

MARINE CASUALTY REPORT

STRANDING OF THE SS STEEL VENDOR ON LOAITA
BANK IN THE SOUTH CHINA SEA ON 7 OCTOBER 1971
WITHOUT LOSS OF LIFE

U.S. COAST GUARD
MARINE BOARD of INVESTIGATION REPORT
and COMMANDANT'S ACTION

ACTION BY
NATIONAL TRANSPORTATION SAFETY BOARD



DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C., 20590

REPORT NO. USCG/NTSB-MAR-73-1
RELEASED 15 OCT 1973

Report No. USCG/NTSB-MAR-73-1	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Marine Accident Report - SS STEEL VENDOR, South China Sea, October 7, 1971		5. Report Date August 28, 1973	
7. Author(s)		6. Performing Organization Code	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Surface Transportation Safety Washington, D.C. 20591 and U.S. Coast Guard Washington, D.C. 20590		8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address National Transportation Safety Board Bureau of Surface Transportation Safety Washington, D. C. 20591 and U.S. Coast Guard Washington, D. C. 20590		10. Work Unit No. 1143	
15. Supplementary Notes This report contains Marine Safety Recommendations M-73-7 through M-73-9.		11. Contract or Grant No.	
		13. Type of Report and Period Covered Marine Accident Report October 7, 1971	
		14. Sponsoring Agency Code	
<p>Abstract</p> <p>On October 5, 1971, the fully loaded cargo ship SS STEEL VENDOR lost all propulsive power in the South China Sea, while en route from Manila, R.P.I., to Saigon, R.V.N. The ship drifted in heavy winds and seas and stranded on the Loaita Bank reef on October 7. Although the ship was a total loss, the entire crew was rescued.</p> <p>This report contains the action taken by the National Transportation Safety Board in determining the probable cause of the casualty and in making recommendations and the Marine Board of Investigation report and the action taken by the Commandant, U.S. Coast Guard.</p> <p>The National Transportation Safety Board determines that the probable cause of the loss of the SS STEEL VENDOR was the crew's inability to prevent the ship from being driven into a region of dangerous reefs. Contributing to the accident were (1) the crew's inability to maneuver the ship, which was the result of damaged boilers and inoperable feed pumps; (2) limitation of the engineering plant design, which did not provide for filling and testing a boiler when both boilers were secured; (3) errors in operating and maintenance procedures committed by the crew because of lack of competence and proper supervision; (4) the deck officers' inability to plot the vessel's position and to determine its set and drift; and (5) failure by the ship's officers to report the malfunction of the boilers, feed pumps, and ship's service generator to the Coast Guard while the ship was in Manila.</p>			
17. Key Words Ship Boiler Failure, Feed Pumps, Loss of Ship, Stranding, Machinery Liability, Crew Competence, Ocean Currents, Inspection Effectiveness		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Va. 22151	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages	22. Price



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TABLE OF CONTENTS

	<u>Page</u>
ACTION BY THE NATIONAL TRANSPORTATION SAFETY BOARD	
Synopsis.....	1
Analysis.....	2
Probable Cause.....	6
Recommendations.....	7
ACTION BY THE COMMANDANT - U. S. COAST GUARD	
Synopsis of Findings of Marine Board of Investigation.....	9
Remarks.....	10
Action Concerning the Recommendations.....	11
MARINE BOARD OF INVESTIGATION	
Findings of Fact.....	12
Conclusions.....	28
Recommendations.....	30





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

SS STEEL VENDOR, SOUTH CHINA SEA
OCTOBER 7, 1971

ACTION BY THE NATIONAL TRANSPORTATION SAFETY BOARD

This casualty was investigated by a U. S. Coast Guard Marine Board of Investigation convened at San Francisco, California, on October 12, 1971. A representative of the National Transportation Safety Board attended the proceedings as an observer. 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 October 5, 1971, the fully loaded cargo ship SS STEEL VENDOR lost all propulsive power in the South China Sea, while en route from Manila, R.P.I. to Saigon, R.V.N. The ship drifted in heavy winds and seas and stranded on the "Loaita Bank" reef on October 7. Although the ship was a total loss, the entire crew was rescued.

The National Transportation Safety Board determines that the probable cause of the loss of the SS STEEL VENDOR was the crew's inability to prevent the ship from being driven into a region of dangerous reefs.

Contributing to the accident were:

1. The crew's inability to maneuver the ship, which was the result of damaged boilers and inoperable feed pumps.
2. Limitation of the engineering plant design, which did not provide for filling and testing a boiler when both boilers were secured.
3. Errors in operating and maintenance procedures committed by the crew because of lack of competence and proper supervision.
4. The deck officers' inability to plot the vessel's position and to determine its set and drift.

5. Failure by the ship's officers to report the malfunction of the boilers, feed pumps, and ship's service generator to the Coast Guard while the ship was in Manila.

ANALYSIS

Boiler Performance

From July 26, 1971, when the STEEL VENDOR departed Houston, until September 4, 1971, the day before arrival in Rangoon, the vessel's boilers performed without any reported malfunction. When the port boiler economizer ruptured on September 4, the engineering personnel committed an error by failing to shut off the fires in the starboard boiler as the water level in the boiler dropped out of sight. Nevertheless, the starboard boiler continued to operate satisfactorily until September 30, when it became necessary to plug one leaking tube. Permanent repairs were also made to the port boiler economizer during the ship's stay in Manila from September 26 to October 3. Both boilers reportedly were hydrostatically tested after these repairs, but it is not clear whether these tests were applied to the entire boiler or just to certain sections of the boiler. The adequacy of these repairs and tests appears questionable, since leaks were noted immediately before and after the ship's departure from Manila on October 3.

Many of the boiler problems experienced after the ship left Manila were aggravated by the difficulty which the crew experienced in identifying which boiler was malfunctioning, in diagnosing the malfunction, and in isolating the two boilers. During the first few hours after departure from Manila, the loss of water was attributed to the port boiler by some crewmembers and to the starboard boiler by others. When both boilers are operating, they have common liquid and steam mixing paths that make it very difficult to distinguish which boiler is losing water unless the origin of the leak can be seen. Clues can sometimes be obtained from changes in stack temperatures, chemical content of the boiler water, and position of the automatic feedwater regulator, but the investigative record does not show whether the engineering personnel looked for such clues. The repairs which were made on both boilers within 14 hours after the ship left Manila probably gave the crew confidence that they had taken care of any problem in either boiler. These repairs however may have reduced the loss of boiler water but did not stop it. The captain was not informed of this situation at that time and therefore had no opportunity to make a decision whether to continue to the ship's destination, 544 miles away, or return to Manila, 214 miles away.

On the morning of October 5, when the chief engineer was notified that the water level was dropping in both boilers, the two ship's service generators, the emergency diesel generator, and the two reciprocating steam feed pumps were out of service because of prior malfunctions.

While attempting to determine the origin of the leak, the chief engineer had the speed of the ship reduced to 35 r.p.m. This reduced steam demand on the boilers should have reduced the falling rate of the boiler water level. The investigative record does not show where the water level was in each boiler at that time. The chief engineer continued to fire the port boiler while the starboard boiler was being secured, and he then refired the starboard boiler before he decided to shut down both boilers. During this period, he noted that the superheat temperature was 870° F.; the designed superheat temperature for these boilers was 765° F. A small rise in the designed superheat temperature could be expected from the reduced efficiency caused by the bypassing of the economizer. However, the excessive superheat temperature indicated a serious imbalance between the heat input and the steam output of the boilers.

The most likely cause of an excessive superheat temperature is a severe low water condition. Such conditions can seriously damage the boiler tubes in a very few minutes by causing distortion, rupture, or leaks in the tube seats in the headers. In the STEEL VENDOR casualty, the futile efforts from October 5 through 7 to repair these boilers indicate the magnitude of the additional leakage caused by the overheating of the boilers. The chief engineer may have been reluctant to shut down both boilers immediately, because without the use of the emergency generator, all power and lights would have been lost with the ship adrift in stormy seas. However, the alternative resulted in irreversible damage to the boilers and loss of all power and lights.

Some crewmembers stated that if the reciprocating feed pumps had been operable, sufficient water could have been supplied to the boilers from reserve feed tanks to compensate for the leaks, and thus the low-water conditions which repeatedly forced boiler shutdown could have been avoided. Although this course of action would have attacked the symptoms rather than the cause, it possibly could have permitted the ship to continue on limited uninterrupted power with the minor leaks that existed on the morning of October 5. Availability of these pumps might even have avoided the high temperature damage on that morning. However, after the superheat reached 870° F., and extensive leaks developed, it is improbable that the boilers could have been kept in operation long enough for a rescue vessel to arrive and tow the STEEL VENDOR out of danger.

