room could have provided immediate and full steering control. However, vessels entering or leaving the harbor normally do not man this station. Also, these vessels do not have established drills or alarms to prepare for the manning of the emergency steering station on short notice.

Numerous mechanical failures on the SEA WITCH's steering system were not reported to the Coast Guard. This is because the Coast Guard does not require failures to be reported when the repair costs are below $1,500. Also, a failure is not reported if it does not result in a "near accident" and its repair is considered routine, because the failure is not regarded as having affected the seaworthiness of the ship. However, the reliability of a steering system can be measured best by how often it fails, and this cannot be determined if some failures are unreported. Without these reports, faulty systems cannot be identified and corrected.

APPENDIX

Even a reliable steering system is useless when the ship's power is lost. Like other vital systems aboard ship, the steering system should be supplied automatically from the emergency generator when normal power is lost.

Except for some instruction book procedures provided by the manufacturer of a portion of the steering gear, the crew of the SEA WITCH had no established emergency procedures to guide them when steering control was lost. The master applied these instruction book procedures without success. There were other means which could have been applied concurrently to bring the ship under control, but they were not specified emergency procedures. If these other means had begun as soon as steering control was lost, the collision might have been prevented.

After steering control was lost, the danger of collision did not become evident immediately. When it did become evident, the ship was going too fast to prevent the collision. Reliance on the anchor to prevent collision in such a situation is unjustified because the anchor may not drop, may drag excessively, or the anchor gear may fail from the stresses due to the high speed.

If the bow of the SEA WITCH had not penetrated the hull of the ESSO BRUSSELS, there would have been no fire, pollution, or loss of life. Conventional bows such as that of the SEA WITCH are dangerous because of their unnecessary axial strength, which exceeds normal operating requirements. An analysis, performed for the Safety Board by a firm specializing in marine systems' analysis and design[1/], showed that a ship's bow can be designed so that if it collides with another ship at a reasonable speed, it will not penetrate the other hull and it will not damage itself beyond the collision bulkhead. This would provide collision protection against any mechanical or human failure. In addition to the safety benefits, tankship operators probably will realize economic benefits if such a bow design is adopted widely, because the defensive design required for the tankships could be reduced.

This accident and past accidents demonstrate that it is difficult to reconstruct accurately the sequence of events which lead to a casualt . There is a need for automatic recording devices which will preserve vital navigational information aboard oceangoing vessels. Such devices may also improve safety by performing the routine logging tasks which sometimes distract the deck officers.

The Marine Board of Investigation made two recommendations which the Safety Board had issued previously to the Coast Guard. Although the Coast Guard recognizes the need for these improvements, the Safety Board's initial recommendations have been only partially implemented. For example, the Coast Guard has made little progress to require each life preserver to be equipped with a battery-powered light. The Marine Board of Investigation repeated this recommendation.

1/ Conceptual Design of a Non-Penetrating Ship's Bow by George G. Sharp, Inc.

The second recommendation made by the Marine Board of Investigation which the Safety Board previously issued to the Coast Guard dealt with the need to prepare emergency contingency plans to respond to catastrophic accidents involving hazardous materials for those waterways which carry large quantities of these materials. The Coast Guard concurred with this recommendation in November 1972. However, the Commandant's current response concerning the use of conferences, seminars, and critiques for this purpose in lieu of an organized written plan with commitments by the participants is not responsive to the original Safety Board recommendation.

Therefore, the National Transportation Safety Board recommends that the U.S. Coast Guard:

1. Revise its interpretation of 46 CFR 58.25-55, which requires separate and independent steering controls, to prevent the use of a single control path up to the steering power units as was done on the SEA WITCH. (M-76-1) (Class II, Priority Followup)

2. Establish a requirement for oceangoing vessels in designated restricted waters such as New York harbor to have the emergency steering station manned. This also should apply to foreign vessels. (M-76-2) (Class II, Priority Followup)

3. Require all steering failures aboard U.S. oceangoing vessels to be reported to the Coast Guard. Such failures aboard foreign vessels also should be reported if the failure occurs in U.S. waters. (M-76-3) (Class II, Priority Followup)

4. Require that the emergency generator on future U.S. vessels provide power to the steering gear upon loss of a ship's normal electric power. (M-76-4) (Class II, Priority Followup)

5. Require all U.S. oceangoing vessels to establish written emergency procedures and alarms for loss of steering control. Emergency drills for loss of steering control should be required and logged. (M-76-5) (Class II, Priority Followup)

6. Include, as part of its speed limit stipulations for large vessels transiting New York harbor, a requirement that any vessel which loses steering control shall immediately stop or slow, and anchor as soon as it is safe to do so. (M-76-6) (Class II, Priority Followup)

7. Initiate research to develop a technical guide for the design of nonpenetrating ships' bows. The scope of protection sought as to vessel types and collision speeds should be determined by risk analysis, but should not be less than that which would protect typical modern tankers in collisions with similar vessels at a speed of 6 knots. (M-76-7) (Class III, Long-Term Followup)

8. Require the installation of an automatic recording device to preserve vital navigational information aboard oceangoing tankships and containerships. (M-76-8) (Class III, Long-Term Followup)

9. Expedite implementation of the Safety Board's 1972 recommendation to prepare emergency contingency plans to respond to catastrophic accidents involving hazardous materials for those waterways which carry large quantities of these materials. The contingency plan for New York harbor should be given priority. (M-76-9) (Class II, Priority Followup)

10. Expedite implementation of the Safety Board's recommendations to require each life preserver to be equipped with a battery-powered light. (M-76-10) (Class II, Priority Followup)

REED, Chairman, THAYER, and BURGESS, Members, concurred in the above safety recommendations. McADAMS and HALEY, Members, concurred and dissented.

[redacted]

By: [redacted]
Acting Chairman

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-MVI-3/83)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20591
PHONE:

5943/C. V. SEA WITCH
ESSO BRUSSELS
A-3Bd

15 AUG 1975

Commandant's Action

on

The Marine Board of Investigation convened to investigate circumstances surrounding the collision between the SS C. V. SEA WITCH and SS ESSO BRUSSELS (Belgium) in New York Harbor on 2 June 1973 with loss of life

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.

REMARKS

1. Concurring with the Marine Board of Investigation, the cause of the casualty was the loss of steering control aboard the SS C. V. SEA WITCH. The cause of the loss of steering control was the failure of the control shaft universal coupling connection to the differential mechanism of the steering gear.

2. Contributing to the cause of the loss of steering control were:

a. The repair to the coupling connection to the differential in which a modification was performed and a Woodruff key replaced with a square key without providing a means to secure the key in position.

b. The modification of the coupling connection to the control shaft at the rotary hydraulic power unit end of the assembly by the installation of a set screw. This positive restraint thwarted the original design which allowed axial motion through a feather key arrangement at this connection. Abnormal stresses were thus placed on control shaft and differential components and probably caused loosening, wear and the eventual failure of the differential coupling connection.

3. A factor contributing to the collision and the severity of the casualty was the failure of the master and the pilot to take timely action to stop the vessel.

4. Also considered contributory to this casualty was the failure on the part of the owners of the vessel to report repetitive steering gear failures to the Coast Guard and the action on the part of the owners in carrying out unauthorized repairs and modifications to machinery critical to the seaworthiness of the vessel. The matter of the apparent violations of law and regulations will be referred to the appropriate Officer in Charge, Marine Inspection for disposition.

5. An emergency steering procedure whereby the steering engine room is manned while the vessel is transiting congested waters may have prevented the collison. The failure of the control shaft coupling did not impair the operation of the trick wheel in controlling the rudder. An advance notice of proposed rulemaking was published in the Federal Register dated 28 June 1974 advising that the Coast Guard was considering adding requirements to the ports and waterways safety regulations. The proposed requirements included a provision for the manning of the primary steering machinery space while the vessel is operating within the confines of harbors and hazardous waterways. Public response to the notice is currently being evaluated.

6. The problem of materials with a thermal resistance less than that of steel is being examined. Materials such as bronze, brass and aluminum that are currently used in various control and containment portions of tank vessel construction are being examined by means of full scale tests and also system safety analysis. A survey of foreign requirements in this regard is being undertaken.

7. The relative ease with which the fire breached the center shell of both houses of the ESSO BRUSSELS has been reported to the IMCO Subcommittee on Fire Protection. A film report was presented which detailed the problems encountered with combustible interior divisions. As indicated in the conclusion IMCO Resolution Nos. A(213) VII and its replacement Nos. A(271) VIII would prohibit the use of combustible divisions. A similar proposal is under consideration which would require similar construction standards for cargo vessels. While this proposal does not contain the full requirements of the resolution for tank vessels, it is a significant step forward for the international community. Heretofore SOLAS 60 required relatively little structural fire protection for cargo vessels. U.S. regulations are significantly more stringent than those currently in effect internationally.

8. In an effort to improve communication during search and rescue operations. the Federal Communications Commission on 19 November 1974 issued a Report and Order which made Channel 6 (156.3MHz) available to vessels, aircraft and the Coast Guard for on-scene SAR communications. Channel 6 is an intership safety channel and it is mandatory that all U.S. vessels which are equipped for VHF-FM communications other than Bridge-to-Bridge be equipped to operate on this channel.

9. The heroic action of the many individuals and vessel units that were engaged in the rescue of survivors or fire fighting has been given special recognition by the Coast Guard. An awards ceremony was held in New York on 7 November 1974.

ACTION CONCERNING THE RECOMMENDATIONS

1. Recommendation: That the control shaft arrangement on vessels in service fitted with similar steering gear be specifically examined to ensure that the conditions which were the primary cause of this casualty do not exist.

Action: U. S. vessels having similar steering gear were identified and the owners were notified on 13 June 1973 of the possibility of defects in the control shaft assembly. Also, on the same date, all Coast Guard Marine Inspection Units were notified by ALDIST 161. The American Bureau of Shipping was notified and the information was also published in Notice to Mariners releases. Subsequently, the steering gear of all the vessels was examined by Coast Guard marine inspection personnel.

2. Recommendation: That the Commandant initiate a review of current approved design and construction standards of steering gear control systems to determine if the single system of linkage aft of the rotary hydraulic power units in the steering engine room, as was installed aboard the SS C. V. SEA WITCH, meets the intent of duplicity of steering gear control.

Action: The steering gear system as installed aboard the SS C. V. SEA WITCH meets the requirements of duplicity as required by 46 CFR 58.25-25. However, the importance of steering gear reliability is recognized and research is being started into possible requirements which may include additionaly reliability factors in steering systems.

3. Recommendation: That the Commandant amend applicable regulations to require that approved combination fire hose nozzles providing straight stream, high velocity fog and shut off capability be installed at all fire stations.

Action: Concur. Action has been initiated to amend the regulations to require combination solid stream and water spray fire hose nozzles at all fire hose stations.

4. Recommendation: That in view of the inability to start the SS ESSO BRUSSELS lifeboat engine the Commandant review the requirements and the suitability of lifeboat engines that only have hand crank starting capability.

Action: Concur. The matter of the means of starting lifeboat engines is under study and various methods and test results are being evaluated.

5. Recommendation: That a survey of the cargo, location of containers, hazardous cargo and other container or cargo characteristics on board the SS C. V. SEA WITCH be conducted to document the condition of the containers and cargo after the fire. The information obtained can be used to check the adequacy of existing container construction standards, sufficiency of container identification, cargo identification and possible need for additional shipboard fire protection standards in view of the rapid spread of fire through the containers during the fire.

Action: All containers on deck and within the holds were surveyed and a systematic documentation of their location and contents and the condition of the containers and their contents was made. Research into general container safety requirements is currently being conducted under a Coast Guard contract. Container fire tests are being conducted at the U. S. Coast Guard Fire and Safety Test Facility, Mobile, Alabama.

6. Recommendation: That speed control of vessels transiting the main channel of New York Harbor be initiated. A requirement for vessel to proceed at a speed sufficient for safe navigation and yet to provide a margin of safety, to maneuver or take corrective action to prevent or reduce the effects of a casualty in the event of difficulty warrants urgent consideration. This is particularly urgent since vessels using New York Harbor must pass through or adjacent to anchorages where large bulk carriers are anchored and at times off-loading hazardous materials into barges alongside.

Action: Coast Guard Captain of the Port, New York has forwarded recommendations to Coast Guard Headquarters concerning speed limits in New York Harbor. The matter is being considered. Also under review are proposed changes to the regulations concerning the anchorages in the area.

7. Recommendation: That further study be conducted to develop methods whereby the spread of smoke within the interior of burning vessels could be prevented. Ventilation systems should be designed to provide manual or automatic means to not only prevent the spread of fire but also the spread of smoke.

Action: The applicable regulations (46 CFR 92.15-10(a)) do require a means to close off all vents and ventilators. The U. S. Coast Guard is monitoring a U. S. Navy study being conducted at the Navy Research Laboratory concerning the propagation of smoke through shipboard spaces. One method under consideration is the establishment of zones in which the atmosphere is maintained at an elevated pressure thereby excluding smoke.

8. Recommendation: That the applicable regulations for all vessels in ocean and coastwise service be amended to require that each life preserver be equipped with a water proof battery powered light and that retroreflective material be required on all life preservers.

Action: The Coast Guard has purchased a quantity of several types of lights and has made arrangements with a steamship company operating on routes in various climate zones for a test program. The lights are being placed on life preservers on several ships and will be checked periodically to determine serviceability.

