U.S. Department of Transportation

United States Coast Guard

MARINE CASUALTY REPORT

SS MARINE ELECTRIC, O.N. 245675,

CAPSIZING AND SINKING IN THE ATLANTIC OCEAN ON 12 FEBRUARY 1983 WITH MULTIPLE LOSS OF LIFE

U.S. COAST GUARD

MARINE BOARD OF INVESTIGATION REPORT

AND

COMMANDANT'S ACTION

REPORT NO. 16732/0001 HQS 83

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15. Supplementary Notes

16. Abstract

At 0251, 12 February 1983 (all times are EST, +5 zone time), the coal collier MARINE ELECTRIC, while enroute from Norfolk, Virginia to Brayton Point, Massachusetts with a full load of steam coal, reported to the Coast Guard that she was taking on water and going down by the head. Gale force weather conditions existed at the time. At 0415, 12 February 1983, as the vessel's crew was preparing to abandon ship, the MARINE ELECTRIC capsized, throwing most of the 34 crewmen into the water. Rescue efforts by U. S. Coast Guard and U. S. Navy aircraft and surface vessels, and merchant vessels resulted in the recovery of 3 survivors and 24 bodies. 7 persons remain missing and are presumed dead. The overturned stern of the vessel remained visible until approximately 1130, 12 February 1983. At that time the vessel sank in about 120 feet of water, approximately 30 nautical miles east of Chincoteague, Virginia. The Commandant has determined that the actual cause of the casualty is unknown. The most probable cause was determined to be the wasted top plating of the dry cargo hatch and wasted main deck plating which permitted boarding seas to flood the vessel's forward spaces.

This report contains the U. S. Coast Guard Marine Board of Investigation Report and the action taken by the Commandant to determine the proximate cause of the casualty and to provide a response to the recommendations to prevent recurrence.

17. Key Words	18. Distribution Statement
Hatch covers, Coast Guard inspections, ABS surveys, flooding, lifeboats, life-rafts, bilge wells, diving operations, stability, coal trade	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

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Unclassified	Unclassified		

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SS MARINE ELECTRIC, O.N. 245675, CAPSIZING AND SINKING
IN THE ATLANTIC OCEAN ON 12 FEBRUARY 1984
WITH MULTIPLE LOSS OF LIFE

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PART I

U.S. Department of Transportation
United States Coast Guard

Commandant
United States Coast Guard

Washington, DC 20593
Staff Symbol: G-MMI-1
Phone: 202-426-1455

11 JAN 1985

Commandant's Action

on

The Marine Board of Investigation convened to investigate the circumstances concerning the capsizing and sinking of SS MARINE ELECTRIC, O.N. 245675, in the Atlantic Ocean, 30 miles east of Chincoteague, Virginia, on February 12, 1983, with multiple loss of life.

The report of the Marine Board of Investigation convened to investigate the subject casualty has been reviewed; and the record, including the findings of fact, conclusions and recommendations, is approved and concurred with subject to the following comments.

REMARKS

1. Finding of Fact 8: The statement that the hatch covers were approved by the American Bureau of Shipping (ABS) and the Coast Guard for a static loading of 220 lbs. per square foot is misleading. The hatch covers were originally approved by ABS on September 15, 1961. At that time there was no specific analytical standard in effect for hatch cover strength. The 220 lbs. per square foot criteria, which is recorded in the owner's manual, is believed to have been recommended by MacGregor, the hatch cover manufacturer. However, the International Convention on Load Lines of 1966 did establish a standard for hatch cover strength analysis which still exists. That standard requires hatch covers to be designed for an assumed load of 358 lbs. per square foot with a safety factor of 4.25 on the material ultimate strength. In the process of issuing the MARINE ELECTRIC's 1966 load line certificate ABS reviewed the vessel plans, including those for the hatch covers, and confirmed that the hatch covers complied with the new standard. Recent calculations verify that, when originally constructed, the hatch covers did conform to the new standard.

2. Finding of Fact 125: The ready helicopter at USCG Air Station, Elizabeth City, North Carolina was in a Bravo-0 status, as established by Fifth Coast Guard District policy, requiring that it be ready to proceed within 30 minutes from time of notice. As indicated in the report and the supporting record, the aircraft was delayed in launching due to three factors: (a) off-loading of pumps from the ready helicopter upon learning that the vessel crew was preparing to abandon ship, (b) arranging for a fixed wing aircraft (C-130) to provide cover for the helicopter due to the severe weather, and (c) additional briefing from weather personnel in order to ascertain the expected flying conditions. These actions are standard operating procedures during events of this nature, and were acceptable reasons for delaying the launching of the ready helicopter.

COMMENTS ON CONCLUSIONS

1. Conclusion 2 and 3: These conclusions are concurred with in part. The actual cause of the casualty remains unknown. The most probable cause of the casualty is the wasted top plating of the dry cargo hatch and wasted main deck plating which permitted boarding seas to flood the vessel's forward spaces resulting in the loss of the vessel. Although other scenarios describing the full sequence of events are possible, there is ample evidence to support the sequence developed by the board.

2. Conclusion 4: This conclusion is concurred with. If the Master had maneuvered the MARINE ELECTRIC to minimize the effects of the boarding seas when he first realized that the vessel was down by the head, his action might have altered the sequence of events developed by the board.

3. Conclusion 10: This conclusion is not concurred with. According to finding of fact 315, there were known discrepancies in the ballast piping in No. 4 starboard double bottom. That fact, in conjunction with the circumstances of the casualty (i.e. listing and capsizing to starboard), raises doubt concerning the ballast system's part in the casualty. Therefore, the possibility of progressive flooding by way of the ballast system cannot be ruled out.

4. Conclusion 17: This conclusion is concurred with in part. Given the knowledge of major repairs to the hatch covers, the inspector could have scheduled a return visit to the vessel to insure that the hatch covers had been returned and properly repaired and installed. However, the issuance of load line certificates and the associated surveys to ensure compliance with the load line regulations is a function which has been delegated to the ABS pursuant to Title 46 App. USC 86d. The reason for delegating certain inspection functions to ABS is to eliminate duplication of effort whenever possible. Also, it is clear that the owners, as discussed in the conclusions regarding responsibility, had a duty to maintain the vessel and hatch covers in a seaworthy condition. At the time of the drydock inspection, the owners had removed the hatch covers from the vessel for repairs and the hatch covers were not reinstalled until a few hours prior to the sailing of the vessel. The difficulties described by the chief mate in his testimony concerning the condition and operation of the hatch covers upon their return to the vessel were not reported to the Coast Guard. Under existing circumstances, it was not illogical for the Coast Guard inspector to have a degree of confidence that the owners and licensed officers would ensure that the hatch covers were properly repaired before allowing the vessel to sail. It was also not illogical for the Coast Guard inspector to have relied on the ABS periodic load line survey which was completed on 22 February 1981.

There is no express statutory or regulatory grant of cancellation authority to ABS or other classification societies. The Coast Guard will review this matter to determine if a regulatory project should be initiated to grant ABS and other classification societies this authority.

5. Conclusion 18: This conclusion is concurred with. Although the Coast Guard inspectors' reliance on the load line certification was consistent with

46 USC 3316, their cursory inspections of the hatch covers were inadequate to ensure that the ABS surveyors had carried out their delegated duties.

In July 1983, the Coast Guard established an inspection program to determine the effectiveness of field inspections with regard to vessels 20 years of age or older and 4000 gross tons or more in the U.S. fleet. This oversight program is being accomplished by senior officers with extensive marine inspection experience who are assigned to Coast Guard Headquarters. The program has served not only to monitor of our field inspection activities but also to provide additional training for less experienced field inspectors who accompany the senior officers. In addition, the inspection records for all vessels of the same tonnage and age are now forwarded to Headquarters for review. This program has resulted in more uniform compliance with the recordkeeping guidance in the Marine Safety Manual.

6. Conclusion 19: This conclusion is concurred with. However, it should have been stated as two separate conclusions: one conclusion addressing the inspectors' failure to take notice that the cargo bilge wells were covered with solid metal plates, and a separate conclusion regarding the confusion of the inspectors as to when metal hatch covers were to be examined.

7. Conclusion 21: This conclusion is concurred with in part. The officer in charge, marine inspection (OCMI) has the responsibility to assign personnel with the prerequisite qualifications to perform inspections. Relying on the inspector's general inspection experience and maritime background, the OCMI would be expected to have considered the inspector conducting the drydock examination in February 1981 qualified to perform that examination. The marine inspection experience of the two inspectors conducting the remaining three inspections was not nearly as extensive. While this experience level may have been a factor in the quality of the inspections, other factors, as discussed in the comments on conclusions 17 and 18, also influenced the inspectors and affected the overall quality of the inspections.

The Coast Guard has in progress a project to revise its marine safety training program which was initiated before the MARINE ELECTRIC casualty. As a first step a detailed job task analysis was used to identify the knowledge and learning objectives necessary for marine safety personnel. With this as a foundation the most effective methods of training and qualifying personnel were qualitatively developed. This has resulted in the implementation of revised resident training course materials and curricula with emphasis on specialization. The analysis also provides for a formalized qualification system with new qualification manuals and enhanced training aids. Also included in the revised training program is the "training port concept". This new concept will centralize the training of all newly assigned marine safety personnel at the nation's largest shipping ports, thereby providing greater emphasis on training and greater exposure to a variety of inspections and vessel types.

8. Conclusion 22 and 23: These conclusions are concurred with. Before the MARINE ELECTRIC casualty, there was no published guidance on drydock extensions other than the authority to issue them. Policy guidance has been issued for such extensions.

9. Conclusion 24: This conclusion is concurred with. The load line certificate and its endorsements provide evidence of a thorough annual verification by a competent surveyor who is responsible to the Administration. This survey is independent of the owner's organization. A load line certificate or endorsement should not have been issued unless the vessel was equipped and maintained to warrant such a certificate or endorsement. This is required by both the load line regulations and the International Convention on Load Lines, 1966.

10. Conclusion 27: This conclusion is not supported by the findings of fact and is not concurred with. ABS or any other classification society surveys, when performed for the Coast Guard, are performed on behalf of the Administration's interest. If the ABS surveyor is on board for the endorsement of a load line certificate or issuance of a certificate, he is acting on behalf of the Coast Guard and not on behalf of the owner. As such, the surveyor may look at all parts of the vessel to the extent needed for the annual or periodic survey. The MARINE ELECTRIC surveys in question were poorly conducted, but that fact does not condemn the entire system of third party delegation which has been authorized and encouraged by the Congress.

11. Conclusion 37: This conclusion is concurred with. However, it fails to note that the licensed officers assisting the Coast Guard in their inspections aboard the MARINE ELECTRIC were bound by law (46 USC 3315) to report any known deficiencies to the Coast Guard. Their failure to do so cannot be justified by their interest in retaining employment.

On October 30, 1984, Title 46, USC Chapter 21 was amended to include protection for seamen against discrimination for reporting violations of laws or regulations to the Coast Guard. This casualty clearly reinforces the continuing necessity for the persons sailing on and living aboard merchant vessels to provide information on safety discrepancies to the Coast Guard. This input is a vital component of the overall marine safety program.

To promote reporting, the Coast Guard instituted a 24 hour toll free telephone hotline (800-323-SAFE) over which merchant seamen can report safety discrepancies. Persons making reports may identify themselves if they wish, in which case their identities will remain confidential; or they may remain anonymous.

12. Conclusion 43: This conclusion is concurred with in part. The difficulty in launching the lifeboat is related both to the type of davit and the absence of a winch. With a quadrantal davit, the boat must be hand cranked to the outboard position, whereas with a gravity davit the boat is lowered into the outboard position using the force of gravity. Once in the outboard position, a davit with a winch enables the boat to be boarded at the deck and lowered into the water with only one crew member remaining aboard to control the launch of the boat. Without a winch, the boat must be lowered by hand with several crew members remaining on board the vessel. These crew members must either climb down a ladder or jump into the water.

Under the 1983 Amendments to SOLAS 1974 (SOLAS 74/83) a totally enclosed lifeboat system which includes gravity davits will be required on new ships. With this system persons abandoning ship board the boat in its stowed position, and control the launch from inside the boat. Had such a system been

in place on the MARINE ELECTRIC, more lives might have been saved due to the decreased time required to launch the lifeboats.

13. Conclusion 44: This conclusion is not concurred with. There were no facts developed that show that the ABS did not act impartially; rather the investigation shows that on two occasions their surveyors failed to fully carry out their responsibilities. To cite the failures of the surveyors in this one casualty as evidence that the work product of the ABS should not be accepted by the Coast Guard discounts the many years of service and literally thousands of competent inspections conducted by surveyors of the ABS, and is without merit. This casualty more accurately highlights the need for more formal oversight of surveyor performance.

Additionally, the casualty indicates a need for improved guidance for ABS surveyors. In recognition of this fact, ABS has already published revised guidelines for surveys of older vessels (20 years of age or more), updated criteria for intermediate and annual surveys which emphasizes hatch cover condition, and updated criteria for gaugings on older vessels. ABS has also instituted a program of unannounced visits to field offices by representatives from the New York main office. The program's intent is to verify the efficiency and accuracy of field personnel, and to highlight any need for additional training or more experienced personnel.

The part of the conclusion relating to the capabilities of the Coast Guard inspectors to enforce the laws and regulations in a satisfactory manner is too broad. The failure of the Coast Guard inspectors to detect the deteriorated condition of the hatch covers on the MARINE ELECTRIC is not an accurate reflection of the Coast Guard's ability to carry out the laws and regulations. The Coast Guard conducts thousands of inspections annually which include drydock examinations, inspections for certification, mid-period inspections and foreign vessel examinations. Furthermore, the Coast Guard is recognized as a world leader in developing and furthering international safety standards through its participation in the International Maritime Organization. This casualty does identify the need for additional training of Coast Guard inspectors and additional policy guidance for inspection and oversight functions. Action has been taken to revise the marine safety training program, provide guidance on drydock extensions, implement the inspection program for vessels 20 years of age or older, and develop oversight guidance.

14. Conclusion 46: This conclusion is concurred with. The inspection records were not maintained in full compliance with the guidance contained in the Marine Safety Manual. The program of spot checking field units' vessel inspection records has been expanded to include the examination of inspection records for all vessels 20 years of age or older. This has resulted in more uniform compliance with the recordkeeping guidance contained in the Marine Safety Manual.

15. Conclusion 47: This conclusion is concurred with. Before the MARINE ELECTRIC casualty, the Coast Guard enforcement of load line regulations dealt primarily with the unlawful submergence of the load line marks of all vessels in U. S. waters. There was no formal systematic oversight of load line assignment functions delegated by the Coast Guard to ABS. The Coast Guard is now conducting an in depth review of all third party delegations and the issue of proper oversight. Appropriate guidance implementing systematic oversight

will be published in the Marine Safety Manual and incorporated into the inspector training program. In addition, interim guidance for inspection of hatch covers has been issued.

16. Conclusion 48: This conclusion is concurred with in part. The board's conclusion that the ability to pump both the bow spaces and cargo holds might have provided early indication of flooding is concurred with. The board's conclusion that the ability to pump the cargo holds through the bilge system played no part in this casualty is not concurred with. If the existing bilge wells in the cargo holds had been prepared in accordance with the National Cargo Bureau's publication, "Code of Safe Practice for Solid Bulk Cargoes", as set forth in finding of fact 409, and if the bilge system had been utilized, the flooding of the cargo holds might have been controlled.

17. Conclusion 51: This conclusion is concurred with in part. The Coast Guard has reviewed Navigation and Vessel Inspection Circular 7-68 and has concluded that the guidance provided with respect to the use of doublers is sufficient. However, additional guidance concerning periodic reevaluation is necessary. Accordingly, the location of doublers aboard the vessel will be recorded in the marine safety information system vessel inspection record. Additional guidance for periodic reevaluation will be included in the Marine Safety Manual.

ACTION CONCERNING THE RECOMMENDATIONS

1. Recommendation 1: This recommendation is not concurred with. It is not supported by the findings of fact. The recommendation is contrary to 46 USC 3316 and 46 App. USC 86d regarding delegation of Coast Guard load line inspection functions to classification societies. As previously stated, the poor quality of the American Bureau of Shipping surveys in question cannot be justifiably expanded to condemn the entire system of third party delegation. What this casualty does support is the need for a more formalized oversight program by the Coast Guard. In this regard, the issue of proper oversight of all third party delegations is being studied in depth and appropriate guidance will be published in the Marine Safety Manual.

2. Recommendation 2: This recommendation is not concurred with. Efforts commenced before and after this tragic casualty are already addressing the mentioned issues. These efforts include the reorganization of the marine safety training program, the additional guidance in the Marine Safety Manual, the establishment of the toll free number for reporting safety discrepancies, the initiation of the old vessel examination program, the examination of field inspection records and development of oversight guidance. In view of these efforts establishment of a panel for the purpose recommended is not necessary.

3. Recommendation 3: This recommendation is concurred with. In July 1983, the Coast Guard published guidance on granting drydock extensions. Coast Guard regulations on cargo vessels require a 24 month drydock interval while classification societies permit a 30 month interval. Coast Guard regulations regarding drydock intervals and tailshaft surveys are now being considered in a regulatory project (CGD 84-024). When the required intervals for drydockings and tailshaft surveys are resolved through the rulemaking process recently published guidance pertaining to drydock extensions will be reevaluated.

4. Recommendation 4: This recommendation is concurred with. Interim guidance pertaining to hatch cover inspections has been issued and will be incorporated in the Marine Safety Manual.

5. Recommendation 5: This recommendation is not concurred with. While it may be more efficient to perform both inspections at the same time, there are valid reasons why vessel owners are unable to schedule concurrent inspections. In fact, separate inspections provide the Coast Guard with the opportunity for more frequent, thorough inspections of a vessel.

6. Recommendation 6: This recommendation is concurred with. The Coast Guard will propose that inspected cargo and tank vessels in ocean and coastwise service, equipped with mechanical davits of any type, be fitted with enclosed lifeboats and launching systems that meet SOLAS 74/83 no later than July 1, 1991. This would result in the replacement of quadrantal davits and other launching systems without winches by July 1, 1991, five years after SOLAS 74/83 goes into force for new construction. In addition the Coast Guard will propose that all existing inspected cargo and tank vessels on ocean and coastwise voyages, presently equipped with open lifeboats and gravity davits, be fitted with enclosed lifeboats and launching systems that meet SOLAS 74/83 no later than July 1, 2001.

7. Recommendation 7: This recommendation is concurred with. Reference to scantling plans during drydocking and other examinations would be of assistance in making proper determinations regarding vessel hull deterioration. A regulatory project will be initiated to propose an amendment to the regulations concerning this subject.

8. Recommendation 8: This recommendation is concurred with. Evidence of violation of 46 USC 10908 on the part of Captain James K. Farnham will be forwarded to the Department of Justice for their review and possible prosecution.

9. Recommendation 9: This recommendation is concurred with. Evidence of violation of 46 USC 10908 on the part of Mr. Joseph Thelgie will be forwarded to the Department of Justice for their review and possible prosecution.

10. Recommendation 10: This recommendation is concurred with. As part of the present regulatory project concerning SOLAS 74/83, the Coast Guard will propose that new inflatable liferafts be equipped with a boarding ramp. Further, the Coast Guard intends to propose that existing inflatable liferafts be retrofitted with boarding ramps, or stiffeners with standoffs for boarding ladders, or both.

11. Recommendation 11: This recommendation is concurred with. In a related area, the Coast Guard is developing a regulatory project which would require flooding alarms for normally unmanned spaces that are vulnerable to substantial undetected flooding. While this action was initiated in the context of mobile offshore drilling units, its scope will be expanded to include other vessel types and arrangements.

12. Recommendation 12: This recommendation is concurred with. The Coast Guard will work with the FCC to ensure that over the next year, Martech Whaler EB-2BW EPIRBs are tested either during the FCC or Coast Guard inspection. The test will involve immersing the unit in water to determine if the pressure switch will activate the unit.

13. Recommendation 13: This recommendation is concurred with in part. As discussed in the comments on conclusion 51, NVIC 7-68 has been reviewed and the guidance contained therein with respect to the use of doublers is considered sufficient. As recommended, doubler repairs will be made a part of the vessel's official record in the marine safety information system and guidance for reevaluation of these repairs will be included in the Marine Safety Manual.

14. Recommendation 14: This recommendation is concurred with.

[redacted]

J. S. GRACEY
Admiral, U.S. Coast Guard
Commandant

PART II

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U.S. Department of Transportation
United States Coast Guard

Commander
Fifth Coast Guard District (m)
Federal Building
431 Crawford Street
Portsmouth, Virginia 23705

16732/MARINE ELECTRIC
25 July 1984

From: Marine Board of Investigation
To: Commandant (G-MMI)

Subj: SS MARINE ELECTRIC, ON-245675; Capsizing and sinking in the Atlantic Ocean, 30 miles east of Chincoteague,Virginia, on 12 February 1983, with multiple loss of life

Ref: (a) COMDT ltr. 16732/MARINE ELECTRIC dated 14 February, 1983; Precept for the Marine Board of Investigation.

SUMMARY

1. The SS MARINE ELECTRIC departed Norfolk, Virginia, with a cargo of steam coal about 2345 on 10 February 1983, bound for Brayton Point, near Somerset, Massachusetts. (All times are EST + 5 Zone Time.) A winter storm was underway when the vessel loaded, and continued to build as she departed the Chesapeake Bay. Winds were from the northeast from 35 - 55 knots, and the seas built from about 4 feet in the Chesapeake Bay to 20 - 40 feet in the ocean. The vessel steamed at 80 RPM (11 - 12 knots) until about 0900 on 11 February 1983, when the turns were reduced to 40 RPM (4 - 5 knots).

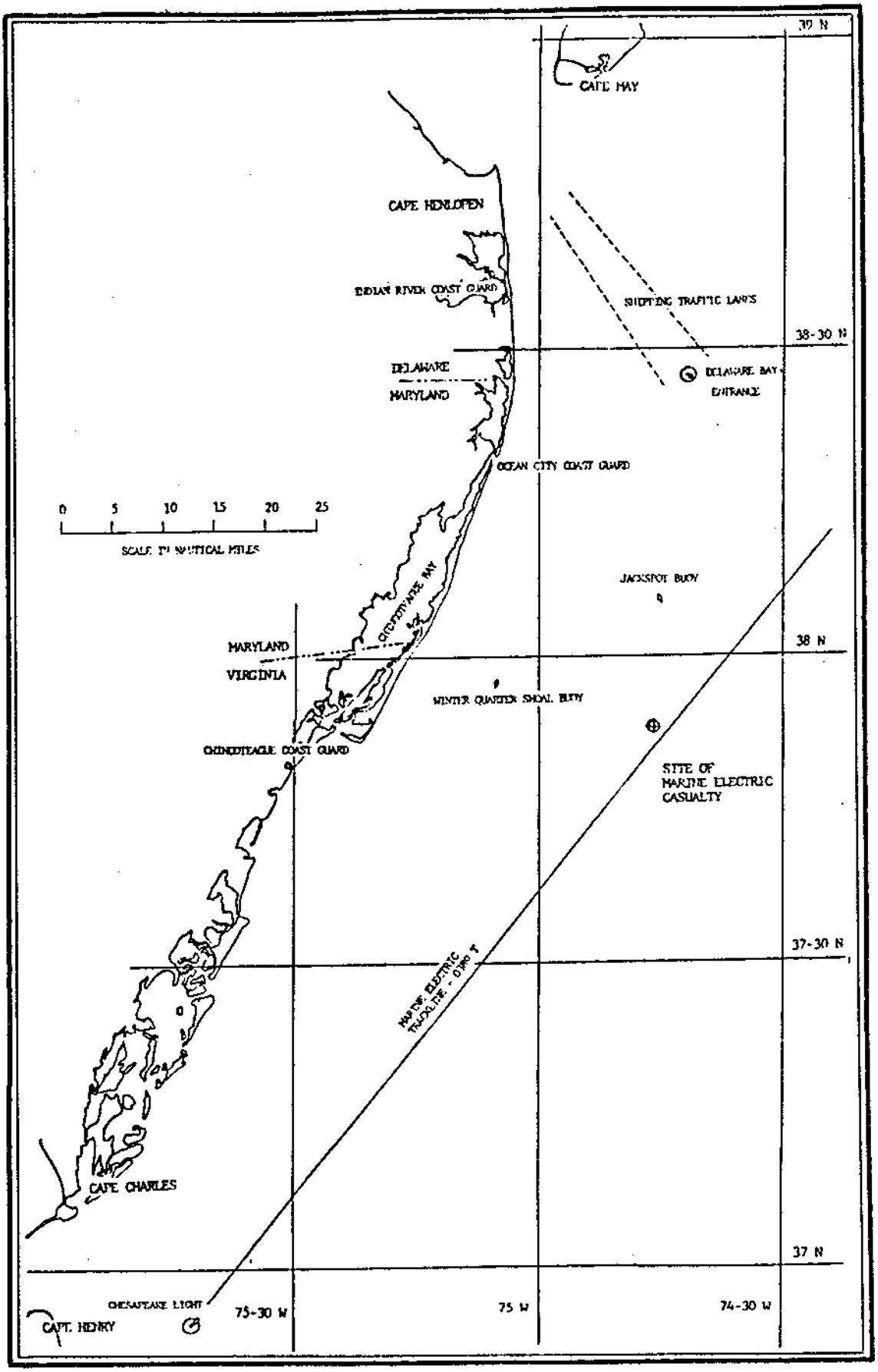
2. About 1600 on 11 February 1983, the MARINE ELECTRIC sighted the fishing vessel THEODORA, which was taking on water, disoriented and requesting assistance from the Coast Guard. Joining in the radio conversations, the MARINE ELECTRIC gave her position - she had made good only about 95 miles from the mouth of the Bay. The MARINE ELECTRIC stood by the THEODORA on a westerly course toward Chincoteague, Virginia, until about 1825, when she resumed a course to Massachusetts.

3. At about 0000 12 February 1983, it was noted the vessel was trimmed by the head. At about 0115, the bow was noticeably behaving sluggishly. At 0251, The Master called the Coast Guard, Ocean City, Maryland, and reported he seemed to be taking on water and going down by the head. At about 0300, the crew was awakened and mustered at the starboard lifeboat, and the vessel altered course to 000 degrees True. Trim by the bow continued to

increase, but no list was reported until 0350, when a 5 degree starboard list was reported. The list increased to 10 degrees by 0410, and the Master reported he was abandoning ship at 0414. At about 0415, with most of the 34 crewmembers on the starboard boat deck, the ship took a sudden roll to starboard, throwing the crewmembers into the 37 degree F. water before the boat was lowered.

4. Three men survived, and were rescued by a Coast Guard helicopter, which arrived on scene at 0520. Twenty-four bodies were recovered, most of whom died due to hypothermia. Seven bodies remain unrecovered, including that of the relief Master, Captain [redacted]. The vessel capsized shortly after taking the sudden roll, and a portion of the stern section was visible until about 1130, 12 February 1983.. The vessel sank in position 37-52.8N, 74-46.0 W , in about 120 feet of water.

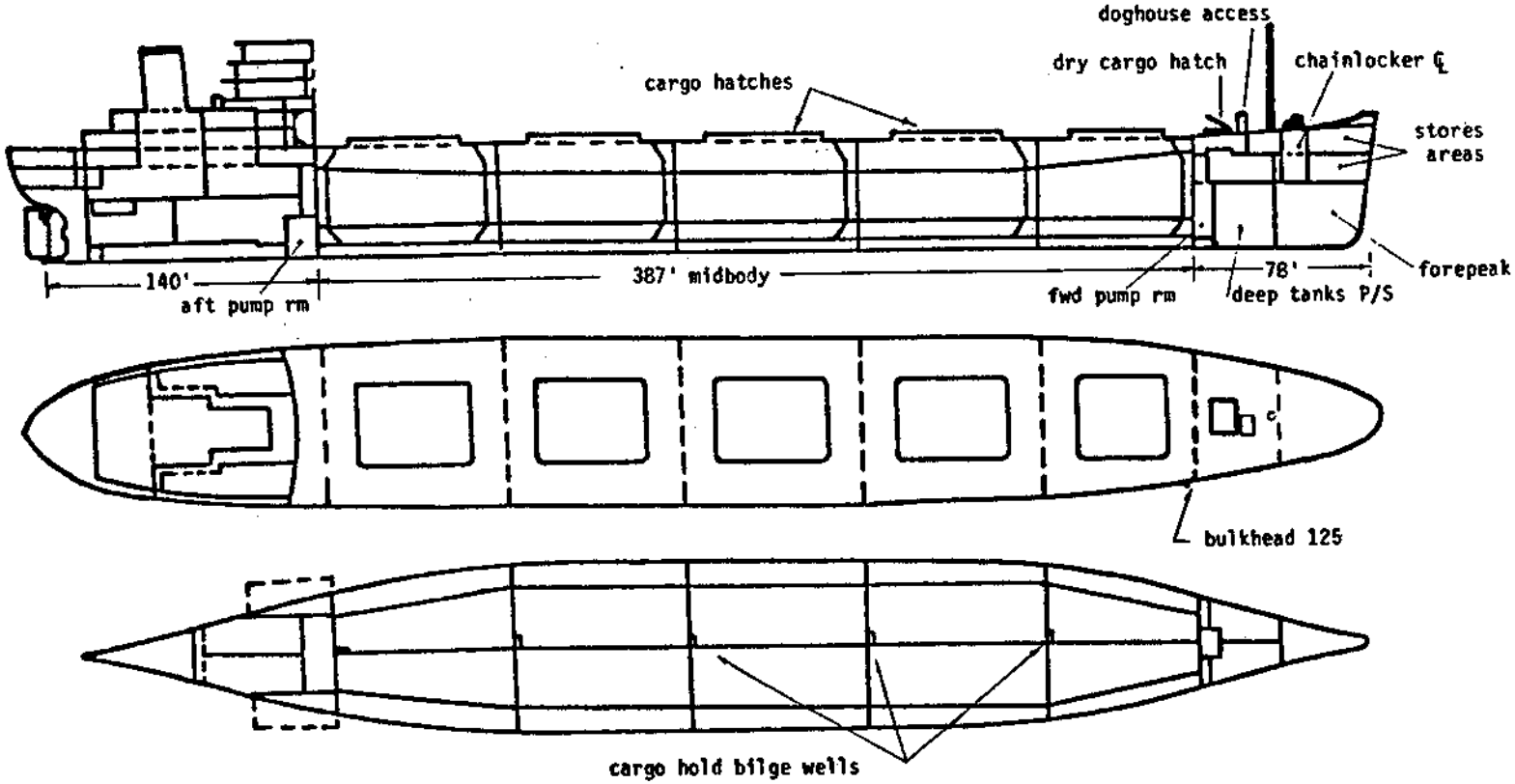
5. The three survivors testified before the Marine Board. They were the Chief Mate, [redacted] the 8-12 Third Mate, [redacted], and one of the 12-4 AB's, [redacted]. Testimony was also taken from the vessel's Permanent Master, Marine Transport Lines' Fleet Manager, Marine Superintendent and Structural Steel Engineer, American Bureau of Shipping and Coast Guard inspectors, divers who surveyed the wreckage, others who had surveyed or assisted in the loading of the vessel, and other technical witnesses.