Safety Provisions

Engineering Plant. Many factors influenced the reliability of this ship's engineering plant. The duplication of boilers, turbine and reciprocating feed pumps, generators, etc., provided increased reliability through redundancy. Since the two steam driven generators and the two reciprocating feed pumps were out of operation before the final breakdown of the boilers on October 5, some reliability had been lost. However, even with all equipment operating, the engineering plant could not have coped with a failure of both boilers. First, there was no designed means

for replenishing the water in the boilers under such conditions, since all feed pumps were steam-operated. Second, repairs to any leaks in the boilers could not have been hydrostatically tested, since pressures on the boilers could be applied only with steam driven pumps. An electrically driven feed pump, capable of being supplied from the emergency generator, would have overcome both handicaps. There is probably more justification for such a pump on older vessels such as the STEEL VENDOR than on newer vessels. Newer vessels have more reliable machinery and also have appropriate countermeasures in their design to guard against boiler failures.

Crew Qualifications. Inadequate repair capabilities of the engineering plant were important factors in the continued malfunctioning of the plant. The mistakes made in the operation of valves on September 30 and October 4, which resulted in complete loss of steam power, indicate a lack of familiarity with the piping installation and a lack of proper supervision. Two similar errors in the operation of valves on October 6 may have stemmed from the same causes but were made more possible by the extremely adverse working conditions which then existed in the boilerroom. Although the engineering crew worked diligently after October 5, the quality of their work could have been expected to deteriorate under the very uncomfortable and tiring working conditions.

The crew's unsuccessful efforts during the several months prior to the casualty to repair the reciprocating feed pumps and their mistaken belief at times that repairs were completed show a lack of competency. An engineering crewman's certificate indicates general competence in operating machinery and, to a lesser extent, competence in repair capabilities. Operating knowledge is determined only by spot checks of a crewman's technical knowledge and by a crewman's years of experience. Any special detailed knowledge of each piece of machinery and the skills required for the repair of such machinery are not resolved in the present overall management of ship operations.

Regulations. One administrative control which is intended to monitor the seaworthiness of a ship is a statutory requirement that any serious injury to a vessel's hull, equipment, boiler, or machinery be reported to the Coast Guard.^{1/} The STEEL VENDOR departed Houston with an inoperable generator and two inoperable feed pumps without making such a report to the Coast Guard. The ship also left Manila without reporting an additional inoperable generator and without reporting the boiler casualties which occurred before arrival in Manila. Thus, the regulatory provision for initiating a review of shipboard decisions and actions did not function.

The Coast Guard and the American Bureau of Shipping (ABS) periodical inspections are apparently made with the expectation that the vessel's seaworthiness will not drop below minimum standards before the next inspection. Such an expectation is less valid for machinery

^{1/}United States Code, Title 46, Section 234.

reliability than for hull reliability. However, with sensors that can measure variables related to machinery deterioration and with rapid communications and monitoring capabilities, a "trend analysis" system could be instituted. Such a system would provide a means for the company management to become actively involved in maintaining the machinery reliability of the vessel.

In its investigative record, the Coast Guard states that it is examining its existing vessel inspection frequency and that a research and development study into inspection techniques, particularly regarding older vessels, is in the planning stages. Since in this casualty, however, the major machinery problems began about 6 months after completion of the biennial Coast Guard inspection and about 2 months after completion of the special ABS machinery survey, it appears that a sufficiently rapid cycle of inspection is not practical.

Navigation

Four days elapsed from the time the STEEL VENDOR departed Manila until its crew sighted "Loaita Bank" reef on the morning of October 7. During that time, the ship's officers were unable to establish the ship's position. Only from well established positions could the captain have determined the drift of the ship caused by varying ocean currents and wind pressure. Less reliable alternatives were use of historical published data or reliance on the captain's own recent experiences in that area. Neither alternative could have accurately reflected the strong winds which varied in direction and intensity during the 4 days.

In this instance, the applicability of historical published data was further reduced by the method of its collection and presentation. The Atlas of Surface Currents - Northwestern Pacific Ocean was compiled from observations submitted before 1935 by cooperating ships whose computations are of unknown accuracy. The ocean current drift and set is shown by the month in which the observations were made. These individual observations are then grouped into a statistical summary display ("rose") showing the percentage of time the ocean current can be expected in a given direction. For October, the current distribution "rose" along the STEEL VENDOR's trackline shows a fairly even percentage of ocean currents in all cardinal and intercardinal directions. On this basis alone, a captain could expect an almost equal probability of being set in almost any direction.

The Pilot Chart of the North Pacific Ocean presents less specific data but is in fact compiled from the same pre-1935 data as above, combined with more recent observations from cooperating ships. Such data suffice to alert navigators to the probability of a ship's being set in a given direction, but are not suitable for calculating a ship's position by dead reckoning, since to calculate a dead-reckoning position, the ship's course and speed must be combined with a specific set and drift. The set and drift calculated by the crew of the STEEL VENDOR

in that same area several weeks earlier was at least as good as the published data and could be used directly in the navigation problem. This is the alternative the captain chose.

At the beginning of the voyage, the captain assumed that the effect of the wind on the ship canceled the effect of the ocean current. However, when the winds intensified because of the typhoon, the captain did not reassess his assumption. The typhoon winds not only directly affected the vessel, but also altered the ocean currents. As a rough rule of thumb,^{2/} after about 12 hours, a wind-generated current will have a speed of about 2 percent of the wind speed and a direction 15° to 45° to the right of the downwind direction. In this casualty, such an estimate, based on the winds during the 24 hours before the reef was sighted, would have resulted in an approximate easterly set at about 0.9 knots. However, since other influences from nearby land masses or shoals can make even an approximation grossly inaccurate, a general estimate was probably not justifiable under the circumstances. Nevertheless, the captain should have expected that the previously assumed set and drift were no longer valid. The uncertainty of the situation, coupled with knowledge of reefs in the vicinity to the south and east, should then have generated sufficient alarm so that the captain would explore additional means of obtaining help.

The captain's failure to plot the typhoon was a departure from good practice, since knowledge of a typhoon's course and position is important for planning correct evasive action. However, because such a plot would not have altered the difficulty of determining the ship's set and drift, this neglect did not contribute to the loss of the ship.

Although conditions were not suitable for determining the ship's position using the radar, fathometer, or radio direction finder, navigation by means of LORAN was available in this region. The STEEL VENDOR, however, did not have the necessary LORAN receiver aboard and was not required to have one. Since the cost of such a unit is moderate and most U.S. commercial merchant ships and large fishing vessels are equipped with LORAN receivers, the acceptance by the company management of the increased risks involved in not having this means of navigation appears questionable.

PROBABLE CAUSE

The National Transportation Safety Board determined that the probable cause of the loss of the SS STEEL VENDOR was the crew's inability to prevent the ship from being driven into a region of dangerous reefs.

Contributing to the accident were:

^{2/}American Practical Navigator, U.S. Navy Hydrographic Office, Washington, D. C. 1966, Chapter 32.

1. The crew's inability to maneuver the ship which was the result of damaged boilers and inoperable feed pumps.
2. Limitation of the engineering plant design, which did not provide for filling and testing a boiler when both boilers were secured.
3. Errors in operating and maintenance procedures committed by the crew because of lack of competence and proper supervision.
4. The deck officers' inability to plot the vessel's position and to determine its set and drift.
5. Failure by the ship's officers to report the malfunction of the boilers, feed pumps, and ship's service generator to the Coast Guard while the ship was in Manila.

RECOMMENDATIONS

The National Transportation Safety Board concurs in the Commandant's decision that the Coast Guard should conduct a research and development study of the efficacy of its inspection techniques, particularly those directed towards older vessels.

The Safety Board recommends that:

1. The Coast Guard study the need, based on frequency of simultaneous boiler failure, for all steam vessels certificated for ocean service to have a means of filling and hydrostatically testing the propulsion boilers with an electrically driven pump that can be powered from the emergency generator. (Recommendation No. M-73-7)
2. The Coast Guard publicize to the merchant marine industry, the importance of the requirement in the U.S. Code, Title 46, Section 234, that all licensed officers must notify the Coast Guard of all significant hull, machinery, boiler, or equipment failures for any vessel on which such licensed officers sail. (Recommendation No. M-73-8)
3. The Coast Guard consider the feasibility of requiring all U.S. ships on an ocean voyage to have on board long-range, electronic navigation capability. (Recommendation No. M-73-9)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

Adopted this 29th day of August 1973:

[REDACTED]

[REDACTED] Member

[REDACTED]

[REDACTED] Member

[REDACTED]

[REDACTED] Member

[REDACTED]

[REDACTED] Member

[REDACTED], Chairman, was not present and did not participate in the adoption of this report.



DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

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5943/STEEL VENDOR
C-12 Bd
2 JAN 1973

Commandant's Action

on

The Marine Board of Investigation convened to investigate circumstances surrounding the stranding of the SS STEEL VENDOR on Loaia Bank in the South China Sea on 7 October 1971 without loss of life

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

SYNOPSIS OF FINDINGS OF MARINE BOARD OF INVESTIGATION

1. On 3 October 1971 the SS STEEL VENDOR departed Manila, R.P.I. on an intended voyage to Saigon, RVN. During this voyage the vessel suffered a series of mechanical breakdowns while underway in heavy weather, losing all power on 5 October 1971 and due to heavy seas and strong winds drifted into and became stranded upon Loaia Bank on 7 October 1971 at or about 1436 local time.
2. On 3 October 1971 prior to the SS STEEL VENDOR departure from Manila, R.P.I., the Chief Engineer advised the Captain that there was a leak in the port boiler which was minor in nature and that he felt could be corrected while the vessel was underway. The vessel had undergone repairs to mend a leak in the starboard boiler during the stay in Manila in addition to repairs to the port boiler economizer.
3. Although the SS STEEL VENDOR had maintained no radio watch while in Manila and therefore had no weather information prior to departure, the Captain was advised by the Manila Bay Pilot that "there is a typhoon several hundred miles off the East Coast of Luzon." The Captain checked

the charts and satisfied himself that the typhoon would pass astern of him and pose no threat to the vessel. No plot of the storm was maintained from subsequent weather advisory messages received during the remaining voyage.

4. Within three hours of departure from Manila the first of a series of mechanical failures occurred when the Chief Engineer reported to the Captain that he was having trouble maintaining water level in the boilers. The starboard boiler was taken off the line at 1600 on 3 October 1971.

5. During the voyage, after departure from Corregidor Island and until 1200, on 7 October 1971 the vessel's positions were estimated by dead reckoning only, due to overcast skies. The STEEL VENDOR was not equipped with LORAN. No radio stations were within range of the vessel's radio direction finding equipment after departure from Manila.

6. At about 1700 on 5 October 1971 the Captain of the STEEL VENDOR sent a message to the vessel's agents in Manila requesting a towboat. On 6 October 1971 the agents in Manila advised STEEL VENDOR that a tug, the BUCKEYE had been dispatched from Saigon, RVN and would arrive at their reported position at about 2000, on 8 October 1971. At about 1200 on 7 October 1971 a sun line and the sighting of a reef showed that the vessel was in fact some 90 miles South of their dead reckoning position and only 4 miles West of Loaia Bank. A distress message was sent as soon as possible and the HMS EAGLE responded that they would proceed to the aid of STEEL VENDOR.

7. At 1420, 7 October 1971 the STEEL VENDOR's port anchor made contact with the bottom and started to hold the vessel. At about 1430, 7 October 1971 the anchor broke free and at 1436 the STEEL VENDOR made contact with Loaia Bank reef. The starboard anchor had not been dropped during this period because the Captain was anticipating that he would get the main engine back on the line in time to maneuver away from the reef. The Captain felt that with two anchors out his chance of making this maneuver would be lessened because of the time required to retrieve both anchors.

8. The STEEL VENDOR was stranded higher on the reef with each roll the vessel took from the beam seas and wind. The vessel became permanently stranded very quickly. At 1645, 7 October 1971 the evacuation of the crew was commenced by helicopter from HMS EAGLE and the entire crew was removed by 1745, with one person having been injured in the incident. That person, the Chief Engineer fell down a stairway when the vessel rolled while on the reef. He was incapacitated over 72 hours but was returned to duty since the casualty.

REMARKS


1. Although the casualty resulted after the failure of tubes in both the port and starboard boilers, the cause of the casualty was the drifting onto the reef at Loaia Bank after having lost all propelling power.

2. Contributing to the cause of the casualty was the obvious poor condition and lack of maintenance of the engineering plant of STEEL VENDOR. The Coast Guard is examining existing vessel inspection frequency and a research and development study into inspection techniques, particularly as directed at older vessels is in the planning stages. In addition, our Information and Analysis Staff will continue to point to possible trouble areas through computerized sorting of inspection and casualty data.


3. In addition, it is evident that some of the ship's licensed officers were negligent in the performance of their duties during the several failures experienced by STEEL VENDOR.

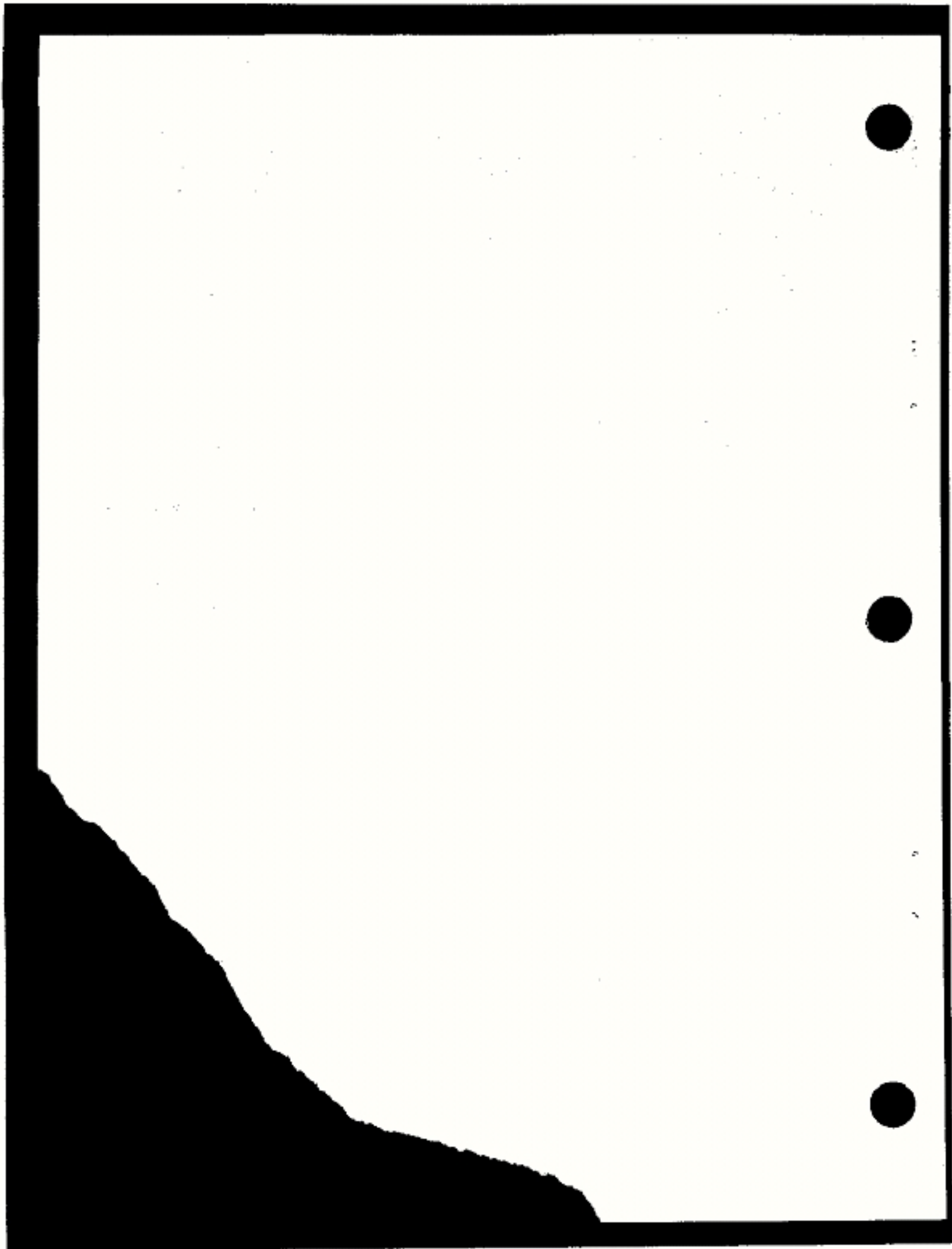
ACTION CONCERNING THE RECOMMENDATIONS

1. Appropriate action under the provisions of the Suspension and Revocation Procedures, has been completed on the three recommendations of the Marine Board of Investigation.



C. R. BENDER
Admiral, U. S. Coast Guard
Commandant







DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
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630 Sansome St.
San Francisco, Calif. 94111

5943/C-112-72/REN
Marine Board
SS STEEL VENDOR

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

31 JUL 1972

Subj: SS STEEL VENDOR, O.N. 246464 stranding on Loaita Bank, on 7 October 1971, without loss of life

FINDINGS OF FACT

1. At about 1330 (all times zone description -8), on 3 October 1971, the SS STEEL VENDOR, O.N. 246464, departed Manila, R.P.I., with a cargo of cement, on an intended voyage to Saigon, RVN; however, the vessel suffered a series of mechanical breakdowns while underway in adverse weather. On 5 October 1971, at about 0812, both boilers were secured because of serious leaks. Repairs were attempted through the next two days, as the vessel drifted in heavy seas. On 7 October 1971, at about 1145, Loaita Bank shoal (LAT 10°44'N., LONG 114°19'E.) was sighted about 4 miles off. The vessel drifted towards the shoal, in heavy seas and strong winds, and grounded at about 1436. At about 1500, the evacuation of the crew by helicopters from the British Aircraft Carrier HMS EAGLE commenced, with the last man being safely removed at about 1745.