The Maritime Safety Committee of the Intergovernmental Maritime Consultative Organization (IMCO) has proposed a recommendation that governments should encourage owners of all vessels to fit retroreflective material on lifesaving applicances and to report on any experiences. The Coast Guard has advised the manufacturers of approved lifesaving equipment that they may use retroreflective material on the equipment. The Coast Guard has conducted tests using persons in water wearing life preservers fitted with retroreflective tape. These test observations, reports by other governments, and experiences in the use of other methods of improving detectability are being evaluated.

9. Recommendation: That the Commandant initiate efforts through the International Convention for the Safety of Life at Sea to require that all lifeboats for vessels in ocean or coastwise service be equipped with mechanical disengaging apparatus which will simultaneously release both boat falls from the boat when under tension.

Action: Chapter III of the International Convention for the Safety of Life at Sea, 1960, is being considered for complete revision by the Subcommittee on Lifesaving Appliances of IMCO and the matter of disengaging apparatus for lifeboats will be one of the areas under consideration. Mechanical disengaging apparatus for lifeboats is required for U.S. vessels.

10. Recommendation: The stowage location of the oxygen breathing apparatus and emergency equipment should be carefully considered. Emergency equipment should be stowed above weather decks in the interior of the forward and after superstructures where they may not be isolated by collision, fire, or smoke and will be accessible from several avenues.

Action: An amendment to the International Convention for the Safety of Life at Sea, 1960, requiring fireman's outfits which include oxygen breathing apparatus and other emergency equipment to be stowed convenient for use in widely separated accessible locations has been made. This was supported by the United States. Draft regulations have been prepared and are being considered within the regulatory rule making procedure.

11. Recommendation: That the District Commander with officials representing local, federal governmental and marine commerce review the adequacy of contingency plans to effectively coordinate all resources to minimize effects of large catastrophies that may occur in New York Harbor.

Action: Concur. The use of conferences, seminars and critiques for this purpose is described in Section 0615 of the Coast Guard Addendum to the National Search and Rescue Manual (CG-308).

12. Recommendation: That the Commandant should consider the feasibility of a requirement for merchant vessels for a recording device, similar to that installed on commercial aircraft, that will preserve vital information subsequent to fire or submergence.

Action: The primary purpose of a flight recorder is to reconstruct events in the case of a non-survivor crash. Unlike the aircraft accident, very seldom are there vessel casualties that kill everyone immediately concerned or those persons that are witnesses to the accident.

It is agreed that in certain incidents a record of courses and speed changes and certain other operational functions would provide facts which would assist in determining the cause of the casualty. However, the number of incidents where such information would lead to improved vessel safety is not considered sufficient to justify the cost of providing and maintaining the equipment necessary to record and protect the information.

13. Recommendation: That further investigation under the Suspension and Revocation Proceedings be initiated in the case of Chief Mate, Max R. Stirn, License No. [redacted] in that he failed to have the port anchor clear for letting go.

Action: This matter has been forwarded to the appropriate Officer in Charge, Marine Inspection for disposition.

14. Recommendation: That a copy of this report be forwarded by the Commandant to the state pilot commission for further action on their part against the state license of Pilot John T. Cahill, in accordance with the agreement with the American Pilot's Association, since the SS C. V. SEA WITCH was sailing under registry at the time of the casualty and the pilot was serving under the authority of his state license.

Action: A copy of the report will be forwarded to the state pilot commission for their information. It should be noted that the Coast Guard agreement with the American Pilots' Association has been abrogated.

It must be borne in mind that the tragic loss of the master and the officer on the bridge of the SS C. V. SEA WITCH at the time of the collision seriously hampers any attempt to accurately reconstruct the events and conversations which preceded the collision.

On the basis of the facts as known, it would appear that the pilot's actions in response to the sudden emergency i.e. his blowing of whistle signals (danger), and his orders directing the engine full astern and to drop the anchor were proper and all that would be expected of a pilot in

that situation. The apparent tardiness of the action to order the engine reversed is extremely regrettable. However, it is considered that this was an error in judgement rather than a matter of negligence.

[redacted]

O. W. SILER
Admiral, U. S. Coast Guard
Commandant

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5943/SS C.V. SEA WITCH/
SS ESSO BRUSSELS Marine
Board of Investigation
31 January 1974

From: Marine Board of Investigation
To: Commandant (G-MVI-3/83)

Subj: SS C.V. SEA WITCH O.N. 516197, SS ESSO BRUSSELS of Belgian Registry; collision and fire 2 June 1973 in New York Harbor with loss of life

FINDINGS OF FACT

1. On 2 June 1973, at about 0042 EDST, the outbound American Cargo Ship SS C.V. SEA WITCH experienced a loss of steering control, veered out of the channel, and collided with the laden and anchored Belgian Tankship SS ESSO BRUSSELS at Federal Anchorage 24, Stapleton, Staten Island, New York (C&GS Chart 541). The collision caused major structural damage to the bow of the SS C.V. SEA WITCH. The rupture of three cargo tanks containing Nigerian crude oil on the SS ESSO BRUSSELS resulted in an intense fire that totally engulfed the two ships for about one hour. The Master and two crew members on the SS C.V. SEA WITCH died on board during the aftermath following the collision. The Chief Engineer of the SS C.V. SEA WITCH received severe burns to his hands, arms and face resulting in his being incapacitated for a period in excess of 72 hours. The Master of the SS ESSO BRUSSELS and ten crew members died as a result of drowning or burn related injuries after abandoning ship, one crew member died on board and one crew member remains missing.

2. Description of Vessels Involved:

Name:	SS C.V. SEA WITCH	SS ESSO BRUSSELS
Official Number:	516197	ONET (Belgian) S.A.
Service:	Freight (Container)	Tankship
Gross Tons:	17,902	25,906
Net Tons:	12,898	19,782
Length:	594.2	677.4
Breadth:	78.2	97.3
Depth:	49.5	49.2
Propulsion:	Steam	Steam
Horsepower:	17,500	16,500
Year Built:	1968	1960
Homeport:	New York, New York	Antwerp, Belgium
Owner:	American Export Lines, Inc. 26 Broadway New York, New York	Esso Marine (Belgium) S.A. Frankrijklei 101 Antwerp, Belgium

Operator:	Owner	Owner
Master:	John L. PATERSON [redacted] Upper Montclair, New Jersey	Constant DERT 37-9830 Sint Matens Latem Twee Oreven, Belgium
Certificate of Inspection:		
Last Inspection:	Biennial	Annual
Date:	13 January 1973	3 April 1973
Place of Issue:	New York, New York	Antwerp, Belgium
Document:	Certificate of Registry Permanent Number 30 New York, New York	Letter of Registry No. Z.K. 65 Antwerp, Belgium
Issued:	24 September 1968	September 1967
Draft:		
Forward:	24'06"	Mean: 38'00"
Aft:	30'00"	

3. Personnel:

a. SS C.V. SEA WITCH - Known dead:

Name: William R. LALIBERTE
Wiper Z-481109
SSN:
Address: [redacted]
Manchester, New Hampshire 03103
NOK: Sister - [redacted]

Name: Marko LOVSIN, License [redacted]
Third Mate
SSN:
Address: [redacted]
Plainfield, New Jersey 07060
NOK: Wife - [redacted]

Name: John L. PATERSON, License [redacted]
Master
SSN:
Address: [redacted]
Upper Montclair, New Jersey 07042
NOK: Unknown

b. SS C.V. SEA WITCH - Injured in excess of 72 hours:

Name: [redacted] License [redacted]
Chief Engineer
SSN:
Address: [redacted]
Allentown, Pennsylvania 18100

c. SS ESSO BRUSSELS - Known dead:

Name: Leo BEELAERT
Fifth Engineer
Address: [redacted]
Lede, Belgium

Name: Constant Robert DERT
Master
Address: [redacted]
Twee Dreven, Belgium

Name: Manuel LEIS CANLE
AB - Wiper
Address: [redacted]
La Coruna, Spain

Name: Francisco MARTINEZ RIVAS
AB - Wiper
Address: [redacted]
Pontevedra, Spain

Name: Bertil Alaim Marie OTTO
Steward
Address: [redacted]
Antwerp, Belgium

Name: Francisco OUBINA PORTAS
Pumpman
Address: [redacted]
Pontevedra, Spain

Name: Alois Maria Lodewijk PEETERS
Boatswain
Address: [redacted]
Antwerp, Belgium

Name: Gisele AUBERTINAY-ROME
Stewardess
Address: [redacted]
Lamoura, France

Name: Rene Jean Victor ROME
First Steward
Address: [redacted]
4000 Liege, Belgium

Name: Laidi Ben Lachmi TAJI
Fourth Engineer
Address: [redacted]
Schoten, Belgium

Name: Francisco VILLAVERDE PEREZ
Steward [redacted]
Address: [redacted]
Pontevedra, Spain

Name: Jacob Johannes Pieter WILLEMSEN
AB - Wiper [redacted]
Address: [redacted]
Antwerp, Belgium

d. SS ESSO BRUSSELS - Missing:

Name: [redacted]
AB - Wiper [redacted]
Address: [redacted]
Minho, Portugal

4. Weather Data:

The weather prevailing at the time, date and location of the casualty was as follows:

Wind Direction:	Westerly
Wind Force:	8 Knots
Air Temperature:	65°F.
Sea Water Temperature:	61.5°F.
Barometer:	29.94"
Visibility:	Over 10 Miles
Sea Height:	Calm
Current:	2.4-2.6 Knots (Ebbing)

5. SS C.V. SEA WITCH Outbound Voyage and Collision:

The SS C.V. SEA WITCH departed Howland Hook Container Terminal on Staten Island at 2329, 1 June and proceeded to sea around the northern end of Staten Island by way of Kill Van Kull. The vessel was under the control of a Docking Pilot with two Moran Company tugs in attendance until the vessel reached a point near New Brighton, Staten Island, where the Harbor Pilot, Captain John T. Cahill, relieved the Docking Pilot. The engine was placed on slow ahead, 20 RPM at 0023 to slow the vessel and permit the Docking Pilot to disembark onto one of the assisting tugs. The vessel's speed was increased to half ahead at 0025 and the Harbor Pilot ordered a course of 109° True coming out of Kill Van Kull on Constable Hook range.

The normal maneuvering speeds used during harbor transit were 20 RPM slow, 40 RPM half, and 60 RPM full speed ahead. The astern speeds were 20, 40 and 55 RPM. Calculations using the pitch of the vessel's

propeller indicate that the vessel will attain a speed of advance of approximately 4.7 knots at slow speed, 9 knots for half speed and 13.4 knots for full speed.

In addition to the Pilot, Captain Cahill, the Master, John Paterson; Third Mate Marko Lovsin; Helmsman, Able Seaman [redacted]; and Deck Cadet [redacted] were on the bridge of the SS C.V. SEA WITCH.

The fo'c'sle and anchor windlass were manned by Chief Mate Max Stirn, Boatswain [redacted], and Lookout [redacted] The port anchor pawl was down and jammed against a link of the anchor chain and unable to be raised. The riding pawl on the starboard anchor was down resting against the chain and was able to be raised. Both anchors were fitted with chain stoppers which passed through the large anchor shackles. The freedom of the anchor pawls was not checked after undocking, however, the stopper chains were loosened with the pelican hooks engaged so that they could be easily released. Both anchors were housed in the hawse pipe. During the in port period prior to sailing, a defective windlass bearing had been replaced by shoreside mechanics.

In the engine room of the SS C.V. SEA WITCH on departure from Staten Island the regular watch was supplemented alternately by the Chief Engineer or the First Assistant at the operating console. Routine tests of steering equipment, steering controls and communications systems were conducted prior to departure. All machinery was operational except the bow thruster and the pilothouse engine room control system. Control of the main engine was being accomplished by conventional engine order telegraph as had been the practice in recent months.

At 0029 the vessel's speed was increased to harbor full and four to five minutes later the vessel's course was changed to 167° True to transit the channel towards the Verrazano-Narrows Bridge. Buoy 22 (LL 1595) was passed 700 to 800 feet off to port at about 0036. Four vessels were observed on the starboard hand in Stapleton Federal Anchorages 23 and 24. The SS ESSO BRUSSELS was the last vessel and was anchored nearest to the Verrazano-Narrows Bridge. One tug and tow proceeding outbound was passed on the starboard hand. The Pilot ordered a course change to the left to 158° True and at about 0037½ the Helmsman reported to the Captain, that the ship was not steering. The vessel started drifting very slightly to the right and the Pilot ordered hard left rudder. The Master immediately proceeded to the helm, verified the loss of steering, and was heard to exclaim "that damn steering gear again." He transferred from the starboard to port steering system which had no affect on restoring steering control. The steering power alarm on the bridge had not sounded. The vessel was still on full ahead as the right swing accelerated. The SS C.V. SEA WITCH passed about 150 feet ahead of the Tug BARBARA MORAN with the barge O.D. No. 1 in tow alongside as the vessel cut out of the channel at a point about one half mile distant from the anchored SS ESSO BRUSSELS. The Pilot commenced blowing a series of short rapid blasts on the whistle and then locked the whistle to sound continuously. The bow

of the SS C.V. SEA WITCH first appeared to be heading astern of the SS ESSO BRUSSELS and as the heading of the SS C.V. SEA WITCH lined up with the stern of the SS ESSO BRUSSELS at about 0041 the Pilot ordered the engine full astern, the port anchor let go and the general alarm rang but the swing continued rapidly to the right and the vessel headed toward the middeck between the forward and after houses of the SS ESSO BRUSSELS. The Chief Mate and the Boatswain attempted to let go the port anchor but were unsuccessful due to the jammed pawl and then on their own initiative immediately released the starboard anchor. They were able to raise the starboard pawl, release the chain stopper and windlass brake but the starboard anchor did not run and after impact the anchor was found lying on the deck of the SS ESSO BRUSSELS.