39 N
CAPE MAY
CAPE HENLOPEN
INDIAN RIVER COAST GUARD
SHIPPING TRAFFIC LANES
38-30 N
DELAWARE
MARYLAND
DELAWARE BAY
ENTRANCE
OCEAN CITY COAST GUARD
0 5 10 15 20 25
SCALE IN NAUTICAL MILES
JACKSPOT BUOY
CHESAPEAKE BAY
38 N
MARYLAND
VIRGINIA
WINTER QUARTER SHOAL BUOY
CHINCOTEAGUE COAST GUARD
SITE OF
MARINE ELECTRIC
CASUALTY
37-30 N
MARINE ELECTRIC
TRACKLINE - 019° T
CAPE CHARLES
37 N
CHESAPEAKE LIGHT
CAPT. HENRY
75-30 W
75 W
74-30 W

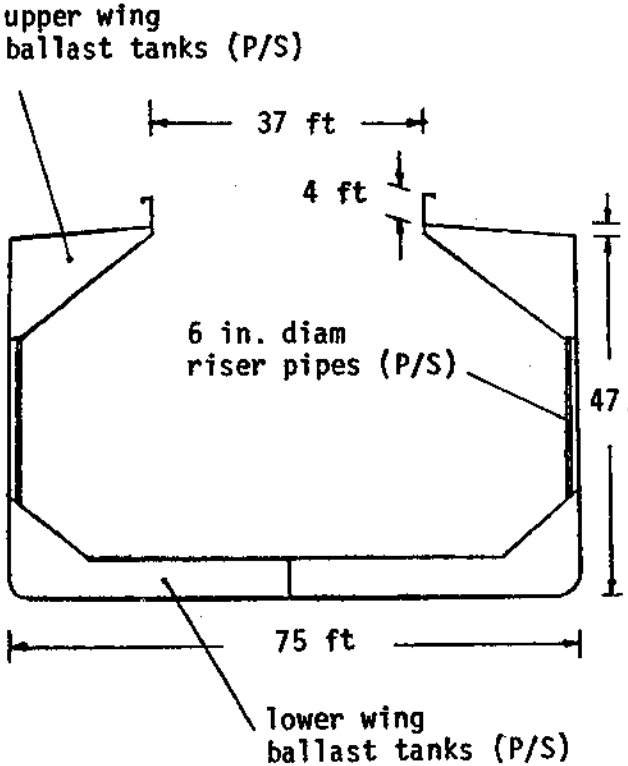
DESCRIPTION OF THE VESSEL

Name	MARINE ELECTRIC (T-2 bow and stern portions of the former GULF MILLS (1961), Ex MUSGROVES MILLS, (1947)
Official No.	245675 (US)
Service:	Cargo (bulk grain or coal)
Document:	Registry, Homeport: Wilmington DE
Gross Tons:	13,757
Net Tons:	9,226
Deadweight:	25,575
Length:	587.7 feet (Registered) 605 feet (overall) 584.5 feet (LBP)
Breadth:	75 feet
Depth:	47.25 feet
Built:	Retained bow and stern: May 1944, at Sun Shipbuilding and Drydock Chester, PA. Conversion with midbody by Bremer-Vulkan, Bremen Germany: November, 1962, at Bethlehem Steel Co., East Boston, MA.
Date/Place USCG Cert. of Inspection:	Issued: 9 June 1981 Expires: 9 June 1983 by MSO Providence, RI
Date/Place Drydocked:	February 1981, Jacksonville, FL
SOLAS 1974 Cargo Ship Safety Construction Cert.:	Issued: 28 May 1981 Exp.: 28 February 1986 by ABS
SOLAS 1974 Cargo Ship Safety Equipment Cert.:	Issued: 7 August 1981 Exp.: 8 June 1983 By USCG MSO Houston TX

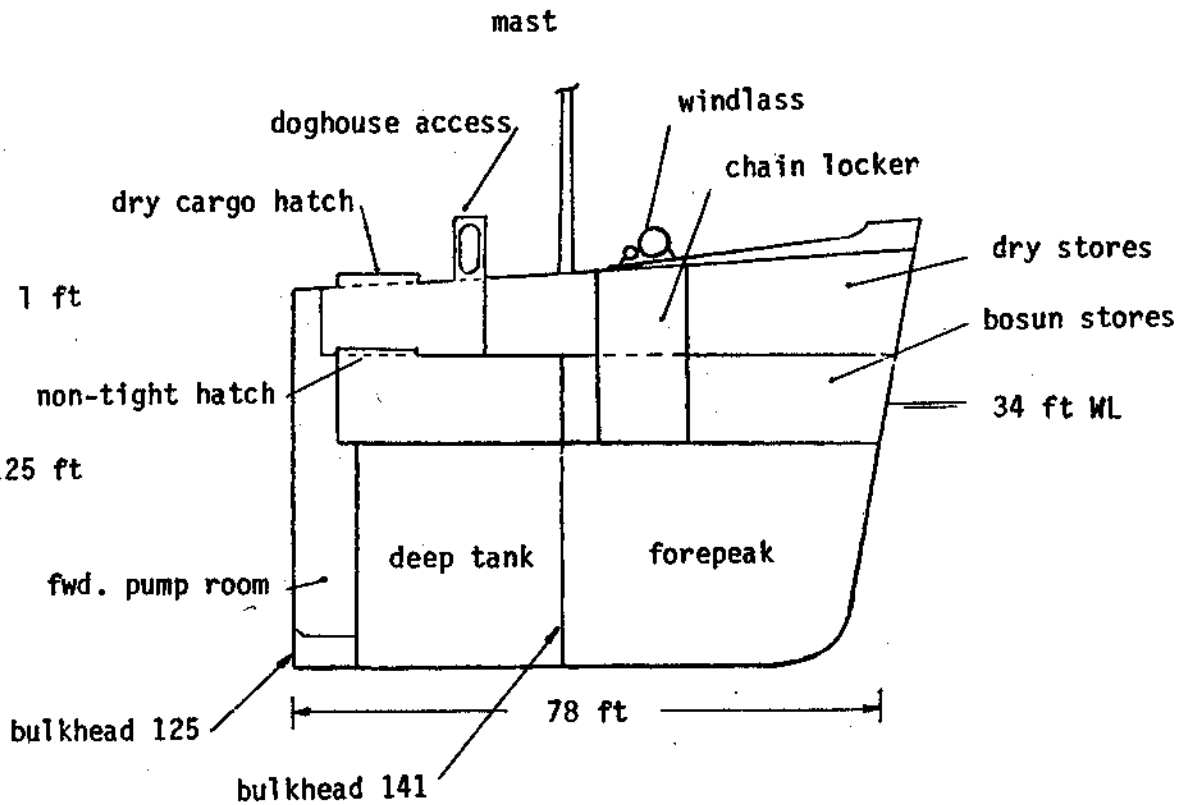
Cargo Ship Safety Radio Telegraphy Cert.:	Issued: 17 June 1982 Exp.: 17 June 1983 By FCC, Boston MA
Vessel Bridge to Bridge Radio-telephone Cert:	Issued: 17 June 1982 Exp.: 17 June 1983 by FCC Boston MA
Load Line Cert.:	Issued 22 February 1981 by ABS
Annual Load Line Endorsement:	Issued 24 February 1982 by ABS at Baltimore MD
Cargo Gear Safety Equipment Cert.:	Issued: 7 August 1981 Exp.: 8 June 1983 by USCG Houston TX
Classification: American Bureau of Shipping	+A-1 (E) Hull +AMS Machinery
Hull:	Steel, welded
Propulsion:	Steam Turbine Generator to Electric Motor
Horsepower:	7,240
Owners:	Marine Coal Transport Corporation 100 West 10th St. Wilmington DE 19801
Operators:	Marine Transport Management Inc. 5 Hanover Square New York NY 10004
Master:	Phillip H. Corl 867 N. Lamb Blvd. No. 61 Las Vegas NV 89110
License:	Master, Steam and Motor Vessels Any Gross Tons, Oceans, Radar Observer



S/S MARINE ELECTRIC



MIDSHIP SECTION



BOW SECTION

FINDINGS OF FACT

GENERAL DESCRIPTION

Hull

1. The bow and stern sections of the SS MARINE ELECTRIC were built as part of the SS MUSGROVES MILLS, a T2-SE-A1 tanker, at Sun Shipbuilding and Drydock Company, Chester, Pennsylvania, in May 1944. It was operated by the U. S. Maritime Administration until May 1947, when the vessel was sold to Gulf Oil Corporation, and the name was changed to the SS GULF MILLS. In May 1961, it was purchased by the Marine Transport Lines Corporation, and renamed the MARINE ELECTRIC.

2. A new mid-body for carriage of grain or ore was constructed at the Bremer-Vulkan Yard, Bremen, Germany, in 1961, and towed to the Bethlehem Steel Company Shipbuilding Yard in East Boston, Massachusetts. To the 387 foot mid-body was attached the bow and stern, with the addition of the old midship deck house on top of the old aft superstructure, and a small portion added to the forecastle deck forward to bring the foredeck flush with the main deck of the mid-body. Work was completed in November 1962, and the vessel's new length overall and depth became 605 feet x 47.25 feet. Ownership changed to the Marine Coal Transport Corporation in November 1962.

3. The MARINE ELECTRIC's converted mid-body consisted of five cargo holds, separated by watertight bulkheads, spaced 80 feet apart, for holds 2 - 5, and 67 feet in hold 1. Each hold was covered by MacGregor "Single Pull" hatch panels, which folded and stacked aft of the hold when opened.

4. Upper port and starboard triangular cross-section wing ballast tanks with a sloping bulkhead between the hatch opening and the side shell at about 1/3 the depth of the hull from the weather deck were connected by two 6 inch diameter riser pipes to the lower ballast tanks in each hold. The lower ballast tanks were comprised of an 8 foot double bottom at the keel, in common on each side, with a lower, triangular cross-section tank with a bulkhead sloping upward from the bottom of the hold to the sideshell about 1/3 the depth from the bottom. A longitudinal watertight bulkhead at the keel divided the ballast spaces into port and starboard tanks.

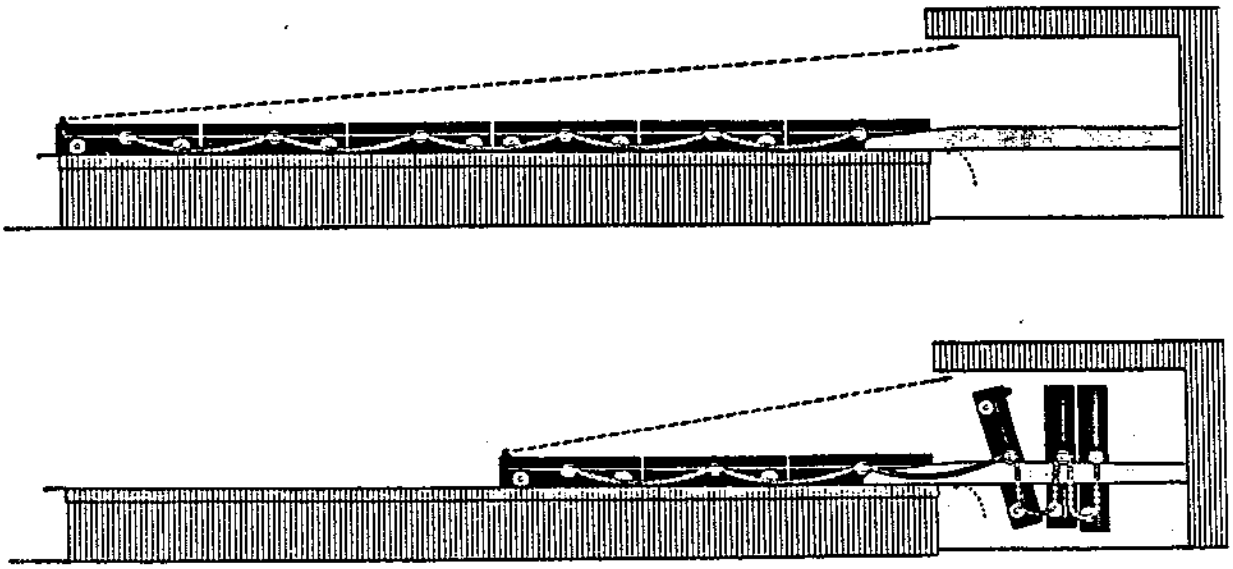
5. The former T-2 bow section started just forward of No. 1 hold with a cofferdam and centerline pump room. Forward of these and below the third deck level were port and starboard fuel or ballast deep tanks, and the forepeak. On the third deck level was a dry cargo space with a non-tight hatch to the second deck level. Forward on the third deck was the lower part of the chain locker and a bosun stores space. The second deck in the bow section was the main deck level of the former T-2.

6. Just forward of No. 1 hold on the second deck was a dry cargo hold, added at the 1962 conversion to bring the weatherdeck flush with the deeper mid-body. It was covered by a steel hatch cover on the main deck, hinged on the forward side, secured by non-ferrous bolts and wing nuts around the perimeter of the cover. The non-tight hatch in the second deck previously mentioned, was at Frame 129 and directly below the steel dry cargo hatch on the main deck. This second deck hatch consisted of heavy wooden boards which were covered loosely with a tarpaulin. A small booby hatch at the forward port corner of the steel dry cargo hatch was typically opened to permit deckhands to lower mooring lines from the main deck. The tarpaulin served to prevent water from wet mooring lines from seeping into the stores space below. Access to the second deck cargo hold was also possible through a "dog house" access trunk from the main deck. A non-tight bulkhead spanned the second deck level just forward of the ladder to the dog house at Frame 136, with port and starboard openings. Through these openings there was access to a stores space, which surrounded the upper portion of the chain locker and continued all the way to the bow.

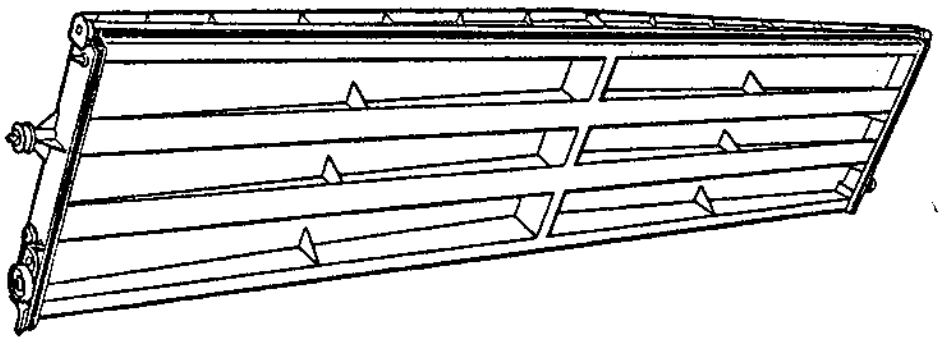
7. Outboard of the cargo holds, a riveted strap spanned the full main deck, port and starboard. The straps were about 10 feet wide at the midship section, and tapered at the ends of the hatch openings. Riveted strakes stretched along the sheer strake and turn of the bilge through the midship section of the hull.

Cargo Hatches

8. The MacGregor hatches constructed in 1961 at the Bremer-Vulkan Yard, Bremen, Germany, were Single-Pull Type. The design and construction of the hatch covers were approved by the ABS and the Coast Guard for a static loading of 220 lbs. per square foot, and met the minimum thickness standards for the rules effective at that time. To prove weathertightness, as required by the Coast Guard regulations and the ABS Rules, the hatch covers were to be subjected to a hose test (30 psi) at the time of construction and at subsequent ABS special hull surveys. Six panels, each approximately 6' 9" by 37' 10-3/8" (the width of each hatch opening) made up the cover for hatch #1. Seven panels were used on hatches 2-5, the width of each athwartship panel being about 7' 2-1/2". Athwartship "L" beams were spaced about every 2'-2" in hatch No.1. The top plating on No. 1 hatch was 9/32" on the end panels and 1/4" on the middle panels. The stiffeners were 1'-9" apart on the first and last panels of hatches 2-5,and 2'3-1/2" apart for the middle five panels. The original top plate thickness for hatches 2-5 was 5/16" on the end panels and 1/4" on the middle panels.



The method of opening a 6-panel MacGregor Single-Pull Hatch System



The underside of one MacGregor Hatch Panel

9. Quick-acting dogs secured the panels to the gasketed hatch-coaming perimeter, and cross-joint wedges secured each adjacent panel section, compressing the sections onto a gasket running along the panel joints. Each panel section was moved by wheels rolling along the coaming. When in the closed position, a small section of the coaming where the wheels set was lowered by hydraulic jacks, allowing the weight of the hatches to rest on the sealing bar welded to the coaming. To open the hatches, the dogs and wedges were released, and the hydraulic jacks were engaged to raise the rollers flush with the top of the coaming. Then a single wire rope was attached to a padeye at the center, forward end of the first panel. The wire rope was led aft to a fairlead and then forward to a deck winch used to haul the panels to their stacked position clear of the hatch opening.

Bilge and Ballast System

10. Each of the ten ballast tanks were served by a single, independent 6 inch diameter suction/discharge line lead aft to the after pumproom, where port and starboard manifolds joined the lines to 3 electrically driven, 2000 GPM pumps (former T-2 cargo pumps) with 12 inch diameter suction and discharge lines. The upper wing tanks were filled by first filling the respective port or starboard lower tanks and pressing up through the 6 inch riser pipes; there were no valves in the riser pipes. There were no gravity dump valves installed in the upper wing ballast tanks to discharge the ballast over the side. Although the upper and lower tanks were in common, they were often referred to separately- such as No. 1 port upper wing tank.

11. Bilge and ballast piping controls for the cargo and ballast areas were located in the after pumproom. The surviving Chief Mate stated the engineers were in charge of the ballast system controls on the MARINE ELECTRIC.

12. A pumproom forward of No. 1 hold had steam driven pumps with fixed piping for the forepeak and two deep tanks. Eductors were fitted to drain the dry cargo space, stores spaces and chain locker. No automatic bilge alarms were installed in the bow spaces.

13 The bilge system in the cargo holds consisted of a 16 inch x 24 inch rose box at the aft end of each hold on the centerline, with 4 inch diameter drains from smaller drain wells ("hi-hats") on the port and starboard lower slant sections. No "hi-hats" were installed in cargo hold No. 5, however. An independent 4 inch diameter line ran from the center drain well aft to the pumproom manifold, then through a 6 inch line to the stripping and bilge pump. Cross connections to the ballast pumps were provided. Check valves were originally installed at the

centerline rose boxes, and stop or stop-check valves [could not be determined] were at the manifold in the pumproom. No automatic bilge alarms were installed in the cargo holds.

14. The bilge piping was renewed during the yard period at Jacksonville, two years before the accident. Swing-check valves at the roseboxes in holds 1-4 were subsequently removed. No swing-checks were ever installed at the rosebox in hold No. 5.

15. In the grain trade, perforated plates covered the center and side drain wells, and a layer of burlap was "glued" over the plates. However, since the 1981 drydocking, and when in the coal trade, solid plates were fitted over the drains in lieu of the perforated plates.

16. According to the plan (Exhibit 9), it was possible to gravitate ballast to or from one side while pumping the other side. Two sea chests were installed in the after pumproom.

Maneuvering Characteristics

17. The MARINE ELECTRIC had the following approximate correlations between shaft RPM's and speed in calm water:

Engine Order	RPM	Speed in Knots
FULL SPEED	86	12.5
HALF SPEED	60	8
	50	6
SLOW SPEED	40	4
	20	2

Machinery Installation

18. Two Babcock and Wilcox sectional header 500 psi boilers provided the steam for the MARINE ELECTRIC. Each boiler was built in 1944, and was oil fired. The boiler feed and combustion controls were automatic.

19. The single turbo-electric propulsion unit was built by Westinghouse. The AC generator was rated at 5400 KW, the motor was rated at 6000 KW, and provided 7000 horsepower to the single screw.

20. Electrical service was provided by two Westinghouse steam turbines coupled to 450 KW (AC)/125 KW (DC) generators. The Emergency Generator, located on an upper level in the engine room, was driven by a General Motors four cylinder diesel engine, and was rated for 60 KW.

21. The shaft alley could be separated from the boiler room by a remotely operated watertight door. Similarly, the boiler room could be isolated from the engine room by a watertight door. A full-flooding CO-2 system protected the boiler room, engine room, and the after pump room, and a separate group of CO-2 cylinders protected the main motor from fire.

22. The steering gear was a double ram electric-hydraulic system with two emergency rams actuated by a manual hydraulic telemotor system.

LOADING INFORMATION

23. In the coal trade, the normal run of the vessel was between Brayton Point, Massachusetts, and Norfolk, Virginia. The northbound voyage carried a full load of coal, and the southbound voyage was in ballast. The trip took about 32 hours one way.

24. On 3 February 1983, Captain [redacted] relieved Captain Farnham in Brayton Point, and steamed south to Norfolk. The southbound voyage was very smooth. Usually, on the southbound voyage, ballast was not carried in the upper wing tanks, but gravitated into the lower wing tanks,about 4,551 tons. This, together with overcarried coal, was enough ballast without having to fill the upper tanks. Due to the deteriorated condition of the upper wing tanks, these tanks were kept empty unless it was necessary.

25. The Chief Mate typically prepared a loading plan on the southbound voyage, showed it to the Master, and received his approval. On 10 February 1983, the Chief Mate was in charge of the loading of the vessel, even though a night relief officer was on board.

26. The MARINE ELECTRIC did not have a loading manual for coal beyond the general guidance found in the U. S. Coast Guard approved Trim and Stability Book. A "Coal Loading Sequence" worked up on a weight/displacement sheet was made out by Captain [redacted], the Company's Port Captain, in the spring of 1981, when the ship first entered the coal trade. The Chief Mate stated that the loading sequence did not exactly follow that of Captain [redacted], but that the order was basically the same. The Coal Loading Sequence was not used or referred to when loading the vessel, he said.

27. On the fatal voyage of the MARINE ELECTRIC, neither the vessel's stability, nor the hog and sag numerals were computed. On entering the coal trade, and based on the loading sequence supplied by the owners, the Permanent Master, Captain Farnham, had worked up calculations as to the vessel's stability, sag and

hog numerals. He calculated a GM of 2.8 - 3.0 feet, and hog and sag numerals between 95 and 98 while in the loaded condition. It was not the practice of the vessel to compute stability, sag and hog on each voyage.

28. At about 1430, 10 February, 1983, the MARINE ELECTRIC was moored starboard side to Pier 6, Norfolk and Western Railroad Terminal in Norfolk, Virginia. The Chief Mate estimated that the ship held about 1400 tons of overcarried coal from the previous voyage to Brayton Point. He noted that this amount was not unusual, as it was more economical for the Company to turn the ship around quickly than to clean each hold. The Chief Mate estimated the overcarry of coal in the No. 1 hold was 800 tons, and the other 600 tons was spread roughly equally through the other four holds.

29. On 10 February 1983, the 8-12 Third Mate was assigned to assist in the de-ballasting of the vessel. Normal practice was to start pumping the ballast as soon as the ship docked, and take the tanks down to where only a couple of inches remained in the tanks. The engineer then stripped the tanks until the pump lost suction. Once stripped, the tanks were sounded again. De-ballasting was completed at 2120 on the night of 10 February. A leak was noted between ballast tanks 3 and 4 starboard. "Every time we went back to sound it, we would get a different sounding." But he said these tanks, too, were stripped out before sailing. The ballast tanks were dry when the ship departed that night.

30. While in the coal trade, the forepeak was not used for ballast and was empty on its last voyage. The ballast tanks, forward cofferdam, forward pumproom and forepeak were sounded routinely each day weather permitting. The deep tanks were not generally sounded by the deck department. About two weeks before the accident, the man holes of the port and starboard deeps had been lifted and the tanks sounded and found dry. It was undetermined if the covers to the deep tanks were resecured in place.

31. The Chief Mate had prepared a loading sequence on a sheet of paper, which was given to the Night Mate, and the Loading Master for the coal dock. The vessel was loaded in two "passes," with a third and final pass made to trim out the ship. The sequence of loading the holds was normally 2, 4, 3, 5, then 1, but in this case, since the Mate wanted to keep trim by the stern to assist in de-ballasting, the sequence was 4, 2, 3, 5, then 1.

32. The Chief Mate's loading plan was as follows:

HOLD	FIRST PASS (Long Tons	SECOND PASS (Long Tons)	TRIMMING PASS	
4	3000	2450 or fill		
2	3000	2450 or fill		
3	2500	2700 or fill		
5	3000	700	400	
1	2000	0	700	
TOTALS	13500	8300	1100	22900

33. The coal was dumped from railroad cars onto a belt, which was fed into a machine that drops the coal into the holds through a conveyor-chute system. The chute was omni-directional - able to be directed into any corner of the hold. The coal was granular, and flowed easily, so that the hold was filled pretty evenly.

34. The Dockmaster said the two classes of coal loaded on the MARINE ELECTRIC, listed as "Betty" and "Cairo" on Exhibit 65, are not distinguishable from each other by eyesight, and he was not familiar with any laboratory analyses of the coal. He described the coal as "steam coal" typically used by power plants.

35. The coal varied in its grain size from 1 1/2" diameter chunks down to powder. A laboratory analysis on a sample believed to be similar to what was loaded on the MARINE ELECTRIC revealed the following sieve analysis:

PASSING	RETAINED	%
------	1 1/2" Sq.	0.3
1 1/2" Sq	1" Sq.	0.9
1" Sq.	1/2" Sq.	7.7
1/2" Sq.	1/4" Sq.	15.1
1/4" Sq.	No. 8	27.7
No. 8	No. 16	17.1
No. 16	No. 30	12.9
No. 30	No. 60	9.2
No. 60	0	9.1
		100.0%

36. Other laboratory tests revealed that the permeability of a fixed volume of coal to water, expressed as the ratio of the void space to the total volume, was between 0.37 and 0.39. The Chief Mate and the Dockmaster reported the stowage factor of the coal at about 42.5 cubic feet per long ton. Laboratory analysis for similar coal produced a stowage factor range between 45 and 49

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cubic feet per long ton. Since actual weights of the cargo loaded into the ship were recorded by Norfolk and Western, the stowage factor was not necessary to determine the cargo loading.

37. The Dockmaster said he had experienced the loading of similar coal into railroad cars at the mine. He had noted that very little settling seemed to occur from the jostling of the cars such that the coal cars were still "rounded up" when they reached the ship loading pier as they were when they left the mine.

38. After the second pass, the ship was termed "dumped down," and the only place additional coal would be stowed was in Nos. 1 and 5. Before this trimming took place on 10 February 1983, the Chief Mate checked the drafts, and using the hydrostatic data, calculated the amount of coal that could be added to bring the ship to its summer load line, plus the fresh water allowance. The Chief Mate used a hydrometer aboard the ship and checked the sea water salinity, which read 1.013. The fresh water allowance above the summer loadline was about 5 inches. (At Norfolk, the Loadline Regulations allow 60% of the ship's fresh water allowance of 9.5 inches) He recalled that on the final trimming pass, 400 tons were added to hold No. 5, and 700 tons to hold No. 1.

39. Holds Nos. 2, 3, and 4 were filled up into the hatch coaming "to the very level top", as the Dockmaster testified. Void spaces remained in holds Nos. 1 and 5. The void in hold No. 1 was described variously as 200 and 250 tons of cargo space. The void was wedge shaped, starting at the middle of the hatch opening and sloping downward toward the bow, ending on the forward bulkhead of No. 1 hold, about 8 feet below the main deck. The void space in hold No. 5 was less than the void in hold No. 1, having a volume equivalent to 50-100 tons of coal.

40. The ship took on about 2700 barrels of fuel on 10 February, 1983, bringing the total fuel aboard to about 3600 barrels, or 545 tons, at the time of sailing. The fresh water aboard, potable and distilled, was estimated at 100 tons, and the stores at 100 tons. These figures were then deducted from the summer deadweight figure of 25,575 tons, to obtain 24,800 tons. From this figure, the loaded cargo figure of 23,410 tons, supplied by Norfolk & Western was deducted, and the remainder represented the amount of coal over-carried from the previous voyage. The figures are summarized below:

Summer deadweight (from T&S Book)	25,575
Fuel, Stores, Water	- 745
Net cargo capacity	24,830
N&W Loading Figure for 10 Feb 83	- 23,410
Overcarried coal	1,420

41. The Chief Mate observed the ship's drafts at the completion of loading as follows: at the bow- 34 feet 0 inches, at the stern- 34 feet 8 inches, and amidships- 34 feet 4 inches, with no sag or hog, and no list. Loading operations were completed at about 2300 on 10 February 1983.

42. The loading figures developed from testimony, documents from Norfolk and Western, and ship's plans were compiled to form the weight summary below:

	Weight (LT)	Vertical Center of Gravity above Baseline (ft)	Long. Center of Gravity from Amidships (ft)
Light Ship	6925.0	28.9	- 39.9
Crew and Effects	10.0	60.0	-209.0
Cargo Stores Aft	100.0	48.0	-257.0
Cargo Hold No. 1	3442.0	24.9	+179.9
Cargo Hold No. 2	5681.0	26.1	+107.3
Cargo Hold No. 3	5346.0	26.1	+ 27.3
Cargo Hold No. 4	5587.0	26.1	- 52.7
Cargo Hold No. 5	4754.0	25.5	-131.3
Fuel Oil Aft	545.0	24.7	-189.4
Dist. Water	39.4	23.0	-261.2
Potable Water	28.6	37.9	-269.5
Fresh Water in DB fr.11-27 P	16.0	3.8	-246.6
Fresh Water in DB fr.11-24 S	16.0	3.8	-251.9
TOTALS	32490.0	26.5	+ 0.7

SECURING FOR SEA

43. Under the direct supervision of the Chief Mate, the cargo hatches were being secured by the ship's force as they completed loading.