2. The vessel involved in the casualty was:

Name:	SS STEEL VENDOR
Official Number:	246464
Year built:	1944
Service:	Freight, C-3
Gross Tons:	7752
Net Tons:	4575
Length:	468.5 Feet
Breadth:	69.6 Feet
Depth:	29.5
Propulsion:	Steam Turbine
Horsepower:	8500



Homeport:	New York, New York
Owners/operators:	Isthmian Lines, Incorporated 90 Broad Street New York, New York
Master:	Cecil H. LAMBERT
License:	Master Issue S-8, No. 291566 Merchant Mariner's Document Number 2-166002-D2
Last Biennial USCG Inspection:	12 March 1971 Portland, Oregon
Last ABS Inspection:	21 July 1971 Special periodical survey of machinery completed at Mobile, Alabama

3. There were no deaths as a result of the casualty. One person, Chief Engineer Roger L. SHACKLEFORD, [REDACTED], License Number [REDACTED], sustained injuries which resulted in incapacitation for over 72 hours. Mr. SHACKLEFORD's injuries were diagnosed at the U. S. Naval Hospital at Subic Bay, Philippines, as two superficial lacerations to the scalp with underlying hematomas, a small laceration of the left 5th finger and more serious, a trauma to his left kidney.

4. Weather advisory broadcasts by the U. S. Fleet Weather Central Guam for the Philippines and South China Seas indicated the following storm conditions during the period of time from 3 October 1971 to 7 October 1971:

- a. On 3 October 1971, at 1400 (all times zone description -8), a tropical depression was forecasted at a position of LAT 11.7°N., LONG 124.4°E., moving west-northwest at 12 kts., with 30 kt. winds at the center. At 2000, the tropical depression was upgraded to a tropical storm named ELAINE. At 2357, tropical storm ELAINE was observed at LAT 12.8°N., LONG 124.3°E., moving west-northwest at 10 kts. Maximum winds at the center were reported at 45 kts., with 30 kt. winds extending 100 nautical miles from the center. Forecast for the storm was that the intensity would increase with winds reaching 70 kts. within the next 48 hours.
- b. On 4 October 1971, at 0600, tropical storm ELAINE was observed at LAT 13.0°N., LONG 122.7°E., moving northwest at 14 kts. Maximum winds at the center were reported at 45 kts. At 1100, the storm was over Mindoro Island, at a position of LAT 13.1°N., LONG 121.3°E. The SS STEEL VENDOR was about 210 miles west of the storm at this

time. Tropical storm ELAINE was reported to be moving towards the west-northwest at 12 kts. Maximum winds at the center were reported at 60 kts. At this time, the storm was located approximately 90 miles south of Corregidor Island. Tropical storm ELAINE crossed the track line of the SS STEEL VENDOR, passing astern of the vessel approximately 230 miles.

- c. On 5 October 1971, at 0014, tropical storm ELAINE was at a position of LAT 14.4°N., LONG 119.0°E., moving northwest, with maximum winds at the center of 60 kts. At 0613, tropical storm ELAINE was upgraded to a typhoon. The storm was positioned at LAT 15.2°N., LONG 117.9°E., moving towards the west-northwest at 12 kts. Winds at the center were reported at 65 kts. The 24 hour forecast predicted winds increasing to 80 kts. at the center of the storm. Winds of 50 kts. were predicted at a radius of 150 nautical miles and winds of 30 kts. at a radius of 350 nautical miles. At 1158, typhoon ELAINE had moved to a position of LAT 14.5°N., LONG 116.9°E. Maximum winds at the center continued at 65 kts. High seas warning was issued for seas greater than 30 feet near the center of the storm. The position of the storm was located at LAT 14.6°N., LONG 116.4°E., moving towards the west-northwest at 11 kts. Maximum winds at the center were reported at 60 kts.
 - d. On 6 October 1971, at 0605, tropical storm ELAINE was again upgraded to a typhoon. The storm's position was reported at LAT 15.0°N., LONG 115.9°E. The storm was moving towards the west-northwest at 10 kts. Maximum winds at the center were reported at 70 kts. By 0840, the winds were reported to have increased to 105 kts. and the eye of the typhoon was stationary. Winds of over 100 kts. were reported 50 nautical miles from the center in the southeastern quadrant. Winds of over 50 kts. at a radius of 200 nautical miles and winds of over 30 kts. were reported at a radius of 400 nautical miles from the center. At 1800, the typhoon started to move towards the west-northwest at 3 kts. Winds at the center of the storm continued at 105 kts.
 - e. On 7 October 1971, at 0020, typhoon ELAINE was positioned at LAT 16.0°N., LONG 115.4°E. The storm was moving towards the west at 6 kts., with maximum winds at the center of 100 kts. At 1200, the storm was positioned at LAT 16.5°N., LONG 115.3°E., moving towards the northwest at 4 kts. Maximum winds at the center were reported at 95 kts.
5. Weather recorded aboard the vessel in the deck log book indicates the vessel experienced the following weather conditions between 3 October 1971, upon departure from Manila, and 7 October 1971, at Loaita Bank:

- a. On 3 October 1971, the weather was recorded at 0400 (all times,

zone description -8) as wind northerly force 2, barometer 29.78. At 1330, the vessel was underway from Manila bound for Saigon, RVN. The weather at 1536, on departure from Corregidor Island, was recorded as good visibility, squalls in the vicinity of Manila Bay, vessel riding easily to a low westerly swell. At 1600, weather was recorded as wind northeasterly at force 3, barometer 29.69. At 2400, the wind had shifted to northwesterly force 3 with a barometer of 29.69.

- b. On 4 October 1971, at 0800, the weather was recorded as wind from northwest at force 4, barometer 29.58, light rain with good visibility, vessel riding easily in a moderate-to-rough northwesterly sea. At 2000, the dead reckoning position of the vessel was LAT 12°44'N., LONG 115°49'E. The weather was recorded as wind from the west-southwest at force 5, barometer 29.58, rain, with moderate visibility, causing the ship to roll easily in rough west-by-southerly seas. By 2400, the winds had increased to force 6 out of the west-by-south.
 - c. On 5 October 1971, the weather continued as before with rain squalls and overcast skies. At 0800, the vessel's dead reckoning position was LAT 11°49'N., LONG 113°04'E. Wind was out of the west-by-north at force 5, barometer at 29.64. By 2200, the wind had increased to force 8 and shifted to the southwest.
 - d. On 6 October 1971, at 0600, the weather was recorded as increasing with the wind shifting to the west at force 8. Skies remained overcast with occasional rain. The vessel was rolling heavily in heavy westerly seas and swells while dead in the water. The 0800 dead reckoning position was recorded at LAT 11°47'N., LONG 113°21'E., with the vessel rolling heavily in a westerly sea and swell. At 1000, the wind had increased to force 9 from the west-by-south. At 1700, the wind lessened to force 8 from west-by-south. The sea conditions were recorded as "taking heavy seas over #3 and #4 midships." The 2000 dead reckoning position was recorded at LAT 12°01'N., LONG 113°34'E.
 - e. On 7 October 1971, at 0100, the wind again was recorded at force 9 from the southwest. The barometer was at 29.68. The vessel was reported to be rolling to heavy westerly swells. The weather continued about the same with the wind shifting to the west at force 8 at about 0500. At 0800, the seas were recorded as heavy on the starboard beam causing the vessel to roll heavily. At 1200, the overcast skies gave way to a heavy haze allowing a poor sun line position to be obtained. The SS STEEL VENDOR was receiving radio weather advisory reports twice daily from Manila. However, these messages were lost when the vessel was abandoned on 7 October 1971.
6. On 4 October 1971, at 2000, the dead reckoning position of the SS STEEL VENDOR was recorded as LAT 12°44'N., LONG 115°49'E. On 5 October 1971, at 0800, the vessel's dead reckoning position was recorded as LAT 11°49'N., LONG 113°04'E. The Master and Second Mate testified that the appropriate

pilot charts were consulted for current information. A review of the pilot charts for both September and October revealed the following information:

4 OCTOBER VESSEL's POSITION

SEPTEMBER	drift-----16.6 miles per day
	set-----northeasterly
OCTOBER	drift-----not specified
	set-----east-northeasterly

5 OCTOBER VESSEL's POSITION

SEPTEMBER	drift-----not specified
	set-----northeasterly
OCTOBER	drift-----not specified
	set-----east-northeasterly

In addition, the September Pilot Chart indicated a current setting south-southwesterly along the Philippine Coast, but this was wide to the east of the dead reckoning position. A review of the Atlas of Surface Currents, Northwestern Pacific Ocean, H. O. Publication #569, a more detailed publication of ocean currents, gives the following current information:

4 OCTOBER VESSEL's POSITION

SEPTEMBER	drift-----12.0 miles per day
	set-----east
OCTOBER	drift-----7.0 miles per day
	set-----northeast

5 OCTOBER VESSEL's POSITION

SEPTEMBER	drift-----12.7 miles per day
	set-----southeast
OCTOBER	drift-----2.4 miles per day
	set-----east-northeast

From the Atlas of Surface Currents, Northwestern Pacific Ocean, H. O. Publication #569, it is noted that the majority of the area between the dead reckoning position of the vessel on 5 October 1971 and Loaita Bank indicates, that once the vessel had entered this area the vessel could experience a southeasterly set of approximately 13.4 nautical miles per day towards Loaita Bank. The vessel's radar was not in operation during the course of the casualty.