During the outbound transit the SS C.V. SEA WITCH was monitoring Channel 13 on the bridge and the Radio Operator was monitoring Channel 16 in the radio room. The Pilot of the S.S. C.V. SEA WITCH exchanged passing information with an overtaken tow while en route from St. George to the Narrows on his portable radio set on Channel 13. Moments before the collision the Pilot of the Tug RODERICK McALLISTER overheard radio communications on Channel 13 while in a position off St. George, Staten Island, to the effect "all vessels keep clear of the SEA WITCH she's lost her steering." The Captain of the Tug JANE McALLISTER heard on Channel 10 "two ships are about to have a collision in the Narrows." He then immediately shifted to Channel 13 at which time he heard Mayday, Mayday, the Container Vessel SEA WITCH has lost steering and is going to have a collision. The Pilot of the SS C.V. SEA WITCH testified that he did not originate these communications or have knowledge of these communications being sent.

When the vessel was about 200 feet away from the SS ESSO BRUSSELS, the Pilot advised the Master to clear the bridge and get the Mate off the bow. The entire bridge watch ran down the ladder to the next deck below the bridge when the impact of the collision was felt.

At about 0039 the Chief Engineer while proceeding to his stateroom heard the ship's whistle and general alarm and immediately ran back to the engine room. Upon arrival, he saw that the engine room was answering an astern bell which was logged in the engine room bell book at 0041. The shaft RPM indicator was observed by the Chief Engineer at 35 to 40 RPM astern and increasing. Shortly thereafter the Chief Engineer felt the impact of the collision. The engine room started to fill up with smoke and he secured the engine room ventilation supply and exhaust fans and returned to the operating console. About a minute later the Chief Engineer received a telephone call from Captain Paterson who inquired as to the status of the main plant and he advised the Captain that the engine was still at full astern. The Master ordered the engine full ahead and after answering this engine order, the Chief Engineer telephoned Captain Paterson that the engine room had to be abandoned because of the smoke rapidly filling the space. The Master then ordered full astern, which was accomplished and the remaining engineering personnel

abandoned the engine room and joined the remainder of the crew in and about the after deckhouse. Prior to abandoning the engine room, Assistant Engineer, George Meixner, started the forward pump room auxiliary fire pump from the remote operating controls at the main engine control console. The smoke was rapidly being drawn into the engine room by the negative pressure created by the boilers' force draft fan intakes. The main plant on automatic control was still backing and was lost about eight or nine minutes after the collision. The emergency generator automatically cut in, providing electric power for emergency lighting and power for the emergency fire pump. This generator ran for two days after the collision.

The entire fo'c'sle and bridge watch ran aft on the port side of the ship with the fire on the surface of the water following rapidly behind them. Other personnel who were berthed in the forward deckhouse were awakened by the ship's whistle and general alarm and also ran aft along the same route. Within minutes fire and smoke engulfed the ship, igniting containers, exterior paint and combustible material. The air was filled with fire draft blown debris. A portion of the crew congregated on the port after quarter of the vessel in an attempt to avoid the fire and smoke, but were subsequently forced to take shelter inside the after house.

The bow of the SS C.V. SEA WITCH made contact with the starboard side of the anchored SS ESSO BRUSSELS at an angle of approximately 60° to the starboard bow. The area of impact was in way of number 7 and 8 starboard cargo tanks. The lower portion of the SS C.V. SEA WITCH bow penetrated the hull of the SS ESSO BRUSSELS, and that portion of the SS C.V. SEA WITCH bow above the main deck of the SS ESSO BRUSSELS overrode the deck severing number 8 starboard tank top and the starboard king post. The vessels remained locked together until approximately 0630 when they were separated by the Tug GRACE McALLISTER.

Upon impact both vessels locked together began to drift toward the Narrows in the 2.5 knot strong ebb current. Both vessels were being restrained by the port anchor of the SS ESSO BRUSSELS which was only partially holding in the current conditions which existed. Oil from the ruptured tanks on the SS ESSO BRUSSELS spread on the surface of the water aided by the tide, slight wind and the astern propeller wash of the SS C.V. SEA WITCH. The oil caught fire on initial impact and the high flames engulfed both vessels within minutes of the collision. Flames from the burning vessels which drifted under the Verrazano-Narrows Bridge in approximately midchannel extended up into the lower levels of the bridge. Vehicular traffic crossing the bridge at the time of the incident was stopped, and there is no evidence of any persons or vehicles being damaged by the flames. A closed circuit traffic surveillance camera and cable, a remote temperature sensor and transmitter, two lamp post luminaires were damaged and some scorching and discoloration of the underside of the roadway did result from the incident. The vessels continued to drift with the SS ESSO BRUSSELS' anchor still ranging forward until they grounded in Gravesend Bay with Coney Island Light (LL 1590) bearing 312° True at a distance of 1660 yards.

6. SS C. V. SEA WITCH Aftermath and Survival:

The Chief Engineer and a few crew members, after being advised by the Master in the after superstructure, that they had collided with a tanker, went forward on the port side in an attempt to assess the situation. The group went athwartships between rows of containers and when they were close to the starboard side, a flare-up occurred during which time the Chief Engineer, who was in the lead, suffered severe burns to both arms, hands and his face. These men after returning to the after deckhouse also assisted in fire fighting and survival efforts.

The only fire fighting equipment utilized was the 1½ inch interior hoses equipped with straight bore nozzles. These hoses were used to direct streams of water to cool exterior doors and to gain a supply of fresh air by sweeping adjacent areas of the weather deck to drive the fire and smoke away from the partially opened doors. They were considered, by the crew, to be ineffective in providing a protective screen of water. The exterior fire hose stations equipped with 2½ inch hoses were all inaccessible due to the heat and flames and were not able to be used. The fire main lost pressure and became ineffective about ten minutes prior to the crew abandoning ship.

The Boatswain and several crew members who were on the after deck went below to the carpenter shop to break out and distribute additional life preservers and take shelter. When the smoke below deck became dense, and upon realizing that there was only one means of escape from the space, they went up to the weather deck and took refuge with the remainder of the crew in the after deckhouse. The Chief Mate cautioned the crew to remain with the ship and not jump overboard; however, seven crew members who were wearing life preservers jumped overboard from the boat deck and upper deck and were subsequently rescued.

Some members of the crew went below to the main deck starboard side passage which connected the fore and aft part of the vessel. Upon opening the partition door to the passageway flames and smoke were sighted. The emergency gear lockers which contained oxygen breathing apparatus and spare recharges were located aft in the starboard main deck passage and forward in the port main deck passage. Both lockers were inaccessible because of the smoke and flames. A few crew members used water soaked clothing and towels to filter smoke from the air to assist in breathing as they moved about in the passageways. Lighting provided by normal or emergency power was virtually ineffective for illumination or to indicate exit corridors because of dense smoke. An explosion occurred in the vicinity of the stairway in the after athwartships passageway of the upper deck. The force of the explosion was sufficient to knock down several crew members who were in the vicinity of the stairway on both the boat deck and upper deck. The explosion at first thought to be caused by exploding nitrogen cylinders located in the vicinity was probably caused by the sudden stress deformation of bulkhead paneling surrounding the stairway. Shortly after the explosion, a crew member, William Laliberte, was observed lying on the port side of the athwartships passageway on the boat deck.

All personnel on board were assembled in the after house. During some periods portions of the crew were able to go on the weather decks. During the initial stages some of the crew gathered on the port side of the boat deck and when the flames and heat became intense they retreated into the deckhouse. The smoke and heat within the interior of the deckhouse worsened as time passed and the crew eventually congregated on the upper deck as the main deck, boat deck and cabin deck became untenable. The Master was observed to collapse outside of the after deckhouse on the port side of the upper deck and immediate examination detected no sign of life. When rescue craft were observed through the weather doors crew members used flashlights to attract their attention and just prior to rescue at about 0145 the Fireboat FIREFIGHTER while extinguishing flames on the SS C.V. SEA WITCH was able to clear a path through the smoke and fire which permitted them to effect rescue of the 31 persons on board.

7. Rescue Evolution:

The conflagration enveloped both vessels within moments of the collision. Flames were first observed in the area of the impact and the flames spread on the water at a rapid rate affecting immediately the starboard side of the SS C.V. SEA WITCH and the starboard side of the SS ESSO BRUSSELS.

Rescue craft consisting of commercial tugs, New York City Fireboats, New York City Police Launches, the U.S. Army Corps of Engineers Patrolboat, Coast Guard floating units, and three Coast Guard helicopters rushed to the scene upon receiving notification on radio telephone Channel 13 (bridge to bridge), Channel 16 (disaster and calling, intership and ship to shore) or commercial frequencies used between tugs and dispatchers. The police launches used separate FM communications, and the New York City Fireboats utilized Channel 13 and five special municipal frequencies. On scene communications between ships were, in the main, conducted on Channel 13. The communications on Channel 13 were heavily burdened by conversational traffic between tugs maneuvering to pick up survivors or to position themselves for fire fighting and passing of general information relative to maneuvering in the area of the disaster. Some voice traffic exchanging marine bridge to bridge information between vessels in other parts of the harbor was heard. Radio communications on Channel 13 during the disaster were not controlled.

The rescue efforts by vessels in the vicinity although not totally coordinated were effective in the saving of many survivors. The strong outgoing current caused debris, survivors and victims to drift out of the Narrows toward the Gravesend Bay area. The dark night background prevented easy location of survivors in the water. Although the life preservers worn by survivors were of international orange color some were discolored by oil and difficult to see even with the use of searchlights. Life preservers from both vessels were not fitted with lights or retroreflective material. The life preservers worn by crew members

of both vessels were fitted with whistles but if used they were not heard by rescue vessels. Crew members mainly attracted attention by yelling and flailing their arms and all survivors except one were wearing life preservers when rescued. Many of the victims were wearing life preservers when their bodies were recovered. Whether all of the deceased recovered from the water wore life preservers cannot be determined.

Most crew members who attempted to swim from both vessels were rescued outside the perimeter of the fire which initially extended about 200 yards around both vessels. One crew member was saved by a New York City Police Patrolman who entered the water to effect rescue at the fire perimeter between patches of burning oil. Several crew members were saved at the fire perimeter by tugs whose bow fenders scorched as they maneuvered in the vicinity.

Distant observers and many rescue boats which first arrived on scene were not aware that two vessels were locked together until a considerable period of time had passed. The Fireboat FIREFIGHTER, first to arrive on the scene, attempted to quench the flames of both vessels which were afire from stem to stern. All the deck containers on the SS C.V. SEA WITCH appeared to be on fire and the sound of many minor type explosions were heard. As the Fireboat FIREFIGHTER sprayed the flames on the starboard side and came around the port quarter of the SS C.V. SEA WITCH, a deckhand reported seeing a flashing light on the stern. The Fireboat FIREFIGHTER approached the stern of the SS C.V. SEA WITCH and the bow was held in position by maneuvering the engines.

About an hour after the collision the crew of the fireboat raised two ladders to the upper deck rail and thirty members of the crew and the Pilot descended to the fireboat. A few crew members lowered themselves by means of a fire hose secured to the deck rail. Before the Chief Mate departed the vessel he lowered Captain Paterson's body to the waiting fireboat. The fireboat with the survivors left the side of the SS C.V. SEA WITCH after the last person on the upper deck came aboard. Unknown to the rescuing fireboat, Mr. [redacted], the Electrician, remained in the emergency generator room at his assigned fire station. He was rescued about an hour later by the Tug BRIAN McALLISTER, whose personnel sighted him through the emergency generator room port hole. Three of the tug's crew members boarded the vessel by ladder up to the boat deck, broke out the port hole glass, and assisted Mr. [redacted] to safety.

A total of 38 persons from the SS C.V. SEA WITCH and 26 persons from the SS ESSO BRUSSELS was rescued. The New York City Fireboat FIREFIGHTER saved thirty one persons and the tug BRIAN McALLISTER saved one person from on board the SS C.V. SEA WITCH. The Tug GRACE McALLISTER saved eleven persons and the Tug TEXACO FIRE CHIEF saved seven persons. The U. S. Army Corps of Engineers Patrol Boat SENTRY, the New York City Police Launch No. 1 and No. 8, the Tug DOROTHY McALLISTER, the Tug JANE McALLISTER, the Tug RODERICK McALLISTER, the Tug LESTER J. GILLEN and the M/B NIMROD, N. J. 7130A participated and saved nine persons from the water.

Survivors were taken either to the Quarantine Station Pier on Staten Island or the 69th Street Pier, Brooklyn, N. Y., where they were taken to local hospitals for observation and treatment and most were released shortly after being examined.