44. The Chief Mate related there were about 15 dogs on each of the fore and aft edges of the hatch covers and about 20 on each of the port and starboard sides of each hatch cover. He said only about 50% of these dogs were useable, however. Not always were the hatches dogged down completely prior to sailing. He said, "Under ordinary conditions," and "in the general coal trade," it was customary to dog the corners and one or two side dogs. About four were dogged on each fore and aft side, and three or four on each side. However, concerning the departure on 10 February 1983, he stated:

"On this particular voyage, we got all of them on that we could. I had men started on them, securing them while the vessel was still at the dock loading. The hatches were closed, and as we put down the forward lines, I had two men going around continuously, putting all the dogs...their instructions were, and they did: Put all the dogs that would get on that would come up into the snugs."

45. The weather was cold and raining throughout the loading of the vessel on 10 February 1983. Prior to sailing, the Chief Mate, for his own information, went to the bridge and listened to the weather report. The report called for gale warnings with winds 25-35 knots. This did not concern him, as the vessel had gone out many times in similar type weather.

46. On or about 2345 10 February 1983, with the Pilot and Docking Master aboard and with the aid of tugs, the ship departed its berth. On clearing the berth, the Docking Master and tugs were dismissed, and the vessel proceeded to sea. Enroute, the forward lines were stowed through the small booby hatch in the dry cargo hatch, and laid on top of a tarpaulin over top the wooden hatch cover in the second deck over the dry cargo storeroom. The mooring lines back aft were secured on deck. Prior to reaching Cape Henry, they put steel covers over the anchor chain spill pipes, secured the devil's claws on the anchor chain, and took the windlass out of gear. Normally the anchors would not be secured before the ship cleared the Chesapeake Bay Bridge-Tunnel, but due to the adverse weather conditions, they were secured earlier. The small booby hatch in the main deck dry cargo hatch cover was secured. The dry cargo hatch itself was secured with all the dogs. The door at the "dog house," which led below to the forecastle spaces was also dogged and secured.

47. The Chief Mate inspected the fore part of the vessel prior to leaving the dock. His examination revealed the access doors to the chain locker were dogged, the access plates to the bitter end of the chain were in place, the booby hatch from the stores area to the bosun stores was secured by its six bolts, and the access cover to the forepeak was secured. As the ship transited the Chesapeake Bay, before it reached Old Point Comfort, the Chief Mate made his report to the bridge that the ship was secured for sea, and made specific mention of the spill pipe plates and devil's claws being attached. He testified that all doors and hatches in the bow section below decks were secured except the wooden hatch between the stores compartments on the second deck, and the door to the pumproom, which was customarily left open and was not designed to be watertight.

48. On the bridge, the 8-12 Third Mate made preparations for getting underway. He tested the steering gear, general alarm, whistle, navigation lights, Channel 16, Loran C set and radar and found them to be satisfactory. The course recorder was not in operation.

49. Captain Farnham, the vessel's Permanent Master, informed Captain Corl on his relief two days earlier that all navigation gear, with the exception of the course recorder, was in excellent working condition, and that the Loran set was accurate to 2/10 mile, and was in good condition.

50. The ship arrived at the pilot station at the mouth of the Bay at 0200 on 11 February 1982, and the Chief Mate watched the pilot get off safely. Once the pilot was off, the pilot ladder and the two doors leading to the main deck on the forward part of the house were secured. At no time subsequent to this event were any inspections made of the foredeck and hatch covers, nor were any soundings taken of the cargo hold bilges and/or other spaces, nor were such actions discussed or contemplated.

UNDERWAY

51. While underway, a sea watch consisted of one licensed officer, two Able Bodied seamen, and one Ordinary Seaman. A sea watch consisted of four hours on duty, and eight hours off duty.

52. It was raining and stormy as the vessel got underway. The wind and seas were north-northeast, with about 4 foot waves in the Bay. On departure from Hampton Roads, Virginia, the MARINE ELECTRIC, while on a northeasterly course at a speed of about 80 RPM's (about 8 knots over the ground), encountered head winds of gale force and boisterous seas which caused the vessel to roll, pitch and ship water over its main deck and forward hatch covers. The trackline inked onto the chart was 038 1/2 degrees true from the Chesapeake Light to Narraganset Buzzard's Bay- a distance of 322 NM.

53. Early Friday morning, the weather was estimated as 34-40 knots with seas 10-15 feet (Force 8) from the northeast. By dawn, the wind increased to 50 knots with seas between 20 and 40 feet (Force 10) from the northeast.

54. At 0700 on 11 February 1983, the vessel was pitching in a heavy northeasterly sea. Nothing unusual was reported to the 8-12 Third Mate upon relieving the watch. Around 0900, the Captain came up and reduced the vessel's speed to 40 RPM.

55. Weather was logged every four hours, at the end of the watch, and described the weather of the previous four hours. For the 0800-1200 watch on Friday, the 8-12 Third Mate recorded the wind to be from the northeast at Beaufort Force 10 (48-55 knots) and "very rough" seas with heights of 25 to 30 feet, with an occasional "rogue" wave of 35 to 40 feet. There was no change in the weather conditions during this watch. Occasionally he was at eye level with the seas. The vessel was taking green seas over the starboard bow and foredeck. The seas were breaking fairly heavy up on the forecastle deck area. The bow was rising and readily shedding the water. The seas were fine on the starboard bow and broke right at the anchor windlass, in the vicinity of the doghouse.

56. During the 0800-1200 Friday watch, the ship was 2-3 miles west of the trackline drawn on the chart, making a speed of about 1/2 miles per hour. At this time, the vessel was on a course of 041 degrees true.

57. During the afternoon on 11 February 1983, the wind and seas continued to build. The vessel was still taking green seas over the bow, and the bow was rising and falling without any sign of sluggishness throughout the afternoon. The metal guards covering the bull gears on the windlass were torn off. From time to time, seas were coming over the hatches, and occasional green seas were coming over the bow. Seas were hitting on the dry cargo hatch during the storm. The dog house protected the starboard side, but the port side was being hit by the seas. Occasionally green seas came over the cargo hatches. The vessel was not slamming or pounding, but occasionally she shuddered. At no time was the propeller heard to be racing.

58. The Operations Department of MTL received a message from the ship at noon on Friday, 11 February 1983, stating they had left Norfolk at 10 knots and slowed to 8 knots due to the weather. At 1500 Friday, the MTL operator received a call stating the ship was hove to, proceeding at one knot. This was the last message received from the ship by the owners.

THE THEODORA RESCUE

59. The 65 foot fishing vessel THEODORA left Cape May, New Jersey after 1800 on 10 February 1983, to steam out to the 42000 line, an east-west Loran C line east of Ocean City, Maryland. Around 1320 on 11 February 1983, the boat was taking on water, and the crew was disoriented. The Captain on the THEODORA radioed for assistance from the Coast Guard.

60. Coast Guard Group Eastern Shore, at Chincoteague, Virginia, responded to the radio calls. A helicopter was dispatched from Elizabeth City, North Carolina, to carry pumps to the vessel, and the 80 foot POINT HIGHLAND was dispatched from Chincoteague. The winds were reported as 35-40 knots and steady out of the northeast. By 1600, the Coast Guard helicopter was close to the scene, trying to locate the vessel and drop de-watering pumps. The MARINE ELECTRIC had been monitoring the conversations on Channel 16, and responded to the THEODORA once they had sighted the fishing vessel, giving their position as 37-54 North; 74-40.8 West. At 1605, the Coast Guard requested the MARINE ELECTRIC stand by the fishing vessel until Coast Guard assistance arrived. The MARINE ELECTRIC agreed.

61. At 1628, the MARINE ELECTRIC came about and had the THEODORA two points on starboard bow at two miles. Once on the southwesterly course, the ship rode much easier with the seas on the quarter. The vessel rolled more, and took some seas on the stern, but shipped little over the bow. At about this time, the Coast Guard requested the MARINE ELECTRIC stand by the fishing vessel until the Cutter POINT HIGHLAND could rendezvous with it and escort it into Chincoteague.

62. At 1640, the MARINE ELECTRIC, with the fishing boat in sight, was heading on a course of 270 degrees True.

63. At 1650, the helicopter reported the fishing vessel's position at 37-51.7 North; 74-47.0 West, and at 1714, the position was 37-50 North; 74-49 West. At 1724, the POINT HIGHLAND was underway from Chincoteague.

64. At 1732, the THEODORA's position was 37-50 North; 74-51 West. The helicopter departed the scene to return to Elizabeth City. The position at 1733 of the MARINE ELECTRIC was given as 37- 51.2 North, 74-50.5 West. At 1734, Eastern Shore Coast Guard reported the THEODORA was not taking on a lot more water, and was "holding their own." At 1738, the Coast Guard reported the POINT HIGHLAND would be out to rendezvous with the THEODORA before midnight. After consultation with Coast Guard units, the MARINE ELECTRIC agreed to stand by the stricken fishing vessel.

65. At 1742, the THEODORA reported she was steering 270 and making about 5 knots. At 1750, the MARINE ELECTRIC reported a position of 37-50.1 North; 74-53.6 West.

66. At 1818, the POINT HIGHLAND estimated rendevousing at 2030. They were making 8 knots at the time. At 1822, the MARINE ELECTRIC reported to the Coast Guard they did not know if they would be able to hold the course. "I'm taking an awful beating out here. I'm going to be in trouble myself pretty soon." At the time they were taking green water over their starboard side,

all the way across the deck. The THEODORA replied they were running pretty good, and should be able to make the rendezvous with the Coast Guard. At about 1824, the Coast Guard told the MARINE ELECTRIC she was free to proceed to the original destination. The MARINE ELECTRIC confirmed they were released from standing by the THEODORA, then reported they were heading for Breton Reef, Newport, Rhode Island.

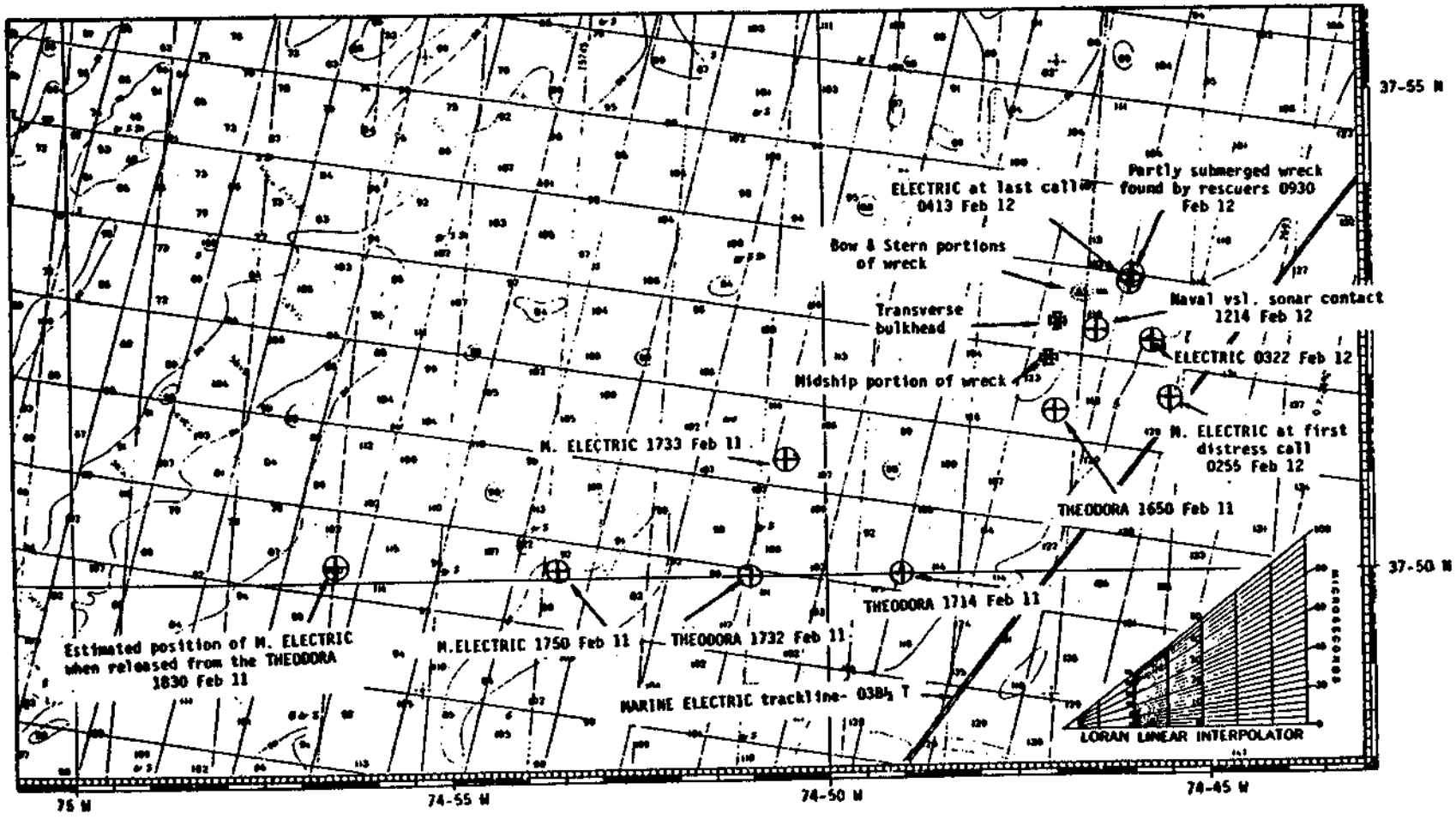
67. The Chief Mate believed the vessel turned to port after being released from the THEODORA. He felt the seas had increased, but the vessel was still lively with the bow rising with the sea. There was no noticeable change in the behavior and response of the vessel when it resumed its northeasterly course. The Chief Mate looked at the charted positions of his vessel while aiding the THEODORA, and returning to its original trackline and estimated the depth of water where the MARINE ELECTRIC left the THEODORA to be about 16 fathoms (96 feet). At no time did he feel the MARINE ELECTRIC grounded. During this incident, the fathometer or its recorder was not in use.

FRIDAY, 11 FEBRUARY 1983 - 2000 - 2400

68. The Captain had been up all day, and napped on the settee in the Chart room behind the wheelhouse during the 2000 - 2400 watch on 11 February. Every half hour he asked to be awakened and informed of the headway the vessel was making. The ship was making very little way - the automatic readout on the Loran set read 0.3 knots to 1.2 knots. The Third Mate recalled making only 1 1/2 to 2 miles the whole watch. The ship's speed was 50-55 RPM on a course of 041 degrees true, and within two miles of the original trackline.

69. The Third Mate estimated the sea to be greater than 25 feet. The seas were climbing aboard and hitting the No. 2 hatch coaming, and rolling back as far as No. 4 hatch. He said the top 8 to 9 feet of the waves would clear the main deck, and strike the deck at the base of the hatch coamings. The waves were not breaking as heavily on the vessel as they had been in the morning, but he said, "There was still an awful lot of sea water coming across the deck." The Third Mate could not make out details on the bow - if anything was adrift, or had come loose, but he could see the dog house, since it was white, and make out the shadow of the anchor windlass. The ship was rolling 15-16 degrees either way during the watch.

70. The Third Mate noted the 1600-2000 watch had logged a Force 9 wind. The wind subsided to a Force 5 or 6 (winds about 27 knots from the northwest) around midnight Friday.



1 0 1 2 3

nautical miles

Portion of NOAA Chart 12211, dated 10 Sep 83,
describing various positions of the MARINE ELECTRIC

THE ACCIDENT

71. At the end of the watch, Third Mate [redacted] came up to the bridge "It was a standard, routine relief," the 8-12 Third Mate said. The 8-12 Third Mate noticed no change in the trim of the vessel during his watch, nor any list at any time. To his belief, on being relieved, the vessel was still shipping water and the bow was still rising and shedding water.

72. The surviving 12-4 AB relieved his watch on the bridge, at about 2345. He noticed the bow was down a little bit, and was not rising like it had been before. It appeared to him that the vessel was plowing through the waves. The vessel was on a course of Ø4Ø at a speed of 5Ø RPM. He observed waves breaking over the bow. The seas were still rough- 15 to 2Ø feet high, and the air filled with spray. There was no comment from the man he relieved as lookout. The 12-4 AB asked, "Okay?," and the man replied, "nothing out there," and went below.

73. Between ØlØØ and Ø15Ø 12 February, the 12-4 AB was below in the mess hall. One of the ship's engineers asked him, "Are we down by the head?." He responded that he thought so. There was no list on the vessel at this time. At about Ø115, the watch officer noted that the bow was sluggish, and not rising out of the water as it previously had. It is undetermined if this information was passed on to the Master.

74. At Ø15Ø, the AB went to the bridge and relieved the helm. The Captain had been sleeping in the chart room, and got up shortly after that, and was up the rest of the time. He recalled the watch officer trying to call the engine room, to inform them the outside temperature was 28 degrees, but the phone was not working. The Ordinary Seaman was sent down to relay the message Later, hand-held radios were used to communicate between the bridge and the engine room.

75. It was the practice of the vessel to turn on deck steam to the anchor windlass, mooring and hatch panel winches when the temperature dropped to 28 degrees F. This was done at about Ø2ØØ.

76. At or about Ø21Ø, the 12-4 AB estimated that green water was washing back on the main deck as far as No. 2 hatch.

77. At about Ø23Ø, the Master summoned the Chief Mate to the bridge. The Chief Mate testified:

> "shortly before 3 o'clock in the morning, the Captain came to my room. He said to me, come up on the bridge, Mate, he said, I believe that we were in

trouble. He said, I think she's going - settling by the head. And he said to me, "This may be my imagination, with the way the seas are running, I can't really tell, but I think she's settling by the head..

"I went up, took one look, and I run down and got the Chief Engineer, [redacted]. The two of us went right back to the bridge, took one quick look, and it was apparent that she was. The seas were staying up there. They were not....the bow was not lifting up properly."

78. The MARINE ELECTRIC's first radio call of distress came at 0251 on 12 February 1983. They informed the Ocean City, Maryland Coast Guard Station, "I'm approxiately 30 miles from Delaware Bay entrance, and I'm going down by the head. I seem to be taking on water forward." After initial responses by the Coast Guard, the Captain said, "We need someone to come out and give us some assistance, if possible." The Coast Guard contacted Station Indian River to pass on the distress information, and then asked the MARINE ELECTRIC if she had pumps on board that could control the flooding. The MARINE ELECTRIC replied, "Our problem is we don't know exactly what our situation is."

79. The wind had now shifted to the northwest. The seas were "roaring down the deck." No suggestion or attempt was made to bring the ship about. At this time the Captain ordered the Chief Mate to call all hands and to stand by the boats. The General Alarm was not sounded.

80. The Chief Mate dispatched the 12-4 Ordinary Seaman to call the men. He woke the bosun and the day-man himself, told them to dress in heavy clothes, and come up and ready the boats. They removed the covers from the boats and released the forward gripes, leaving the after gripes on. They then removed the stanchions from around the life rafts, but did not release the strip to the hydrostatic release gear. They also gathered life rings and stacked them on the boat deck. The general belief was that nothing serious was going to happen - the lifeboat covers were folded and stowed in anticipation of soon recovering the boats.

81. At 0255, the MARINE ELECTRIC radioed they were having the crew muster at the lifeboats. They reported their position as 37-51.8 North; 74-45.5 West, and their heading as 030 degrees. At 0257, the Captain altered course to 000 degrees. The ship reported a speed of advance of only 1.5 knots.

82. The davits for the lifeboats were as originally installed on a T-2 tanker - sheath screw. The falls were 3 1/2 inch manila line. A three-fold purchase at the releasing gear was linked to a

second three-fold purchase at the davit arm, from which a single line led to a cruciform bitt attached to the deck. The line was secured at the bitt, and the remainder was coiled around a reel beside the bitt. During drills, and at the time of the accident, two men were stationed at each bitt, fore and aft, and one man at each reel, to insure it paid out properly. The releasing gear was a single pull lever arm that was secured by a pin amidships in the boat, and released both falls simultaneously.

83. At about 0245, the 12-4 AB heard the First Engineer, who was in the engine room at the time, announce he had "good head pressure on No.1 and 2 starboard" (these were assumed to be wing ballast tanks). He then heard the First Assistant ask if the Chief Engineer wanted him to gravitate from starboard to port; the Chief Engineer asked the Captain, and the Captain simply replied, "keep pumping."

84. The 12-4 AB was at the helm; the vessel still had steerageway, and he could keep the course within 10 degrees, using a great amount of rudder. The waves were still on the bow. The bow was further down than when he had first noticed the condition, and was continuing to go down slowly.

85. At 0300 on 12 February 1983, the 8-12 Third Mate was awakened in his stateroom by the Ordinary Seaman. He reached the bridge about 0306. He noticed the bow was definitely down. He could see the foredeck covered with about 6 feet of seawater, and waves breaking as far back as No. 3 hatch. The dog house was still visible. The seas were fine on the starboard bow. The whole main deck was awash. After the waves broke on the hatches, they rolled right back against the house. He said he couldn't see if any of the hatches had been ripped apart, since the water covered them.

86. The 8-12 Third Mate heard reports on the bridge that No. 1 and No. 2 starboard tanks were being pumped out after he went up around 0300. He didn't know why the engineers had selected No. 1 and No. 2 starboard ballast tanks to pump, but assumed it was because the ship was down by the head. He said the valves to forward port tanks may have been open also.

87. The 8-12 Third Mate and the Chief Engineer were on the starboard bridge wing. The Chief Engineer was shining a tankerman's portable light up forward. There was no spotlight on the ship. The Chief Engineer said he thought the No. 1 hatch was stove in.

88. At 0309, the MARINE ELECTRIC attempted to contact by radio two ships showing on his radar screen about five miles to the starboard side with negative results. At 0312, the MARINE ELECTRIC radioed the Coast Guard that they were continually taking on water forward with the bow going down.

89. At 0315 the MARINE ELECTRIC requested the Coast Guard provide a helicopter with a spotlight to illuminate the forward part of the vessel. The Coast Guard responded, "We are in the process of doing that right now." They also stated the CGC POINT HIGHLAND was diverted and enroute their position.

90. At 0317, the MARINE ELECTRIC notified the Coast Guard on Channel 16, "What we think has happened is the No. 1 hatch is broke...." They also stated they were pumping with good head pressure.

91. At 0322, the MARINE ELECTRIC stated she was 13.5 nautical miles due south of Jackspot Buoy, and gave her latitude and longitude as 37-52.4 North; 74-45.7 West. Her Loran coordinates were 42032.5 and 26937.7. The Captain said they had not located the source of the flooding, and that the forward decks were becoming awash.

92. At 0327, the tanker TROPIC SUN called to say she had picked up the distress messages, and that she was in position 38-21 North; 74-35 West, about 8 miles southeast of the Delaware Sea Buoy. They estimated at 0336 they were about 32 miles north-northeast of the MARINE ELECTRIC, and mentioned a Norwegian vessel, the BERGANGER, was closer, and trying to contact the MARINE ELECTRIC on the wireless. The TROPIC SUN, at 0344, said they were making 10 knots, and estimated they would be on scene in about 3 hours.

93. The 8-12 Third Mate was ordered to go down and see if the Chief Mate had cleared the boats. He walked down and saw this was so, and talked to the Chief Mate. He saw that the sea painter was led correctly, and witnessed an AB putting in the boat plug. He heard someone suggest gathering the life rings and stacking them on the boat deck, so he collected a couple from the port side. He also went up and put the EPIRB upright in its box on the port bridge wing. When he returned to the bridge about 0350, the vessel had developed about a 5 degree starboard list.

94. At 0351, the MARINE ELECTRIC radioed they were listing a little bit. At 0352, the ship reported that her forward deck that leads into the forecastle was under water, and that she was taking a starboard list. When informed the POINT HIGHLAND would be on scene around 0615, the MARINE ELECTRIC replied they didn't think they could hold on that long. The degree of list was reported as 5 degrees at 0356, and it was rolling to 14 degrees. About this time the 8-12 Third Mate observed the inclinometer showed a 6 degree starboard list. He said the ship would roll to starboard about 20 degrees, then come back to 6 degrees. "She wasn't rolling too much to port at this time," he said.

95. At about 0400, the Captain ordered the Chief Mate to swing out the boats. The ship had about 5 degrees starboard list at this time, and only the starboard boat could be swung out. The Chief Mate stayed by the boat. At 0404, the MARINE ELECTRIC reported an 8 degree starboard list. At 0408, the Master radioed, "I think I'm going to lose my ship here.....we are starting to take a real bad list to starboard. The Chief Engineer told the First Engineer to shut down the engines. Before he left the bridge, the AB noted the RPM indicator showed the engines to be completely stopped.

96. At about 0410, the radio operator came on the bridge and said he had messages from two merchant vessels. One was due on scene at about 0800. The Third Mate said this news was met with a sigh of dispair from those on the bridge, since they knew the ship would not stay afloat that long. The ship then listed about 10 degrees starboard. The Captain told the helmsman, to leave his station, since the ship was not answering the rudder too well by that time.

97. At 0410, the Coast Guard said a helicopter should be on scene in half an hour. At 0413, the Master said they were about to abandon ship. The list had now increased to 15 degrees. Their position was 37-53 North; 74-46 West. The last voice transmission came at 0414, "We are abandoning the ship right now. We are abandoning the ship right now."

98. The General Alarm was never sounded. The Third Mate gave a quick blast on the whistle for "Abandon Ship" just before leaving the bridge. The orders to stop or secure the engines were passed verbally over the hand-held radios - the engine order telegraph was not used.

99. When readying the starboard lifeboat, the Chief Mate said the wind was off the port bow, and appeared to have "lightened up a lot right around that time." The seas were coming farther and farther aft down the deck. He could not recall whether the ship fell off into a trough of the waves just before the last roll. The seas were coming from the starboard side when the ship took its last roll, the 8-12 Third Mate said. "I don't know if we had turned into the sea, or turned broadside to the sea at that time. I know she was washing up on the starboard side because the waves were coming at me."

CAPSIZED

100. Having been relieved from the helm, the 12-4 AB went below on the inside and came out on the starboard side, one deck above the boat deck. When he reached the ladder above the boat deck,he said the men had just finished cranking the starboard boat in some, since the vessel was listing such a degree. He said the line the man was taking off the cruciform bitt was manila, and probably was a frapping line. Three or four people were hanging onto the ladder as he worked his way down to assist in launching the boat. Just as he reached the cruciform bitt that the falls were secured to, the ship jerked, and he went into the water.

101. The boat had been only about 5 feet from the water when the ship took the roll, now it was floating, but still attached to the falls. The 12-4 AB was between the ship and the boat when he felt himself being pushed under water by some steel. He finally was able to break free and reach the surface again. He saw the ship still slanted at about 60 degrees, and swam on his back away from it. Within 5 to 15 minutes of the capsizing, he reached back, felt a line, turned, and saw it was attached to a liferaft still contained in its cannister. Propping his feet against the cannister and pulling on the line, he caused the raft to inflate. He tried for 15 to 20 minutes before he was able to enter the raft. Three other men swam to the raft as he was trying to get in. He tried to help one man into the raft, but had no success. The AB said they just clung to the raft and did not try much to get inside- they may have been in shock. The Second Mate also came to the raft. The Mate told the AB to get the ladder. He looked through the raft, then saw there was cargo-netting-type ladder on the side of the raft opposite from where the other four men were. He directed the men to the other side of the raft, and stated he had to repeat himself many times to be understood by those in the water. Even with the assistance of the ladder, and after half an hour of trying, the AB could not get anyone into the raft. The netting was flush against the raft, and the Mate couldn't get his hand around it. One by one, the men drifted away, leaving the AB alone with the raft.

102. When the AB heard the Coast Guard helicopter, he flashed his flashlight in the air. He said he wasn't too concerned about rescue, since the raft was riding very well, with only 3 to 6 inches of water in the bottom. It was still dark when the helicopter lowered the rescue basket to him, but he said it was very shortly after his rescue that he saw daylight. He said he shivered all the time, but he felt that the security of being in the raft helped calm him down.

103. The AB did not energize the chemical light on his life jacket - it was the type that must be squeezed to energize. He saw lights around him, floating by, and recalled many were blinking "by themselves," that is, not connected with a body. Because the waves periodically obscured the lights, he was not sure if he saw any steadily burning lights. Both he and the Chief Mate said they knew how to energize the lights, but did not think to do it during the casualty.

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104. Just after relieving the helmsman of his duties, the Captain radioed the Coast Guard and said he was about to lose the ship, and was abandoning ship. The Captain left the bridge by going out the starboard bridge wing; the surviving 8-12 Third Mate went out using the inside passage. The Third Mate picked up a walkie-talkie before leaving, and at the top of the ladder he heard the First Engineer calling to ask if they wanted the fuel oil pumps secured. The Third Mate yelled to him to get out of there, the ship was going down. The Third Mate fell down the ladder, and the radio broke into pieces. He said he just wanted to get outside before she went under.

> "At that time I didn't think it was going to roll over. I thought she was going to go down straight by the head. I don't think anybody expected it to roll over.
>
> "I got outside ---right directly outside the radio shack, and I went down one ladder to about 7 or 8 steps maybe 10 steps,and I came to the spot where we had piled all the life rings. I stopped there and I started throwing life rings over the side of the ship. I believe it was probably half a dozen life rings sitting there, and I think maybe 3 or 4 of them made it into the water. The rest hit the overhead and bounced directly back down onto the deck.
>
> "It seemed like only seconds after that that I started down the ladder to the boat deck. It is only a short little ladder, down to what they call the stack deck, where the stack is located, and I was watching the lifeboat being launched. The falls were being paid out. The Mate was there - the Mate was on the forward fall. He was paying it out. And I don't know who was on the after fall, but all of a sudden, the ship rolled, and I saw the water level start to rise, and before the releasing gear was even released on the life boat, the seas picked it up and brought it right in front of me up against the stack. And I just watched the ocean level come up and grabbed me.

"As I went into the water, I looked up and I saw Captain [redacted] on his deck, climbing over the railing, trying to get into the water. This is the last time I saw the Captain. I wasn't in the water with him."