7. On 26 July 1971, the SS STEEL VENDOR departed the port of Houston, Texas, after signing foreign shipping articles for a voyage to one or more Far East ports via one or more Indian Ocean ports and back to a final port of discharge in Continental United States. Preceding departure from Houston, the SS STEEL VENDOR was on a coastwise voyage on the East and Gulf coasts. During the coastwise voyage repairs were made to the economizer units on both boilers.

8. On 21 July 1971, while the SS STEEL VENDOR was in Mobile, Alabama, during the coastwise voyage, the outstanding U. S. Coast Guard material inspection items for the last biennial inspection and the American Bureau of Shipping Machinery Survey items were completed. No outstanding deficiencies were pending against the vessel upon departure from Mobile, Alabama. At that time there were no known mechanical deficiencies to the vessel other than one reciprocating feed pump which would not operate at sufficient pressure to maintain feed water to a steaming boiler. The other reciprocating feed pump and both steam turbine feed pumps were functioning properly and the defective pump was scheduled for repair at sea as a routine matter. First Assistant Engineer [REDACTED], C. E. License [REDACTED], was a non-watchstanding engineer and was in charge of all repair work. As was Mr. [REDACTED] policy, he made up a list of necessary repairs and overhauls to be accomplished during the forth coming voyage. However, during the time the vessel was in Houston it was determined that both reciprocating pumps were in need of repair and both pumps were placed on the list for overhaul, giving them first priority. It was noted that even though these pumps would not perform satisfactorily at boiler pressure they would perform satisfactorily as a feed water transfer pump, which was the usual function of the pumps.

9. Rangoon, Burma, was the first scheduled port for cargo discharge. Refueling stops were made at Balboa, Canal Zone, on 1 August 1971 and at Yokohama, Japan, on 23 August 1971. During the voyage to Yokohama the "forward" reciprocating feed pump was overhauled. From observation of the pump while in operation, it was noted that in addition to its failure to maintain adequate output pressure the pump had some obvious steam leaks about the pump glands and also in the vicinity of the Masoneilan automatic regulating valve. With the consent of the Chief Engineer, Rodger L. SHACKLEFORD, [REDACTED], License Number [REDACTED] the Masoneilan regulator was isolated to stop the steam leak; however, this rendered the regulator inoperative and control was maintained by throttling the steam supply valve. A complete overhaul of the forward reciprocating feed pump was accomplished which included disassembling, renewal of worn parts with new or good used parts, and polishing and grinding of machined surfaces. All steam leaks on the pump were corrected. After repairs to the "Forward" reciprocating pump were completed, the same repair procedures were accomplished on the "After" reciprocating pump. At the completion of all repair work, a static test against a closed discharge valve was conducted on both pumps at a maximum output pressure of approximately 700 PSI. Neither pump was tested by placing them in operation to supply feed water to the boilers

while the boilers were steaming with the vessel underway. Mr. [REDACTED] considered both pumps to be in satisfactory working condition and reported this information to Mr. SHACKLEFORD. In addition, Mr. [REDACTED] kept a personal work log that contained his repair work and priority of work to be accomplished. This log was turned over to Mr. SHACKLEFORD when Mr. [REDACTED] departed the vessel in Manila and was subsequently lost when the vessel was abandoned.

10. On 4 September 1971, the day prior to arrival at Rangoon, Burma, during evening hours, a casualty occurred to the port boiler. One section of the port boiler economizer ruptured, but it happened in such a manner that it was not possible to determine immediately which boiler was effected. The D.C. heater was emptied before the trouble could be isolated, resulting in loss of suction to the coffin turbine feed pumps. The trouble was determined to be in the port boiler and it was secured but not before the water level diminished in the starboard boiler to where it was necessary to secure the starboard boiler also. During this casualty, the reciprocating feed pump was placed in operation but it would not supply sufficient feed water pressure to steam a boiler. The main engine was secured to conserve steam for the generators. The steam pressure dropped in the starboard boiler to about 200 PSI, causing the turbo-generator to slow down and resulting in the lights dimming. After the port boiler was isolated, the starboard boiler was mistakenly thought to be full of water by Mr. SHACKLEFORD, who ordered the fires lit on three burners in the starboard boiler. During the lighting-off of the starboard boiler, Mr. ADKISSON and Mr. SHACKLEFORD had a disagreement as to the level of the feed water in the starboard boiler. Later, Mr. [REDACTED] was proved correct in his evaluation that the water level was low. The starboard boiler was fired for a short period of time with the water level out of sight in the gauge glass. The fires were again extinguished and the boiler allowed to cool. It was agreed that the boiler did have some water in it and it was the opinion of both Mr. [REDACTED] and Mr. SHACKLEFORD that the starboard boiler did not sustain any damage. The next morning, the starboard boiler was filled with feed water by using the wash water pump and a garden hose. The starboard boiler was brought up to steaming pressure and the vessel proceeded to Rangoon on one boiler. During the in port period in Rangoon, the port boiler economizer was isolated by blanking it off and bypassing the unit. Mr. SHACKLEFORD stated that while in port he ordered new parts for the reciprocating pump through the vessel's agent to be delivered to the vessel at some later date. However, these pump parts were never received aboard the vessel. The SS STEEL VENDOR departed Rangoon, on 6 September 1971, bound for Singapore with both boilers in operation. During this casualty, it was determined that the reciprocating feed pumps were still not operating properly as they would not maintain adequate output pressure to supply feed water to a steaming boiler.

11. On 9 September 1971, the SS STEEL VENDOR departed Singapore en route to Sattahip, Thailand. On 13 September 1971, the vessel departed Sattahip,

Thailand, en route to Saigon, RVN, to off load the remaining cargo. On 21 September 1971, the SS STEEL VENDOR departed Saigon, RVN, bound for Manila, RPI, to load bagged cement for a return voyage to Saigon. The seasonal monsoon was affecting the weather on the voyage to Manila, but no unusual set or drift due to current was encountered during the passage. The voyage from Rangoon, Burma, to Manila, RPI, was described as routine and uneventful.

12. On 25 September 1971, the SS STEEL VENDOR arrived at Manila and anchored inside the Manila breakwater, with two anchors, to commence loading cargo. After arrival, the port boiler was secured and allowed to cool for completion of more permanent repairs to the port boiler's economizer. The bypass piping and blanked off ends were removed and the ruptured section was plugged by the ship's engineers. The remaining three sections of the economizer were again placed back in service. A hydrostatic test was conducted on the port boiler at working pressure and no leaks were found. During this time, the forward reciprocating feed pump was again disassembled for repairs. On 30 September 1971, at about 1300, Mr. [REDACTED] went to the fire room where he was met by the engineering watch officer, Mr. [REDACTED] License Number [REDACTED], who reported that he was having trouble maintaining proper water level in the starboard boiler. Mr. [REDACTED] directed him to start lighting-off the port boiler, as the economizer repairs and test had been completed to the port boiler, and to bring up steam and put the boiler on the line as fast as possible. The starboard boiler was then to be secured to determine the source of water leak. Mr. [REDACTED] examined the starboard boiler and detected steam vapor coming out of the rear superheater doors. Both Mr. [REDACTED] and Mr. [REDACTED] stated that when the pressure was up to about 400 PSI on the port boiler, they started to cut in the boiler and cut out the starboard boiler. However, the generator stop check valve on the port boiler stuck, causing the steam flow to the generator to be interrupted. Mr. [REDACTED] detected the problem and reopened the generator stop check valve on the starboard boiler. Mr. [REDACTED] went to the machine shop, got a hammer and tapped the generator stop check valve on the port boiler until he could hear that it opened. While the fires were secured the pressure on the port boiler had dropped to about 300 PSI. Steam flow was interrupted for a few minutes and during this time the generator on the line was tripped off causing the emergency generator to come on the line. The fires were relit and the pressure brought back up on the port boiler and it was again cut in and the starboard boiler was taken off the line. During this casualty, Mr. SHACKLEFORD had come to the engine room and was on the upper level. Mr. SHACKLEFORD did not have the same recollection of the casualty and stated that the cause of the problem was that Mr. [REDACTED] mistakenly opened the valve supplying steam to the soot blowers rather than the generator stop valve. Later the same day, Mr. [REDACTED] was released from the service of the vessel after appearing before the American Consular Officer, accompanied by Captain LAMBERT and Mr. SHACKLEFORD. A message was sent by the agents in Manila to send a replacement First Assistant Engineer to

meet the vessel upon arrival at Saigon. Third Assistant Engineer, Mr. Joseph B. CHADA, First Assistant Engineer, License Number [REDACTED] D1, had been standing the 12-to-4 watch at sea. Mr. CHADA was approached by Mr. SHACKLEFORD, after Mr. [REDACTED] had departed the vessel, requesting that he be the new First Assistant Engineer. Mr. CHADA told Mr. SHACKLEFORD that he would rather not but would if necessary. It was understood that Mr. CHADA would continue with his regular duties as a watchstanding officer, while being assigned as First Assistant Engineer.