Upon receiving first telephone notification of the casualty, the Captain of the Port Duty Officer, Governors Island, New York, dispatched a 40 foot patrol boat to the scene which arrived at about 0120. Other units, including Coast Guard harbor tugs were alerted and dispatched. The Acting Captain of the Port was notified and proceeded to the site of the casualty assuming on scene commander duties upon arrival about 0140. About 0215 a safety broadcast was made by the Captain of the Port closing the main channel to traffic. At about 0400 a representative of American Export Lines, Inc., delivered cargo manifests to the on scene commander who, after reviewing the dangerous cargo manifests, determined that the SS C.V. SEA WITCH did not contain any extremely hazardous materials but did have a large quantity of flammable cargo on board. The New York City Fire Chief on scene was advised and later a decision was reached with the fire department officials that no attempt to separate the vessels should be made before dawn. The vessels were separated at about 0630 and the cargo tank fire on the SS ESSO BRUSSELS in way of the collision damage was easily extinguished, but the fire in the deckhouses continued to burn. The main channel was opened to one way traffic about 0700 under supervision of patrolling Coast Guard Cutters. A Coast Guard security zone was subsequently set up around both vessels which were aground in Gravesend Bay while fire fighting efforts continued.

The SS C.V. SEA WITCH developed a port list before the vessels were separated. The starboard anchor of the SS C.V. SEA WITCH was lying on the deck of the SS ESSO BRUSSELS and slipped into the water as the vessels were separated. The SS C.V. SEA WITCH was towed stern first toward Gravesend Bay until the starboard anchor became taut. The anchor chain was severed and the SS C.V. SEA WITCH was beached. An anchor from the SS ESSO BRUSSELS was attached to the remaining anchor chain of the SS C.V. SEA WITCH to provide an efficient anchoring arrangement. A decision was reached the next day between fire officials and the Captain of the Port, New York, to limit the amount of water introduced into the SS C.V. SEA WITCH to preclude the possibility of capsizing as a port list of 18-20 degrees had developed. This decision limited the fire fighting effort to extinguishing flare-ups in deck containers and cooling the exterior of the hull.

Many Coast Guard and commercial tugs with fire monitoring equipment lined up alongside the SS C.V. SEA WITCH in an attempt to extinguish the container fire. The capacity of the combined monitors was relatively ineffective. The most effective fire fighting of the container fire was accomplished by the New York City Fireboats fitted with several high pressure monitors. The container fire aboard the SS C.V. SEA WITCH continued to burn for about two weeks following the casualty. The fire within the number 2 cargo hold was extinguished by CO2 flooding. Examination of the cargo holds after the fire was extinguished revealed considerable flooding water.

Subsequent to the collision, and after extinguishment of the major fires aboard the SS C.V. SEA WITCH, boarding parties from the New York City Fire Department and the Coast Guard located two bodies aboard the vessel. The body of William Laliberte, Wiper, was found lying in a prone position in the after athwartship boat deck passageway of the after superstructure. The body of Marco Lovsin, Third Mate, was found lying in a prone position near the foot of the ladder on the main deck level in the vicinity of the carpenter shop.

8. SS ESSO BRUSSELS Inbound Voyage and Anchorage:

The SS ESSO BRUSSELS departed Bonny, Nigeria, on 18 May 1973 en route New York, New York, after loading 319,402 U. S. barrels of light Nigerian crude oil. The crude oil cargo flash point was undetermined, however, being unrefined, the cargo probably contained a percentage of volatile substances whose flash point extended over a wide range. The cargo had a specific gravity of .8381 @ 60°F. The cargo was being shipped from Shell-BP Petroleum Development Company of Nigeria, LTD, to the EXXON Corporation at Bayway, New Jersey. Loading ullages were as follows:

TANK	PORT	CENTER	STARBOARD
No. 1	MT	3'7"	36'7"
No. 2	3'5"	3'7"	3'5"
No. 3	3'3"	3'7"	3'2"
No. 4	3'3"	3'6"	3'2"
No. 5	MT	3'7"	MT
No. 6	3'1½"	3'6"	3'5"
No. 7	3'1½"	12'4¼"	3'2½"
No. 8	3'1½"	3'7"	3'2"
No. 9	4'4½"	3'6"	3'3½"
No. 10	3'2½"	3'6½"	3'3"
No. 11	3'1½"	3'6"	3'4"

At about 1800, 31 May, upon arrival at the Port of New York, the SS ESSO BRUSSELS anchored at Stapleton Federal Anchorage 24, off Staten Island awaiting company arrangements for offloading and berthing instruction. The vessel was anchored in about 74 feet of water using the port anchor and four shots of chain. The position was fixed by the Mate on watch on the morning of the collision using radar ranges at 40°36'46" North, 74°03'17" West. On 1 June, between 1755 and 1900, a portion of the cargo in number 2 center tank was offloaded into a barge to an ullage of 28 feet, 6-2/3" to attain a lighter draft for berthing.

Federal Anchorage 24 which is designated on the U.S.C.&G.S. Chart Number 541 as a Quarantine Anchorage and provides that vessels shall clear the area after being granted pratique. Title 33 CFR, Part 110.155(d)(7) describes the boundary of Anchorage 24. Captain of the Port, New York, Navigation Order 4-73 published in Notice to Mariners Number 14 dated 4 April 1973, extended the period of permissible anchorage in Anchorage 24 for vessels having an entering draft of 35 feet or greater. The Notice also temporarily relocated the eastern and southern boundaries of the anchorage.

9. SS ESSO BRUSSELS Collision and Survival:

On the night of the collision, the SS ESSO BRUSSELS was displaying prescribed anchor lights and lights on the forward and after superstructures provided illumination of the decks. The deck anchor watch after midnight consisted of a Mate, Peter Van Lierde, and Able Seaman, Feliciano Diaz. The vessel was lying approximately parallel to the Staten Island shoreline and swinging about 10° each side of a 330° True heading. The vessel's position was being periodically checked by radar ranges of nearby fixed structures and the shoreline. After midnight no cargo was being transferred, and all tank and ullage openings were secured. About two minutes prior to the collision, the Mate, who was on the bridge, heard a whistle signal from the approaching SS C.V. SEA WITCH. The Able Seaman on watch on the port wing of the bridge heard the whistle, sighted the approaching ship and advised the Mate on watch. Nearly the entire crew except for the watch standers were asleep or in their rooms preparing to go to bed.

The Mate, upon first sighting the SS C.V. SEA WITCH and hearing her whistle, thought the vessel would pass astern; however, the SS C.V. SEA WITCH continued to veer and upon realizing that a collision was imminent, sounded the general alarm to alert the crew. The Mate proceeded to the port bridge wing as the collision occurred. The Mate described hearing the sound of impact followed by a rushing of air, then saw flames rapidly engulfing the area of the collison. Immediately he and the seaman on watch left the bridge and prepared the forward port lifeboat for lowering. Fire which was advancing along the starboard side rounded the port bow and rapidly spread on the water under this lifeboat. They abandoned the attempt to lower the lifeboat and both ran aft outboard of the handrail on the port side.

The remainder of the crew had already started lowering the port after lifeboat. A large portion of the crew was already in the lifeboat with the Master supervising the lowering operation. After the boat was waterborne some difficulty was experienced in releasing the boat and the falls had to be overhauled by hand to provide sufficient slack to release the falls. As the fire on the water approached an engineer attempted to start the lifeboat's Diesel engine. This engine was of the hand starting type and required manual release of compression while being cranked to obtain sufficient momentum of the flywheel. Due to overcrowding around the engine, difficulty in hand cranking was experienced and the engine could not be started. The crew then attempted to push the boat away from the vessel with oars, but this too was unsuccessful due to the current and wind which was holding the boat against the side of the vessel. As flames started to engulf the lifeboat some of the crew jumped overboard to get away from the flames and burning oil and attempted to swim to the Staten Island side of the Verrazano-Narrows Bridge abutment.

The Tug GRACE McALLISTER after arriving on the scene rescued eleven of these survivors who had drifted with the current under the center

span of the bridge. An object resembling an overturned lifeboat was sighted near the burning vessels by one of the assisting tugs. The lifeboat was not sighted again and has not been recovered. The eleven survivors were taken by the Tug GRACE McALLISTER to the Staten Island Quarantine Station where they were transferred by ambulance to the U.S. Public Health Service Hospital on Staten Island for treatment and examination.

The remaining fifteen survivors were picked up by other tugs, fireboats and police boats who were searching the area. Eleven victims, identified as crew members from the SS ESSO BRUSSELS, were recovered from the waters of New York Harbor during the period from 2 June to 17 June 1973. The remains of Bertil Alaim Marie Otto, Steward, were found on the after deck of the SS ESSO BRUSSELS and [redacted] an AB-Wiper, remains missing.

10. SS C.V. SEA WITCH General Description:

The SS C.V. SEA WITCH, MA Design C5-S-73b, MA Hull No. 205, is the first of three container ships incorporating automation features built by Bath Iron Works Corporation at Bath, Maine, for American Export Lines, Inc., and was completed in September of 1968. The vessel, built to class under American Bureau of Shipping Standards, is a full container vessel with the bridge deck located forward and the engine room aft. The vessel has a modified clipper stem and a transom stern. The hull is subdivided by seven watertight transverse bulkheads forming five cargo holds, four forward of the after deckhouse and one aft. The vessel meets a one-compartment standard of subdivision.

Accommodations for deck officers are located in the forward superstructure and those for the engineering officers and unlicensed crew are located aft. Two underdeck enclosed passageways on the main deck level outboard of the cargo holds provide sheltered access between the forward and the after deckhouses.

A fixed carbon dioxide extinguishing system consisting of a main bank of 113 100-pound cylinders is installed to protect cargo holds and the machinery space. The quantity of CO2 is sufficient to flood number 3 cargo hold which is the largest space protected. Paint rooms, emergency generator room, storerooms and other isolated areas are provided with separate fixed systems. The releases for the main CO2 system to the cargo holds were located on the starboard side of the second deck in the after deckhouse. The system was not activated prior to the crew abandoning the vessel.

The interior fire stations are fitted with 75 foot lengths of 1½ inch hoses and straight bore nozzles. The exterior stations are fitted with 50 foot lengths of 2½ inch hoses and approved combination nozzles. Seven 1½ inch fire hydrants were found in the open position after the casualty in the interior of the after superstructure.

The vessel can carry a total of 1,070 standard twenty foot containers or their equivalent. At the time of the casualty, the vessel had on board 112, 20-foot and 173, 40-foot containers on deck and 290, 20-foot and 155, 40-foot containers in the holds.

The four forward container holds are arranged to stow two transverse bays and the after hold is arranged to stow one transverse bay of 40 foot standard containers or two standard 20 foot containers. Containers are stowed six deep in the four forward holds and three deep in the after hold. All five container holds are fitted with a guide structure affixed to webs and bulkheads for cellular stowage of containers. On the outbound transit deck cargo consisted of eight bays each with three containers high forward and bay number 9 consisted of containers two high on number 5 hatch. No cargo handling gear is provided and all cargo handling is accomplished by shoreside facilities. The cargo hatches are equipped with weathertight, steel, pontoon type hatch covers. The covers, supported on raised coamings with the exception of number 5 hold which is of the flush deck type, are fitted with gaskets, quick acting dogs and cargo securing fittings for container stowage.

In normal operation all the containers on board a container vessel are not discharged at any one port, rather some are offloaded and others are loaded aboard depending on the cargo commitments. In order to determine the identity of the cargo aboard the SS C.V. SEA WITCH the manifests of loadings at previous ports had to be reviewed. Part of the cargo aboard at the time of leaving New York was loaded at continental U. S. ports or European ports on the previous voyage. The cargo manifests for containers loaded at New York were delivered to the Chief Officer prior to sailing Howland Hook. The general cargo and dangerous cargo stowage plan for containers loaded at other ports was posted on the bridge and destroyed in the fire. The dangerous cargo manifest that was delivered to the Coast Guard by an American Export Lines official shortly after the accident included only that portion of the dangerous cargo which was loaded at New York and did not include two containers of dangerous cargo already on board.

The location of the dangerous cargo containers on board was as follows: two containers in bay number 2, one on deck, one in the hold; fourteen containers in bay number 4, twelve on deck; two containers in bay number 8, both on deck; seven containers in bay number 5, stowed on deck; eight containers in bay number 1, five on deck and two in the hold; and one container in bay number 9 on deck.

Many of the containers on board, although not required to carry a dangerous cargo label contained varying amounts of flammables. Several containers held vehicles. The stowage of individual lots of hazardous materials in some containers was evident and although the individual package sizes were exempted from marking under current regulations, large quantities of these individual packages were stored together within containers.

II. SS C. V. SEA WITCH Machinery:

The vessel is arranged for single screw propulsion with a geared steam turbine and right hand five-bladed propeller having a pitch of 22.73 feet. An engine room operating console combines the operating controls for the main engine and various auxiliaries, main gauge board, combustion control board, engineer's signal, alarm panels and indicating lights. Main propulsion is controlled from either the centralized (engine room) control console or the wheelhouse console. Two main, marine type boilers are provided. Each boiler is fitted with two steam atomizing oil burners, automatic combustion and feed water controls and a motor driven, horizontal, forced draft blower. The forced draft blower is capable of delivering 27,040 CFM of free air at full speed and takes suction from the main machinery space. Two 1,000 KW turbine driven generator sets installed on the operating flat provide auxillary electrical supply. An emergency Diesel driven generator rated at 125 KW is installed on the port side of the boat deck in the after superstructure and provides electrical power automatically upon failure of the main generating plant for the forward fire pump, alarms, emergency communications and emergency lighting systems. The Diesel engine is arranged for automatic or manual hydraulic starting.