105. The 8-12 Third Mate rolled onto his back when he was in the water. He said he may have been in shock, but the realization that the ship was going down hadn't occurred to him. "I knew I was in the water and it was a tight situation," he said. He looked back and saw the stern out of the water, and the stack, but stated he could only make out the shadow of the hull. The ship was on beam end, he said, listed 90 degrees to starboard. He could not state whether the ship was in one piece at that time or not.

106. After what he estimated was half an hour, he found five men holding onto 2 life rings. They "sounded of" by number - The Chief Engineer, Third Mate [redacted], two seamen and the Radio Officer were present. Once on the life ring, he heard an explosion, and the Chief Engineer remarked it was the boilers exploding.

107. By the time the helicopter arrived, only the Third Mate was left holding onto the lifering. The other five seamen had succumbed to the elements of the weather and sea and had drifted away.

108. The Third Mate wore light hunting boots, wool socks, leg warmers, blue jeans, chamois shirt, wool watch cap, a down jacket and gloves in addition to the life jacket.

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109. The Chief Mate had been standing by the starboard boat. He heard the whistle blow - Abandon Ship. He testified:

"Everything was proceeding in a seamanlike fashion. The boat was being paid up. The ship would roll from time to time, roll back, and the sea would come up as the boat was going, under those weather conditions, in a seamanlike manner.

"And without any warning....at this point I was standing there, I wasn't holding onto anything, and it was slacking away on these davits, and at this point, the ship just rolled from a 28 degree list, [apparently confused with the temperature] right completely down on her side.

"And the next thing I knew, it was like the sound of the water going out of a bathtub, amplified a billion times, and I was clawing and swimming up. And I had been standing where I was outside the 12 -4 engineer's room, and the lights were still on. I looked right in the porthole and swam by it. I kept swimming, swimming, till I reached the railing. I turned it, and I shot up. I had on a pair of padded underpants, the quilted type, polyester in them. I believe they had a lot to do with my coming through.

"I come up, broached the surface, took a deep breath, and not far from me, I could see the smoke stack. It seemed to be just a little bit above the horizontal. I started swimming out."

110. Just before rolling over, waves were still coming from the bow and rolling up the deck beyond No. 4 hatch, and the Chief Mate believed that hatches No. 2 and 3 had solid water over them. The Chief Mate testified he heard no loud noises, metal tears, or scraping noises on the vessel until the final roll. Then he heard a noise similar to pipes falling, and thought they may have been the pipes stored on the second deck level above the pump room rolling off.

111. The Chief Mate found an oar after being in the water what he estimated was half an hour. As he rose on the crests of the waves, he recalled seeing the strobe lights of the life rings blinking, and heard cries and groans. He also noted a flashlight beam shining in the air. He then recalled seeing the dark shape of a lifeboat. The lifeboat was swamped, with only a few inches freeboard. He estimated it took half an hour to reach the boat after he saw it. He succeeded in entering the boat and found it warmer to lie in the water, under a thwart, than to stay exposed to the air.

"I kept kicking and thrashing around to keep the circulation. All the time I kept looking out and yelling out, "lifeboat here," just continual yelling out to keep myself going, and maybe someone was there that could come over and I could have helped them. I could have dragged them in very easily, because the boat was only a few inches out of the water. Then I waited and prayed for daylight to come. I never in my life....it must have been another couple of hours until daylight finally came."

112. The Chief Mate was confident that the Coast Guard would be there with a helicopter at daylight, and that he had a good chance to be saved if he held out that long.

113. The Chief Mate believed some seas were about 26 feet high while he was in the lifeboat. He used the length of the lifeboat, 24 feet, as a comparison. He felt the average height at this time was 10 to 15 feet.

114. The Chief Mate recalled the next event was that a Norwegian ship came alongside the lifeboat, and sailors scaled the ship's side, in Jacobs' ladders and nets, and tried to bring him aboard. The seas were too high, however, and the ship backed away. He then heard a whirr overhead, looked up, and saw the Coast Guard helicopter. The rescue basket was lowered, the Mate toppled into it, and was hoisted clear. He was transferred to a hospital in Salisbury, Maryland. He estimated he was rescued near 0700. He said it was broad daylight when the Norwegian ship attempted to rescue him.

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115. The AB was the first into the helicopter. The second in was the 8-12 Third Mate; the Third Mate recalled it was daylight by this time- he could see an orange-colored vessel in the water below. The helicopter circled quite a few times, recovered three bodies, and then the Chief Mate. The Chief Mate was covered with oil and did not look too well. Next, a Navy swimmer who assisted in the rescue was lifted in. Shortly thereafter, the helicopter departed the scene and flew the survivors to Peninsula General Hospital, Salisbury, Maryland. The survivors were treated for hypothermia and shock, and released several days after the accident.

116. Medical Examiner reports for the 29 bodies recovered from the scene of the accident attributed 20 deaths to drowning resulting from hypothermia. Four of the reports stated the cause of death was simply drowning. The reports also stated that many of the bodies were covered with heavy bunker oil.

COAST GUARD RESCUE EFFORT

117. Coast Guard units involved in the rescue efforts included Station Ocean City, Maryland, which kept up continuous dialogue with the vessel on Channel 16 VHF-FM. Station Ocean City was under the opeational control of Group, Eastern Shore, located in Chincoteague, Virginia. The CGC POINT HIGHLAND, an 82 foot search and rescue vessel, was stationed at Chincoteague Virginia, and also under the control of the Group. The Group reported to the Fifth Coast Guard District Operations Center, located in Portsmouth, Virginia. The Operations Center coordinated the rescue efforts.

118. Air Station Elizabeth City, North Carolina, sent the Coast Guard aircraft that responded to the accident. A Navy helicopter from Naval Air Station Oceana, Virginia, was sent at the request of the District Operations Center, and Naval vessels in the area of the accident were requested to respond by the District Operations Center through the Commander in Chief, Atlantic Fleet (CINCLANTFLT) in Norfolk, Virginia.

119. The CGC CHEROKEE, a 205 foot rescue vessel, was performing a law enforcement patrol under the operational control of Commander, Atlantic Area Coast Guard in New York, New York. At the time of the casualty, the vessel was about 40 miles east of the Chesapeake Bay Entrance.

120. The CGC POINT ARENA was moored at the Coast Guard Station, Little Creek, Virginia, just inside the entrance to the Chesapeake Bay, when the casualty occurred.

121. From positions reported during the MARINE ELECTRIC escort of the THEODORA, and estimated speeds of advance, the position when the MARINE ELECTRIC asked to be released from the escort at 1830 on 11 February 1983, was reconstructed by Fifth Coast Guard District Operations personnel. They believed the position to be 37-50 North; 74-56.5 West. The courses steered when the MARINE ELECTRIC resumed a heading to the northeast are not known.

122. The next position reported by the MARINE ELECTRIC was in their distress call at 0251 on 12 February 1983, when they reported they were 30 miles south of the Delaware Bay Entrance. Due to the reference to the Delaware Bay, the Ocean City watchstander notified Indian River Station, Delaware, of the call, and advised them to contact the Coast Guard Air Station at Cape May, New Jersey. Indian River Station was running on their emergency generator, and experiencing electrical problems at the time. When the MARINE ELECTRIC reported their position at 0255 as 37-51.8 North; 74-45.5 West, Station Ocean City realized it was in their area of search and rescue responsibilities. Additional conversations with the vessel verified the position, and at 0311, Station Ocean City notified the Fifth District Operations Center of the distress call. The MARINE ELECTRIC's position was only about 9 miles from the estimated position they were released from the THEODORA.

123. At 0315, the POINT ARENA, at Little Creek, Virginia, was called to get underway. At 0324, the POINT HIGHLAND, which had been standing by the THEODORA at the entrance to Chincoteague Inlet, awaiting daylight, turned and headed toward the MARINE ELECTRIC's position. The CHEROKEE was directed to steam north to the scene at 0330.

124. At 0315, Group Hampton Roads was directed to dispatch the POINT ARENA from Little Creek, Virginia. Two minutes later, the Operations Center asked Commander, Atlantic Area in New York City for operational control of the CHEROKEE. When this was granted, the CHEROKEE was directed to steam north to the scene at 0330.

125. Air Station Elizabeth City was briefed by the Operations Center at 0318, and directed to launch the ready helicopter (CG-1471). Having flown in the area 11 hours earlier on the THEODORA case, and experienced severe turbulence and weather, the Air Station personnel requested a fixed-wing C-130 aircraft (CG-1347) to fly cover for them. Based upon initial reports that the ship was taking on water, the air crew had loaded pumps on board the helicopter. When it was learned the MARINE ELECTRIC crew was abandoning ship, these pumps were off-loaded to enable the aircraft to carry more passengers in a rescue effort.

126. At 0330, the Operations Center passed details of the distress to the Navy CINCLANTFLT duty officer, and requested the Navy to send any available surface units in the area to assist. A reply at 0342 indicated the USS JACK WILLIAMS, and the USS SEATTLE were about 70 miles from the MARINE ELECTRIC, and would divert to assist.

127. At 0320, the District Operations Center sent out an Urgent Marine Information Broadcast. The merchant ship M/V TROPIC SUN,responded to the Urgent Broadcast. It was situated at the mouth of the Delaware Bay. At 0326, this fully loaded tanker changed course for the scene of the accident, expecting to arrive around 0545.

128. At 0344, the Operations Center requested assistance from Naval Air Station Oceana in the form of an HH-3F helicopter. At the same time, the Operations Center was advised Elizabeth City was calling in a second helicopter crew to send an additional aircraft.

129. At 0350, the POINT ARENA was underway, making 12 knots, with an estimated time of arrival on scene at 1100.

130. At 0400, the TROPIC SUN advised the Coast Guard that a Norwegian ship, which was later learned to be the BERGANGER, was about 6 miles ahead of their vessel and proceeding to the MARINE ELECTRIC's position.

131. The Group Eastern Shore watchstander told his Commanding Officer at 0414 that the MARINE ELECTRIC was abandoning ship, and that he expected a helicopter to be there in 15 to 20 minutes. In fact, the helicopter was only airborne from Elizabeth City at 0413, and would not arrive on scene for another hour.

132. At 0506, the TROPIC SUN passed weather information to the helicopter CG-1471. They said they were experiencing sea state 8 and winds gusting to 40 knots. The TROPIC SUN said their lifeboats were the "old type," like the vessel in distress, and that the weather would not permit them to launch them for recovery operations. Because they were loaded, and had little freeboard, they said they should be able to maneuver and lift persons from the water to their deck, however.

133. At 0509, the C-130 aircraft was airborne from Elizabeth City, and the second Coast Guard helicopter, CG-1434, was airborne at 0513.

134. At 0520, the CG-1471 was the first on scene. Captain Blackett, Chief of Search and Rescue in the Fifth District, testified:

> "That was the first indication that we had from anyone that the survivors were not actually in the boats. The transmissions that we had from the MARINE ELECTRIC, which occurred from 0251 until they actually indicated they were abandoning ship at 0413, led us to believe that it was a fairly sequenced event; that they did have boats and rafts; all the crew were in life jackets, and that they would take to their boats and rafts, and we would find them in those boats and rafts. As soon as the aircraft got on scene, we knew right away that that was not the case."

135. The pilot of the Coast Guard Helicopter 1471 stated he spotted a great number of strobe lights in the water. Starting at the southern region of the rescue scene, he noted first an empty liferaft. They proceeded to a second light, which was also a liferaft, and found one person in it. A rescue basket was lowered, and the individual was lifted to the helicopter. The helicopter then went to another group of lights, but a merchant vessel was drawing near them, and the helicopter bypassed the area. They passed over several strobe lights attached to ring buoys, and some strobe lights floating by themselves. About 30 yards away, a group of bodies were sighted. The helicopter was able to recover one individual - the 8-12 Third Mate.

136. When the C-130 aircraft arrived on scene at 0540, they became the On Scene Commander. The merchant vessels TROPIC SUN and BERGANGER arrived at about 0550. The POINT HIGHLAND was about three miles SSW of the capsizing position at 0558, and maneuvering to pick up various lights and retro-reflective objects in the water.

137. At about 0605, the Navy helicopter 737 arrived on scene and transferred a Navy swimmer to CG-1471 to assist in recovering crewmen from the water. The swimmer assisted by placing individuals into the rescue basket. At 0603, the BERGANGER reported sighting two liferafts, both empty. At 0615, the POINT HIGHLAND began recovering bodies from the sea, and had the two liferafts alongside. To assist them, the POINT HIGHLAND launched their small Zodiac-like rigid inflatable boat with a two man crew. The TROPIC SUN and BERGANGER searched for bodies and provided a lee for the POINT HIGHAND's recovery efforts. At 0616, CG-1434 was on scene, and hoisted two immobile persons from the water. At 0637, the BERGANGER reported they sighted one person alive in a lifeboat. The CG-1471 recovered him at 0700, and departed the scene for Salisbury, Maryland, with three survivors and three deceased on board. The Navy 737 departed with them. They arrived at Salisbury, and transferred the survivors to Peninsula General Hospital at 0848.

138. A drift line of about 183 degrees True from the position of the wreck was noted by the rescuers. At 0700, the POINT HIGHLAND found numerous crewmembers in the water. At 0820, CG-1434 departed the scene for Salisbury with two bodies of deceased crewmen on board.

139. At 0825, the USS SEATTLE was on scene, joined by the USS JACK WILLIAMS at 0850. A third Coast Guard helicopter, CG-1496, was on scene about this time. At 0900, the CGC CHEROKEE assumed the duties of On Scene Commander, and arrived at the search area about 0930. At this time, CG-1496 located the overturned hull of the MARINE ELECTRIC. They reported the hull overturned, awash and down by the bow, with part of the propeller showing. It was reported in position 37-53.1 North; 74-46.0 West.

140. The CHEROKEE reported at 1000 that the search area was still covered with bodies concentrated in a half mile radius. The lifeboat and 2 liferafts were about 2 miles south of where the bodies were located. The POINT ARENA arrived on scene at about 1113.

141. At 1107, the derelict hull was no longer seen above the surface. The USS JACK WILLIAMS was called to use their sonar to find the hull. By 1214, the sunken hull was located at 37-52.5 North; 74-46.4 West.

142. At 1155, the POINT HIGHLAND had recovered 16 bodies of MARINE ELECTRIC crewmembers from the water. At noon, three bodies were transferred to the POINT HIGHLAND from the CHEROKEE, and by 1242, the POINT HIGHLAND was released from the search and underway to Chincoteague. They moored at 1603 and transferred the bodies to the custody of the Medical Examiner, Virginia Department of Health. The five deceased crewmembers recovered by

Coast Guard helicopters 1471 and 1434 were taken to the Salisbury, Maryland, airport, then to the Peninsula General Hospital in Salisbury and the custody of the Maryland Department of Post Mortem Examiners.

143. One Coast Guard helicopter stayed on scene to assist with the search for bodies and debris throughout the afternoon. The wreck, lost temporarily, was relocated at 1510 by the USS JACK WILLIAMS. They deployed a passive sonobuoy to listen for signs of survivors still in the hull, but reported at 1607 that no noises were heard other than the creaks and groans normally encountered from a sunken wreck. They reported there was no apparent drift of the hull.

144. At 1550, the merchant vessels involved in the rescue efforts were released from the search by the Coast Guard. At 1656, the CHEROKEE recovered the MARINE ELECTRIC's No. 2 lifeboat at 37-34.5 North; 74-50.5 West. At 1741, the Navy ships were released from the search. The CHEROKEE and the POINT ARENA conducted a night search, and were joined on the morning of 13 February 1983, by helicopter CG-1434. The helicopter reported all the debris remained within 1 or 2 miles of the drift line. No further bodies were recovered. The POINT ARENA was secured Sunday morning due to low fuel. At dusk on 13 February 1983, the active search was suspended. Three men survived, 24 bodies were recovered, and 7 remained missing.

145. No unit reported that the EPIRB signal was received at any time.

146. Efforts were made by Coast Guard divers on 16 February 1983 to investigate the wreck for any signs of survivors trapped in the hull. No responses were heard, however.

147. In response to questions regarding the decision to send helicopters from Elizabeth City, North Carolina, rather than the geographically closer Third District Air Station at Cape May, New Jersey, the Coast Guard Chief of Search and Rescue responded that the type of aircraft stationed at each location was the greatest factor. The helicopters at Cape May are an older type HH-52, while those in the Fifth District are HH-3 models. The HH-3 is larger, has twin engines, and can carry up to 15 passengers, as opposed to 6 in the HH-52. There is an 80 - 120 knot speed differential, and the greater fuel capacity of the HH-3's make them more enduring search aircraft for off-shore search and rescue operations.

148. The Coast Guard carried a pollution case on the oil slick which resulted from the wreck for several weeks after the accident. An estimated 4500 gallons of oil formed the slick. Ultimately, no report of violation was issued against the owners, however, since the oil never came inside the limits of the Contiguous Zone.

WEATHER DATA

149. During 11 and 12 February 1983, a strong low pressure system moved from the North Carolina coast northward to the Virginia Capes, then northeast. The winter storm brought gale warnings to the offshore area from Cape Henlopen to Virginia Beach from the evening of the 11th until mid-morning on the 12th.

150. The following weather data was analyzed and prepared by a National Transportation Safety Board meteorologist. The weather analysis recorded by the NTSB researcher is a composite of many reports and hindcasts. Some of the data was from stations or buoys remote from the accident area. The portion reproduced below covers weather at the scene of the accident in three hour intervals between 0700 (EST), 11 February to 0700 (EST), 12 February. The wave height data consists of Significant Wave Heights, a statistical term used to compare wave height spectrums and defined as the average of the one-third highest waves. Significant Wave Heights are not necessarily the highest waves experienced at the scene.

151. Survivors' testimony provided reports of sea states and winds greater than those shown in the analysis at critical times prior to the capsizing. The highest winds recorded were Force 10 (55-64 MPH), and the highest seas recorded were 35-40 feet from the northeast.

152. Additional weather data is included in Appendix II that was collected from three NOAA weather buoys.

11 FEBRUARY 1983

0700

Sky	: Overcast
Visibility	: 1/2 to 2 miles
Weather	: Light rain and fog
Air Temperature	: 37 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: East-northeast 25 to 35 knots
Sea	: 15 to 20 feet

1000

Sky	: Overcast
Visibility	: 1/2 to 2 miles
Weather	: Light rain and fog
Air Temperature	: 37 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: Northeast 30 to 40 knots
Sea	: 20 to 25 feet

1300

Sky	: Overcast
Visibility	: 1/2 to 2 miles
Weather	: Light rain and fog
Air Temperature	: 36 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: Northeast 35 to 45 knots
Sea	: 17 to 22 feet

1600

Sky	: Overcast
Visibility	: 1/2 to 1 mile
Weather	: Light rain and fog
Air Temperature	: 36 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: Northeast 35 to 40 knots
Sea	: 17 to 22 feet

1900

Sky	: Overcast
Visibility	: 1 to 3 miles
Weather	: Moderate drizzle and fog
Air Temperature	: 35 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: North-northeast 30 to 35 knots
Sea	: 17 to 22 feet

2200

Sky	: Overcast
Visibility	: 1 to 3 miles
Weather	: Moderate drizzle and fog
Air Temperature	: 31 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: North 30 to 35 knots
Sea	: 15 to 20 feet

12 FEBRUARY 1983

0100

Sky	: Overcast
Visibility	: 4 to 6 miles
Weather	: Moderate drizzle and fog
Air Temperature	: 30 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: North-northwest 23 to 28 knots
Sea	: 15 to 20 feet

0400

Sky	: Overcast
Visibility	: 4 to 6 miles
Weather	: None
Air Temperature	: 29 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: North 30 to 35 knots
Sea	: 13 to 18 feet

0700

Sky	: Broken to overcast
Visibility	: 5 to 7 miles
Weather	: None
Air Temperature	: 28 Degrees F.
Sea Temperature	: 39 Degrees F.
Wind	: North-northwest 25 to 30 knots
Sea	: 11 to 16 feet

VESSEL REPAIR HISTORY

BRIEF OVERVIEW

153. The Board focused on the repairs made to the vessel since the drydock and repair period in February 1980. Testimony was taken from the survivors, which included the Chief Mate and the 8-12 Third Mate, the former Permanent Master, the MTL Fleet Director, the Marine Superintendent, the Structural Steel Engineer, the MacGregor representative that surveyed and supervised repairs to the hatches since 1981, and ABS and Coast Guard inspectors. Repairs to the hatches and main deck were the main topics of interest.

154. Of repairs made prior to 1980, the Permanent Master made a few remarks. He recalled inserts and doublers being installed on the hatches between 1975 and 1978, when he served as the Chief Mate. He said, however, the hatches did not require the number of repairs in 1978 that had become necessary in recent years. He did not know when holes started appearing in the hatches before 1981. He also did not recall when epoxy repairs were commenced on the panels.

155. In February 1980, the vessel underwent a drydock and overhaul period at Jacksonville Shipyard, Florida. The Coast Guard performed a drydock inspection. The ABS performed a drydock survey, intermediate hull survey and several machinery surveys. During this period, numerous doublers (about 98) were added to the hatch covers, and some portions of the coaming tracks renewed. A comprehensive set of hull gaugings, including internals, was performed by the D. Voehl Testing Company.

156. The vessel was last examined on drydock December 23, 1980 and February 24, 1981, at the same Jacksonville Shipyard. A Coast Guard drydock inspection was performed. The following ABS surveys were included:

1. Drydocking Survey
2. Special Survey, Hull, No. 8
3. Load Line Certification
4. Annual Classification Survey
5. Special Survey, Machinery
6. Cargo Ship Safety Construction Survey

157. The scope of the Coast Guard and the ABS inspections included the material condition of the hatch covers, their gaskets and securing arrangements to ensure weather-tightness, as well as the condition of the cargo holds, cargo hold bilge suctions and the main deck.

158. Extensive steel renewals were made throughout the ship during the 1981 overhaul, including bulkhead inserts, ballast and deep tank internals and peak tank repairs. In all, about 103 long tons of new steel was installed. Each hatch cover panel was removed from the ship. Wasted stiffeners were cropped and renewed, or doubled where necessary. About 180 doublers were installed over wasted areas on the tops of hatch panel sections.

159. When the hatch panels were replaced aboard the ship at the end of the 1981 overhaul period, it was found that many were distorted, perhaps due to weld distortions imposed by many small-area repairs. The Chief Mate testified that the warpage prevented the covers from being made tight over the sealing bar, and that many of the quick acting dogs did not line up with their mating snugs.

160. Another work item accomplished during the 1981 yard period was the fabrication of blank steel plates to cover the centerline roseboxes in the cargo holds. According to the ship's officers and MTL operations personnel, these were intended for use in the coal trade, to prevent coal dust from entering the lines and clogging the pump.

161. In March 1981, the MacGregor Land and Sea Company was called in to correct the covers so they would open and close without difficulty. This was the first record of involvement with the hatches in the United States by MacGregor. It was recommended that the lead panel on No. 3 hatch be replaced at this time.

162. In 1981, the ship was entered into the coal trade, under charter to New England Power Company, to carry coal to Brayton Point, Massachusetts. There were occasional summertime grain voyages to Israel, but the main employment was for coal.

163. On 8 June 1981, the Coast Guard at MSO Providence, Rhode Island, completed a Biennial Inspection for Certification. Two requirements were made as a result of the inspection - one for a waterside and fireside inspection of the port boiler, and the other for the annual servicing of the fire extinguishers. Both requirements were accomplished shortly thereafter, and signed off by the Coast Guard at MSO Hampton Roads.

164. In June 1981, the MacGregor Company proposed a course of action to effect at-sea repairs to hatch covers, in accordance with Marine Transport Lines desires "to ensure the safe and satisfactory operation of the covers on holds 1 through 5." MacGregor noted these repairs would not be "authorized" and recommended extensive shore side repair work.

165. On 1 July 1981, the vessel grounded at Brayton Point, Massachusetts while approaching the unloading dock. Divers were sent below to look for damage, but the Coast Guard and ABS reports revealed none was found. The ABS required the area to be examined at the next drydocking.

166. While in the coal trade, the New England Power Company contracted with Promet Marine Services Corporation to handle minor damages occurring during the off-loading of the coal. Frequently, the holds and hatch coamings were damaged by the huge off-loading bucket crane, or the front-end loaders lowered into the holds to push the coal from the sides to the center of the holds. During 16 and 17 July 1981, Promet surveyed all the holds. It was during this period (July - August) that MacGregor performed the repairs noted in their June proposal. They removed most of the cross-joint wedges at this time to facilitate the owner's desire to use sealing tape across the joints.

167. Between 22 and 23 February 1982, Maryland Shipbuilding and Drydock Company installed main deck doublers between holds Nos. 2 and 3, and 4 and 5, while the ship was at anchorage in Baltimore. No Coast Guard or ABS inspector was called to witness these repairs ; however, the ABS met the ship at the loading pier in Baltimore, on 24 February 1982, and performed the Annual Load Line Inspection and Annual Hull and Machinery Surveys.

168. Between 4 and 19 March 1982, Olympic Marine Services of Brooklyn, New York, made repairs to the vessel while the ship was in Brayton Point. Included were 84 doubler repairs to the hatch covers, 3 doublers between cargo hatches on the main deck and numerous steel renewals in the ballast tanks.

169. On 20 March 1982, MacGregor delivered 180 hatch cover cross-joint wedge assemblies to the ship.

170. MacGregor performed minor repairs to No. 3 hatch cover at Baltimore on 10 May 1982, after the vessel returned from a grain voyage to Haifa.

171. On 16 May 1982, a survey was conducted in Norfolk, on behalf of the P & I Club - London Steamship Owners Mutual Insurance Association.

172. The Coast Guard completed a mid-period inspection on 18 June 1982, at Providence, Rhode Island. Five requirements were issued to be completed no later than the next drydocking. The ship then made two grain voyages to Israel - one from the Gulf, and one from Canada. The coal trade resumed to Brayton Point on 31 October 1982.

173. September 1982 is the date on some general shipyard specifications drawn up by MTL. There was some plan for a two-week repair period that fall, between the last grain run and the first load of coal, but it never came to pass.

174. From 17 to 24 November 1982, the ship employed Norfolk Shipbuilding and Drydock and MacGregor personnel to renew the lead panel on No. 3 hatch. The MacGregor representative wrote a detailed survey of No. 3 hatch, and made general comments about the condition of the other hatches.

175. On 22 December 1982, a Coast Guard inspector from Providence, Rhode Island, boarded the ship at Brayton Point to make a special inspection to determine if the ship's drydocking date in February 1983 could be postponed. He also signed off a requirement to renew the bushings in the lifeboat davit cranks issued 15 June 1982. On 6 January 1983, an extension of drydocking was granted until 15 April 1983.

176. From December, 1982 through January,1983, the Chief Mate, on directions from Captain Farnham, began scaling and grinding the hatch covers for each hold. He also prepared sketches of each panel requiring doublers or renewals due to excessive wastage. These sketches were sent to the Operations Department at MTL in January 1983.

177. On 2 February 1983, while the ship ballasted at Brayton Point, a puncture was noted in No. 1 port upper wing tank. It was about 3" x 1" and believed to have been caused by the front-end loader when it was being lifted into or out of the holds. The cause was never determined. The Chief Mate was directed by Captain Farnham to put a cement patch over the hole. He did so,

from inside the tank, and braced it with some timbers. A telex was sent from the ship to MTL, New York, stating the cement box was in place. The Coast Guard and ABS were not notified of this hole or the repair.

178. At the time of the sinking, the MARINE ELECTRIC possessed a current Certificate of Inspection from the Coast Guard and had no outstanding requirements from the Coast Guard. In addition, the vessel was classed by the ABS, with no outstanding recommendations other than one dealing with a close examination of the hull at the next drydocking, as a result of the July 1981 grounding. The vessel also held an International Load Line Certificate issued by the ABS, as authorized by the Commandant of the Coast Guard.

DETAILS OF VESSEL SURVEYS AND REPAIRS

VESSEL REPAIRS FEBRUARY 1980 - NOVEMBER 1980

179. During the February 1980 drydocking, an extensive set of gaugings was performed. An "official" portion, which included the shell plating, was certified by the attending ABS Surveyor and forwarded to the Technical Department of ABS in New York. The same gauging company, D.Voehl, also gauged many internals, but these were not attended by the Surveyor, so were termed "unofficial gaugings."

180. Repairs to the hatches in 1980 were minor. An MTL structural engineer witnessed hose tests performed on the doubler repairs to the covers at that time, but not the whole hatch. The covers were not removed from the ship. He insured the Coast Guard and ABS attended the surveys and approved the repairs.

181. Several ABS outstanding recommendations resulted from the February 1980 drydocking. These included recommendations for examining the forepeak and renewing steel noted as "approaching maximum wastage." A leak found between the starboard deep tank and the forward pumproom bulkhead led to a recommendation that the bulkhead be examined by hydrostatic testing. Leaks in doubler plates installed on the longitudinal sloping bulkheads of ballast tanks were to be proven tight before the Intermediate Survey was accomplished. These doublers were to be removed, the plating and stiffeners gauged, and renewals accomplished before completion of the next Special Survey, Hull. A hydrostatic test for the aft bunker tanks to test the bulkhead between the tanks and the pumproom was recommended. Each of these recommendations were completed one year later, during another Jacksonville Shipyard overhaul.

182. In the transmittal letter (Exhibit 153), forwarding the hull gaugings to ABS in New York, in March 1980, the ABS surveyor commented that internals in way of the areas gauged were found satisfactory, and no repetitive fractures were sighted. Under a section of the gauging submittal form letter which read, "Note signs of shell or deck deformation (permanent set) or fractures possibly due to wastage thinning...", the surveyor wrote, "No evidence of wastage thinning on hull or main decks."

183. In April 1980, an ABS Surveyor boarded the ship in Ashdod, Israel, to examine wasted stern shell plating. It was alleged to the surveyor that the holed plating was noticed during the March 1980 crossing of the Atlantic, when strong following seas were experienced. The surveyor permitted doubler repairs to second deck level shell plating between Frames 0 and 41, port and starboard, but recommended permanent repairs be accomplished by 15 October 1980. This recommendation was not completed until the Jacksonville Yard period ending February 1981.

184. The Chief Mate recalled that the spring of 1980 was the last time the hatches were thoroughly coated - four coats of red lead and a couple of color coats. Since that time the crew scraped the loose rust and coated them with red boot topping. During the winter before the accident, the crew had started a complete scaling job and had completed No. 1 hatch. For a coating, "hull black" and fish oil was put on.