13. Shore side engineers were requested to assist the vessel's engineers in making repairs to the leak in the starboard boiler. Their primary duty was to remove the casing doors. Mr. DIXON testified that he determined that the "3rd from the forward end," generating tube had ruptured and after the leaking tube was found, it was plugged and the boiler tested with a working pressure hydrostatic test to prove the boiler tight. Mr. SHACKLEFORD stated that he did not know which tube had been plugged. Mr. [REDACTED] was the engineer who actually went into the steam drums and he recalls that there were other tubes plugged but he could not recall how many. From his recollection, there were 12 plugged tubes in one boiler and 24 plugged tubes in the other, but he couldn't recall which boiler had the 24 plugged tubes. Mr. SHACKLEFORD stated that boiler feed water tests were made daily during the course of the voyage by Mr. [REDACTED] and that the salinity level was maintained at 2 to 3 grains per gallon. All the engine room records and log books were later lost during the evacuation of the vessel on 7 October 1971.

14. On 3 October 1971, at about 1200, preparations were made to depart the port of Manila, after the loading of 10,300 tons of bagged cement had been completed. Draft on departure was recorded at 27'8" forward and 28'0" aft. An amplitude was taken on departure from Manila and the gyro compass error was found to be zero. Mr. CHADA had the 12-to-4 sea watch in the engine room and found all machinery in satisfactory condition. The forward reciprocating feed pump had not been reassembled on departure from Manila. Captain LAMBERT stated that a report was made to him that a check of all machinery and equipment had been made and that the vessel was ready to put to sea. Mr. SHACKLEFORD stated that on 3 October 1971, during the forenoon hours, another leak was found in the port boiler. The leak was determined by him to be minor in nature and apparently coming from the area of the port boiler economizer. Mr. SHACKLEFORD stated that he reported this problem to Captain LAMBERT before the vessel departed Manila. Mr. SHACKLEFORD stated that he felt the problem was minor in nature and once the vessel was clear of the islands the leak could be corrected without causing the vessel to be delayed in port, although it would require the port boiler to be off the line while repairs were made. At 1304, on 3 October 1971, the vessel commenced heaving anchors and at 1330 the vessel was underway. No radio watch had been maintained and no weather information was received from shore while the vessel was in Manila. Captain LAMBERT recalls talking to the Manila Bay pilot, Captain [REDACTED] about the weather after he boarded the vessel and he stated, "There is a typhoon several hundred miles off the east coast of Luzon."

Captain [REDACTED] debarked the vessel at 1342 and at 1536 the SS STEEL VENDOR took departure from Corregidor Island, on a course heading of 251°T. bound for Cu Lao Hon Island, northeast of Cape St. Jacques, off the coast of Vietnam. Captain LAMBERT checked the charts and satisfied himself that the typhoon would pass astern of him and pose no threat to the vessel. No plot of the storm was maintained from subsequent weather advisory messages received during the remaining voyage.

15. Captain LAMBERT stated that at 1600, the speed of the vessel was reduced to 40 revolutions and that Mr. SHACKLEFORD reported to him that he was having trouble maintaining water level in the boilers. Mr. [REDACTED] testified that he was summoned to the engine room and after he inspected the boilers he determined the source of the trouble was with the starboard boiler. The boiler was taken off the line and opened up. Source of the leak was in the starboard boiler economizer and he repaired it by blanking off the economizer and installing the bypass piping. Mr. SHACKLEFORD stated that he thought the trouble was with the port boiler rather than the starboard boiler and that the trouble was confined to a leaking hand hold plate in the port boiler economizer which only required tightening. Mr. SHACKLEFORD stated that the repairs and test were completed and at about 0400, on 4 October 1971, both boilers were again placed in operation.

16. During the day of 3 October 1971, the weather was overcast with good visibility and occasional rain squalls. After departure from Corregidor Island, no celestial observations were made due to a continuing overcast until about 1200, on 7 October 1971, when a hazy sun line was finally obtained. The SS STEEL VENDOR was not equipped with LORAN navigation equipment. After departure from Manila no radio directional bearing stations were within range of the SS STEEL VENDOR's position.

17. During the voyage, after departure from Corregidor Island, the vessel's positions were estimated by dead reckoning only. Mr. [REDACTED] Second Mate, License Number [REDACTED] was serving as navigator and maintained a position plotting sheet for the voyage. Captain LAMBERT was consulted and kept himself aware of the dead reckoning positions of the vessel on the plotting sheet. Due to the wind being on the starboard beam and knowledge that the general current set was to the northeast, no allowance was made for the drift of the vessel as it was considered that the two effects would cancel each other. Therefore, all positions were plotted on the course line of 251°T. Mr. [REDACTED] instructed the other mates on watch that during times of reduced engine revolutions, one nautical mile for each 5 RPM's for every hour underway should be used to advance the vessel's position along the course line. The fathometer was not used due to the limited electrical power available from the emergency generator.

18. At 0456, on 4 October 1971, after the repairs to the boiler had been completed and while the engineering plant was being restored to normal at sea steaming, number one generator sustained a major casualty. Mr.

SHACKLEFORD described the incident as, "a failure to the insulator at the slip ring which caused a surge of 240 volts to jump right across to the 120 volt panel." This affected all machinery and light circuits on the 120 volt switchboard, but it did not affect equipment on the 240 volt switchboard. The main engine was stopped until fuses and lights were renewed. The emergency generator came on the line supplying emergency lighting. During this time, both coffin turbine feed pumps started malfunctioning, apparently due to residue from carry over partially clogging the steam strainers. The strainers on both pumps were opened, cleaned and put back in service with one pump supplying feed water to the boilers. At about 1825, the speed of the vessel was increased to 45 RPM's; at 1837, speed was increased to 58 RPM's; at 1855, speed was increased to 70 RPM's and at 1930, speed was increased to full ahead. The vessel's deck log indicates the winds were from the northwest at force 5 to 6. The 2000 dead reckoning position of the vessel was plotted at LAT 12°44'N., LONG 115°49'E., approximately 298 miles from Manila. The weather had been generally building during the day. However, Captain LAMBERT considered the weather to be the result of the monsoon and not as the result of the effects of Typhoon ELAINE.

19. On 5 October 1971, at about 0745, Mr. SHACKLEFORD received word in his room from the engineer on watch that they were losing water in both boilers and the D.C. heater. Mr. SHACKLEFORD proceeded to the engine room and discussed the problem with Mr. [REDACTED] the engineer watch officer. The speed of the vessel was reduced to 35 RPM's to conserve steam. Mr. SHACKLEFORD observed the superheater temperature in the starboard boiler had increased to about 860 to 870 degrees. After discussing the problem with Mr. [REDACTED] it was decided to cut out the starboard boiler and attempt to steam on the port boiler in an effort to isolate the trouble to one of the boilers. Water was noted coming out of the upper casing area on the exterior of the boilers, but due to the vessel's severe rolling it could not be determined which boiler was the source of the leak. The bridge was notified that the starboard boiler was being secured to test the port boiler. While steaming on the port boiler at a reduced speed, it was observed that the water level in the port boiler was continuing to drop, so Mr. SHACKLEFORD ordered the fires relit in the starboard boiler and for that boiler to be put back on the line. However, after the transfer had been completed, the starboard boiler also was losing water and the level in the D.C. heater could not be maintained. From his observations, Mr. SHACKLEFORD determined that both boilers were leaking, with the port boiler having the more severe leak. The 0800 dead reckoning position was plotted at LAT 11°49'N., LONG 113°04'E., approximately 468 miles from Manila and approximately 290 miles from Cam Rahn Bay, Vietnam. The wind at this time was logged as from the west-by-north, force 5, with a rough westerly sea. The vessel's heading was southerly. Captain LAMBERT considered that the vessel was being set to the northeast, away from shoal area to the vessel's south. At 0812, on 5 October 1971, it was reported to the bridge that the vessel was going to be blacked out because during the previous day's casualty the battery-operated electric starter motor on the emergency generator had burned out. Mr. [REDACTED], Unlicensed Junior Engineer, [REDACTED] D1, fabricated a hand crank from spare material and was able to start the emergency generator