The fire main system is capable of being supplied with sea water from three pumps. Two pumps are located in the engine room and one remotely controlled pump is located in the forward pump room. A main steam turbine driven fire pump rated at 1,000 GPM at 100 PSI and a motor driven pump rated at 300 GPM at 125 PSI are located in the engine room. The prime movers and the pumps are not provided with remote operating controls and start up, stop and valve line up has to be accomplished at the units. Steam supply for the main fire pump turbine is from the 845 PSI auxillary steam line. The electric pump in the engine room is supplied with power from the main switchboard and there are no provisions to supply electric power for this pump directly from the emergency switchboard. The pump, rated at 400 GPM at 125 PSI, installed in the forward pump room is electrically driven and can be remotely controlled, including line up of suction and discharge valves from the engine room control console. This pump receives electrical power from either the main or the emergency switchboard.

The machinery space mechanical supply and exhaust ventilation system consists of two, two speed, motor driven, 50,000 CFM supply fans and two single speed motor driven 3500 CFM exhaust fans. These systems are controlled by bulkhead mounted switches on the operating level in the engine room and remote cutouts located in the after deckhouse passageway.

The after deckhouse is equipped with a recirculating air conditioning and heating system designed so that sufficient outside fresh air is drawn into the intake ducts to provide for a minimum of three air changes per hour within all spaces. The fresh air inlet for this system is located

on the sun deck forward of the stack. Recirculation of interior air is provided mainly by suction from the after deckhouse passageways and through louvered panels in the doors to individual staterooms. Cooled or heated air is supplied to individual compartments by overhead ductwork and outlets. Control of the blowers for this system is provided in the after superstructure and remote emergency cutout control is located on the bridge and in the engine room. Neither the engine room power supply to these blowers at the main switchboard nor the bridge emergency cutouts were secured subsequent to the casualty.

12. SS C. V. SEA WITCH Steering Control System:

A single steering stand housing dual electric steering controls is installed on the bridge to effect steering control of the vessel through a single steering wheel and a non follow-up control lever. Two independent electrical control cables transmit steering orders from the bridge steering stand to the rotary hydraulic power units in the steering engine room. The two control systems are entirely independent and are isolated from each other both electrically and physically. They do not operate simultaneously, but either may be selected at any time. Indicating lights on the steering stand and also in the engine room show which control system is operating and whether power is available to the other system.

Either the port or starboard steering control can be selected at any time by means of the PORT-OFF-STBD system selector switch on the after side of the steering stand. If failure occurs in the control system, either of the two procedures can be followed. The first procedure is to switch from the system in use, by means of the PORT-OFF-STBD system selector switch on the after side of the steering stand, to the alternate system. The second procedure is to switch from one steering mode to another.

The steering stand on the bridge provides three types of rudder control; automatic, hand electric with follow-up and hand electric without follow-up. Selection of the type of operation is accomplished by a mode selector switch. In automatic operation this equipment is controlled by the master gyrocompass. It will detect small course deviations and automatically apply the proper degree of rudder to maintain the desired course. For hand electric control with follow-up the mode selector switch is set at HAND, and the wheel may be turned and the ship steered in the conventional manner. The rudder responds to any movement of the wheel and may be positioned at any angle between 35 degrees port and 35 degrees starboard. For hand electric control without follow-up the Helmsman moves the controller knob to the left or right for left or right rudder. As long as the controller knob is held in either position the ship's rudder positioning equipment continues to apply rudder in that direction until the rudder limit stops are reached or the controller knob is released.

13. SS C. V. SEA WITCH Steering Gear:

The steering gear is of the electric hydraulic type, having dual rams operating in opposed hydraulic cylinders which actuate a single rudder through a double ended tiller. The hydraulic pressure is provided by two

independent variable volume hydraulic pumps driven by electric motors. The single differential mechanism controls the direction and flow of high pressure oil to the active cylinders by means of a stroke rod which varies the volume of the active hydraulic pump. The desired electric rudder signal from the helm is converted by either of two rotary hydraulic power units to a rotary input to the differential mechanism through a control shaft. The signal indicating actual rudder position is fed to the differential by a mechanical follow-up linkage. When the actual and desired rudder positions match, the rudder position remains constant until a new signal is given. The rotary hydraulic power units can also be bypassed, and the rudder controlled through a trick wheel on the differential mechanism.

The two rotary hydraulic power control units are mounted forward over the steering machinery, and either unit depending on system selection can be used to control steering. Two sprockets and a Type III roller chain connect the two rotary hydraulic power unit output shafts to enable either of the units' operating signal to be transmitted to the common output shaft on the port unit.

A control shaft approximately 28½ inches in length and 3/4 inch in diameter and two universal joints couple the port rotary hydraulic power unit output to the differential mechanism. The shafting and connecting universals provided for the transmission of the rotating signal from the rotary hydraulic power units to the differential mechanism and were necessary due to the distance and a difference in mounting heights between the units. The after half of the connecting universal accepts the ½ inch input shaft of the differential mechanism and the shaft was originally milled to hold a half moon or rounded portion of a Woodruff key. The universal hub was milled its entire length, thus allowing assembly by slipping the universal over the shaft and Woodruff key. This in effect captured, or locked in, the key whereby the universal would have to be slipped off the shaft to effect key removal. This universal hub was also drilled and tapped for the installation of an Allen set screw oriented 90° from the keyway. The other half of this universal was coupled to the control shaft with a square key and was fitted with two Allen set screws, one over the key and one at 90 degrees from the key.

The universal coupling at the other end of the control shaft was found to be similarly fitted with a square key and set screws. The manufacturer's drawing for this control shaft detail indicates that the universal coupling was originally designed to be fitted with a feather key without Allen set screws. Whether the shaft and this universal were originally installed as designed or altered subsequent to the original installation could not be determined. The other hub of this universal which was connected to the rotary hydraulic power unit contained a square key and a set screw 90 degrees from the keyway.

14. SS C.V. SEA WITCH - Previous Steering Gear Repair:

On 17 April 1973, during an east bound voyage, the SS C.V. SEA WITCH experienced a loss of steering. Upon examination of the steering machinery, the First Assistant Engineer located a leaking relief valve in the hydraulic system which caused the rudder to go hard over. To restore operation of the steering machinery, the relief valve was adjusted to a point necessary to hold the valve on its seat. The valve seat was defective, and the adjustment and repairs made were considered temporary.

During the inspection and examination of the steering machinery to locate the cause of this steering loss, the after half of the universal coupling the control shaft to the differential gear mechanism was found to have loose motion. This universal was disassembled and the Woodruff key and the keyway in the stub shaft of the differential gear mechanism was found to be excessively worn. A replacement Number 3 Woodruff key was installed and the universal reassembled. This repair was also considered temporary as no repair was accomplished to the worn shaft keyway.

Subsquent to these temporary repairs, the vessel's owners were advised by radio of the steering difficulties and the need for permanent repairs upon arrival in New York. About 20 April, Mr. [redacted], a Staff Port Engineer for American Export Lines contacted Mr. [redacted]. [redacted] of Bond Hydraulics Equipment Service, a specialty firm in the repair of marine hydraulic equipment, concerning the need for repair upon the vessel's arrival. The needed repair to the relief valve and the stub shaft were discussed and plans made for accomplishment of repairs upon arrival. The message, or telegram, from the vessel was garbled and the exact nature of the needed repair to the stub shaft was unable to be ascertained. Some confusion existed as to the identity of the defective part; however, plans were made as if the stub shaft was defective. The instruction manuals for the Hyde steering gear were reviewed and an agreement was reached should the shaft be found defective, it would be milled for installation of an oversized square 3/16-inch key in lieu of the original Number 3 captured Woodruff key.

Prior to the vessel's arrival in New York, attempts to obtain a replacement new stub shaft from W. E. Zimmie Corporation, Cleveland, Ohio, a spare parts vendor for Hyde steering equipment, were unsuccessful.

Upon the vessel's arrival in New York, on 23 April, Mr. [redacted] sent a mechanic to the vessel to remove the differantial gear mechanism stub shaft, key and its connecting universal. Upon his arrival, a conference was held in the Chief Engineer's Office aboard ship between the Port Engineer, Mr. [redacted], the First Assistant Engineer, Mr. [redacted] and the mechanic, [redacted], concerning the replacement of the Woodruff key with a straight key. All agreed that this alteration would be a suitable repair.

The Bond Hydraulic representative then removed the stub shaft assembly and its connecting universal and took them to the company machine shop in

Linden, New Jersey. In the shop, the stub shaft was milled out so the original Number 3 Woodruff keyway was replaced by a 3/16-inch square keyway approximately one inch long and open to the end of the shaft. The keyway in the connecting half of the universal was also milled out from 1/8 inch to 3/16 inch from end to end. A new square key was fabricated from standard AISI 4140 key stock, and it was ground for a size to size press fit. The key and universal hub were coated with Lock-Tite, a commercial hardening type lubricant that eases assembly and provides increased adhesion quality after hardening. The universal hub was pressed on the shaft and the new square key by use of a hydraulic press using approximately 50 pounds of pressure. Upon completion of the machine shop work, the repaired parts were returned to the vessel for reassembly.

Upon Mr. [redacted] and the mechanic's return to the vessel, the differential gear mechanism stub shaft and control shaft were reinstalled. The Allen set screw 90° from the keyway in the after half of the universal was reinstalled and tightened. The stub shaft was not countersunk for the Allen set screw and depended on the friction exerted during the tightening process for its retention and holding ability.

A new relief valve seat, manufactured by Bond Hydraulics Machine Shop, was also installed. After assembly, the repaired relief valve was pressure tested and adjusted to its design relieving pressure.

After the above repairs, the steering machinery was operationally tested dockside, alternately using both steering units and all control systems. These tests were jointly conducted by Mr. [redacted] the mechanics and ship's personnel. The repair was considered satisfactory.

These steering gear repairs were not reported to the Coast Guard, Officer in Charge, Marine Inspection, as both American Export Line officials and the ship's personnel did not consider the repair as meeting regulatory reporting requirements.

During the in port period preceding the casualty a Sperry representative adjusted a misalignment of the rudder angle indicator between the bridge and the steering engine room of the SS C.V. SEA WITCH.

15. SS C.V. SEA WITCH - Previous Incidents Involving Malfunction of Steering:

Since being placed in service in September 1968, the SS C.V. SEA WITCH experienced several incidents involving malfunction of steering equipment or a loss of steering. Operating logs, casualty reports, company records and testimony received before this Board record the following:

a. 22 May 1969

A vessel casualty report filed at the New York Marine Inspection Office records a grounding in New York Harbor on 22 May 1969. This

grounding was caused by a loss of steering that was the result of a loss of the main plant. The plant loss according to the vessel casualty report was due to the inadvertent closing of a remotely controlled generator vent valve during the process of securing the bow thruster unit for sea. The vessel grounded off Hoffman Island in New York Harbor. The bow thruster was damaged as a result of the grounding and dirt and debris were picked up in the main condenser intake.

b. 8 July 1971

Two losses of steering control were experienced while the vessel was at sea on 8 July 1971. The first occurred at about 0820. Investigation by ship's personnel revealed the square key in the control shaft between the differential gear mechanism and the rotary hydraulic power units fell out. The square key is located in the differential universal at the half connecting it to the control shaft. The two retaining Allen set screws were found to be loose and without the key allowed free rotation of the shaft without transmitting its rotation to the differential gear mechanism. To effect repairs, the key was reinserted from the shaft side of the universal and both Allen set screws were tightened.

At 1255, the same day, another loss of steering control was experienced. The same set screws had worked loosed, and the same key had fallen out. To effect repair, the key was reinstalled as before, and the set screws tightened, and as a precaution an additional Allen set screw was installed over both original set screws in the same tapped hole to prevent the lower set screw from working loose.

c. 21 July 1971

A Master's voyage letter report documents that the vessel departed Bremen 54 minutes behind schedule on 21 July 1971, due to steering engine trouble. A bridge log entry for the same day at 0000 states, "Starboard steering gear malfunction" and at 0050 states, "Repairs completed - steering gear in working order." No explanation of the trouble or nature of repair was documented in the log.

d. 23 July 1971

The bridge log for 23 July 1971 contains the entry, "2010 Steering gear failure - slow speed. 2033 Repair completed - sea speed." A comment also appears in the engine room log for the same day, "Greased steering gear." The logs for this date did not comment further on the failure or corrective action taken.

e. 29 July 1971

A written "Requisition for Material" was submitted by the Chief Engineer on 29 July 1971 requesting certain modifications to the steering

gear. His request is quoted as follows, "Supply labor and materials to provide a more secure linkage between the Sperry steering equipment and the steering medium. On two occasions the set screws at the various points of 6 connections have worked loose. -- A tapered pin at each of these 6 connections, in addition to the present double set screw and key arrangement, is suggested."