185. In June 1980, the ABS completed the review of the shell gaugings taken in February 1980. A list of shell plates that needed renewing was submitted to the owners (Exhibit 98). In the letter, the ABS informed the owners that the gauging requirements for Intermediate Survey were complete, and that these gaugings could be credited toward Special Survey Hull No. 8, provided the Survey was completed by May 1981, the steel renewals were made, and the outstanding recommendations of February 1980 were complied with.

186. MTL's Steel Engineer took the gaugings made in February 1980 and compiled a list of repairs necessary for renewals. He worked on this report for several months, starting in March 1980. He said he was encouraged not to spare anything - "to get the ship in the best possible condition because we expected a long term use out of the vessel."

187. A letter from ABS, dated 17 October 1980, to Marine Coal Transport Corporation, discussed the results of the unofficial review of owner's gaugings (Exhibit 99). The five page document listed areas of the vessel's internals gauged to be below allowable thickness limits. Included were tank tops, floors,

transverse bulkheads, wing ballast tank internals and side shell longitudinals where steel renewals were needed. This ABS report on the unofficial gaugings was used by MTL's Steel Engineer to prepare specifications for the 1981 drydocking.

188. The ABS Surveyor attending the overhaul ending in February 1981 stated this 17 October letter was not sent to him prior to the drydock and overhaul. However, after reviewing the letter during the hearings, he stated repairs were accomplished in each of the eleven areas cited in the letter. The ABS review of unofficial gaugings did not satisfy any requirements of the ABS rules, since the gauge readings were not certified by a surveyor.

189. A report (Exhibit 77) from an MTL Port Engineer on his attendance at Houston, Texas, between 1 and 9 September 1980, cites 20 doublers being installed on the cargo hatches. Doublers and weld repairs were made to ballast tanks 1S, 2S, 3S and 5S.

190. An attendance report (Exhibit 78) by the Port Engineer for repairs made between 3 and 6 November 1980, noted there were 22 doublers installed over holes in hatches 3 and 4. He put a note, "The cargo hold covers are very thin and the steel channels for the sealing rubber are 75% gone."

DRYDOCK AND SURVEYS, DECEMBER 1980 - FEBRUARY 1981

191. The owner's Structural Engineer stated the vessel was drydocked in December 1980, because the Company had decided to put the vessel into long-term coal use. ABS Special Survey No. 8 was due to be completed by June 1981, and the Company originally was going to ask for an extended year of grace. However, since the ship would be entering the coal trade, the Company decided now to do all the items the Structural Engineer had made them aware of after the 1980 drydocking.

192. The Chief Mate stated there was an indication in 1980 that the vessel would be scrapped if it didn't get the coal run to New England. Just before entering the shipyard, he and Chief Engineer Powers and the Permanent Master made up repair requisitions to be entered on the shipyard repair list. He noted on this list the wasted condition of the sealing bars and channels holding the gaskets between hatch panels, and specified the correct gasket material from MacGregor.

193. The MARINE ELECTRIC entered the shipyard on 22 December 1980. The Senior Hull Inspector for the Coast Guard had 25 years of active duty. He had served as a Chief Damage Controlman before he made Warrant Officer and came into Marine Inspection, and had about 6 years sea duty with the Coast Guard. He had

served four of 13 years as a Marine Inspector in New York, then 3 years in Miami, 3 years in Morgan City, Louisiana, and the remainder at Jacksonville. Despite the 13 years experience, the majority of this inspector's time was spent on foreign flag vessels (not drydockings), passenger vessels, coastwise tankers, small passenger vessels and barges.

194. The attending ABS surveyor for the overhaul was an engineer officer with the Greek Merchant Marine between 1956 and 1964. In 1965 he obtained the National Board certification for inspection of power boilers and pressure vessels and went to work for the Hartford Steam Boiler Inspection and Insurance Co. He served with them as a field inspector until 1970, then became a supervisor of ten inspectors until 1974. At this time he joined the ABS, served a six to eight week indoctrination period, then became a Surveyor at the Todd Brooklyn Shipyard in New York City. In late 1975, he was transferred to the Jacksonville Shipyard, Jacksonville, Florida, and remained a Surveyor there up to the time of his testimony before the Marine Board.

195. During the overhaul, the Coast Guard performed a credit drydock inspection. There were no outstanding Coast Guard inspection requirements prior to entering the Yard. The ABS completed a Drydock Survey, Annual Classification Survey, Annual Load Line Inspection, Special Survey Hull No. 8 and Machinery, and the International Safety of Life at Sea (SOLAS) Cargo Ship Safety Construction Survey. Outstanding recommendations from the ABS noted on their computer printout of the vessel status, dated 15 December 1980, included those from the February 1980 drydocking, the April 1980, Ashdod, Israel inspection, and the June 1980 letter concerning the results of the official gauging survey of the hull.

196. The ABS computer printout of the vessel status indicated that in February 1980 a hose test was performed on "hatch covers not fitted with tarps." The surveyor during the February 1980 overhaul period at Jacksonville did not mention a hose test of the hatch covers in his Survey Report (Exhibit 103), and testified that none was performed except on some local doubler repairs to the hatch panel tops. The hose test called for in Section 18.9.3 of the ABS Rules to test weather-tightness of hatch covers specified 30 psi pressure, and was to be conducted at the time of construction and, if considered necessary, at subsequent surveys. The hatch covers on the MARINE ELECTRIC were never given a hose test meeting Section 18 during the time of the special survey No. 8. In a letter from ABS to the National Transportation Safety Board, dated 26 August 1983, Mr. [redacted] explained that the entry for the hose test on the computer printout was an electronic malfunction, or the mistake of the Reports Analyst who entered the data into the computer.

197. Specifications for the yard overhaul were entered in the record of the Marine Board as Exhibits 42 and 106. Among items recorded in these specifications was one concerning hatch cover repairs, and one dealing with the fabrication of solid covers for the bilge drain covers in the cargo holds. Such a change would render the cargo hold bilge system ineffective and in violation of Coast Guard regulations. The ABS surveyor said he received the shipyard overhaul specifications, but did not review them to note modifications to the cargo hold bilge strainer plates, or repairs to the hatch covers. The Coast Guard inspector did not recall seeing the item concerning the bilge system modification, and said he did not recall seeing the solid plates installed over the drain boxes. The Surveyor and the Coast Guard inspector took no appropriate action concerning the installation of these blank plates.

198. During the bottom survey, the Coast Guard Inspector did not notice any "real heavy pitting," or bad set-up areas. Hull plates B-21, K-21, A-15 and G-4, starboard; and J-21, H-5 and G-5 port, were renewed due to wastage. The Inspector believed the plate renewals were based on the gauging report, and no additional shell plates were picked out by the Coast Guard for renewal. One plate on the starboard side, in way of No. 1 hold, was cropped and renewed where there was a set-in portion. the inspector did not recall any welds in the shell plating being veed out and renewed.

199. MTL's structural engineer said he found no problems of wastage on the hull exterior. There were no rippled plates, or evidence of pounding damage. He said the forepeak was in good condition - he noted no buckling in the area. Similarly, he said the deep tanks were in good condition. He said he saw no signs of stress corrosion in the vessel, or evidence of the hull working.

200. The Company's Fleet Director wrote a report on his attendance to the shipyard from 19 - 21 January 1981, when the vessel was in the drydock (Exhibit 80). He wrote: "The underwater hull condition was found to be in a very satisfactory condition, with approximately 85% of the hull coating intact. He also estimated that $1,314,000.00 would be spent for structural steel renewals, with an estimated 103 long tons of new steel added to the vessel. Forty-four tons were added to the upper wing ballast tanks, forty-three tons to transverse bulkheads in holds 1 through 5, five tons to the forepeak and six tons to the forward deep tanks.

201. The ABS surveyor stated additional gaugings were taken on the hull with his attendance during the 1980-1981 drydocking. He mentioned in particular that the keel plates were gauged.

202. Each of the plate renewals cited in the ABS gauging review letter (Exhibit 98) was performed during the 1980-81 Jacksonville Yard period, except that only a 2 foot by 2 foot plate was renewed in strake M. Pad welding and a reinforcing plate was used to satisfy the outstanding recommendation regarding wasted side shell at the stern in strakes M and N, port and starboard.

203. According to the owner's steel engineer, additional gaugings were made during the 1981 drydocking to recheck areas that had shown weakened areas. He gave the transverse bulkheads as an example - some gaugings were made in 1980, but more complete gaugings were made in 1981, and some renewals were generated as a result of the additional gaugings. Areas such as Web Frame 157, and breast hooks were renewed because of minor distortion or wastage. He stated that none of the hull repair items he wrote up in the specifications were insurance items.

204. In the 1981 drydocking, the Company's steel engineer said he personally went into every hull compartment on the ship. The ABS and Coast Guard Inspectors accompanied him. The Coast Guard inspector said that every hold, every wing tank, every cargo hold, forepeak and every internal area was examined, with deteriorated and wasted areas repaired, and hose tested or hydro tested. The inspector did say he did not look at the chain locker during the inspection. He recalled the lower part of the forepeak was wasted out, and many stiffeners on the forward deep tank bulkhead were wasted. Hydro tests of all the ballast tanks in the midbody were noted in the Inspection Book, except for No. 3 port.

205. The inspector mentioned he looked closely at the collision bulkhead, meaning, as he described it, the bulkhead at Frame 141, between the deep tanks and the forepeak. Diary entries in the book, and testimony by the inspector, indicated that each double bottom tank, wing tank, tanks under the engine room, void and cofferdam was entered and inspected.

206. The Coast Guard inspector testified a doubler plate was permitted to be put over a wasted plate in a non-strength area. He felt that doublers on the tank top above the double bottom would be permitted, and that that area was a non-strength deck. He did not recall any doublers on the main deck, and when asked about the hatch coamings and vents, he replied there was quite a bit of wastage, but that it was all taken care of.

207. During the yard period, the cargo space bilge piping was renewed in its entirety, and the ballast piping was tested and repaired as found necessary.

208. During the 1981 overhaul period, each cargo hatch panel was removed from the MARINE ELECTRIC. Twenty-seven of the thirty-four hatch panels were loaded on barges and floated to the Bellinger Shipyard. The other seven panels were repaired by the Jacksonville Shipyard.

209. On the 27 panels, 2012 feet of flat or angle bar was renewed, 1120 feet of gasket material, the stiffeners received 101 doublers, 89 brackets and 16 inserts, and 26 doublers were placed on top of the hatch covers. Similar repairs were noted for the seven panels repaired at Jacksonville Shipyard. In all, about 180 doublers were applied to the tops of the thirty-four hatch panels.

210. The Coast Guard Inspectors were aware of extensive repairs being made to the hatch covers. These repairs were discussed with the Port Engineer when the vessel first entered the Yard. Having this knowledge, at no time did he, or did he cause any other Coast Guard personnel to oversee these repairs in progress or determine the material thickness of the hatch covers. In addition, on re-installation of these covers on board, he failed to conduct or cause to be conducted any operational test or weathertightness test of those covers. The Coast Guard did not inspect the repairs on the covers once they were re-installed on the vessel. The Port Engineer assured the Coast Guard inspector that tests would be handled by ship's personnel. The inspector felt the hatches were "an owner related item." The senior Coast Guard Inspector did not know or ask if the ABS Surveyor inspected the hatch cover repairs or installation.

211. The senior Coast Guard inspector did not feel hatch covers were specifically treated in the Drydock Inspection Book, but later testified he believed inspection of the hatch covers on a vessel was a part of the drydock inspection, and also an item to be checked at the Biennial and Mid-Period inspections.

212. The ABS Surveyor did not observe, inspect or test the hatch cover panels as renewals and doublers were applied to them at the Jacksonville and Bellinger Yards. He did not recall that the covers were removed for repairs. He said the owners did not notify him of hatch panel repairs. He did state, however, he saw the covers closed three or four days before the ship left the yard. He stated he gave the covers "close visual inspection," but did not recall seeing any doublers on the top surfaces. The hatches were satisfactory in the closed position, he said, and he checked the dogging devices "all around." He stated that by not indicating any further types of examination in his report, he did not notice anything deficient about the hatch covers at the time and recommended renewal of the Load Line Certificate. He made no tests for watertightness.

213. The last recorded Coast Guard inspection at the Jacksonville Yard period was completed on 21 February 1981. The Inspection Book indicates over 80 man hours were spent on the inspection. The ABS Surveyor's last visit to the vessel was on 22 February 1981.

214. The hatch panels were eventually returned to the vessel on 23 February 1981 and installed aboard in the open position. The Chief Mate testified a smaller sized gasket was installed in the panels than that required by the MacGregor manuals. He said:

> "The hatches were put on at the last moment, at the last day. I spent the whole night trying to get them to open and close. They were in much worse condition as far as opening and closing the hatch covers than they were when we took them off. None of the sealing bars would work, because this particular gasket, this short gasket, wasn't even reaching, in many cases, to the sealing bar. Instead of the gasket itself coming down in the middle of the knife edge of the gutter, maybe it was missing it entirely. ...It was very, very fouled up. It was so bad that they got the MacGregor Company down to work on it."

215. The crew spent the night trying to close them with assistance from a shipyard crane. No Coast Guard or ABS inspectors came to look at them. The hatches would close, but were not effectively watertight at the time the ship sailed. The Chief Mate stated the covers still had a lot of thin metal when the ship left the yard. He felt the hatches were still in very poor condition at that time. This fact was made known to the company's Fleet Director, who indicated he would get the MacGregor Company to work on the hatch covers.

216. The ship got underway at 0515 on 24 February 1981, and proceeded to Norfolk, Virginia, to load the first cargo of coal.

217. An adjustment to the charges made by Jacksonville Shipyard was negotiated by MTL due to the fitting and repairs that were necessary for the hatch covers upon leaving the yard. A claim of sixty to seventy-five thousand dollars was made.

MACGREGOR COMPANY SURVEY- FEBRUARY 1981 - MARCH 1981

218. Mr. [redacted], of the MacGregor hatch company, visited the MARINE ELECTRIC at Brayton Point just after it left the shipyard in February 1981, to advise the owners what could be done to get the covers to open and close correctly. From March 6 - 18, 1981, [redacted] worked on the hatches in order to, as it states in Mr.

[redacted] report to the owners, "bring the panels to a condition where they could be operated normally without resorting to chainfalls and jacking, and also to bring the cross joints together sufficiently to allow sealing tape to be fitted."

219. Mr. [redacted] report noted that the recently fitted compression bars were distorted, and in some areas, the cross joint compression bars were not contacting the rubber gasket. The cross joint channels and gaskets were of a smaller size than specified by MacGregor.

220. No chalk or hose tests were performed. No inserts or doublers were installed. Most of the work consisted of straightening or cropping portions of compression bars or channels to insure clearance with the hatch coamings. On completion of this work, the hatch covers were not weathertight or materially in a satisfactory condition, and the owners were notified in writing. Neither the owners, agent, or master notified the Coast Guard of these repairs as required by 46 CFR 91.45-1 or the assigning and issuing authority as required by 46 CFR 42.09-50.

221. MTL's Fleet Director, in a memo dated 13 March 1981, noted the MARINE ELECTRIC Chief Engineer telephoned to say "a suitable repair and adjustments" were made to the hatch covers by MacGregor. He noted that hatches 1, 2, 4 and 5 should now be in a reasonably satisfactory condition, but additional work would be required for No. 3 hatch, "due to the distortion caused by the repairs and renewals at Jacksonville Shipyard.

222. A "Damage Report", dated 5 April 1981, was prepared by two former ship's officers. It consisted of a detailed 21 page list, and described mostly dented and bent internal members of each cargo hold. In some cases, fractured face plates on stiffeners were recorded. Typical of remarks concerning the tank tops were those for No. 2 hold, where five spot welds over leaks caused by the discharge bucket were noted, and several other similar weld repairs noted. Bent ladders and sounding tubes were also common entries in the report. The double bottom sagging between the floors was also noted for all holds.

COAST GUARD INSPECTION FOR CERTIFICATION, JUNE 1981

223. By statute, 46 USC 391(b) (46 USC 3301 through 3313) the MARINE ELECTRIC was required to be inspected by designated U. S. Coast Guard Marine Inspection personnel at least once in every two years, to determine to their satisfaction and warrant the belief that the vessel was suitable for its intended service, the vessel could be navigated safely, and that the vessel was in full compliance with the applicable regulations.

224. On 2 and 8 June 1981, Inspectors of the Coast Guard Marine Safety Office, Providence Rhode Island, conducted a Biennial Inspection on the MARINE ELECTRIC in Somerset, Massachusetts.

225. The hull inspector was assigned to marine inspection duties in March 1978, and worked at MSO Providence, Rhode Island until the end of 1981. His prior Coast Guard experience spanned 23 years and consisted mostly of serving on various Coast Guard cutters dating back to 1960. While at MSO Providence, he served in the Licensing and Investigation Departments, Port Operations, and as an Administrative Assistant. From late 1979 until June 1981, he was an inspector in the field. His experience was mostly with small passenger vessel inspections, though he said he had inspected a couple of tankers.

226. The hull inspector explained that there was no specific examination he had to pass before he became a qualified hull inspector, but it was up to the judgment of a more senior inspector. When he inspected the MARINE ELECTRIC, he was considered qualified with the reservation that, if he had any questions or requirements to issue, he was to ask the more experienced inspector, in this case, the engineer inspector. The MARINE ELECTRIC was one of the first deep draft vessels he had inspected.

227. The lifeboats were not stripped out for the Biennial. The Inspector noted that this had last been done in April 1981, according to ship's records. The Inspector did check the emergency rations and equipment, and weight tested the davits and releasing gear. In exercising the boats, He did not recall the crew having difficulty fitting the oar locks into the positions on the gunnels. He recalled that all, or almost all of the hatches were open when he inspected them. Consequently, no detailed examination could have been made to evaluate the condition of the hatch covers. The inspector did not walk through the cargo holds, and said he did not recall any of the holds being completely empty. He remembered nothing specific about the hatch covers, beyond the fact they were rusty. He did not recall seeing any doubler plates on the covers. He said that determining the weather-tightness of hatches was part of the Biennial inspection. He looked visually at the hatch covers, but never conducted a hose test or chalk test. He was not certain if the determination of weather-tightness or strength of hatches was part of a drydock inspection. The inspector said he should have listed in his Inspection Book, Exhibit 25, spaces inaccesssible for the inspection due to not being gas-free, or interference from cargo operations. Instead, the entries in the book under the "Hull, Decks, Fittings and Watertight Integrity" were initialed, and no comments or diary entries were made on the topics in this section.

228. The term "hatch covers" was not used in the Inspection Book (Coast Guard Form 840-A), but under the Hull portion, entries were noted for "Hull Openings and Closures," "Deck Openings and Closures," and "Hull Structure." which itemized "Decks, Shell, Bulkheads, Tank Tops and Strength Members". The Inspector did not recall the ship's crew opening any spaces for the inspection that were normally closed. He did not inspect the cargo holds, cofferdams, ballast tanks, forward deeps or the forepeak.

229. The inspector spent a total of 7 hours on the inspection on 2 June and 8 June 1981. He did not require the vessel to call a Coast Guard inspector at a time when the hatch covers were in the closed position, and did not return to the vessel himself at a time when he could have inspected the covers.

230. The inspection concluded with two outstanding "835" requirements. One was to have all the portable CO-2 fire extinguishers serviced, and the other was to make the port boiler available for inspection. Both were to be accomplished by 24 June 1981.

REPAIRS AND SURVEYS, JUNE 1981 - FEBRUARY 1982

231. A letter from MacGregor Land and Sea Company, to the MTL Fleet Director, dated 22 June 1981, stated that extensive shore side repairs were necessary to restore "the correct degree of watertightness and operational safety." Instead , MacGregor agreed to make repairs required to ensure "safe and satisfactory operation of the covers," to make adjustments so that adjacent panels were sufficiently level "to enable sealing tape to be fitted at cross joints, as per your specific request", and thirdly, to make repairs to the steel to maintain weather-tightness, giving consideration to the Company's desire to use sealing tape. The report concluded that MacGregor would not recommend or guarantee repairs on this basis, and that the repairs were not "authorized" MacGregor repairs.

232. Most of the cross-joint wedges were removed by MacGregor at the owner's request in July and August 1981, to facilitate the use of sealing tape across the joints. No order was received by MacGregor to restore the cross-joint wedges, only to supply the parts. This order was placed in January, 1982.

233. While making an approach on the unloading pier at Brayton Point, the MARINE ELECTRIC grounded at 1940 on 1 July 1981. Refloating with the assistance of four tugs was accomplished at 0950 on 2 July 1981. The forepeak and deep tanks were surveyed internally with the Coast Guard and ABS. The Coast Guard required a diver's survey, which was conducted on 3 July 1981.

No damage was noted, other than paint abrasions 10 to 15 feet aft from the stem, about 3 to 4 inches wide, then an additional 3 foot wide abrasion along the port turn-of-the-bilge, approximately 75 to 100 feet aft. No dents or set-in plates were noted.

234. The Chief Mate prepared repair lists (Exhibit 74) for inclusion in the Master's and Chief Engineer's reports to the New York MTL office. On 9 September 1981, he wrote concerning two holes in the main deck between hatches 3 and 4. He noted a hole in the starboard forward bunker deep tank sounding trunk. Concerning the hatches, he wrote that epoxy had been used to fill holes in the covers where the cross-joint wedge assemblies were removed. He said there were 83 such holed areas. Of a total of 290 wedge saddles, he wrote that 15 remained, all on the No. 1 hatch. He said 14 additional holes appeared in the hatch covers, beside those where the saddles were removed. He wrote, "Don't replace the saddles (unless required by a regulatory agency.)" He testified that he was instructed by Captain Farnham to remove the saddles, since they were loose and would fall between the panels when closing the hatches, causing interference. He stated he added the parenthetic note to his report because he felt the wedges were probably required by the ABS or Coast Guard. A hand-written note beneath this typed report, signed by the MTL Fleet Director, indicated the hatch repairs were accomplished at Port Neches, Texas by 2 October 1981. Doublers 1/4" thick were used.

235. Repair lists dated 14, 16, 19, 20 and 22 November 1981, by the Chief Mate, cited a need for 51 doubler repairs to the hatch covers, and two holes between hatches 4 and 5. Concerning No. 3 hatch, he wrote an item to refit all seven panels. "At present, they are in a warped condition, misaligned, to the extent that they tend to jump off the tracks on both the port and starboard sides when opening up." A hole was also noted in the dry cargo hatch, and the forward bulkhead (No. 125) of the No. 1 hold, where it passed the second deck dry cargo hold. Holes in the ballast piping were reported in No. 1 and No. 3 starboard, and No. 3 and No. 5 port double bottoms. On 19 November 1981, another hole was recorded in No. 4 cargo hatch. Small leaks in five upper wing ballast tanks were also recorded.

236. The holes in the deck and repairs requested for the winch beds noted in the Chief Mate's Repair Requisition of 5 May 1982, (Exhibit 74), were not sighted or checked by Captain Farnham, although the Captain said he was aware of the Chief Mate's report on these items.

237. A report from an attending Port Engineer for the period 6 August to 8 August 1981, at Houston, Texas (Exhibit 83), indicated the vessel was preparing to take a load of grain to Israel. The report noted that both the National Cargo Bureau and U. S. Department of Agriculture representatives passed the

vessel's holds, but required "considerable work to remove heavy scale" from the hatch covers. Fifteen men worked two days to accomplish this.

238. The Chief Mate said that when the vessel made a grain voyage, the hatches were closed as well as they could be, and then a product called Ramneck was placed over all the joints. Ramneck was a tar-paper-like substance which the crew laid over the joints and then stamped it down. Then roofing tar, about 35 buckets, was applied over the Ramneck. He stated he never had any of it break away and allow water to enter the cargo hold. This technique was not used in the coal trade. The Chief Mate stated the Coast Guard and ABS were not aware of the hatch cover arrangement using the tar, but he said the National Cargo Bureau attended the vessel each time it loaded grain. He said the National Cargo Bureau did not, however, check the closed hatch covers, but made sure the vessel was loaded to her proper marks. In the coal trade, the National Cargo Bureau did not attend the vessel.

239. A memorandum from an MTL Port Engineer, dated 1 December 1981, noted, "The leaks in the ballast lines in double bottom tank seams [sic] not too big for the reason that the ballast could be pumped out with not too many problems. There are patched up holes in cargo hatch panels, main deck, living quarter decks and bulkheads. These holes are not leaking now, but need attention on a later date. Maybe when the weather gets better, to send a riding crew out, or wait until there is more time."

240. The Port Engineer's reports dated 18 December 1981 (Exhibits 87 and 88) discuss repairs made while the vessel was in Newport News, Virginia, on 16-17 December 1981. He wrote:

> "The cargo hatch panels are leaking in way of the rubber enclosures. The main reason for this is that the landing of the knife-edge into the rubber is not perfect strait [sic] and was not designed to be. Wedges on top of the panels were designed to give the knife-edge a compression into the rubber, and by doing so, to give it a watertight enclosure."

He stated MacGregor recommended installing wedges every 3 1/2 to 4 feet, about 10 per hatch panel, and quoted some prices. Since the tops of the hatch covers where the wedges would ride were thin, he recommended installing doublers and stiffening brackets in those areas. On 19 January 1982, the same Port Engineer wrote that 177 wedge assemblies would be required to get "a reasonable closure of the hatch panels." He said the fitting of the wedges and doubler pads would be accomplished in the spring, but in fact, the pads and wedges were never replaced.

241. Four leaks in ballast tanks 1, 3 and 4, presumably made during off-loading operations at Brayton Point between 23 and 26 January 1982, were repaired by welding the cracks and fitting doublers over them (Exhibit 90).

242. On 28 January 1982, MTL ordered 180 hatch wedge assemblies from MacGregor.

243. A telex was sent by the Permanent Master from the vessel to MTL on 14 February 1982, stating No. 2 port and starboard wing tanks had holes due to wastage, and recommended they be repaired at Brayton Point, with workmen standing on the coal in the hold.

244. On 17 February 1982, the Permanent Master requisitioned two doubler plates for No. 2 port and starboard wing tanks, to be installed by Promet Marine. The deck logs showed that Promet repaired the leaks on 19 February 1982.

245. On 20 February 1982, Promet was aboard the vessel to repair a 3-inch crack in No. 5 hold.

246. On 21 February 1982, the Permanent Master sent a telex to MTL requesting repairs to two holes through the main deck, between hatches 4 and 5. On the morning of 22 February 1982, the vessel was anchored at No. 2 Anchorage, Baltimore, Maryland, and that afternoon personnel from Maryland Shipbuilding and Drydock were on board. Doublers were installed between hatches 2 and 3, and hatches 4 and 5. The work was completed on 23 February 1982. The Coast Guard and ABS were not notified about the repairs made at Baltimore.

ANNUAL LOAD LINE INSPECTION

247. An ABS Surveyor was notified of the scheduling of a required Annual Loadline Inspection for the MARINE ELECTRIC in Baltimore, Maryland, on 24 February 1982, the same date as the examination.

248. The Surveyor sailed as an engineer for 13 years with the United Fruit Company, and holds a Coast Guard license as Chief Engineer, Steam and Motor, any horsepower. He began working for the ABS in 1952.

249. The Surveyor met the vessel on 24 February, when it docked at the Curtis Bay Coal Pier, Baltimore, Maryland, where it prepared to load coal. About one-half hour was spent by the surveyor viewing the main deck area and the hatches in company with the vessel's Chief Mate. The Chief Mate testified the hatches were closed at the time, and that he pointed out doublers on a ladder trunk at the forward end of No. 4 hold, and on

the main deck between No. 3 and No. 4 holds. To this, the surveyor made no significant comment and did not take any appropriate action. In spite of the Chief Mate pointing out numerous doubler plates, epoxy patches, and taped-over holes in the hatch covers, the Surveyor recalled no deficiencies in the hatches. His report (Exhibit 37 and 38) stated the hatches were in satisfactory condition. Conditions of the cargo holds were also noted as satisfactory, but no hold was entered for examination, and the plated-over cargo bilge wells went unnoticed. The Surveyor endorsed the Load Line Certificate and recommended the vessel be retained in class with the Bureau. No outstanding recommendations were issued as a result of this survey.

REPAIRS AND SURVEYS, MARCH 1982 - MAY 1982

250. Between 2 and 19 March 1982, while the ship was at Promet Marine in Somerset, Massachusetts, stevedore repairs were made to the cargo holds. Eighteen doublers were installed over leaks in the ballast wing tanks, being fitted over the outside of the tank surfaces. (Exhibit 91). Men from Olympic Marine also worked on board during this period, installing 84 doublers over all the hatch cover tops, one doubler on the main deck between hatches 2 and 3, and two doublers between hatches 1 and 2. Eight hold-down brackets were installed on the hatch coamings. With ballast tanks 1, 2, and 3 filled, tanks 4 and 5 were entered, and 5 leaks from ballast lines serving the first three tanks were found where they passed through tanks 4 and 5. Repairs to the piping were made using pipe clamps. In their invoice, Promet distinguished between damage caused by "stevedores" during unloading, and damage attributable to wastage. Overall, they wrote, about 35% of the cost of their repairs was due to wastage.

251. An MTL representative reported on the repairs made during March 1982. In his attendance memo, he related he discussed means of keeping the anticipated cargo of grain dry during the voyage. He wrote, "Shore gang presently aboard welding patches on all hatch covers. "Ram Neck" heavy duty sealant tape will be used as a usual precaution. ...Inspection of the hatch covers indicates numerous wasted holes, which are being patched with welded plates, and that due to the existing cover to cover, gasket to knife edge arrangement, rain or sea water may enter the hold if the "Ram Neck" fails." A note by the MTL Fleet Director was added to this report, indicating the Ram Neck had held up very well with the hatches in poorer condition.

252. On 20 March 1982, the MacGregor Company delivered the 180 cross-joint wedge assemblies to the ship.

253. A Vessel Condition Report, MTL's Form No. 40, was included as part of Exhibit 82. It was undated, but cites certificates issued to the vessel dated February 1982, and individuals who read and initialed the report noted the dates of 7 and 8 April 1982. The report stated:

> "Cargo hatch panels need attention. The crew will scale and paint the hatches on the trip from Israel to the U.S.A. Many wastage [sic] can be expected on the hatch covers when the vessel comes back in the U.S.A."