by about 1135. During the morning a message was sent to the owners, Isthmian Lines in New York, advising them that the vessel was experiencing boiler and emergency generator difficulty. After the emergency generator was on the line, the wash water pump was jury-rigged with a garden hose and used to start to fill the D.C. heater with wash water. The port boiler was secured as it was the opinion of Mr. SHACKLEFORD that if he could fill the starboard boiler and the D.C. heater, he could raise steam on the starboard boiler and start repairs on the port boiler. After about 6 hours of pumping water to the D.C. heater, Mr. SHACKLEFORD stated that Mr. CHADA had apparently inadvertently neglected to properly close the "filling valve" to the double bottom and all the water was drained out of the D.C. heater. Repair work was concentrated on the port boiler and after the port boiler had cooled, the steam drum and mud drum were opened in preparation to locate the source of the leak. At about 1645, Mr. SHACKLEFORD reported to Captain LAMBERT that he thought the problem with the boilers was hopeless and that it would be best to request a tow. At about 1700, on 5 October 1971, Captain LAMBERT sent a message to the vessel's agents in Manila requesting a towboat to come to their assistance.

20. On 6 October 1971, at 0545, a reply was received from the agents in Manila, relating that the Tug BUCKEYE had been dispatched from Saigon and would arrive at the vessel's position at about 2000, on 8 October 1971. Intentions were to tow the vessel to the sheltered waters of Cam Rahn Bay, Vietnam. At 0800, the vessel's dead reckoning position was recorded in the deck log as LAT 11°47'N., LONG 113°21'E. The vessel was dead in the water, rolling 35-to-40 degrees in heavy seas and force 9 winds. Bilge water was about 14 inches deep and was sloshing over the deck plates in the engine room. Limit power was available from the emergency generator for lighting and ventilation. Jury-rigged power jumper wires were run from the emergency board to the main board to operate some of the auxiliary equipment. Hand tools were sliding across the deck plates and becoming lost in the bilges with the heavy rolling of the vessel. Sea water was coming in the stack from the wind-driven seas and was dripping down on the men and equipment below. One of the forced draft fan motors was shorted out by this condition, before covers could be installed. On deck, the vessel was taking heavy seas over #3 and #4 hatches. Throughout 6 October 1971, the engineers continued in their efforts to restore the plant. The port boiler was opened and a test of the tubes was made with the use of flashlights by men entering both the steam drum and the mud drum and filling each tube separately from the steam drum with a garden hose, while plugging the other end in the mud drum, in an effort to attempt to locate a leaking tube by watching the water level after the tube was filled. A bad leak was found in one screen tube and this tube was plugged. Being satisfied that this was the sole source of the leaks, no further tests were conducted and the boiler was closed up. At about 0800, the slow and tedious process of filling the boiler with water, by use of a garden hose through the test cock and air cock, was started. Mr. SHACKLEFORD directed Mr. CHADA to secure all the valves on the starboard boiler, so that only the port boiler would receive water, and the fires were then lit in

the port boiler. Later, after steam was raised to about 260 PSI, it was noted that water was rising in the starboard boiler and dropping in the D.C. heater, apparently through the starboard boiler feed line which had been left inadvertently cracked open. This again resulted in the loss of the water in the D.C. heater. One of the generators was on the line supplying power for about 30 minutes, with the emergency generator running in standby, when the plant was again secured and the electrical board shifted back to the emergency generator. Mr. DIXON stated, "If we had one reciprocating pump, we would have been all right; see, because we could have dragged water from the double bottom." Without a head of water in the D.C. heater, the turbine feed pumps lost suction, resulting in the necessity of securing the fires in the boiler. This caused a delay while the port boiler was taken off the line and cooled and the D.C. heater refilled. During this incident, it was also apparent that there was still some unknown source of leak in the port boiler. However, this leak was not considered to be serious and it was felt that the boiler could be steamed and the water level maintained, once the D.C. heater and the boiler were again refilled.

21. On 7 October 1971, during the morning hours, filling of the D.C. heater had been completed. Mr. [REDACTED] Third Assistant Engineer, License Number [REDACTED], had rigged a hose connection between the wash water pump and #2 auxiliary condenser so that water could be added to the condensate system and pumped to the D.C. heater with the condensate pump, thereby speeding up the filling of the D.C. heater. In addition to water being added more quickly, it was felt that any small leaks in the boiler could be compensated for. Mr. SHACKLEFORD spoke with Captain LAMBERT during the morning and told him that he thought that he could get steam up in the port boiler and get the vessel underway on limited turns by about 1500 to 1600. At 0800, the dead reckoning position of the vessel was plotted at LAT 12°10'N., LONG 113°48'E. This position was approximately 48 miles northeast of the 0800 position, on 5 October 1971, when the plant was lost. At about 1115, Mr. [REDACTED] Third Mate, License [REDACTED]-DL, woke Mr. [REDACTED] and told him that the sun was breaking through the overcast for the first time since the vessel departed Manila. Mr. [REDACTED], Mr. [REDACTED] and Mr. MC MASTERS proceeded to the wing of the bridge to take navigational observations of the sun. During the time of these observations, Mr. [REDACTED] noticed white breaking water on the horizon on their port side. The area appeared to be a reef with what was later identified as a small island lying beyond. By reviewing the charts of the area and crossing the sun line position with possible location of islands, a new estimated position of the vessel was ascertained at LAT 10°43'N., LONG 114°12'E., about 4 miles west of Loaita Bank. This position was approximately 90 miles south of the dead reckoning position of 0800 that morning. Mr. [REDACTED] immediately went below and informed Captain LAMBERT of the situation. Captain LAMBERT proceeded to the bridge, observed the reef and confirmed the fact that the vessel was being set towards the reef by the strong winds and seas on the vessel's starboard beam. A distress message was sent out on 500 Khz after a delay of about 30 minutes due to another vessel, the KEE LUNG (Chinese) who was also in distress,

blocking out the SS STEEL VENDOR's transmissions. Mr. [REDACTED] Radio Officer, License [REDACTED] 01, received a response from the Tug BUCKEYE, the HMS EAGLE and the SS GREEN PORT. The HMS EAGLE responded that they would proceed to the aid of the SS STEEL VENDOR and the SS GREEN PORT was released to continue its voyage.

22. Preparations were made aboard the SS STEEL VENDOR to abandon ship in the event help did not arrive in time. Captain LAMBERT informed Mr. SHACKLEFORD of the impending danger and work in the engine room was accelerated. The engineers started to reassemble the forward reciprocating feed pump in the event that it might be placed in operation if the need arose. No test or evaluations were made of the pump during this final assembly. Both life rafts were inflated on deck and a heavy painter line attached in lieu of the light tether line supplied with the raft. These precautions were taken because of the heavy seas and strong winds to prevent the rafts from being blown away. The rate of drift of the vessel was calculated by Captain LAMBERT and he estimated that the vessel would be in dire danger of grounding by about 1400 that afternoon. Both life boats were uncovered and prepared for lowering. Extra water and provisions, chronometers, sextants, charts and emergency radios were made ready to place in the boats. At about 1300, Mr. [REDACTED] Chief Officer, License Number [REDACTED] was directed to the forecandle to prepare both anchors for lowering. At 1345, the port anchor was ordered to be let out easily on the hand brake since there was no power to operate the windless. However, at about five shots the brake failed to hold and the chain ran out to the bitter end. The anchor riding pawl was set and the anchor chain was observed to be tending straight up and down. At about 1420, the anchor touched bottom and started to hold the vessel even though the wind and seas caused the heading of the vessel to remain in a southerly direction at right angles to the direction the anchor chain was tending. At this time the reef appeared to be about 1/4 mile off on the port beam. At about 1430, the vessel shuddered and it was the opinion of Captain LAMBERT that the anchor had broken free and was dragging as the vessel continued to drift toward the reef. The starboard anchor was not ordered lowered as Captain LAMBERT was anticipating that Mr. SHACKLEFORD would get the main engine ready in time to maneuver the vessel away from the reef. Captain LAMBERT felt that if two anchors were out, his chances of making this maneuver would be lessened because of the time required to retrieve both anchors.