Upon the vessel's arrival in New York, a Port Engineer for American Export Lines, Mr. [redacted], visited the vessel and discussed the above proposed modification with relief Chief Engineer Johansen and regular Chief Engineer [redacted]. Mr. [redacted] did not concur with Chief [redacted] proposal as he believed that the drilling, reaming and installation of tapered pins would weaken the shafts excessively. At the time, Mr. [redacted] proposed that if the Allen set screws again worked loose they should be "staked", i.e., center punch the periphery of the screw to prevent it from loosening.

f. 5 August 1971

The bridge log for 5 August 1971, while the vessel was at sea on a voyage from Norfolk to Bremen, contains the following entries; "0800 Steering gear failure." "1200 Steering gear repairs in progress." "1500 Reduced speed to make repairs on steering engine." "1626 Repairs completed - Proceeding - Detention 1h 16M." The corresponding engine room log for the same day contains a comment, "Repairing steering gear control." The logs for this date did not comment further on the failure or corrective action taken.

A Master's voyage letter report for voyage #40 contains the following statement, "On August 5th 1971 vessel had steering gear trouble causing a diversion of 12 miles and a detention at reduced speeds of 01H - 16M."

g. 21 January 1972

The bridge log for 21 January 1972 on an outbound voyage from Staten Island contains the following entry; "1815 Port steering gear broke down. Full astern - off #17 Whistle. Way off vessel with heading on #17 Bell buoy approx. 0.25 Mi off bearing 270°. Steering by stbd. gear. Backed vessel down and let go stbd. anchor (3 shts) at 1831 hours. Making repairs. 1910 Anchor aweigh proc. to Gravesend Bay to swing vessel around to seaward. 1942 Proceeding to sea."

The corresponding engine room log for the same day contains the following entry; "Port steering gear failed at approximately (sic) due to low oil pressure through fault of a 1/4" gauge valve bonnet which blew out. The low sump alarm was found to be set at #3 on the engine room gauge which apparently is too low a setting. Steering was changed over to the stbd. unit. The L. O. was restored in the port system. The gauge valve bonnet was replaced tightly and port steering was tested O.K. after leaving pilot station."

A comment appears in the Master's voyage letter report for voyage #46 also documenting this steering failure and is quoted, "Vessel left berth at 1730 hours and took departure for Norfolk at 2036 hours. There was a detention of 1H - 27M between berth and pilot due to steering engine failure. Vessel sailed 30M behind schedule."

h. 17 December 1972

The bridge log on 17 December 1972 on an inbound voyage from Felixstowe to New York contains the following entries; "0530 Reduced to 40 RPM to check steering engine rm. Stbd motor out. 0620 Increased to 50 RPM to maintain steerage." The corresponding engine room log for the same day contains the following entry; "at 0410 Stbd. steering failed to respond - checked same flexible coupling found to be faulty. Port engine operating."

The engine room log for the following day, 18 December 1972, also contains the following entry; "Stbd steering engine running - servo pump flexible coupling repaired."

i. 22 February 1973

The engine room log for 21-22 February 1973 while the vessel was in Bremerhaven contains the following entry; "Rudder post bearings found with excessive wear. Ship unable to proceed because of same. Drydocking arranged for tomorrow February 22/73 11AM. Mr. [redacted] A.E.I. Port Engineer in attendance. Mr. [redacted] of Salvage Association and Mr. [redacted] of ABS in attendance. Lower pintle bearing found cracked to be renewed. Crack in weld of port aft peak tank making to stern frame." (sic)

j. 10 April 1973

During docking maneuvers, in Amsterdam, the vessel suffered a loss of steering due to a failure in the steering engine follow-up gear. A split pin that secures the follow up spiral input shaft to a clevis connection providing follow up input signal to the differential gear mechanism fell out. This allowed rotation of the spiral shaft, upon rudder movement, without rotating the follow up input shaft of the differential gear mechanism. The rudder went hard over in one direction due to the resultant loss of follow up signal.

To effect repair a new split pin was installed and a safety wire was inserted through the axis of the pin and lock wired around the clevis.

16. SS C.V. SEA WITCH Structural and Fire Damage:

The impact of the collision caused the entire stem of the SS C.V SEA WITCH to shear horizontally about 21 feet aft on both sides, about 10

feet above the load water line and all plating below this point to be driven aft about the same distance into the fore peak tank. One longitudinal and one transverse welded seam on the side shell fractured due to heat in the area of number 3 cargo hold.

Cargo in containers on the weather deck was consumed or severely damaged by the fire. The shell frame of some of these containers and remnants of cargo is all that remains. Light exterior sheathing of these deck containers burned away exposing their contents to the fire. Some wooden floors of the containers ignited and provided additional combustible material. Containers sheathed with plastic laminated wooden sides offered little resistance to the spread of fire and were consumed. Aluminum and steel sheathed containers also eventually collapsed and burned from the intense heat which developed. The skeleton structures of many containers remain stacked with deck lashings in place after the fire was extinguished.

The containers stowed below deck, especially those in holds number 2 and 3, were the most damaged by the fire. In the other cargo holds damage from smoldering caused by the effects of the radiant heat through the hatch covers and the side shell was evident on containers stowed adjacent to these boundaries. The containers located on the starboard side showed the more severe effects of radiant heat. A vertical progression of fire through a tier of containers without affecting adjacent tiers was noted.

Paint on the exterior of the after superstructure was burned. Both lifeboats which are located aft were distorted, buckled and nearly consumed by fire. The engine spaces are free of fire damage, but both the engine spaces and the interior of the after superstructure suffered heavy smoke damage.

Port lights, although crazed in the main, were all intact. Interior accommodations constructed of Marinite (asbestos) panels with metal furnishings were discolored from heat and suffered fire damage in staterooms along the starboard side of the deckhouses and the damage extended several feet inboard. The remainder of the interior suffered light to heavy smoke damage. The damage was most pronounced on the starboard side of the upper deck staterooms and storerooms in way of the side shell on the main deck level. There is evidence that draperies in the staterooms forward and to the starboard caught fire, but the flame did not spread. The exposed paint on the interior of the hull girder was burned on the starboard side and blistered on the port side. Heavy smoke damage occurred on the lower deck levels of the forward superstructure.

The containers on deck and in number 2 and 3 holds continued to burn for many days after the casualty and the ship's supply of CO_2 was used by the New York City Fire Department to extinguish the last fire in number 2 hold. After all fires were extinguished the containers on deck and containers within the holds were offloaded and surveyed. A systematic documentation of the location, extent of damage, structural details,

effects of the fire and identification of cargo within the containers was undertaken by a joint group including owners, underwriters, Coast Guard and MARAD representatives. The survey was initiated by a preliminary recommendation of this Board.

17. SS ESSO BRUSSELS General Description:

The SS ESSO BRUSSELS was built by Kockums Mekaniska Verkstad of Malmo, Sweden, in 1960 to American Bureau of Shipping class standards as an A-1 oil carrier. The vessel is constructed with eleven cargo tanks, numbered one through eleven from forward aft, each separated by a transverse bulkhead. They are further divided by longitudinal bulkheads into port, center, and starboard tanks for a total of thirty three individual cargo tanks. The capacity of a center tank is approximately 16,500 barrels, and each measures about 39 feet long, 49 feet wide and 50 feet deep. The capacity of the side tanks, port and starboard, varied due to the configuration of the vessel, but their individual capacity is approximately 8,250 barrels each. Side tank dimensions are approximately 39 feet long, 25½ feet wide and 50 feet deep. Total cargo carrying capacity is approximately 340,000 U. S. barrels when loaded to 95% capacity. Tank venting is of the common header type which consists of a branch vent line leading from each tank to common headers that extend about 35 feet above the weather deck and are fitted with flame arrestors and weather hoods.

The vessel is constructed with two deckhouses. The forward deckhouse located over number 5 and 6 cargo tanks contains the bridge, berthing areas for the Master, Chief Officer, other deck officers, radio room, hospital, owner's stateroom and day rooms. Two 26-foot lifeboats with gravity davits are provided on the boat deck. The starboard lifeboat is equipped with a hand starting two cylinder Diesel engine, and the port lifeboat is oar propelled. The after deckhouse is located over the machinery spaces and provides living spaces for the licensed engineers and all unlicensed ratings. The crew's mess room, pantry, galley, officer's mess room and pantry are also provided in the after deckhouse. Two 41 person capacity lifeboats with gravity davits are installed on the boat deck aft. The port lifeboat is equipped with a hand-starting two cylinder Diesel engine and the starboard lifeboat is oar propelled.

The fire fighting equipment on the SS ESSO BRUSSELS consisted of deck fire hydrants and steam smothering to the individual cargo tanks. Neither the deck fire main nor the steam smothering was activated prior to the crew abandoning the SS ESSO BRUSSELS. The engineering personnel, however, did start the emergency generator before abandoning the vessel.

18. SS ESSO BRUSSELS Structural and Fire Damage:

The bow of the SS C.V. SEA WITCH penetrated the side shell in way of number 7 and 8 starboard tanks severing number 8 cargo tank top and the starboard king post of the SS ESSO BRUSSELS. The athwartships bulkhead

separating number 7 and 8 starboard tanks collapsed. The longitudinal bulkhead separating number 8 starboard tank and number 8 center tank was penetrated approximately 15 feet by the bow of the SS C.V. SEA WITCH, allowing cargo from that tank to have free communication to the sea. The rupture of number 7 and 8 starboard tanks and number 8 center tank allowed approximately 31,000 U. S. barrels of cargo to be spilled and provided the initial fuel for the resulting fire. In addition approximately 1,000 U. S. barrels of cargo from the remaining cargo tanks were consumed in the fire.

Flames from the burning oil on the water ignited exterior paint and exterior combustibles. The resultant heat from the fire ruptured piping, melted brass components in vent lines and steam smothering lines, burned tank fitting gaskets which permitted the rapidly expanding vapors to escape and ignite contributing to the severity of the deck fire. The interior of both deckhouses was paneled with a pressed wood panel board which offered little resistance to the spread of fire. The engine room and lower levels of the pump room did not burn. The fire effectively consumed nearly all combustibles on and above the weather deck level and caused severe fire damage to those areas of the after deckhouse and empty cargo tanks above the water line which were subjected to the intense heat.

19. SS ESSO BRUSSELS Events Subsequent to the Casualty:

After the fire was extinguished asbestos material was used to seal tank tops, ullage and tank cleaning openings where gasket material had burned out. Flame screening material was used over severed and burned away piping to insure flame tightness of cargo tank boundaries. Wooden plugs were used to seal other pipe openings not required for tank venting. Offload of the remaining cargo was accomplished through the vessel's existing piping by the use of a steam cargo stripping pump located in the pump room. An undamaged pump room cargo riser was used to transfer the cargo to the main deck level where cargo hoses were used to offload the cargo to barges alongside. The ability to use the stubs of the burned off valve stems protruding from the packing glands to open and close valves made possible the use of the vessel's internal cargo piping for the cargo transfer. Upon completion of the offloading the SS ESSO BRUSSELS was gas freed at which time a preliminary damage survey was started.

The bulk of oil spilled from the SS ESSO BRUSSELS was consumed in the fire which pocketed between the vessels as they drifted down the channel under the Verrazano-Narrows Bridge. Pollution from the residue of the cargo was recovered from Staten Island, Coney Island, Manhattan and Jones Beaches, Sandy Hook and Nortons Point areas.

20. SS C.V. SEA WITCH, Initial Board Steering Machinery Inspection:

On 7 June representatives of the Board and the owners of the SS C.V. SEA WITCH visited the vessel to examine the steering machinery and the

steering control system. The steering machinery room was found to be relatively free of fire damage, however, smoke damage, soot and some paint scorching was evident. The position of the ram indicated right rudder and the rudder angle indicator was found at 12° right rudder.

Examination of the control shaft between the rotary hydraulic power units and the differential mechanism revealed that the shaft would rotate when turned by hand without rotating the differential gear mechanism stub shaft. Further examination disclosed a 3/16 inch square key approximately one inch long lying in the jaws of the connecting universal at the differential gear mechanism end and that the keyway in the stub shaft no longer contained a key.

The examination was terminated and the steering machinery space was secured and sealed as a security measure. Plans were made for a thorough inspection of the steering machinery and the control system.

21. SS C.V. SEA WITCH, Subsequent Board Steering Machinery Inspections:

A visit was made on 8 June with representatives of the Board and all parties in interest to examine the steering gear installation on board the SS C.V. SEA WITCH. The differential gear mechanism and the controlshaft were removed for complete analyses to determine if any malfunction or derangement of these components could have contributed to the loss of steering. The assemblies were brought ashore, placed in custody of Coast Guard officials and the steering engine room was resealed. Upon disassembly of the control shaft several set screw indentations were noted at different locations under the universal connecting hubs.

On 11 June representatives of the Board, parties in interest and Sperry Rand representatives examined the Sperry rotary hudraulic power units in the steering engine room. Both units were opened, examined and found to be at full left rudder. Resistance readings confirmed the rotor positions of both Sperry units. The steering gear room was again resealed.

On 14 June the representatives of the Board and the newly designated party in interest, Bath Iron Works, Inc., visited the SS C.V. SEA WITCH and were afforded an opportunity to view the steering gear on board and also the components which were ashore in the custody of the Coast Guard.

All parties in interest were given the opportunity to submit proposed test procedures to be utilized in the planned disassembly and analyses of the differential gear mechanism and the control shaft.