254. On 19 March 1982, the ship departed Brayton Point, and docked at Philadelphia on 20 March 1982. Some additional repairs were made by the Phillyship Company, including main deck doublers as follows: a 2 foot by 1/2 foot doubler at No. 4 hold, a 1 foot by 1 foot doubler between holds 2 and 3, and a 1 foot by 1/2 foot doubler between holds 3 and 4.

255. The ship completed loading grain at Philadelphia on 23 March 1982, and got underway for Israel. Arrival at Haifa was on 10 April 1982. Between 20 and 22 April 1982, the vessel discharged its cargo and got underway for Baltimore on 23 April 1982, arriving 9 May 1982.

256. On 5 May 1982, the Chief Mate submitted a repair list for ten holes in the hatch covers (Exhibit 74). Also noted was a hole in the dry cargo hatch coaming. A note to refit the first panel on No. 3 hatch was made. He wrote, "...it gives us fits when opening it - the after section hangs up on the after coaming track, making it a difficult and dangerous operation."

257. On 9 May 1982, MacGregor prepared an attendance report for making repairs to the No. 3 hatch in Baltimore, Maryland. (Exhibit 75). No repairs or surveys had been made to the hatches by MacGregor since the repairs noted in their 22 June 1981 report were completed in August of 1981. Mr. [redacted] noted severe wasting on the panel, and noted that the deflection of 2-1/2 inches in the panel, when in the stacked vertical position, increased to 4 inches when horizontal. He concluded, "It would seem that the transverse beams are no longer able to support the weight of the panel without distorting," and suggested the panel should be renewed. Mr. [redacted] testified the hatches were not watertight in May 1982, and commented that, although the 9 May 1982 report dealt mostly with No. 3 hatch, the covers on the other holds were in roughly the same condition.

258. An MTL Port Engineer wrote of his attendance between 9 and 11 May 1982, at Baltimore,Maryland. (Exhibit 94). He observed the problem opening No. 3 hatch, where the aft end had sagged

about 3-4 inches and hit the hatch coaming. He said the ship's deck department scraped and painted all the hatch covers. About 18 "Red Hand" epoxy patches were applied. The forward pumproom was painted out, and the forward fuel oil deeps were washed, mucked out, and chemically treated. Upon arrival of the vessel, all ballast tanks were pressed up, and no leaks were found except for a pinhole in No. 5 double bottom tank.

259. Repairs commenced in Norfolk, Virginia, and completed at Somerset, Massachusetts, between 22 and 24 May 1982, were described in a Port Engineer's report dated 26 May 1982. (Exhibit 95). The main repair item noted was for the outboard generator, for which an ABS Surveyor was called to check the repairs, but also noted is a doubler applied by Promet in the No. 3 cargo hold. Under "Special Notes," the Port Engineer wrote some recommendations to be accomplished before the vessel entered the grain trade again. Among repairs needed, he cited 3 holes in the main deck, requiring 3 foot by 4 foot doublers between cargo holds, and 12 holes in all the cargo hatch covers, requiring 100 square feet of doublers.

260. On 25 May 1982, MacGregor wrote MTL and offered to replace the lead panel on No. 3 hold, for a price of about $19,000.00. Delivery time was expected to be four weeks from placement of the order by MTL. MacGregor noted they could not guarantee watertightness between the new and old panels without making additional repairs at the time of installation. On 27 May 1982, MTL ordered the replacement panel.

P & I SURVEY

261. On 16 May 1982, a survey was performed on behalf of the ship's Protection and Indemnity Club, the London Steam-Ship Owners Mutual Insurance Association.

262. The Surveyor said the purpose of his examination on 16 May 1982 was to see if there were any conditions that should be made known to the P & I Club that might influence them in retaining the vessel in the membership of that Club, and be grounds for denying insurance to the vessel. Items considered to be "deficiencies" were in the opinion of the surveyor. There were no guide lines on what constituted a deficiency.

263. He "looked at all of the areas that were safely accessible." He saw the forward port deep tank, the pump room, No. 3 port upper wing ballast tank and all the holds and machinery spaces. He said the hatches were open when he examined them. In his

survey of the deep tank, he could not remember if the man-hole cover was removed before he got there, or whether it was removed at his request. He said he did not think the vessel had advance notice of his arrival for the survey.

264. The surveyor's report described the hatches equipped with wedges, when, in fact, all the cross joint wedges had been removed months earlier, except for a few on No. 1 hatch. He testified, however, that he never inspected the hatches - his description was what "normally constitutes this type of hatch cover design," rather than what he actually saw. He also stated he did not see the cargo hold bilge wells because of coal laying on top of them. Some leaking welded doublers were noted on the sloping ballast tank bulkheads in holds Nos. 4 and 5. He noted the face plates on deep web frames at the side shell and bulkheads, "were variously indented and distorted consistent with cargo operations on the subject vessel."

265. In his concluding remarks, He wrote:

> "Apart from the deficiencies noted herein, the subject vessel was found to be in a well-maintained condition, which is considered to reflect the superior performance of the crew aboard the subject vessel."

A disclaimer at the end cautioned against construing the survey as a Certificate of Seaworthiness, but that it was an unprejudiced opinion of the surveyor. Because all the areas that the surveyor viewed appeared to him to be in good condition, he concluded that the whole ship was in similar good condition.

FCC INSPECTION

266. On 17 June 1982, an FCC Inspector boarded the MARINE ELECTRIC in Providence, Rhode Island, and performed an inspection of the ship's radio gear. A Cargo Ship Safety Radiotelegraphy Certificate, and a vessel Bridge-to-Bridge Radiotelephone Certificate were issued. During this inspection, a new EPIRB and mount was installed. The EPIRB was a Martech Whaler EB-2BW. The EPIRB was installed on the port bridge wing in a horizontal 4" x 18" box designed to let the device float free. The inspection report indicated the expiration date on the battery was January 1983. The EPIRB is activated by water closing a pressure switch; setting the device upright in its box is insufficient to energize it.

267. The FCC has previously investigated this model Martech Whaler EPIRB, and found a high failure rate in the water-activated switch stemming from improper maintenance procedures when changing the battery. The loss of the U. S. merchant vessel

POET in October 1980, which had also been equipped with this model EPIRB, raised questions about the reliability of this EPIRB. The manufacturer had previously made a change to its service manual, at the request of the FCC, and it was hoped the change would correct the problem.

COAST GUARD MID-PERIOD INSPECTION

268. A hull inspector of the Coast Guard Marine Safety Office, Providence, Rhode Island, performed a mid-period inspection on 18 June 1982. He was accompanied by an Engineering Inspector. He testified that a mid-period was not as extensive an inspection as a Biennial, and stated it was primarily performed since the owners requested it, and also to permit some Department of Transportation auditors to see how such an inspection was performed. It was the inspectors belief that a Mid-period examination was optional for vessels such as the MARINE ELECTRIC and confined mainly to safety items and a general "walk-around" inspection of the over-all condition of the vessel.

269. In a message sent in January, 1982, (AIG 8994 R 201810Z JAN 82), the Commandant cancelled midperiod inspections for Cargo and Miscellaneous vessels such as the MARINE ELECTRIC. An annual survey was required to meet the SOLAS 74 requirements, however, but was to be a cursory inspection. The message stated:

> "This survey should consist of a check of the vessel's log and other documents, and a spot check of the vessel and equipment, with emphasis on the lifesaving, fire-fighting, and navigational systems. It is intended that this survey be minimal unless conditions indicate a more detailed inspection is necessary."

Since the vessel was subject to the SOLAS 74 convention, this annual survey was required.

270. The hull inspector had 22 years active duty in the Coast Guard and five years of Marine Inspection experience at Providence, Rhode Island, before testifying before the Board. He had been Senior Inspector Personnel for one and one half years, and spent one year as Assistant Senior Inspector, Material. He said that Providence did not see many ocean-going vessels; he had inspected about five in his time so far. He said there were two mid-periods on tankers, two mid-periods on bulk carriers and some large barges that he had performed inspections on. He had followed an experienced inspector for about six months before he performed inspections on his own. Most of the ocean-going

vessels inspected at Providence were tank vessels, he said. He had had no instructions regarding the inspection of hatch covers, and had not inspected them on the two bulk carriers he had seen. He said he had inspected about six lifeboats in his career.

271. The vessel was undergoing a change of cargo employment at the time of his mid-period inspection, changing from enrollment to registry, and preparing for a cargo of grain overseas. Between 14 and 19 June 1982, Olympic Marine made repairs to the hatch covers while the vessel was in Providence, Rhode Island. The location and extent of the repairs was not specified in the records, but the cost was $8,500.00.

272. Just prior to this mid-period inspection, the Chief Mate had been relieved. He stated he waited on board three extra days because of the inspection, and because of the hold cleaning job.

273. The Inspector could not recall any doublers or "Red Hand" patches visible on the hatch covers, but noted that most covers were open during the mid-period, and only the topside of the last panel and the underside of the first panel were visible. He recalled seeing one hatch cover being welded on, but did not question such work or make a detailed examination of the cover or take any other appropriate action. He said he did not check the condition of the hatches. In his opinion, the ABS would normally take care of inspecting the hatches during a load line inspection. When the inspector initialed the entry for "Deck Openings and Closures," in his Inspection Report, he said what he checked was the watertight door to the forecastle area, and other such doors.

274. No tanks or compartments were entered during the mid-period inspection. The Inspector said the guidance in the Coast Guard Marine Safety Manual indicated the Mid-period inspection emphasized safety equipment checks, and was not as detailed or comprehensive as the Biennial inspection.

275. Entries in the mid-period Hull Inspection Book indicated a lifeboat suspension test was performed. Also, the book indicated no semi-portable fire extinguishers were required for the vessel, although one, in fact, was required for the fire room. The inspector wrote, "No tanks or compartments entered," but stated he did visit accessible compartments in the forecastle area. There were no deficiencies he spotted in the hulls of the lifeboats.

276. The inspector sometimes used the symbol "N/A" to indicate the vessel did not have the equipment indicated in the Inspection Book, (such as the notation beside "Hull Openings;") and sometimes to indicate that he did not inspect that item, (such as

bulkhead penetations, valves and controls for the bilge system, bilge wells and other items under the "watertight integrity" part of the Inspection Book.).

277. The mid-period inspection took about eight hours. One requirement remained following the inspection: to make repairs to the worm gear assemblies for the port and starboard lifeboat davits.

VESSEL REPAIRS AND SURVEYS, JUNE - DECEMBER 1982

278. On 19 June 1982, the vessel got underway for Port Aransas, Texas, arriving 25 June 1982, for a load of grain. The loading took place between 30 June and 3 July 1982, after which she sailed to Haifa, Israel. She returned to Port Cartier, Canada, on August 21 August 1982. The Canadian Coast Guard and the U. S. Department of Agriculture inspected the holds.

279. On 30 August 1982, the Relief Master, Captain [redacted], sent in a Requisition for Service to MTL, noting repairs already accomplished between 23 and 26 August 1982 at Les Reparations Industrielles, E.D., Inc. He stated one section of ballast line was changed out, and doublers were installed "in No. 2 tank" and the main deck.

280. Another grain trip commenced from Port Cartier to Haifa from 1 September to 18 September 1982. The vessel lay at anchor until 8 October 1982, when it moved to the discharge pier. The Permanent Master relieved Captain [redacted] in Israel on 30 September 1982. The vessel was underway on 11 October 1982, and docked at Norfolk and Western Pier 6, on 31 October 1982, to commence the coal runs again. The Master said he toured the main deck while the ship was in Israel, where he joined it in September 1982. The hatches were still closed, and the ram-neck still covered the seams between panels. He noted in surprise that some ram-neck was installed along the hatch sides, fore and aft; usually that was necessary in only one or two places. There was some damage to the grain cargo due to water when the ship reached Israel; but there was no insurance claim, and the Master did not report it to the Company.

281. September 1982, is the date on a brief list of owner's specifications for a yard overhaul and drydock. The MARINE ELECTRIC's Marine Superintendent explained that these yard specifications were hastily drawn up when it was learned the ship would have a two week wait between finishing the grain run to Israel, and starting the coal trade. The specifications included an item for renewing the lead panel on No. 3 hatch cover, and a general item calling for fifteen 3 ft. by 3 ft. doublers at unspecified locations on hatches 1-5. The overhaul period never came about, however.

282. During the return crossing of the Atlantic, on 19 October 1982, when the ship was at Algeciras, Spain, the Master sent a telex to MTL, listing ballast tank leaks. Included were five leaks in the No. 2 starboard upper tank, one leak in No. 2 starboard double bottom, one leak in No. 2 double bottom, two in No. 5 hold, and two in ballast lines running through double bottom tanks 4 and 5.

283. On 31 October 1982, the Marine Superintendent visited the ship in Norfolk, Virginia. In his attendance report (Exhibit 112), he noted repairs were necessary to a deck steam line at the port side of No. 2 hatch. He related that, due to the rupture in the line, the forward pumproom salt water pump could not be used to deballast the deep tanks. Because of the need to deballast so that a full cargo load could be received, a pumping truck and crew were hired to complete the job.

284. The Superintendent also stated that the crew was having great difficulty handling the forward most panel on No. 3 hatch, and recommended the replacement cover, which MacGregor had ready at their Norfolk Office, should be installed at the first opportunity.

285. On 9, 10, 15 and 16 November 1982, Promet workers came on board at Brayton Point and made various repairs to a No. 3 hatch guide wheel, upper wing tanks 2 and 5, and temporary repairs to punctures in tank tops.

286. In the early morning of 18 November 1982, the MARINE ELECTRIC anchored at Norfolk, Virginia,and was met by the Derrick Barge SAMPSON. The SAMPSON had been hired by Norfolk Shipbuilding and Drydock Corporation to bring a new hatch cover panel out to the vessel, and take the old lead panel from No. 3 hatch off the ship.

287. Mr. [redacted] attended the vessel at this time, and supervised the installation of the new panel. He rigged the hatch to open and close over eleven times, making adjustments to chains and tracks to prevent frequent derailments. He obtained a satisfactory chalk test of the lead panel. He wrote, "Although the panels were not adjusted correctly as new, they could now be opened and closed fully without derailing and, by means of the towing wire on the rear panel, they could be closed up to each other correctly." Mr. [redacted] returned to shore on 19 November 1982, as the vessel was preparing to load.

288. In his observations, Mr. [redacted] recalled his visit in March, 1981, when he noted the panels on No. 3 hold were in poor condition due to distortion and wastage. He wrote:

> "They have deteriorated badly in the interim. At present, the coamings have holes in the wheel tracks, and are so wasted that there is no strength left to support the weight of the panels without further distortion. The coaming compression bar is badly scaled and wasted, such that it should be renewed. The falling tracks are likewise weakened, wasted and damaged. The rising tracks have slopes of uneven angle and are distorted; in addition, they are weakened so as to flex and distort easily. The panels themselves are in an even more serious state of decay. The top plates are weak, wasted, buckled and holed in many places. The cross joint wedges are all missing, which is a serious omission, and although the wedges are on board, the state of the panels is such that extensive welding on them could lead to further rapid deterioration. There are heavy deposits around and on the panels where hatch tape is used. The rubber gasket channels are of an incorrect size (required during past repairs) and do not fit correctly to the adjacent panels. The distortions in the panels are such that fore and aft bowing precludes the side rubber from seating on the compression bar, and the transverse sag causes problems at the cross joints and on the coaming back. The panels on the remaining hatches appear to be in a similar condition. A judgment as to the seaworthiness and cargo protection capabilities of these panels must be examined in conjunction with the ship's Classifiction Society to fully determine their exact state with an eye to the duration of further use, if any."

289. Of all the surveys made by MacGregor, the MTL Marine Superintendent claimed he was aware of only the last report, dated 30 November 1982. After receiving the report, he went aboard the ship, on 2 December 1982, at Norfolk, Virginia. He discussed the hatch cover situation with the Master and Chief Mate, and requested the Chief Mate make a detailed examination of the covers so that a specification for repair could be made. The Superintendent said the covers were open when he visited the ship, and because of this, he asked the Chief Mate to perform the examinaton when the hatches were closed at sea.

290. In his attendance report, the Marine Superintendent wrote, "The crew is presently in the process of chipping, scaling and painting the hatch covers. In this process, the top plating of

the covers becomes holed in many cases, especially along the welding of the frame beams where new beams were welded onto existing plating. Such wasted and holed areas are being temporarily repaired with an epoxy cement." He stated that MacGregor offered to replace a number of hatch panels at $12,000.00 apiece. He wrote, "In view of the costs already incurred in repairing the hatch covers, such offer, if upheld by MacGregor, is obviously attractive. The Chief Mate testified there were no specific maintenance manuals for the hatch covers on board, but that the crew performed maintenance. Formerly, the hatch covers were painted with "red lead" and a color, but in the months before the accident,, due to the deteriorated condition, he scraped off the rust and coated them with a mixture of hull black and fish oil. He said "This seemed to do the best thing, working into the porous metal."

291. The Chief Mate joined the vessel on 2 November 1982, after it had made a grain run to Haifa, Israel. He testified he prepared a set of sketches, showing the wasted portions of the hatch covers, Exhibit 20, at the request of the Master. He felt they would be used to identify locations where doublers would be fitted. He described a characteristic area of wastage as 10 feet by 1 foot, and 12 feet by 3 feet. He testifed:

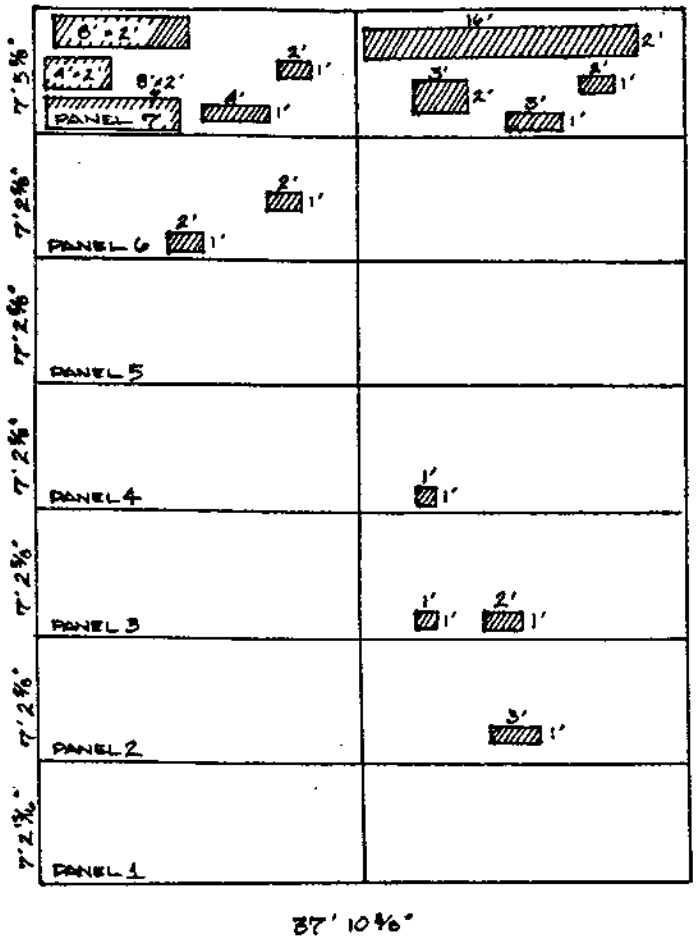
> "These were the areas that had rusted away, and in many cases, it was across the whole length of the hatch, and it was in the way of an area where, when the vessel was in the shipyard in Jacksonville two years ago, and they had the lids ashore, they worked on them and they put in a lot of new steel work on the beams underneath, and here after two years, that area had wasted right away through the hatches. There was whole strings of several feet long where there was little holes, from a pinpoint to maybe a pencil-size hole, through that area."

Concerning the holes in the hatches, he continued:

> "You could see daylight through them. You could put your finger through them. The metal was very thin. There was holes completely right through it, and if you would see it, you would wonder how they would ever be able to weld a doubler onto it, because you wouldn't think any of the surrounding metal was thick enough to weld without blowing it through."

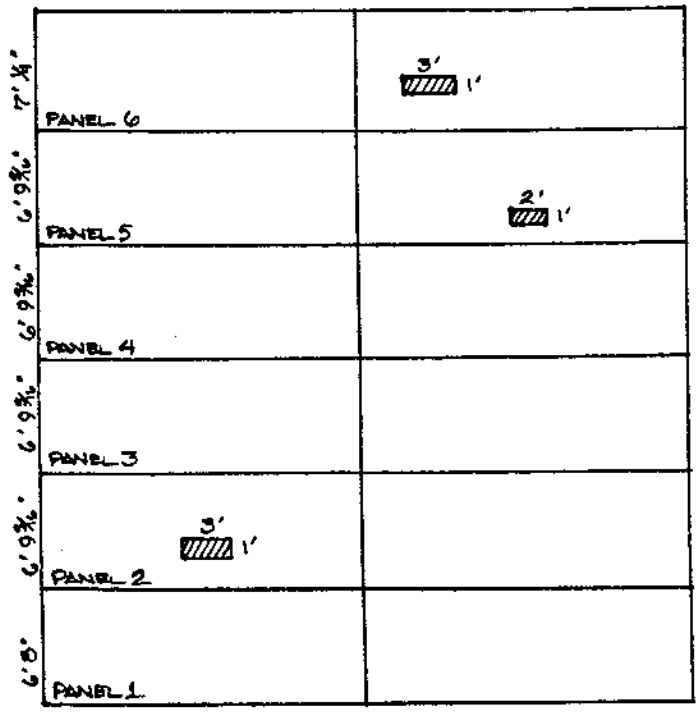
292. The hatch cover sketches, Exhibit 20, showed that three of six panels for No. 1 hold had areas that were deteriorated, and wasted, and that five of seven panels on No. 2 hold had wasted and holed areas. The exact locations of the deteriorated areas

HATCH NO. 2



Hatch Cover Areas needing repairs, as identified on sketches by Chief Mate, from Exhibit 20

HATCH NO 1



within each panel were not clear from the sketches, but the dimensions of each area were described in feet. The preceeding figure shows a scale drawing of each panel, for holds Nos. 1 and 2, with the areas which the Chief Mate identified shaded in. It should be noted that guagings were not taken on any of these covers.

293. After the Chief Mate made the list of areas needing repair on the hatch covers, he submitted the list to the Permanent Master. Subsequently, the list was sent to the company's main office. The Chief Mate then started putting tape and "Red Hand" epoxy on the holes. Only No. 5 hatch was left without patching, to enable the Marine Superintendent to see the condition when he visited the ship in February, 1983. He found, however, that the repairs would fall off when the panels banged together on opening, so he discontinued the repairs. He said he understood the ship would go into the shipyard shortly, and have the areas repaired. At the time of the accident, the Chief Mate said that not too many of the holes in the hatch covers were covered by duct tape and "Red Hand." The lead panel on No. 4 hatch was noted in particularly bad shape, according to the Chief Mate.

294. On 26 November 1982, the Chief Mate typed a repair request, stating that while undocking from Norfolk and Western's Pier 6, a tug applied a heavy strain to the starboard bow breastline chock, upsetting the chock and dislodging ten feet of half-round chafing bar. Repairs were accomplished by Promet on 8 December 1982, at Brayton Point.

DRYDOCK EXTENSION INSPECTION

295. In December, 1982, the owners of the MARINE ELECTRIC, due to a logistical problem, made a written request to the Marine Safety Office, Providence, to extend the required drydocking of the vessel from February until 15 April. On 22 December, 1982, the Coast Guard Inspector who performed the Mid-period Inspection went aboard the MARINE ELECTRIC to check satisfactory repairs to the lifeboat davits' worn gear assemblies, and also to inspect the vessel with respect to the requested extension of the drydock period. Concerning the extension, He was made aware of three areas of emphasis discussed in a telephone call between the OCMI at Providence, and MTL's Fleet Director. These were:

1. Boarding the ship and inspecting the "sea chests, etc."
2. Having an opportunity to operate selected sea valves.
3. That the extension be for a fixed period of time, and that a commitment be made for the time of dry docking.

296. The Inspector testified he received no other special instructions, and knew of no pre-dispositions of his office toward granting or denying the extension. "I was pretty much under the impression that the results of my inspection were going to determine whether or not the extension would be granted or not granted," he said.

297. The Inspector met the vessel at the Brayton Point Power Plant, and talked with the Chief Engineer, Mr. [redacted]. He toured the aft pump room, and checked the pump foundations on the advice of a boiler inspector, who had told him these areas were deteriorated. He went next to the engine spaces and checked a cement patch placed over a settler tank, which showed no signs of deteriorating. He operated all of the through-hull valves and the bilge injection valve; these seemed to operate satisfactorily. He hammer-tested a few spool pieces. Leaving the engine spaces, He went to the lifeboat davits. He inspected the repairs made as a result of his mid-period outstanding requirement. He signed the "bridge card," and left the ship.

298. The Inspector said he did not go forward of the deck house, since cargo was being unloaded, but felt confident he had seen enough of the vessel to allow him to advise his superiors whether an extension should be granted or denied.His written report recommended a short extension be granted.

299. When he checked the replaced pins and bushings in the lifeboat davit worn gear assemblies, He checked the over-all condition of the lifeboats, but did not hammer-test their hulls. He said the hulls appeared sound. He recalled some scaling of paint on the lifeboats when he saw them in December 1982, but could not reconcile the February 1983 photographs taken of the recovered port lifeboat, which showed excessive deterioration, with what he had observed two months before the accident. (See section entitled "Recovered Port Lifeboat Inspection.") The special inspection for drydock extension lasted about one hour.

300. The Fleet Director, prior to calling the Coast Guard to request an extension of the drydock time, called the Master and Chief Engineer and asked if there were any particular problems aboard the ship which would not permit operating until April 1 - 15, as the Charterer, New England Power, had requested. The ship's officers replied they had no problems.

301. In a letter dated 6 January 1983, the Officer in Charge, Marine Inspection, Providence, Rhode Island, granted an extension of drydock requirements to no later than 15 April 1983.

302. The Chief Mate said he pointed out some holes in the No. 1 cargo hold forward bulkhead to the Master and Marine Superintendent before his sketches of the wasted portions of the hatch covers were turned in, in early January 1983.

303. The Permanent Master wrote to MTL, New York, on 21 January 1983, stating that the No. 4 cargo hatch cover, forward panel, was beginning to sag the same as No. 3 did, and recommended a replacement as soon as possible. On 31 January 1983, MTL issued a Purchase Order to MacGregor to fabricate a single hatch panel for No. 4 hatch.

304. On 2 February 1983, while the ship was in Brayton Point, a puncture in the No. 1 port upper wing tank was noticed. Allegedly, it was made by careless handling of the bulldozer lowered in and out of the holds. The Chief Mate described the hole as 3 inches by 1/2 inch, located 6 inches below the sheer strake. He stated that the 8 -12 Third Mate noticed water coming from this location during ballasting operations. The Master was informed, and called someone on the phone (The Chief Mate believed it was the New York Office of MTL), and then ordered the Chief Mate to place a cement patch over the hole. No one from the Coast Guard or ABS was notified.

305. The Master said the cement box repair on the hole was put on by orders from MTL to him. He said the repair was intended to last until the ship reached Norfolk. It was not known to the Master why it was not repaired when the ship reached Norfolk. The Master told the Chief Engineer on the next northbound trip that the hole was to be repaired in Brayton Pt. The Chief Engineer said he would definitely have it done, and mentioned a patch being placed over the outside at Brayton Pt. The Master did not tell Captain [redacted] about the patch when he was relieved because he assumed it was repaired.

306. Concerning the hole in No. 1 port upper wing tank, the Fleet Director said the ABS or Coast Guard was not called in to inspect the hole. He had considered it insignificant, and, as it was "one of these last-minute findings," he requested the Master to install a cement patch, intending to make permanent repairs on the next return to Brayton Point.

307. The Marine Superintendent visited the ship at Brayton Point on 8 February 1983, to prepare an addendum to the shipyard specifications. At this time the hatch covers were in the open position, and only a cursory examination could be made. He made a routine round of the ship. The hole in No. 1 port wing tank was reported to him when he went aboard, but no other structural

problems were shown him. He said he was aware of the doublers on the main deck, but was not aware of what was under them, whether a crack or deterioration. He was aware of holes in the hatch covers, but believed, based on what he was told, they were all temporarily repaired using epoxy and tape. The only exceptions were several areas on No. 5 hatch, which the crew left uncovered for him to see. He told the Chief Mate during the visit that a new panel was being built to replace the lead panel on No. 4 hatch. The Superintendent also told the Chief Mate he had received the sketches he had prepared. The Superintendent understood the portions of the hatch panels identified by the Chief Mate would have to be repaired by doubler plates or inserts to restore the hatch to its proper strength and condition. He wrote no attendance report for this visit.

308. The Fleet Director testified that probably three hatch panels were going to be replaced at the planned Norshipco Yard period in April, one on Hatch No. 4, and perhaps two others at unspecified locations.

309. The Permanent Master stated he did not feel he needed to discuss the condition of the hatch covers with Captain [redacted] on his relief, though Captain [redacted] had not seen them since 1 October 1982, and many repairs had been made in those intervening months.

GENERAL COMMENTS ON THE HATCHES AND VESSEL CONDITION :

310. The Permanent Master did not participate in any Coast Guard inspections since the 1981 drydocking. He had served aboard the vessel as Chief Mate from 1975 to 1978, and thereafter was the vessel's Permanent Master.

311. The Chief Mate did not participate in any Coast Guard inspections over the last three years of the vessel's life. He had been on board in June 1982, during the Coast Guard Mid-period inspection, but had been relieved of duties by another Chief Mate. He was also on board during the February 1981 Jacksonville dry dock period.

312. The Chief Mate stated he would not make a North Atlantic run with the vessel in its condition, but felt safe making coastwise trips because the Coast Guard was nearby for a rescue if necessary. Although the condition of the hatch covers and main deck was common knowledge among the ship's crew, no report or complaint was made by them to the Coast Guard, or to affiliated Maritime Union representatives, or to any other organization or agency.

313. The main deck outside of the hold openings was in very good condition according to the Chief Mate. The plating between the hatches was thin, however. Over the last two years before the accident, holes would appear in the deck in this area. At various times, doublers were welded over the wasted areas. On the last voyage, at Brayton Point, he showed a hole in the deck between the hatches to a Promet representative. The Promet man said he had no work items to repair it, so the Chief Mate had an epoxy patch put over it.