23. Mr. SHACKLEFORD had the output of the wash pump increased from 70 PSI to 120 PSI by overriding the automatic feature of the controller. At about 1300, the water level in the port boiler appeared sufficient, even though the vessel was rolling heavily and it was difficult to ascertain the actual water level. Three fires were lit in the port boiler in an attempt to raise the steam as quickly as possible. When the steam pressure reached about 220 PSI a generator was placed on the line. The main circulator pump was inoperative due to an electric ground and the main fire pumps

were cross-connected to the circulating system in preparation for getting the vessel underway.

24. At about 1436, a heavy jolt was felt as the vessel first made contact with Loaita Bank Reef. Mr. SHACKLEFORD had just contacted the bridge and reported that he had 20-inches of vacuum and that he could make about 25 RPM's on the main engine, but by this time the vessel was slamming onto the reef with each roll the vessel took. On deck, the port life boat was lowered to the boat deck in the event the vessel took a list which would prevent the gravity davits from operating. The inflated life raft was lowered to the water on the port side which provided a lee to the crashing breakers. No difficulty was experienced in launching the inflated raft from the vessel. As the SS STEEL VENDOR struck the reef it was apparent that #1 double bottom tank was immediately holed, as fuel oil and water were observed gushing from the starboard vents for the tank and blowing over the forward area of the vessel. Mr. [REDACTED] went aft to the steering engine room in response to Captain LAMBERT's request to check the steering gear. Mr. [REDACTED] tried to move the rudder with the hand cranking gear but he was not successful. From the sound of the vessel apparently hitting against the reef, Mr. [REDACTED] considered that the rudder had been damaged.

25. Captain LAMBERT received word from the engine room that the main engine was ready for limited turns; however, the vessel was now grounding hard on the reef and double bottom tanks #2 and #3 had also been holed, sending water and oil spewing from their respective vents. The vessel appeared to be walking further onto the reef with sharp snap rolls with every wave that struck the vessel. At about 1445, Captain LAMBERT received word from the engine room that the fuel oil settling tanks had been ruptured and water had contaminated the fuel oil system, putting out the fires in the boiler. Water was also observed gushing from the sounding tubes for #4 double bottom tanks. Captain LAMBERT ordered the engine room evacuated. Mr. SHACKLEFORD gathered the engine room logs and records and took them to his room, placing them in a satchel bag along with his own personal papers.

26. At about 1435, a helicopter from the British Aircraft Carrier HMS EAGLE appeared over the SS STEEL VENDOR, hovered and lowered a man to the deck. A crewman from the helicopter asked Captain LAMBERT if he desired to have his crew evacuated to the HMS EAGLE. After an exchange of communication with the Commanding Officer of the HMS EAGLE by radio from the helicopter, it was decided to commence with the evacuation of crew and divert the HMS EAGLE within 40 miles of Subic Bay, in the Philippines, in order to transfer the crew of the SS STEEL VENDOR by helicopter to the U. S. Naval Base. The helicopter departed and returned at about 1645 and the evacuation commenced by hoisting the crew aboard the helicopter and ferrying them to the HMS EAGLE. During the final minutes of the evacuation, Mr. SHACKLEFORD started to go below from the chart room to his cabin to retrieve the engine room logs. As he started down the stairway the vessel took a snap roll, causing Mr. SHACKLEFORD to lose his footing and fall down the stairs, landing at the bottom of

the stair well. The four remaining officers aboard the vessel put Mr. SHACKLEFORD, who was unconscious, in a litter and hoisted him to the hovering helicopter. Captain LAMBERT was the last one to leave the vessel, departing at 1745. Captain LAMBERT discussed the unexpected set of his vessel with the Commanding Officer of the HMS EAGLE who stated that he had also experienced an unexpected 20-mile set in a southerly direction during the preceding night. On departure from the SS STEEL VENDOR, it was noted that the vessel was listing about 15 degrees to starboard. It appeared that the vessel was starting to hog just forward of the deck house in the vicinity of #3 hold. Some fractures were noted inside the deck house, in the hull and in the strake below the shear strake on the port side. The emergency generator was still running, supplying emergency power when the vessel was abandoned. The HMS EAGLE arrived off shore from Subic Bay, RPI, on 8 October 1971, and transferred the survivors ashore.

CONCLUSIONS

1. That the cause of the casualty was the result of the failure of one or more tubes in both the port and starboard boilers, which resulted in the SS STEEL VENDOR drifting dead in the water from about 0812, on 5 October 1971, until about 1436, on 7 October 1971, at which time the vessel grounded on Loaita Bank Reef in the South China Sea.

2. Contributing to the loss of the SS STEEL VENDOR were the following significant events:

a. The inability of either reciprocating feed pump to supply feed water at a rate adequate to fire one or both boilers while taking suction from the double bottom tanks.

b. The time consuming methods of filling the D.C. heater and boilers with the wash water pump when the plant was lost and with only the emergency generator supplying limited electrical power.

c. The failure of the anchor to hold the vessel when it first touched bottom at about 1420, on 7 October 1971, presumably due to the nature and the steepness of the contour of the bottom and adverse weather conditions.

3. It is concluded that the decision of Captain LAMBERT to use only one of the vessel's anchors at the time of initial contact with the reef was prudent in view of the report from the engine room that the vessel possibly would be able to get underway at any moment. If two anchors were used, they could have possibly fouled and thereby delayed the vessel from proceeding seaward away from the shoal area, if the engineers were able to get the vessel underway in time.

4. There is evidence that Captain LAMBERT failed to properly evaluate the current and effect of Typhoon ELAINE, resulting in the vessel unknowingly drifting into dangerous water. Captain LAMBERT erroneously presumed that the set of the current was carrying the vessel back along its track line towards open water. This conclusion is based on the following facts:

a. No plot of Typhoon ELAINE was maintained aboard the vessel, thereby generating a misconception that the adverse weather being experienced was not the result of the typhoon. The American Practical Navigator by Bowditch, H. O. Publication No. 9, offers the following advice for navigators: "The first action to take if one finds himself within the cyclonic circulation (tropical cyclone) is to determine the position of his vessel with respect to the storm center." It is reasonable to expect that a prudent navigator would plot the movement of a nearby typhoon in an effort to detect any change in its direction of motion.

b. The information available from the pilot charts alone would indicate that a reasonably prudent navigator might expect a current setting to the

northeast. However, due to the dates in question, consultation of the Atlas of Surface Currents would indicate the possibility of a current setting east-southeast. Further, if the vessel were set to the south of its track line by the westerly wind experienced after the vessel was dead in the water on 5 October 1971, the vessel could come under the effects of the south easterly current set of 13.4 nautical miles per day. This apparently is what occurred and accounts for the vessel stranding on Loaita Bank Shoal some 90 miles south of her last dead reckoning position.

5. There is evidence of negligence on the part of Captain LAMBERT in that he knowingly departed the port of Manila on 3 October 1971, with knowledge that the SS STEEL VENDOR was experiencing mechanical difficulty with one of the boilers which would require the boiler to be taken off the line for an undetermined length of time to make repairs at sea. This would require operating at reduced speed and maneuverability on one boiler. In addition, Captain LAMBERT should have known prior to the departure of the Manila Bay pilot that adverse weather conditions could be expected from the approaching typhoon.

6. There is evidence of negligence on the part of Mr. SHACKLEFORD in that he did not fully explain the possible effects of the unknown leak in the boiler to Captain LAMBERT and that he described the problem as minor. At the time, Mr. SHACKLEFORD did not know the actual source of the leak, but did have knowledge that the vessel was experiencing repetitious failure of the elements of the economizer and the leak could quite possibly be another failure of this type. Further, on departure from Manila, Mr. SHACKLEFORD had knowledge that the forward reciprocating feed pump was inoperative and disassembled and that the after reciprocating feed pump would not supply feed water at a rate sufficient to operate a steaming boiler. Therefore, it was foreseeable that if the leak increased in size or if other leaks developed, there would be a resulting loss of the D.C. heater and the safety of the vessel would be placed in immediate jeopardy.

7. There is evidence of inattention to duty on the part of Mr. CHADA in that he inadvertently failed to properly secure the feed valve on the starboard boiler, on 5 October 1971, during the filling of the port boiler with water, resulting in a delay in lighting-off the port boiler.

RECOMMENDATIONS

1. That further investigation under the provisions of the Suspension and Revocation Proceedings be initiated concerning Captain Cecil H. LAMBERT's part in the casualty.
2. That further investigation under the provisions of the Suspension and Revocation Proceedings be initiated concerning Mr. Roger L. SHACKLEFORD.
3. That further investigation under the provisions of the Suspension and Revocation Proceedings be initiated concerning Mr. Joseph B. CHADA's part in the casualty.


CAPT J. E. GOULD, 3387, USCG
Chairman


CDR John C. HANSON, 6932, USCG
Member


CDR Roy E. NICHOLS, 6030, USCG
Member and Recorder