Mr. [redacted] President, Dynetics, Inc., Erie, Pennsylvania, engaged as the Board's expert witness, directly controlled and supervised the test and disassembly procedures of the differential gear mechanism. The procedures submitted by parties in interest were consolidated and disassembly was performed on 15 June at the Lucius Pitkin, Inc., laboratory, a specialty firm in machinery analysis, metallurgical testing and research in New York City in the presence of members of the Board, attorneys and

technical specialists representing parties in interest. Prior to disassembly, a visual examination of the gear case was made. Its exterior was covered with soot and the glass enclosing the rudder angle and helm order indicator was cracked, however, the paint on the case was not blistered.

Prior to disassembly, a torque test was performed to determine if there was any undue friction or binding in the differential gear mechanism. A standard torque wrench was fitted to the input stub shaft and pressure applied by hand. Initial torque readings began with 42 in-lbs then fell to less than 5 in-lbs after about 160° of wrench rotation. Thereafter, going from full left to full right rudder, the torque readings were 5-10 in-lbs.

The stroke rod was then adjusted to mid position, and torque measurements were taken from this point to full left rudder, then full right rudder. The readings began with 10 in-lbs and varied from 0 to 10 in-lbs throughout the range. The torque wrench was then placed on the follow-up shaft and the input shaft was restrained. Beginning at full right rudder, the torque averaged 35 in-lbs in going to full left rudder and then reversing the direction, the torque peaked at 40 in-lbs, but essentially averaged 35 in-lbs.

Prior to disassembly of the mechanism, the case was drained of all oil and a grease residue was found in the bottom of the case. The spectrographic analysis of the lubricating oil removed from the gear case revealed an ash content of 0.41 per cent. The analysis of the grease residue showed an ash content of 3.17 per cent. No other significant contaminants were noted in either of the two samples. Disassembly of the differential gear mechanism commenced by removal of the cover housing including the dial assembly and pointer drive train. These components appeared normal except for the cracked glass over the rudder angle and helm order indicator.

The following observations were noted during disassembly of the differential gear mechanism.

a. The original keyway in the differential gear mechanism stub shaft, as described in the manufacturer's detailed drawing, specified a Number 3 Woodruff key 1/8 inch wide by 1/2 inch long. The stub shaft in this unit had been remachined for a 3/16 inch square key approximately one inch long and broached to the end of the shaft. The remains of the old root of the original Woodruff keyway were easily discernible at the base of the new square keyway. Evidence of slight distortion existed on the sides of the keyway in way of the original Woodruff keyway.

b. The stub shaft contained a drilled countersink in the shaft's surface approximately 19/32 inch from the end of the shaft and at about 170° opposite the milled keyway. No matching hole for a set screw was found in the hub of the connecting universal. The 3/16 inch square key showed signs of side wear and bore no impression of set screws.

c. The gear assembly driving the indicator pointers and gears inside the barrel cam were all found to be in excellent condition. Although the worm showed no signs of wear or damage, the worm gear showed some signs of wear on the sides of the teeth and some score marks on the tooth tips.

d. The spur gears in the drive train from the input stub shaft all showed surface damage on the teeth. The trick wheel drive and driven gears and the stub shaft input driven gear all showed severe surface damage on the teeth. The spur gears inside the trick wheel housing also had some contact marking on the teeth. The barrel cam and follower were in good condition. The stroke rod had a long score mark on the top of one of the lands and the mating part was not a free fit on the spline. There was no mating score mark in its bore and binding was not considered serious.

Mr. [redacted] made the following conclusions based on his analysis and examination of the differential gear mechanism and its connecting linkage:

"1. There was no condition within the differential mechanism capable of causing loss of steering control.

"2. Loss of steering control resulted from the key joining the universal joint hub to the Sperry input shaft of the differential mechanism, working its way out of the keyway under the influence of vibration. This was not a Woodruff key as employed in the original design, and no mechanical restraint to lock it in place was provided when it was installed.

"3. Although the key might have become displaced at some future time for other reasons, the condition of the gear teeth verify the presence of a severe high frequency vibration applied to the Sperry input shaft that certainly accelerated the displacement.

"4. The source of the vibration, insofar as the differential mechanism is concerned was in the Sperry control unit, but its cause is not known."

22. Board Activities Subsequent to the Casualty:

On 4 June the Chairman and both members of the Board visited the scene of the casualty and sighted the SS C.V. SEA WITCH at anchor at Gravesend Bay. Smoke and some flare-up of deck cargo fire was observed which was being extinguished by fireboat personnel. The SS ESSO BRUSSELS, anchored in the vicinity, was visited by the Board members. The vessel was still loaded with cargo remaining after the fire and floating booms were being used to reduce pollution effects in way of the hull damage. The interior of both deckhouses was observed to be completely gutted by fire.

On 8 June the Chairman and both members boarded the sister class vessel, the SS C.V. LIGHTNING O.N. 518063 for an orientation visit. The chairman and Recorder rode the vessel from Staten Island to Norfolk, Virginia. Prior to the vessel's departure, an examination of the differential gear

mechanism stub shaft and the control shaft was made which revealed that alterations from original design had been accomplished to the shaft securing arrangements. Taper pins had been installed through the hubs of both universals. The differential gear mechanism stub shaft was found to be excessively weakened in way of the taper pin hole and evidence of fracture was found at this location. The square keys in the control shaft showed evidence of wear and working loose. Also, scoring and set screw indentations along the shaft were noted similar to those found on the control shaft of the SS C.V. SEA WITCH.

Repairs consisting of welding the universal hubs to the control shaft to insure positive connection and replacement of the differential gear mechanism stub shaft with a newly manufactured shaft were accomplished. The end of the new shaft which connects to the universal was enlarged from 1/2 to 3/4 inches in diameter and a sunken square keyway was machined in lieu of the original designed Woodruff keyway. When reassembled, this connection was not pinned or locked so as to allow axial motion between the rotary actuator power units and the differential gear mechanism. After these repairs and alterations were completed, the steering gear control system was tested and found satisfactory.

On 15 June the Chairman and one Board Member visited a sister class vessel, SS C.V. STAG HOUND O.N. 520743, while en route New York to conduct tests on stopping and anchoring characteristics of this class vessel. A series of three stopping maneuvers while the vessel was proceeding at 60 RPM and two anchoring maneuvers were accomplished in the vicinity of Ambrose Light (LL 95) at the entrance to New York Harbor. The average time for the vessel to stop dead in the water was four minutes seven seconds and the average advance was about 520 yards as estimated by the distance between the marker target dropped at the start of the test and when the vessel stopped. The average time for the propeller shaft to reach 55 RPM astern after the engine order telegraph signal was received in the engine room was one minute two seconds.

During the in port stay on 15-16 June the differential stub shaft and control shaft of the SS C.V. STAG HOUND were examined and found to be modified from original design. The two square keys in way of the control shaft universals were missing. The key, approximately one inch in length in way of the rotary hydraulic power unit's output shaft, was found to be backed out of its keyway. This key was originally designed to be 2 1/8 inches in length. The spring clip retainers on the after universal pins were also found to be missing. An alteration similar to that accomplished on the SS C.V. LIGHTNING was made prior to leaving port. One Board Member made an orientation voyage between Staten Island, New York, and Norfolk, Virginia.

23. Concept of American Export Lines, Inc., Vessel Operations and Repair:

The American Export Lines, Inc., operates several vessels on a continuous scheduled route between Continental East Coast Ports and the Northern European Continent. The vessels operate on a prescribed schedule and any

delays encountered are not readily made up. In order to prevent in port delays vessels submit requests for supplies and repairs before departing the European Continent and if en route send a radio message outlining their needs. The company has a staff of port engineers who are assigned to certain class vessels to expedite the preparation for and accomplishment of repairs while in port. On arrival the Chief Mate and Chief Engineer submit worklists to the port engineer covering items requiring attention within their departments and those items which can be accomplished during the in port period are normally handled during these periods.

The master normally sends a voyage letter to the company operations personnel advising of reasons for delays in schedule and items considered pertinent for the scheduling and operation of the vessel. The Chief Engineer notifies the company in writing of items pertaining to vessel's machinery and equipment, when circumstances dictate.

24. Coast Guard Plan Approval and Inspection Requirements:

Existing Coast Guard Regulations outline the requirements of plans which are required to be submitted for approval prior to certification of an inspected vessel. The regulations require a general arrangement plan of the main and auxillary steering gear, steering arrangement and associated hydraulic and electrical systems. The regulations specify the plans submitted are to be general in character but are to include intended construction and safety features coming under the cognizance of the Coast Guard. During construction the vessel is inspected in the field to verify that the installation meets the intent of the approved plans.

After construction and during builder's trials the steering gear is performance tested to insure that the steering gear is capable of controlling the vessel and that the movement of the rudder meets prescribed standards. During biennial and periodic mid-period inspections the steering gear is performance tested by field inspectors to insure proper operation. This test is substantially the same as the test performed by operating personnel each time the vessel gets underway.

CONCLUSIONS

1. The primary cause of the casualty was the loss of steering control aboard the SS C.V. SEA WITCH. The resulting collision, fire and loss of life were caused by the high rate of speed, approximately 13 knots, at which the SS C.V. SEA WITCH was proceeding through the water as the vessel approached the anchorage. The strong 2.5 knot ebb current gave the SS C.V. SEA WITCH a combined over the ground speed of approximately 15.5 knots as the vessel approached the anchored SS ESSO BRUSSELS. The engine was not backed or slowed as soon as the difficulty was determined and the full astern maneuver just prior to the impact was ineffective in reducing headway. The severity of the structural damage, the impaling of the vessels and the ignition of the oil cargo may not have occurred had the force of impact been reduced. Without the fire there would have been no loss of life.

2. The cause of the loss of steering control was a failure of the universal coupling connection in the shaft between the hydraulic rotary power receiver units and the differential gear mechanism in the steering engine room. The 3/16 inch square key connecting the after half of the universal coupling to the differential gear mechanism stub shaft loosened, wore and slipped out of the keyway and into the jaws of the universal. The Allen set screw, 90° from the keyway in the hub of the universal also loosened allowing the input shaft from the hydraulic rotary power units to rotate the control shaft without transmitting this rotation to the differential gear mechanism. The loosening and wear of the key and the loosening of the Allen set screw 90 degrees from the keyway, in the hub of the universal, and the ultimate working out from the keyway occurred since the repair and modification 23 April 1973. The backing out of the key at the moment of the casualty was due to the shaft torque, induced axial movement and vibration while the vessel was proceeding at full ahead.

3. The control shaft was originally designed to allow axial motion through a feather key arrangement in the universal hub at the rotary hydraulic power unit end where it connects to the control shaft. The positive restraint imposed by the improper installation of a set screw at this hub probably caused axial thrust through components of the control shaft which resulted in abnormal stress on control shaft components and damage to gear tooth surfaces in the differential gear mechanism. This restraint, in all probability, also caused the wear in the original Woodruff key and keyway in the differential gear mechanism stub shaft which necessitated the repair accomplished by Bond Hydraulics Equipment Service on 23 April 1973. This same restraint caused the key that was installed by Bond Hydraulic Equipment Service to loosen, wear and slip out of position prior to the casualty.

4. The modification to the differential gear mechanism stub shaft and connecting universal conducted by Bond Hydraulics Equipment Service on

23 April 1973, approximately six weeks prior to the collision, was improper. The milling of the stub shaft for the fitting of a square key to replace the originally designed captured or locked-in Woodruff key without a provision for securing the key allowed the new square key to slip out of position and permit free rotation of the shaft.

5. A redundancy of the steering gear control system in the linkage between the rotary hydraulic power units and the differential gear mechanism would have prevented this casualty. The absence of a secondary independent steering connection between the rotary hydraulic power units and the differential gear mechanism placed undue reliance on the single control shaft linkage. The in service reliability of this single linkage was poor as evidenced by the number of steering failures this vessel has experienced since being built in 1968. Had independent control shafts been installed between each rotary hydraulic power unit and the differential gear mechanism, with cross over control provided on the bridge, transfer to the unaffected linkage could have occurred and steering control restored.

6. Despite the failure of the control shaft connection, the trick wheel connected to the differential gear mechanism could have been effectively used to position the rudder and steer the vessel. The absence of any emergency steering procedures whereby crew members would immediately man the after steering controls or provision to have persons standing by the trick wheel, while transiting pilot waters, precluded any timely shifting of the steering gear control to the after steering station in time to prevent the casualty.

7. The force of the impact generated sufficient heat and was the source of ignition of the Nigerian crude oil flowing from the ruptured tanks of the SS ESSO BRUSSELS. The flow of cargo from the ruptured tanks continued over an extended period of time while the SS C.V. SEA WITCH remained impaled in the SS ESSO BRUSSELS. The back wash effect from the propeller of the SS C.V. SEA WITCH and the ebb current tended to retain and pocket escaping oil along the starboard side of the SS ESSO BRUSSELS and eventually caused it to spread around the bow and stern where it surrounded the launched number 4 lifeboat. This retention of the escaping oil provided the major source of fuel that fed the initial fire which ignited and engulfed the two vessels.

8. The extensive loss of life of the crew on the SS ESSO BRUSSELS may not have occurred or may have been greatly reduced had there been no delay in releasing the lifeboat falls and had the hand cranked lifeboat engine immediately started. A lifeboat engine equipped with an adequate hydraulic, electrical or inertia starting system, could have provided rapid availability of propulsion power to get away from the burning oil on the water which was encircling the lifeboat and the vessel.