314. The Chief Mate stated the dry cargo hatch cover "appeared to be thin", though he didn't know what the required thickness was. The Chief Mate recalled that as far back as February 1980, numerous holes appeared when the hatch cover was scaled. He recalled a doubler welded over a hole in the coaming on the aft side, and a doubler "five foot square" on the forward port corner around the booby hatch.

315. According to the Chief Mate, the ballast lines were holed in No. 4 starboard double bottom. The No. 4 Starboard tank had to be pumped after all forward of it were emptied so that the suction would not be lost. He said the ballast tank vents were in fairly good condition. One or two were replaced in the 1981 yard period due to deterioration. They were goose neck type vents with a ball check-valve.

316. The Chief Mate stated the condition of Bulkhead 141 and the condition of the chain locker bulkheads was good. The ladder trunks leading to the holds were in good solid condition.

317. The 8-12 Third Mate's opinion as to the condition of the hatches during his three weeks aboard was based on touring the decks while in port on day-work, observing the crew working on the hatches, and observations made from the bridge while on watch. He related he had used his knife to knock sheets of scale up to 3' by 3' off some hatch covers. He related that all the hatches, on different panels, had wasted areas and holes ranging in size from pinholes to fist size. He found blistered areas where "whole sheets of scale and paint would come off." He saw gaskets not fastened to the covers and hanging down loosely. Portions of the track on top of the hatch coamings were missing or bent, due to damage by the offloading bucket at Brayton Point. He saw numerous doublers, some stretching for several feet and butted end to end. In his opinion, the constant efforts to grind and paint the hatch panels were "camouflage." He said that it was standard procedure to break out chain falls and come-a-longs to reseat hatches after they had jumped off their tracks when being secured. He remembered seeing epoxy patches between the hatches on the main deck, specifically between hatches 2 and 3. He also recalled a crack that had been circled between hatches 3

and 4 on the main deck. He knew of epoxy patches on the main deck between hatches 1 and 2, and forward of No. 5 hatch. These were located adjacent the hatch coamings.

318. On one occasion, the 8-12 Third Mate overheard Captain [redacted] make the statement that the hatches were in no worse condition at that time than when he had served onboard the vessel during the summer of 1982.

319. The crack the Third Mate observed between hatches 3 and 4 was about 3 1/2 inches long and 3/4 inch wide, penetrating the full depth of the metal. The crack ran fore and aft. He located the crack between frames 78 and 79, about ten feet to starboard of the centerline. He first noticed the crack on 4 February 1983, and said he discussed it with the Second Mate and other Third Mate. He did not notify the Chief Mate about the crack, but said the Chief Mate was cognizant of it.

320. The Third Mate did not report any of his concerns over the hatch covers or cracks in the deck to the ABS, Coast Guard or Union, but notified his superiors. He said he followed the chain of command, and reported his concerns about the hatches to the Chief Mate. He saw a Port Engineer on board the last time the vessel was at Brayton Point, but did not talk to him. He was aware, however, that he could call the Coast Guard any time he was concerned the ship was unsafe to sail.

321. The material condition of the hatch panels was poor in the opinion of the 12-4 AB. He related one occasion the day-workers chipped the top of the No. 5 hatch panels. When he got off the wheel watch, it was his job to sweep up. He said he saw "a whole bunch of little holes in the hatch - the average, I guess, would be about 1 inch by 6 inches." Holes were also present in the sides of the hatch panels. He estimated 6 or 7 holes on each panel. He did not remember whether the panels were dogged down at the coamings, but was fairly sure they were not. He didn't take a close look at the other hatches during his ten days on board before the accident to notice if they had holes similar to No. 5 hatch.

322. The MARINE ELECTRIC was the first coal carrier the AB had sailed on, and he related he was interested in learning how the hatches were opened and closed. On Sunday, 6 February 1983, while the ship was anchored off Newport, Rhode Island, the Chief Mate demonstrated the operation of all five hatches. He described the single wire pull that was shackled to the foremost panel and was hauled in by a steam winch. He said the hatches did not operate smoothly, especially when attempting to close them. On one hatch, it was necessary to use a chain fall because the panels were warped, and on another hatch, lines had to be tended on each side to guide it into place.

323. When getting underway, the Permanent Master sometimes told the Chief Mate to just dog the corners, Although he admitted all the dogs were required to make the hatches weathertight, he called the hatches serviceable and seaworthy.

324. On one occasion in 1981 or 1982, on a grain trip to Haifa, the Master recalled grain damage caused by water entering through a hole in the deck. About 100 tons of grain was damaged, in hold Nos. 3 or 4.

325. No member of the ABS or Coast Guard was ever present when Max Graham performed his surveys on the vessel. He said MacGregor hatches were designed and fabricated to ABS standards, and would provide a watertight seal without resorting to tape and sealing tar. All the dogs must be in place for the covers to be watertight The sequence of latching the dogs on the hatches should not matter, said Mr. [redacted]. The dogs were not there to give any extra compression, but to maintain the hatch panel in its position at sea when the ship was moving.

326. MacGregor takes responsibility for getting ABS approval on newly constructed equipment and delivers it with inspection papers. The owner was then responsible for calling in ABS and Coast Guard inspectors for the installation of the new equipment.

COMPANY REPAIR PRACTICES AND POLICIES

327. In the Marine Transport Lines organization, the vessel Port Engineers report to a Marine Superintendent responsible for several vessels. The Marine Superintendent reports to a Fleet Director. There are three MTL "fleets". The Fleet Director serves under the Vice President of Operations.

328. At the time of the casualty, Mr. Joseph Thelgie served as the Fleet Director for the group which included the MARINE ELECTRIC. He served as the Marine Superintendant when the MARINE ELECTRIC was undergoing the Jacksonville overhaul completed in February, 1981, and was later promoted. He attended the vessel three or four times in 1981, and twice in 1982. From the time of the February 1981 overhaul, he was familiar with all repairs and surveys performed on the MARINE ELECTRIC.

329. The MARINE ELECTRIC had a "repetitive operational letter" issued to the Master stating basically the vessel was to enter the coal trade carrying cargo from Norfolk or Baltimore, or whichever port was designated by message, and discharge at Brayton Point. The Master didn't generally write voyage letters to the Company due to the brief sea time and frequency of trips. Usually, the Master telephoned the Company if he had anything to communicate.

330. The Fleet Director said he did not report defects in the hatch covers to the ABS or Coast Guard. He termed work on the hatches as "normal routine repairs." He said he had no report from the ship regarding the fact that only 50% of the dogs were useable on the hatches.

331. Ordinary voyage repair requests flowed typically from the Chief Engineer to the Marine Superintendent, who then notified the Port Engineer in time to attend the vessel when repairs were to be made. When a drydocking or overhaul was due, the vessel crew was notified to prepare repair requistions. The Port Engineer visited the vessel and reviewed these with the Master and Chief Engineer. Then the requisitions were prepared in specification form, and used for bid purposes. Generally, repair requests were to be approved by the Marine Superintendent at MTL's New York Office, either by written request, or a telephone call.

332. When Mr. [redacted] was aboard the vessel as Chief Engineer, he also acted as the vessel's Port Engineer.

333. The Permanent Master sent in repair requests to MTL about every two months. He said the Chief Engineer sent in his own in a separate envelope. He gave the Chief Engineer a copy of repair requests submitted by him. At the end of each foreign voyage, a repair list was sent in to the company, including repairs suggested by the unlicensed crewmen at their union meetings.

334. The Permanent Master did not require the Chief Mate to notify him that deck repairs were taking place or satisfactorily completed, nor was the Chief Mate required to log the repairs. The Chief Mate did keep a daily work sheet, however, which was sent to the company. These daily sheets reflected work done by the crew, not by outside contractors.

335. The Permanent Master repeatedly stated that the authority over repairs was delegated to the Chief Engineer and Port Engineer. He said "They have complete - are in complete charge of all repairs and how they are done. I am not, even though it is my responsibility. I do not have that authority on repairs."

336. The Permanent Master did not notify the company when due dates for surveys, inspections or outstanding requirements approached. This was handled by the company, he said. When asked about arrangements for the Coast Guard and ABS to attend vessel repairs, the Master replied: "I did not make any. Usually if the regulatory bodies were to be informed, why, it was always done by the office or by the Chief Engineer. The Chief Engineer was in charge of making all the repairs. I had never notified any regulatory body since I had been on the ship."

337. Temporary repairs, such as epoxy on the hatches and main deck, or the cement patch for the hole in No. 1 port wing tank, were specified by the Master. He also ordered the perforated plates over the cargo bilge wells removed and replaced by blank covers. He did not inspect the repairs after they were performed, but left this to the Chief Engineer or Chief Mate.

338. Reflecting on the previous testimony related to hatch repairs, the Master said he would not have reported the hatches' condition to the Coast Guard or ABS. Repeating that the hatch repairs were strictly between the Chief Engineer and the company, he responded " I would not do anything differently. I couldn't anyway".

339. Repairs made by Promet Marine, on contract to New England Power Co., were attended by the Chief Engineer, Chief Mate or Master, and not the Port Engineer. Concerning the "stevedore repairs", the Master said he typically was not aware of what the Promet people were called for, or what they were doing.

340. The Marine Superintendent did not know when the hatch covers were last tested for strength or whether they were ever audio gauged or hose tested. (The Chief Mate stated there had not been a hose test performed on the hatches since he came aboard in September 1977 by the crew or anyone else.)

341. The Marine Superintendent stated the area between the hatch openings on the main deck was not considered a strength area, and the installation of doublers in this area had been allowed by classification society rules. He stated the cross-joint wedges, placed on board the ship in March 1982, were not intended for installation by the ship's crew, but for some later shipyard period. No item appeared for the wedges in the preliminary yard specifications dated Sept. 1982, however.

342. The Marine Superintendent said that many times, repair requisitions from the vessel came in the form of phone calls rather than in writing. He stated that repairs were classified as to whether they needed attention right away or whether they could wait for the shipyard availability, and also if the repairs affect safety or simply the vessel operation. He agreed that reports involving a fracture in the deck or hatch covers or wasted areas between hatch covers would necessitate a survey by a company official (other than a crew member) and notification of the Coast Guard and ABS surveyors.

343. The Marine Superintendent said, from discussions held in the office, the MARINE ELECTRIC would operate until 1985. After that, he said, nobody was sure whether the market situation would warrant spending any more money to keep the ship in service. He remarked the engineering plant was in good condition.

DIVING OPERATIONS

344. The Coast Guard performed several dives and conducted a sonar study of the wreck on 16 February 1983. The CGC MADRONA had been on scene 15 February 1983, and was surveying the pollution aspect of the casualty. Early morning, 16 February 1983, the MADRONA's screw became fouled in a mooring line floating up from the wreck.

345. The CGC POINT HIGHLAND was underway to the wreck site on the morning of 16 February with six divers from the Atlantic Strike Team and a civilian side scan sonar operator from the Coast Guard Research and Development Center, Groton, Connecticut, on board. Once on scene, the divers freed the MADRONA'S screw, and used the hawser as a down line to the wreck. Three dives were made using scuba gear only and with a bottom time of about 15 minutes per dive. They found the hawser was tied off at the main deck level, port side, and that the hull was inverted with about a 3 foot clearance under the hull. The underwater visibility was reported to be 10 feet, with little available light. The wreck was in about 120 feet of water, with 75 feet over the wreck. There appeared to be a break in the hull close to where the hawser was attached.

346. On the afternoon of 16 February 1983, side scan sonar traces were made. An analysis of the traces performed by the Coast Guard Research and Development Center revealed the vessel lay inverted in two pieces on the bottom. The position of the bow section was plotted as 37-52.9 North; 74-46.6 West. Operations concluded the night of 16 February 1983.

347. Between 20 and 24 February 1983, a diving expedition, sponsored by Marine Transport Lines, was performed on the MARINE ELECTRIC. The owners hired divers from International Underwater Contractors (IUC) and used the ocean salvage tug SMIT HOUSTON as the platform. Representatives from Ocean Surveys Inc. were hired by the owners to conduct a side-scan sonar survey. Seven divers were employed, two of which (Mr. [redacted] and Mr. [redacted] testified before the Marine Board.

348. The vessel was on scene at dawn on 21 February 1983, and commenced a sonar survey of the wreck site. Two dives were made for general orientation. From the previous dives made by the Coast Guard, the IUC team was aware of the hawser marked by a lifejacket floating on the surface. This hawser was used as a "down line" by the divers, and was found to be attached to the port guard rail of the bow section of the wreck.

349. The divers were equipped with surface supplied air to helmets through an "umbilical," which also carried a communications cable to the surface. The first dives, on Monday, found the hawser connected to the port guard rail, about 10 feet forward of a large break in the hull, and verified that portion of the wreck to include the bow.

350. In describing the wreckage, which was inverted, the 2 terms "up and down" or "above and below" are used with respect to gravity, not the ship's hull. The terms "port" and "starboard" refer to the ship's true sides, as if in an upright position.

351. On 22 February 1983, Mr. [redacted] descended the hawser to the port rail. The rail was about 2-1/2 feet above the hard, sandy bottom. The depth at this point was 120 feet, with visibility of 10-15 feet. He could see little under the hull, which was the main deck, but noted one gooseneck vent. He located the puncture in No. 1 port upper wing tank, and described the crack as 4-5 inches long, half moon shape, and 2-3 inches wide. He used a 14 inch welding rod and felt nothing inside the puncture. As he moved toward the bow, the clearance under the hull opened up to about 12-14 feet in the vicinity of the dog house and dry cargo hatch on the forecastle. He saw the dog house was intact. Forward of the dog house, he saw the mast broken off. Further toward the bow, the sandy bottom rose sharply and the clearance returned to 2-3 ft.

352. He traversed up after reaching the bow and located the port anchor, and verified from the name that it was the MARINE ELECTRIC. He found one horseshoe shaped crack, about 2 1/2 inches long about 8 feet aft of the port bow, at the 27 foot draft mark. The starboard bow was buried in the sand and no rail was visible. He moved 10-15 feet aft on the starboard side, but noted nothing, and made no mention of ever having seen or not seen the starboard anchor.

353. He went under the hull after noting there was no shifting taking place, and worked over to the dry cargo hatch opening. The hatch cover was not there, and hawsers were shooting out of the opening like spaghetti with a surge of current, then being drawn back into the opening. This action repeated every few seconds. Under the opening was a pile of coal, about 1-1/2 feet deep. He could not go under the hatch opening because of the strong currents, but noted several of the hatch dogs around the coaming. One hatch dog was threaded all the way up, but had no nut on it, and two other dogs "looked like somebody comes up with a bolt-cutter and just sheared them off." No sighting was made in this dive or any other of the dry cargo hatch cover.

354. On the afternoon of 22 February 1983, Mr. [redacted] went down. He was to locate the port bilge keel, then go to the starboard side, working back and forth on the bottom to locate damage. He described the angle of the ships port side to the ocean bottom as 15 degrees. He saw the bottom shell plating was intact with very light growth. He discovered a "very large crack", which started just below the port chine at the side. It went directly athwartship across to the starboard side, following a weld butt he said, and down the starboard side. The forward edge of the crack had a weld attached to it, and the metal appeared to be fractured in the heat affected zone. The beginning of the crack on the port side started from a "pucker" about 2 feet below the port chine.

356. On subsequent dives, the crack's location was estimated using arm measurements to be 38 feet aft of the forefoot of the bow. The width of the bottom at the crevice was about 12 feet, and it opened wider as it went from port to starboard. The shell along the edges of the crack was bent inward to the hull for about 2 feet on each side. The crack was also more jagged on the starboard side.

357. Mr. [redacted] followed the crack down the starboard side about 28 feet (estimated by arm measurements) when his feet landed on a flap of steel bent inward to the hull. He stood here and was in the midst of a large hole in the side. The shell around the hole was all bent inward, and the edges were ragged. Some surge went in and out of the hole. Below him was a "floor" with athwartship stiffeners along it. Three feet forward of where he stood in the hole (to his left) was an athwartship bulkhead. His visibility was about eight feet, and dropped to three feet in the hole. He was told by the diving supervisor on the surface he was in the starboard deep tank.

358. Directly to his right (aft) and slightly in from the shell, was a hole through the "floor," about the size of a desk, about four feet by three feet, with rounded corners. He said there was a metal edge or coaming about six inches wide around the perimeter, and there was no cover on it. He estimated the opening was 8 to 15 feet aft of the forward bulkhead, and at least four feet inboard of the shell. The longer sides of the opening were aligned fore and aft. He knelt beside the opening and put his body through to his waist and saw a green tarpaulin within reach, and two "I" beams. The beams travelled away from him, one aft and one forward of the opening.

359. Mr. [redacted] described the bottom as having fairly light marine growth, and said, "Structurally, until I came within a few feet of the crack that I found there was little or no evidence of any sort of metal distortion." Marine growth was also evident on the curved, inward-bent edges of the athwartship crack. He

noticed no fore and aft abrasion marks on the bottom. He said there was some slight "wash board" effect to the bottom plating from 4 to 8 feet forward and aft of the crack.

360. Mr. [redacted] remarked he could not distinguish new plates from old ones on the bottom shell, "All the steel looked fairly new," he said, "...[it] did not look like it was deteriorated."

361. Mr. [redacted] and Mr. [redacted] saw no hatch covers in their dives, and heard no reports from any other divers of having spotted any. They did not examine the starboard bow in the vicinity of the anchor. No diver observed the starboard side of the doghouse, where the weather door to the lower decks was installed.

362. On Thursday, 24 February 1983, three dives were made on the stern section. The stern was found to be in line with the bow section, lying on its starboard side, not quite as inverted as the bow section. The stack was found ripped off and lying six to seven feet away from the main deck. The vessel departed the scene the evening of 24 February 1983.

363. Between 12 and 14 May 1983, Steadfast Marine, Inc. conducted a sonar search of the wreck area aboard the Research Vessel G. W. PIERCE, on behalf of the owners. The towed sonar transducer produced a display on a paper recorder, which was used to plan a dive expedition on the wreck.

364. The results of the sonar study indicated the vessel lay upside down on a heading of 040 degrees True. It indicated the ship was in one continuous piece, with a midship section of about 240 feet missing. A bow section of about 220 feet was noted, and a stern section of 140 feet. Debris or wreckage was noted astern of the vessel, and also to its starboard side. The water depths around the hull were from 115 to 120 feet, with the minimum depths above the hull ranging from 68 to 78 feet.

365. Divers from Steadfast Marine, and personnel from Jered, who operated an ROV (Remotely Operated Vehicle) were embarked on board the G. W. PIERCE on 24 May 1983. (Both Steadfast Marine and Jered were subsidiaries of the Ocean Engineering Diving Company.)

366. The ROV was Jered's RECON-SJ Model - a 900 pound aluminum frame underwater vehicle propelled by four electric motor thrusters. It contained a video camera and still camera, an extension arm, and various lights. It operated from a 400 foot tether, which was coiled on a drum. The drum was lowered by a cable from a deck winch, and kept at a prescribed depth. A containerized van on the deck of the research vessel housed the electronics for the ROV. One man served as operator of the ROV, using a single control stick.

367. On a preliminary scuba dive, it was found the rudder was blown off by explosives, and the propeller removed with air lift bags attached. This was later verified by the ROV and videotaped.

368. A positioning device using a pulsing beacon placed on the wreck failed to operate, and the magnetic compass on the ROV was unreliable near the steel hull, so that accurate fixing of the area being videotaped was not always possible. Techniques such as following weld seams were used, but the difficulties in maneuvering the vehicle still made it hard to establish locations on the hull.

369. About 20 hours of videotapes were produced over the next four days. In general, the wreck was found in one continuous length. A "bow section," which was relatively intact, extended from the stem to about Frame 103 on the port side, and Frame 96 on the starboard side. A stern section was also fairly intact as far forward as the aft pumproom. Between the aft pumproom and the middle of No. 2 hold, where the bow section started, the hull was not in any recognizable shape. Only twisted and buckled structure laying close to the ocean floor was visible. The underside of the hatch coamings with the ten-inch diameter split-pipe reinforcements were visible in places.

370. The bow and stern sections were lying at about the same angle - inverted with the port side elevated about 35 degrees from the ocean floor. The clearance under the port side varied due to sanding in. It was not possible to navigate the ROV underneath the hull. At the bow, it was possible to shine the lights under far enough to view the port anchor chain and anchor securing devices.

371. A diver was sent down to photograph the port anchor and chain assembly. He reported the anchor and chain were intact and housed tightly. The riding pawl was hanging straight down. The devil's claw was tightly made up, with the threaded bolts of the turnbuckle well into the barrel, and the ends only a few inches apart. The claw was engaged about two links outside of the hawse pipe on the main deck. The video camera revealed the port anchor chain visible at the main deck was painted white. Photos and later dives revealed that undetonated explosives had been attached to the port anchor chain at an unknown time by an unknown diver.

372. The athwartship crack noted by the IUC divers in February appeared to be about Frame 140-1/2, at the end of the flat keel plate No. 5. The hole that this crack opened into on the starboard side was found to be much larger than previously thought. As the ROV moved aft and down from the starboard side

of the crevice at Frame 140, the hull opened up wider and more damage was apparent. The starboard bow area appeared more damaged than the port bow area, but no significant damage, other than the athwartship crevice at Frame 140, showed on the flat bottom of the bow section. Both port and starboard sides of the bow section had set-in areas and cracks scattered over the shell plating. The stem was fractured at the 21 foot mark, and was bent to starboard below that point about 10 degrees. The starboard hawsepipe was empty of its anchor and chain.

373. The break in No. 2 hold showed the bottom plating generally pushed inward, and the fracture fairly ragged. Sand covered the starboard side of the break at No. 2 hold, shielding everything below the starboard bilge keel. From the starboard bilge keel to the starboard bottom and across to the port side "C" strake, extensive inward deformation and bending was found. From the port "C" strake to the port bilge keel,much less inward deformation was noted. Along the port side-shell, the metal was flat, with little or no deformation adjacent to the fracture edge noted.

374. The break at the after pumproom seemed to run from Frame 50 at the main deck level to about Frame 47 at the lower level in the pumproom. It was very jagged. A ballast manifold was visible, but broken free of its foundation. A jumble of piping lay twisted in the bottom of the pumproom. The vertical ladder near the centerline was still there, indicating the aft bulkhead of No. 5 hold was still there in part.

375. The stern section was viewed briefly. Portlights on the starboard side were noted, most with the glass broken open. Guard rails along the boat deck were visible, and the house front and bridge wing were visible.

376. The bottom and side shell of the stern section was basically undamaged. Portions of the superstructure were swept off the ship by contact with the bottom, and parts of the superstructure were laying separate on the bottom. The ship was laying on the poop deck on the starboard side, and on the boat deck on the port side. The angles of heel of the bow and stern sections were almost the same, about 35 degrees to the ocean floor.

377. Scuba divers investigated the starboard main deck area around the anchor riding pawl. They reported there were two links of rusty chain visible inside the riding chock with the ends disappearing into the sand. The turnbuckle to the starboard devil's claw was visible attached to the pad-eye in the main deck, but disappeared out of sight in the sand. The divers could not see the wildcat, and no chain was visible from the riding pawl to the hawsepipe.

378. A third phase of the diving expeditions from the G. W. PIERCE was conducted between 7 and 13 June 1983. The purpose of this expedition was to search the area around the wreck using sonar and a magnetometer for signs of the starboard anchor and chain. The search was conducted through 9 June 1983, when the sonar equipment was retrieved to permit divers to investigate a large sonar contact discovered about 1800 yards southwest of the main wreck. It was about 240 feet in length.

379. Dives on this contact proved it to be the missing mid-ship portion. It was sitting upright. The port side was still intact, and the bottom, but the starboard side was missing. Portions of holds Nos. 3, 4 and 5 were included in this section. The main deck on the starboard side was missing. A break occurred along the main deck, starting a few feet inboard of the No. 5 hatch coaming on the port side, and angling toward the centerline as one moved forward, such that about half the width of the No. 3 hatch coaming remained. This tear was very jagged - the metal endings of the hatch coamings and main deck between the hatches was twisted. The transverse bulkhead between Nos. 4 and 5 holds was about 1/3 present, but the transverse bulkheads between Nos. 2 and 3 holds, and 3 and 4 holds, were not there. A horizontal cut extended about 15 to 18 feet into the shell plating at the turn of the bilge on the port and starboard sides. A deep gash, 3 to 4 feet wide, ran the full length of the mid-ship section and through the tank top on the starboard side, where the sloping lower wing tank top met the flat inner bottom tanktop. The starboard sloping wing tank was folded outward and laying horizontal to the ocean floor. A search along the intact port side hatch coamings of this midship portion revealed the hatch cover securing dogs were in place.

380. On 11 June 1983,the G. W. PIERCE returned to the main wreck site, and divers removed the starboard devil's claw. Also found were four "standard links" of chain connected to an elongated link of a type usually attached to an anchor. This piece of chain was found near the starboard stern of the hull, but was never identified as belonging to the MARINE ELECTRIC. This section of chain was not part of the missing starboard anchor chain.

381. The starboard devil's claw turnbuckle was found extended nearly to the full lenght of the barrel, such that three or four more turns, two threads in and two threads out, would drop the threaded rods from the turnbuckle. The threaded portions were not stripped. About three inches of the tip of the two-pronged claw was broken off. The bolt that shackled the turnbuckle to the deck was bent as though a tensile stress had been put on the devil's claw.

382. Another trip was made to the site by the G. W. PIERCE on 20 June 1983. The ROV was back on board to obtain video coverage of the mid-ship section. A transverse bulkhead was located between the two major sections of wreckage.

383. During this expedition, additional studies were made of the main wreck site. Divers recovered 17 links of the 2-5/8" diameter starboard anchor chain. The chain was burned free of the ship at the point it passed through the chain stopper assembly. The 17 links were all forward and outboard of that point. The outboard link appeared bent and stressed. Sand build-up prevented divers from investigating the chain as it went from the riding pawl to the windlass.

384. Additionally, the port ballast manifold was recovered. It had broken free, and was on the starboard side of the after pumproom. It consisted of a double row of five suction and five discharge valves, each serving 6 inch diameter lines. Tags on each valve wheel identified the manifold and the function of each valve. All the discharge valves, for ballast tanks 1 to 5 port were closed. The suction valves for ballast tanks 1 and 2 were closed. Suction valves for tanks 3, 4 and 5 port were found open.

385. Attempts were made on 25 June 1983 to jet sand from the starboard side of the ship to locate the starboard anchor chain, but no chain was found. Searches of the ocean floor, using the ROV at the "abandon ship" location, and a point 1/2 mile northeast of the main wreck also failed to find any sign of the missing starboard anchor and chain.

386. Mr. [redacted] was a private diver, hired by the Union parties in interest. He made 38 dives on the MARINE ELECTRIC between 20 March and 19 July 1983, each of about 50 minutes duration. He took still photographs at the main wreck location, and his testimony coincided with the observations found using the ROV, and those of other divers. He concluded his testimony by saying the damage he saw was likened to what would exist if an explosion had occurred. Of 300 shipwrecks he had dived on, the MARINE ELECTRIC showed the greatest damage.

387. No evidence of the missing starboard anchor or chain was found in any of the searches made of the wreck.

ABS INSPECTION ROLE

388. The ABS is a private, non-profit organization. It develops rules, standards and guidelines for the design and construction of ships hulls, machinery and equipment. Classification by the ABS is a representation by the Bureau of the structural and

mechanical fitness of a vessel for a particular use or service. Classification is not a legal requirement for United States Flag merchant vessels, but does permit owners to obtain a lower insurance premium for the hull and its cargo. The ABS Rules state the Bureau can act only through Surveyors or others believed by it to be skilled and competent. The Bureau represents solely to the vessel owner or client that its certificates and reports evidence compliance only with one or more of the Rules, Guides, Standards or other criteria of the Bureau, in accordance with the terms of such certificate or report.

389. The ABS Rules state that neither the Bureau nor any of its Committees or employees will, under any circumstances, be responsible or liable in any respect for any act or omission, whether negligent or otherwise, of its Surveyors or employees. It will not be responsible for any inaccuracy or omission in the ABS Records or any report or certificate issued by the Bureau.

390. Surveyors undertake surveys on classed vessels on request of the owner. Fees are charged for all surveys to the owners, as well as travel expenses incurred by the surveyor. An ABS full or partial survey must be requested by the vessel's owners or the authorized agent. The cost of such services is borne by the owners. Unless such invitation is extended, a Bureau surveyor is not allowed to attend such vessel, regardless of any known material defects or damages, or the known expiration of a particular ABS Certificate. When invited, the attending surveyor's service is generally confined to the particulars of his engagement, and he is not at liberty to survey other parts of the vessel.

391. In the event of damage to the vessel, which affects classification, the Bureau Rules state that all representations of classification are considered suspended unless the owners promptly notify the Bureau of such damage, and surveys and repairs are carried out to the satisfaction of the ABS. At no time was the MARINE ELECTRIC removed from classification.

392. Necessary repairs, in the opinion of the Surveyor, are issued to the owner in the form of recommendations. These Outstanding Recommendations do not carry the force of law for completion within a specified time.

393. The ABS Drydocking Survey forms do not specifically mention hatch covers, but a hatch cover examination, including securing means, is part of the requirements for Annual Load Line Surveys. An Intermediate Survey (conducted in 1980 for the MARINE ELECTRIC) encompasses the requirements for an Annual Load Line Survey. During Special Surveys, an additional aspect of hatch

cover testing should occur - hose testing the covers to prove weather-tightness. No specific requirement is made in the Rules for gauging hatch covers or other periodic tests to prove the hatch cover strength, but an individual Surveyor has the option to require additional gauging any time he feels it is necessary.

394. The ABS Rules required the MARINE ELECTRIC to have a satisfactory bilge system, and the bilges and drain wells were to be examined at each special survey during the MARINE ELECTRIC Special Survey Hull No. 8, concluded at the February 1981 overhaul period. No action was taken with regard to the installation of blank covers over the cargo hold bilge wells.

LOAD LINE REGULATIONS

395. By statute, (46 USC 86), the Coast Guard was empowered to enforce Load Line Regulations, and by 46 USC 86d and regulations, the Secretary, Department of Transportation, was directed to appoint the American Bureau of Shipping the prime assigning and issuing authority for Load Line Certificates. The ABS was empowered to perform surveys required for load line assignments, including periodic revalidation of the marks, and that the vessel is in compliance with the conditions of the Certificate. Subject to the approval of the Commandant, an owner may request another classification society or the Coast Guard to be the assigning authority.