9. The use of lights attached to the life preservers and retroreflective materials may have substantially assisted in locating survivors

who drifted away from the vessels in the ebb current. The use of searchlights to pick up the international orange life preservers was minimally successful and almost totally ineffective where the life preservers were darkened by oil stains. An oil resistant covering on the life preservers which prevents or reduces discoloration and the use of retroreflective material could provide improved detection. The recovery of all but one survivor from both vessels who attempted to swim to safety can be attributed to the wearing of life preservers. The use of whistles provided on the life preservers may have contributed to the reduction of the loss of life of the crew of the SS ESSO BRUSSELS by attracting the attention of rescuing vessels. Whether crew members used the whistles provided or if some limitation developed in the effectiveness of the whistles in the oily water environment was not determined.

10. The brass and bronze fittings on deck of the SS ESSO BRUSSELS associated with cargo tank venting and piping afforded little resistance to the fire and most burned away permitting vapors from the tanks and piping systems to add fuel to the deck fire.

11. The deckhouse interior furnishings and construction of the SS ESSO BRUSSELS which were primarily made of combustible materials were almost completely consumed by the fire. The complete and rapid spread of the fire through the living spaces of both deckhouses emphasizes the absence of structural fire protection aboard this vessel. Although the crew members departure from the vessel in a lifeboat was not successful, had they sought shelter aboard they probably would have perished in the deckhouse fire. The hazards of combustible construction within the accommodations of a tank vessel, prohibited by the recent IMCO Resolution A.213 (VII), was clearly demonstrated in this casualty.

12. The ability of the crew of the SS C. V. SEA WITCH to survive in the after deckhouse for a period of about one hour and the electrician for about two hours in the emergency generator room until rescue units arrived, while the stern of the vessel was engulfed in flames, can be attributed to the structural fire resistance of the interior paneling and furnishings of the SS C. V. SEA WITCH.

13. The rapid spread of smoke through the engine room and after quarters complicated the survival efforts of the crew of the SS C. V. SEA WITCH. The early abandonment of the engine room because of the dense smoke, although it made little significant change in the outcome of this casualty, could have been a significant factor under different circumstances where positive steps to combat the fire or maneuver the vessel had to be taken by the crew. The securing of the engine room ventilation fans did not preclude the introduction of smoke into the engine room mainly because of the air being drawn into the engine room by the forced draft fans supplying the boilers which were still being automatically fired. The inaccessibility of oxygen breathing apparatus because of isolation by fire and smoke precluded any constructive efforts to activate engine room systems or equipment. The stowage of the oxygen breathing apparatus in a more accessible location in the after deckhouse could have permitted remanning of the smoke filled engine room.

14. The fire fighting and survival efforts aboard the SS C.V. SEA WITCH subsequent to the casualty were hampered by the limitations of the straight bore nozzles at the interior fire hose stations. The subsequent loss of emergency fire main pressure, about ten minutes prior to the abandonment of the vessel, can be attributed to the many hoses left open and some without nozzles to restrain or reduce the flow. The lack of crew training in proper fire fighting techniques is evident by the manner in which the hoses and the fire stations were left open thereby depriving the crew of fire fighting capability prior to rescue. The proper use of combination type nozzles capable of solid stream, fog and cut off capability in one unit, would have been more effective and prevented the loss of fire main pressure.

15. The deck cargo containers on the side of the vessel were first affected by the flames and heat surrounding the SS C.V. SEA WITCH. The contents of those containers affected by the radiant heat once they reached ignition temperatures only required a source of oxygen to erupt into flames. The minor explosions heard on deck were most probably due to the rupture of containers and their contents from internal pressure of gases generated within the heated containers. Once the container ruptured the contents caught fire and spread inboard progressing from container to container. The fire accelerated as containers ruptured or were consumed during the fire exposing additional fuel to the fire. The spread of fire in a vertical plane between containers was probably accelerated by the ignition of the wooden floors of containers. The progress of the deck fire was uninhibited either by the small separation space between bays or the boundaries provided by the containers. The absence of an effective fire stop or separation of the deck containers, stowed three high across the vessel, essentially made this whole mass of containers react as a single unit to the fire situation. Although this fire started from a source external to the vessel it appears likely that a spread of a deck container fire from any source would progress through the mass of a comparable deck cargo in a similar manner. The absence of any effective fire stops to separate the deck cargo mass some 30 feet high over 320 feet in length and extending across the width of the vessel compounded the problem of fire containment.

16. Jose Vieira Novo, A.B.-Wiper, was aboard the SS ESSO BRUSSELS at the time of the collision, is missing and presumed dead as a result of this casualty.

17. The actions of many of the crew members of the vessels involved in assisting their shipmates, and of the numerous persons on the several tugboats, New York City Fireboats, New York City Police Launches, U.S. Corps of Engineers Patrol Boat, pleasure boats and Coast Guard units that were engaged in the rescue of survivors or fire fighting were heroic and in a large measure minimized the loss of life and therefore are considered worthy of special recognition.

18. The suddenness and complexity of the disaster taxed the available resources of the Captain of the Port, New York. There was minimal coordination during the initial stages of the rescue effort and coordination of the on scene forces developed after much time had elapsed. The search for survivors may have been more effective had a prearranged plan of disaster recovery been formulated. Although no two disasters can be expected to present the same conditions the general principles of coordination are basic. The lessons learned from this casualty along with an appreciation of the mutual interdependence and capability of the civic and private resources available can be of immense mutual benefit to all sectors of the community in preparing for future emergencies. The immediate availability of New York City Fireboats in the harbor minimized the property loss and was directly responsible for the saving of the 31 persons who had taken shelter in the after deckhouse of the SS C.V. SEA WITCH. Although there was a high loss of life and property as a result of this casualty, the loss from the same incident could have been multiplied many times had the collision occurred under different prevailing weather and current conditions. Had the current been flooding in lieu of ebbing and the wind been easterly in lieu of westerly the burning oil from the SS ESSO BRUSSELS and the two ships would have drifted toward the Staten Island shore and directly affected the other vessels occupying Federal Anchorages 23 and 24.

19. The availability of a common radiotelephone frequency Channel 13 (Bridge to Bridge) on which most vessels on scene communicated contributed to the effectiveness of rescue of survivors. The use of Channel 13 for port disaster communications although effective in this instance, could be disruptive to vessels requiring this frequency for Bridge to Bridge navigational communications. The lack of a common communications channel between all forces on scene in a large part reduced the effectiveness of the searches for survivors.

20. The hull of both vessels remained intact after being subjected to intense heat and this substantiates the suitability of steel as a structural material. The extensive damage sustained by the non ferrous fittings on the SS ESSO BRUSSELS and aluminum containers on deck of the SS C.V. SEA WITCH also substantiate the suitability of steel as a structural component which can withstand disintegration due to shipboard fire.

21. Speed of vessels in New York Harbor is presently unregulated except for a regulation pertaining to vessels transiting an anchorage in the vicinity of moored vessels. The use of the word "moored" appears to be ambiguous since it is being interpreted as applying to vessels tied to mooring buoys and not applicable to vessels anchored within the anchorage area. The use of New York Harbor by increasingly larger vessels and the use of the general anchorage areas for lightering of deeply loaded tankers with the risk attendant with cargo transfer appears to require a harbor speed control in this area. Speed control would provide a margin of safety for reaction in event of a mishap to vessels entering and leaving port in the main channel which borders on the anchorages in New York Harbor. The common practice of using reduced maneuvering harbor speed

by vessels recognizes the need for special precautions in congested waters where instantaneous maneuvering may be required. The practice followed by many large vessels when transiting the Kill Van Kull and Arthur Kill of having one or more tugs alongside or in immediate proximity to assist in the event of difficulty is prudent and recognizes the possibility of unexpected situations. Had a tug or tugs accompanied the SS C. V. SEA WITCH until she cleared the anchorage this disaster may have been prevented or the results minimized.

22. The in service reliability of the steering gear on this relatively new vessel was extremely poor. Vessel designers, operators and regulatory agencies appear to devote insufficient attention to construction details of steering gear and steering control systems. Record keeping concerning maintenance, past difficulties and repair was inadequate. If reports had been prepared and properly evaluated, corrective alterations or repairs may have been accomplished and the casualty prevented. In service tests during periodic inspections and prior to getting under way mainly check on the performance of the steering gear. Shipboard records of machinery history were not routinely kept and information about repairs and malfunctions were not passed on in a positive way between relieving engineers.

23. The oil spill into the waters of New York Harbor on the morning of 2 June 1973 was in violation of the Federal Water Pollution Control Act of 1972 and was caused by the release of oil from the ruptured tanks of the SS ESSO BRUSSELS.

24. The inability to drop the port anchor of the SS C. V. SEA WITCH, when ordered, about a minute before the collision contributed to the high impact of the collision. Had the port anchor been able to be let go when ordered by the bridge the headway or heading of the SS C. V. SEA WITCH may have been altered sufficiently to reduce the effects of the collision. There is evidence of negligence on the part of the Chief Mate, Max R. Stirn, in that he wrongfully failed to check or have the freedom of the riding pawl checked on the port anchor chain to insure that the anchor was ready for letting go.

25. The failure of the Master, John L. Paterson and the Pilot, John T. Cahill, to take timely action of stopping the SS C. V. SEA WITCH after the steering casualty was first reported was a contributing factor in both the cause and the severity of the effects of this casualty. Although harbor speeds of 13.5 knots and greater are considered common practice in this section of New York Harbor by experienced pilots, this speed of advance leaves little reaction time for vessels which may experience steering or engine difficulties as evidenced by this casualty and the grounding of the SS C. V. SEA WITCH in the New York Harbor in 1969.

26. The investigation by this Board was hampered by the unfortunate loss of the Masters of both vessels and the officer on the bridge of the SS C. V. SEA WITCH at the time of the collision. Vital information and bridge records on the SS C. V. SEA WITCH which could, if available, shed light and provide valuable information on the steering and engine maneuvers were lost in the aftermath of the collision.

RECOMMENDATIONS

1. That the control shaft arrangement on vessels in service fitted with similar steering gear be specifically examined to insure that the conditions which were the primary cause of this casualty do not exist.

2. That the Commandant initiate a review of current approved design and construction standards of steering gear control systems to determine if the single system of linkage aft of the rotary hydraulic power units in the steering engine room, as was installed aboard the SS C.V. SEA WITCH, meets the intent of duplicity of steering gear control.

3. That the Commandant amend applicable regulations to require approved combination fire hose nozzles that provide straight stream, high velocity fog and shut off capability be installed at all fire stations.

4. That in view of the inability to start the SS ESSO BRUSSELS lifeboat engine the Commandant review the requirements and the suitability of lifeboat engines that only have hand crank starting capability.

5. That a survey of the cargo, location of containers, hazardous cargo and other container or cargo characteristics on board the SS C.V. SEA WITCH be conducted to document the condition of the containers and cargo after the fire. The information obtained can be used to check the adequacy of existing container construction standards, sufficiency of container identification, cargo identification and possible need for additional shipboard fire protection standards in view of the rapid spread of fire through the containers during the fire.

6. That speed control of vessels transiting the main channel of New York Harbor be initiated. A requirement for vessels to proceed at a speed sufficient for safe navigation and yet to provide a margin of safety, to maneuver or take corrective action to prevent or reduce the effects of a casualty in the event of difficulty warrants urgent consideration. This is particularly urgent since vessels using New York Harbor must pass through or adjacent to anchorages where large bulk carriers are anchored and at times offloading hazardous materials into barges alongside.

7. That further study be conducted to develop methods whereby the spread of smoke within the interior of burning vessels could be prevented. Ventilation systems should be designed to provide manual or automatic means to not only prevent the spread of fire but also the spread of smoke.

8. That the applicable regulations for all vessels in ocean and coastwise service be amended to require that each life preserver be equipped with a water proof battery powered light and that retroreflective material be required on all life preservers.

9. That the Commandant initiate efforts through the International Convention for the Safety of Life at Sea to require that all lifeboats for vessels

in ocean or coastwise service be equipped with mechanical disengaging apparatus which will simultaneously release both boat falls from the boat when under tension.

10. The stowage location of the oxygen breathing apparatus and emergency equipment should be carefully considered. Emergency equipment should be stowed above weather decks in the interior of the forward and after superstructures where they may not be isolated by collision, fire, or smoke and will be accessible from several avenues.

11. That the District Commander with officials representing local, federal governmental and marine commerce review the adequacy of contingency plans to effectively coordinate all resources to minimize effects of large catastrophies that may occur in the New York Harbor.

12. That the Commandant should consider the feasibility of a requirement for merchant vessels for a recording device, similar to that installed on commercial aircraft, that will preserve vital information subsequent to fire or submergence.

13. That further investigation under the Suspension and Revocation Proceedings be initiated in the case of Chief Mate, Max R. Stirn, License No. [redacted] in that he failed to have the port anchor clear for letting go.

14. That a copy of this report be forwarded by the Commandant to the State Pilots Commission for further action on their part against the state license of Pilot John T. Cahill, in accordance with the agreement with the American Pilots Association since the SS C.V. SEA WITCH was sailing under registry at the time of the casualty, and the Pilot was serving under the authority of his state license.

[redacted]
Rear Admiral J. W. MOREAU, USCG
Chairman

[redacted]
Captain A. S. ZABINSKI, USCG
Member

[redacted]
Commander W. E. WHALEY, Jr., USCG
Member and Recorder