396. Part of Title 46, Code of Federal Regulations, contains load line rules applicable to the survey and maintenance of the hatch covers on the MARINE ELECTRIC. During initial and periodic drydock surveys (when the vessel is initially assigned a load line, and at five year intervals thereafter) the surveyor is to be given access to all parts of the vessel and to ensure the vessel complies with all applicable requirements. Included in the list of items to be inspected during these surveys is "cargo hatch coamings, covers, beams and supports, gaskets, clamps,...cleats and wedges of hatches on exposed freeboard, quarter and superstructure decks." On the MARINE ELECTRIC, this was to have been performed at the 1981 Jacksonville drydocking.

397. During annual surveys for load line requirements, the Load Line Certificate "assigning and issuing authority" (the ABS) is to ensure (among other things) the fittings and appliances for the "protection of openings" are maintained in an effective condition.

398. The Coast Guard load line regulations and the ABS Rules are parallel concerning the construction of hatch openings and covers and follow the requirements of the 1966 Load Line Convention.

399. In accordance with Coast Guard regulations, it was the Master's responsibility to assure that all hatches and other main deck openings were properly secured as designed before leaving protected waters.

400. The enforcement of the load line regulations is a responsibility of the Coast Guard.

401. At the time of the casualty, the Coast Guard had no guide or policy as to acceptable repairs, tests for watertightness or weathertightness, or tests for proof of acceptable strength of metal cargo hatch covers, or the acceptable intervals between such tests.

MERCHANT MARINE SAFETY MANUAL INSPECTION GUIDELINES

402. In the Safety Manual guidelines (Par 30-6-25A) for hull inspections applicable during the 1980-1981 drydocking of the MARINE ELECTRIC, the inspector was instructed to determine the adequacy of the complete hull structure.

> "The approved plans and the ABS Classification Certificate may be accepted by the OCMI in certain cases as evidence of the structural efficiency of the hull. However, the inspector must perform sufficient examinations and tests of the hull structure at the inspection for Certification to determine that the condition of the hull is suitable for the service in which the vessel is to be employed..."

403. Concerning Load Line requirements, the manual stated:

> "Inspections for compliance with these regulations are made by ABS or other such assigning authority approved by the Commandant. A current Load Line Certificate shall normally be accepted by the inspector as evidence that the vessel meets the requirements of Subchapter E." (Part 30-6-25B)

404. When a vessel was found not in compliance with the Load Line regulations, the inspector was to notify the OCMI. The manual concluded:

> "It is stressed that load line assignments are made by the authorized agency, while the enforcement of load lines within U. S. jurisdiction rests solely with the Coast Guard." (Part 30-6-25B)

405. In a revision to the Merchant Marine Safety Manual effective May 1982, the Load Line section was rewritten, but the division of responsibility remained the same. The assigning authority

(primarily the ABS) performs the surveys necessary to assign the Load Line Certificate, and follows up with annual endorsements, and must determine that a vessel is in compliance with the regulations, including the structural efficiency of the vessel.

406. By Coast Guard regulations, 46 CFR 91.40, the MARINE ELECTRIC was required to be examined on drydock by designated U. S. Coast Guard Marine Inspection personnel at least once in every two years, to determine to their satisfaction and warrant the belief that the vessel was suitable for its intended service and compliance with the applicable regulations. The Marine Safety Manual, Part 30-B, cites policy whereby the Commandant delegated authority to the Officer in Charge, Marine Inspection, to grant extensions to this drydock interval of up to six months for vessels such as the MARINE ELECTRIC. The Safety Manual did not, however, provide guidance as to an acceptable reason to honor a request for an extension, or specify any type of vessel examination to be made prior to granting an extension.

NOTES ON REPAIR OF STEEL HULLS:

407. The Coast Guard inspector relies, in part, on guidance published in Navigation and Vessel Inspection Circular 7-68, "Notes on Inspection and Repair of Steel Hulls," when inspecting steel work on vessels. In Part IV, Section D of this guide, the use of welded doubler plates is discussed. While noting that doublers are not generally suitable for permanent repairs to the main hull girder, since continuity of the original material is broken and its strength reduced, the guide permits the use of doublers on "deck plating well inboard between cargo hatches," and on "forecastle decks and poop decks limited to approximately the forward or after one-tenth length of the vessel." The use of doublers in even these locations should not be permitted when local strength is required, the guide continues.

408. An ABS Circular, No. 233, revised 5 January 1980, discusses the use of doubler repairs. It states that "doublers are not acceptable as a permanent repair or wastage compensation on a strength deck (except as reinforcement for openings and at extreme ends beyond cargo spaces), or side shell, bottom plating, or on tank tops in way of cargo spaces or over oil tanks." In the case of the MARINE ELECTRIC, the main deck was the strength deck.

NATIONAL CARGO BUREAU GUIDELINES:

409. In the National Cargo Bureau publication entitled "Code of Safe Practice for Solid Bulk Cargoes," printed in 1980, a cover sheet signed by the Commandant of the Coast Guard accepts their publication as meeting the regulations in 46 CFR 97.12, which requires Masters of general cargo vessels to be furnished

guidance in safe stowage of bulk cargoes. In Section 2.2 of this manual, it states the Master must ensure that the bilge lines are in good order, and that the bilge wells and strainer plates "should be specially prepared to facilitate drainage and to prevent entry of the cargo into the bilge system."

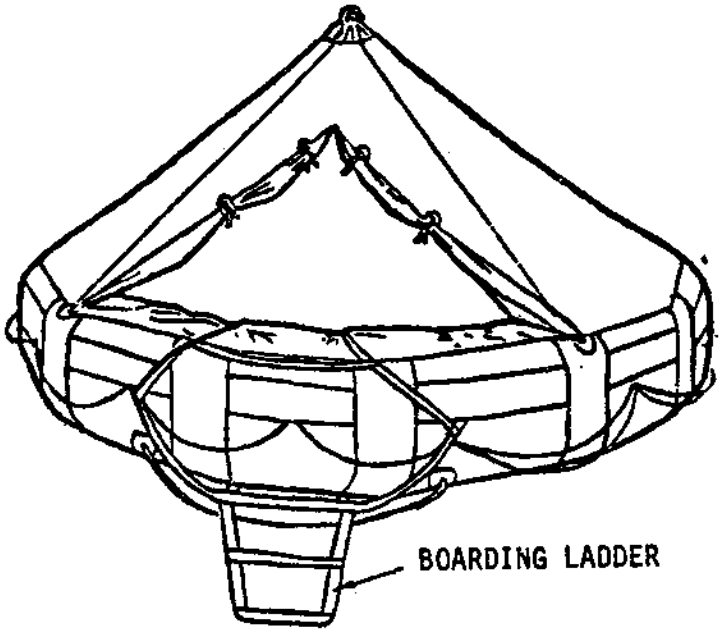
EXPOSURE SUITS

410. A Notice of Proposed Rule Making was published just prior to the MARINE ELECTRIC casualty on 3 February 1983, regarding requirements for equipping certain vessels with exposure suits. On 7 February 1984, the final rules were published, and required vessels such as the MARINE ELECTRIC to carry exposure suits for each person on board unless the ship operated between 35S and 35N latitudes, or had covered lifeboats which met certain requirements.

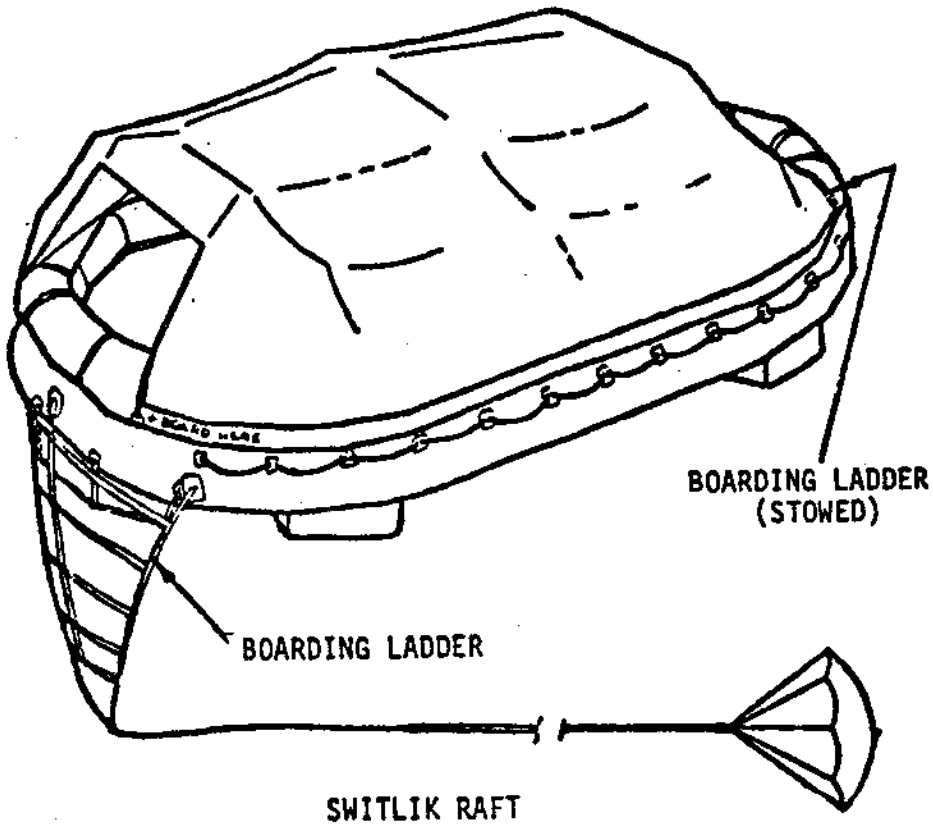
LIFERAFT INFORMATION

411. The MARINE ELECTRIC was equipped with two 15 person liferafts. One was manufactured by the Switlik Parachute Company, and the other by the R.F.D. Company, which has become a part of the B. F. Goodrich Company. Both rafts deployed from the MARINE ELECTRIC after the capsizing, and both were intentionally sunk by rescue vessels after the accident.

412. It was not determined which raft the 12-4 Able Seaman was able to climb into. Both types are represented in the figure below in order to describe the boarding ladder arrangements. With each type, two boarding ladders were provided, each fabricated of polyester fabric belts. One ladder was designed to deploy automatically when the raft was inflated, and had the sea-anchor drogue attached to it. Another web-belt boarding ladder was folded and stowed inside the raft, and designed to be cast over the side of the raft by an occupant.



B. F. GOODRICH (RFD) RAFT



SWITLIK RAFT

TECHNICAL STUDIES

413. Several technical investigations of the MARINE ELECTRIC were undertaken at the Board's request by the U. S. Coast Guard Office of Merchant Marine Safety, Marine Technical and Hazardous Materials Division. These studies included estimating the departure loading condition of the ship, a hull strength study, strength studies of the hatch covers, longitudinal bending moments and shear forces for the hull in still water and wave loading cases, and intact and damaged stability studies.

LOADING CONDITIONS:

414. A "first pass" loading condition was calculated to investigate any excessive stresses that may have been placed on the hull at the midway point of its loading process on 10 February 1983. No excessive loading in this condition occurred - a "hog" stress numeral of 69, and a "sag" stress numeral of 61 were obtained. Hog and sag stress numerals measure the relative longitudinal bending moment, and should not exceed 100.

415. In the full loaded condition, (which was described earlier in this report under "Loading Information") assumptions were made concerning the location of stores, water, fuel and crew's effects to balance the ship about the observed draft readings taken before departure from Norfolk. In the condition assumed, it was found that the vessel's sag numeral was 106, 6% over that allowed in the Trim and Stability Booklet approved for the vessel. The study concluded, however, that based upon other computations of the still water bending moment, the ship was not overstressed, and was operated within design limits.

HULL STRENGTH

416. Gaugings of the hull taken in 1981, together with plate renewals and repairs made at Jacksonville Shipyard in 1981, were compared with original scantlings at the time of conversion in 1961, to assess the strength of the hull girder. A conservative approach of using the thinnest gauging of a strength member to represent the wastage at that location was used in the calculation of the midship section modulus. Missing from the gauging report were readings for the inner bottom and bottom longitudinals, and the main deck under the longitudinal straps.

417. The average overall loss of the deck plating, due to corrosion, was 6.4%. For the double bottom tanktops, the average loss was 20.3%. The wind and water strakes (H and J) showed an average loss of 6.8%; other shell plating losses varied from 1 to 6%. The gauging report covered internals between Frames 76 and

98. Severe corrosion was noted for the under-deck longitudinals, ranging from 5% to 46%. Corrosion in the side longitudinals ranged from 5 to 23%. The floors and center vertical keel showed corrosion of 8 to 20%. About 15% of the upper ballast tank plating and longitudinals was renewed at the Jacksonville Yard. Giving consideration to these renewals, the plating on the upper wing tank sloping bulkhead was wasted from 9 to 30%, and the tank longitudinals were wasted from 7 to 30%.

418. After analysis, the study revealed the following section modulus figures:

	1961 design Scantlings (Sq.In.-Ft.)	1981 Gauged Scantlings (Sq.In.-Ft.)	1982 ABS Rule Scantlings (Sq.In.-Ft.)
DECK	63,340	58,300	54,260
BOTTOM	75,090	68,140	54,260

419. The overall average wastage figure of 10% for the midship section was computed. Some high levels of local wastage were found, however. Even considering the renewals made in the upper wing tanks, an average wastage in the upper wing bottom plating was 28%. An average wastage of 28% was found for the under deck longitudinals, and 20% for the inner bottom plating. The report concluded the calculated existing section modulus exceeded that required by the ABS Rules.

CARGO HATCH COVER NO. 1 STRENGTH ANALYSIS

420. This study consisted of a finite element analysis of the No. 1 hatch cover to determine what loading would be necessary to bring the cover to the yield point. Original scantlings, 50% wasted and 75% wasted conditions were assumed. Assuming symmetry about the centerline, a half-hatch model was used. The boundary conditions were assumed simply supported on three sides, with the centerline unsupported, but restricted to vertical movement only. The boundaries between hatch panels were assumed to be connected, but unable to transmit bending moments. The loading was a uniform static load.

421. The analysis concluded that yielding occurred in the transverse stiffeners with static heads of 8, 4 and 2 feet of water for the as-built, 50% wasted and 75% wasted cases respectively. The report stated that uneven wastage could significantly affect the level of loading required to collapse the cover. Further study to investigate local failure in a hatch cover follows below.

ULTIMATE STRENGTH OF HATCH COVERS

422. The dry cargo hatch cover, No. 1 cargo hatch cover and No. 2 hatch cover (representative of holds 2 - 5) were analyzed using two methods to determine what load of water could cause plate failure. An as-built, 50% wasted and 75% wasted condition was assumed in each method. The first method was a beam-strip analysis, using plate sections of unit width and a length equal to the distance between the stiffeners. A second method - membrane analysis for large deflection, was also employed. This theory recognized that, at large deflections, a plate will have in-plane tensile loads and respond like a membrane.

423. The results tabulated below are static loads of salt water necessary to yield or give ultimate failure to the covers. To obtain results for dynamic loading failures, half of the value listed should be used. For example, in a 75% wasted condition, the dry cargo hatch cover would be broached by 1.5 feet of water using the beam strip analysis, and 1 foot of water using the membrane analysis, if the load was applied dynamically. The locations in the hatch covers revealing the weakest strength were chosen for the study.

STATIC PRESSURE HEAD (Feet Water) TO YIELD AND FAIL CARGO HATCH COVERS NO. 1 AND NO. 2 AND THE DRY CARGO HATCH COVER

HATCH COVER	NO. 1	NO. 2	DRY CARGO
Beam Strip Analysis (Yield)			
As-Built	14	20	22
50% Wastage	4	5	5
75% Wastage	1	1	1
Beam Strip Analysis (Ultimate)			
As-Built	29	40	43
50% Wastage	8	10	11
75% Wastage	2	2	3
Membrane Analysis (Ultimate)			
As-Built	30	46	46
50% Wastage	13	17	16
75% Wastage	4	6	2

LOADING, STRENGTH AND RESPONSE

424. This study used a computer program to analyze the ship's response, under loaded conditions, in still water and seas of 15 and 20 foot "significant wave heights" (SWH). A significant wave height is an average of the 1/3 highest waves over a period of time. Vessel speeds were varied for each of the wave height cases.

425. The still water results for the departure loading condition described in the Loading Information section were as follows:

	CALCULATED VALUES	ABS RULE VALUES
Bending Moment (Ft.-Tons)	119,200 (sag)	229,000
Bending Stress (psi)	4,900 (deck)	*
Shear Force (Tons)	1,090((Sta. 16)	1,920
Shear Stress (psi)	3,240 (At neutral Axis)	*

* Not directly calculable from ABS Rules

426. It was found that the stresses and forces were reduced when flooding of the spaces forward of No. 1 hold was assumed. The ship changed from a sagging condition to a hogging condition at lower stress levels.

427. Wave-induced loading and hydrostatic and dynamic loads placed on the bottom longitudinals were super-imposed with the still water bending stresses to produce the following results:

COMBINED LOADS AND STRESSES - INTACT CONDITION

CALCULATED VALUES

	Speed 8 Kts. SWH 20 Ft.	Speed 10 Kts. SWH 15 Ft.	ABS RULE VALUE
Bending moment (Ft.Tons)	302,900 (sag)	260,700 (sag)	560,700
Bending Stress (psi)	19,900 (bottom)	18,000 (bottom)	23,100
Shear Force (Tons)	2,130 (Sta. 4)	1,900 (Sta. 4)	3,360
Shear Stress (psi)	6,330 (Neut. Axis)	5,650 (Neut. Axis)	15,120

428. As in the still water case, when the combined stresses were studied with flooding at the bow, the stress and force levels dropped.

INTACT STABILITY

429. The intact loading conditions were summarized in the Loading Information section. Using the observed drafts and trim, the cargo loading data from the Norfolk and Western Terminal, the Chief Mate's estimate on "over carriage" of coal, and the Chief Mate's figures for liquid loading and stores, a metacentric height (GM) corrected for free surface was calculated as 3.51 feet. This GM figure is well above that required to meet the Coast Guard's stability criteria regarding wind-heel (weather) - Ø.39 feet.

430. The intact angle of down-flooding was 46 degrees, measured to the top of the midship cargo hatch coaming at the side. A natural roll period was calculated as 13.14 seconds. The angle of repose of the coal cargo was found to be about 25 degrees.

431. The intact righting arm curve showed a maximum righting arm of 2 feet at an inclination of 35 degrees. The range of positive stability went from Ø to about 73 degrees.

DAMAGED STABILITY

432. Eighteen cases of damaged stability were investigated. In these cases, the flooded compartments were considered open to the sea; therefore, flooding was assumed to occur until an equilibrium draft was reached. Various combinations of flooded compartments forward of No. 3 hold were considered in an effort to establish conditions matching those observed on the vessel. The departure loading condition of 1Ø February 1983 was used (displacement = 32,49Ø long tons) to construct static stability curves for each condition. Permeabilities of Ø.98 and Ø.95 were assumed for the ballast tanks and forward stores spaces respectively. A permeability of Ø.38 was used for cargo hold No. 2. Due to the void space witnessed in No. 1 hold, the permeability of that space was increased to Ø.41

INTACT AND DAMAGED STABILITY TABULAR DATA

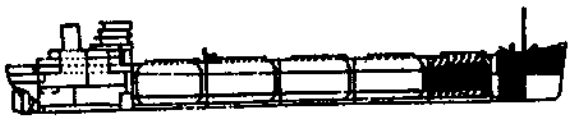
CASE NO/SPACES FLOODED	TRIM BY BOW (FT)	DRAFT AT FP (FT)	MAX RA (FT)	RANGE STAB. (DEG)	STBD HEEL (DEG)
INTACT	Ø.65 (by stern)	34.Ø	2.Ø	73	Ø

1. Fwd. cargo & stores spaces & chain locker	1.55	35.12	1.75	65	Ø

2. Fwd cargo/stores, chain locker & deep tanks	8.6	39.82	1.65	64	Ø

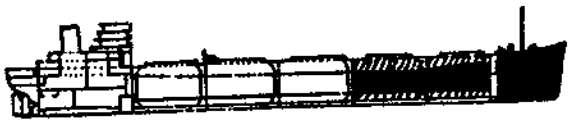
3. Fwd cargo/stores, chain locker, deep tanks, forepeak	12.5	42.33	1.6Ø	64	Ø

CASE NO/SPACES FLOODED	TRIM BY BOW (FT)	DRAFT AT FP (FT)	MAX RA (FT)	RANGE STAB. (DEG)	STBD HEEL (DEG)
4. Fwd cargo/stores, chain locker, deep tanks & Cargo No. 1	20.84	48.25	1.10	52	0

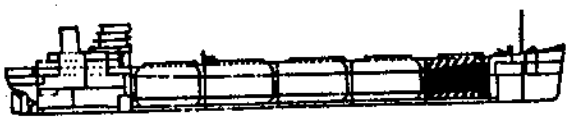


5. Fwd cargo/stores, chain locker, deep tanks, forepeak & Cargo No. 1	25.23	51.06	0.97	50	0

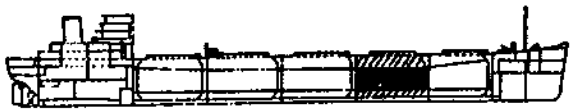
6. Fwd cargo/stores. chain locker, deep tanks, forepeak, Cargo Nos. 1 & 2	STATICALLY UNSTABLE				



7. Cargo No. 1	7.0	39.12	1.77	71	0

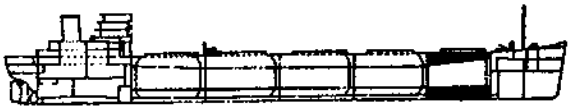


CASE NO/SPACES FLOODED	TRIM BY BOW (FT)	DRAFT AT FP (FT)	MAX RA (FT)	RANGE STAB. (DEG)	STBD HEEL (DEG)
8. Cargo No. 2	5.4	38.73	1.65	69	0

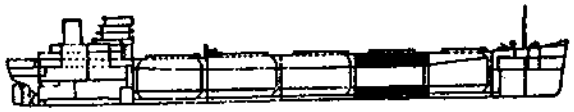


9. Cargo Nos. 1 & 2	14.7	45.4	1.37	62	0

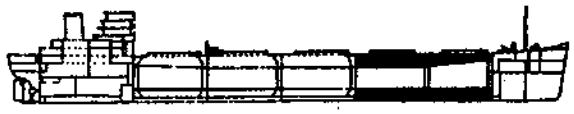
10. STBD Wing Tank No. 1	0.72	34.68	1.9	73	2.0



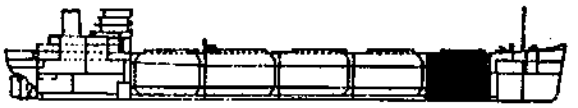
11. STBD Wing Tank No. 2	0.76	34.87	1.7	72	4.5



12. STBD Wing Tanks Nos. 1 & 2	2.25	35.93	1.43	72	6.0

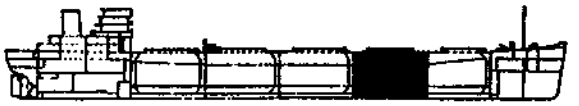


CASE NO/SPACES FLOODED	TRIM BY BOW (FT)	DRAFT AT FP (FT)	MAX RA (FT)	RANGE STAB. (DEG)	STBD HEEL (DEG)
13. Cargo No. 1, STBD Wing Tank No. 1 & PORT Wing Tank No. 1	10.33	41.49	1.70	71	0

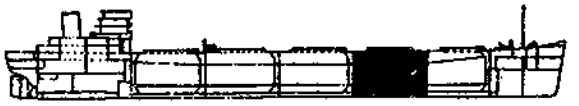


14. Cargo No. 1, STBD Wing Tank No. 1	8.7	40.35	1.52	69	2.3

15. Cargo No. 2, Wing Tanks No. 2 PORT & STBD	8.64	41.43	1.6	70	0

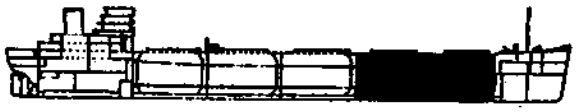


16. Cargo No. 2, STBD Wing Tank No. 2	7.0	40.06	1.2	67	4.6



CASE NO/SPACES FLOODED	TRIM BY BOW (FT)	DRAFT AT FP (FT)	MAX RA (FT)	RANGE STAB. (DEG)	STBD HEEL (DEG)
17. Cargo Nos. 1 & 2, STBD Wing Tank No. 2	16.6	47.0	0.87	54	4.4

18. Cargo Nos. 1 & 2, Wing Tanks No. 1, PORT & STBD; Wing Tanks No. 2, PORT & STBD	24.4	52.8	0.87	52	0



DAMAGE STABILITY, SPECIAL CASES:

433. Two special case studies were requested. The first case considered symmetrical flooding (open to the sea) of No. 1 Cargo Hold, and the spaces forward of that hold (except the pumproom) and Starboard Wing Tank No. 1. This condition yielded a trim by the bow of 29.22 Feet, and an angle of heel of 4 degrees to starboard. A second case was considered whereby Starboard Wing Tank No. 2 was opened to the sea in addition to the flooding above, and no positive righting arm existed - the ship was statically unstable.

434. The report noted that very little water needed to be added to the No. 2 Starboard Wing Tank in Case No. 2 in order for the transverse stability to disappear. The report stated it was not possible to obtain a 10 degree heel under these assumptions, and maintain a reasonable amount of residual stability.

INTACT STABILITY AFTER DOWN FLOODING

435. Three cases of assumed downflooding were investigated to determine the effect on the vessel's stability if certain forward compartments were flooded through the hatch covers. The results are tabulated below. The last case, in which both No. 1 and No. 2 Cargo Holds were flooded in addition to the forward stores spaces, deep tanks and chain locker, showed a trim of 48.4 Feet by the bow - which resulted in the bow being submerged 12 Feet below the waterline. In still water, the righting energy was small, and the range of stability only 17 degrees.

DOWN FLOODING CONDITION	TRIM BY BOW (FT)	DRAFT FP(FT)	MAX RA (FT)	RANGE OF STAB (DEG)
1. Fwd cargo stores, chain locker & deep tanks	14.15	44.14	1.30	62
2. Fwd cargo stores, chain locker, deep tanks & No. 1 cargo hold	23.62	50.11	0.85	47
3. Fwd cargo stores, chain locker, deep tanks & Nos. 1 & 2 cargo holds	48.42	68.45	0.08	17

METALLURGICAL STUDIES

436. In September 1983, an expedition to the wreck site was made by NTSB investigators and metallurgists aboard the CGC HORNBEAM. Divers cut three steel samples from the main wreckage at the break in the middle of Hold No. 2 - one from the starboard E strake (about 2' x 2'); an irregular piece from the starboard A and B strakes (about 14' long); and another rectangular piece from the port E and F strakes (about 3' long).

437. A visual examination of the starboard E strake piece revealed that the thickness varied from 0.794 to 0.803 inches. The nominal original thickness from the shell expansion drawing was 0.850 inches. The after edge of the piece was bent sharply inward, and a chevron pattern on the edge revealed it had fractured from starboard to port.

438. Examination of the starboard A and B strake section revealed it had been bent inward about 90 degrees and fractured from the outside to the inside of the plate. Thicknesses of 0.782 to 0.882 inches were found in the A strake, and 0.749 to 0.870 inches in the B strake, to be compared with the original nominal thickness of 0.909 inches.

439. The portside piece contained about 2-1/2 feet from the F strake, and 6 inches of E strake. About one-third of the fracture surface showed evidence of damage after the fracture by metal to metal impact. The undamaged portion of the fracture indicated it had fractured from the F strake toward the E strake, but that bending forces from outside in had also contributed to the tear. Thicknesses varied from 0.829 to 0.833 inches in the E strake, as compared with a nominal original of 0.850. The F strake thicknesses varied from 0.842 to 0.872, compared to original nominal thicknesses of 0.740.

440. The NTSB metallurgists concluded that none of the samples revealed a failure by brittle fracture. They concluded the fracture direction was down from the main deck, then across the bottom, indicating the fracture originated near the main deck. They found corrosion pitting more severe on the inside surfaces, indicating trapped moisture. Pitting on the outside surfaces was more uniform.

441. Charpy V-notch, tensile and chemical tests were performed on samples from the starboard A and B strake sample by the National Bureau of Standards, Fracture and Deformation Division, in Washington, D.C. The results showed that the steel samples met the 1961 ABS Rules for Class B structural steels.

442. Steel used for the bottom plating in the midship section would have been required to meet the 1961 ABS materials requirements for Class B. This designation applied to structural steel plates over 1/2 inch and less than 1 inch thick. The 1961 ABS requirements specified a tensile strength of 58000 to 71000 psi. There was no yield point criteria. The following chemical limits applied to Class B steel in 1961:

Carbon	max percent	0.21
Manganese	percent	0.80 to 1 10
Phosphorus	max percent	0.05
Sulphur	max percent	0.05

No charpy impact tests were specified at that time, although provisions were made for alternative specifications being acceptable to the ABS, provided a notch toughness program was agreed upon. It could not be determined if the MARINE ELECTRIC steel samples had been accepted on the basis of an "alternative specification" agreement at the time of construction.

443. The results of the chemical and tensile tests performed by the National Bureau of Standards on the samples are tabulated below. The tensile specimens were made in accordance with ASTM Standard E8-81 for 0.50 inch diameter round specimens with a two-inch gauge length. The chemical testing was performed by a commercial laboratory, using spectrographic techniques to identify nine standard elements in ordinary steel. Additional analysis was then conducted to search for "tramp" elements in the steel.

RESULTS OF TENSION TESTS

Specimen	Tensile Strength psi (1)	Yield Strength 0.2% Offset psi (2)	Elongation % in 2" (3)	Reduction of Area, %
1	65,500	48,000	33.0	66.6
2	66,500	40,700	35.2	67.0

1. Values given to nearest 500 psi in accordance with ASTM Standard E8-81.
2. Values given to nearest 100 psi in accordance with ASTM Standard E8-81.
3. Values given to nearest 0.2% in accordance with ASTM Standard E8-81.

RESULTS OF CHEMICAL ANALYSIS

ELEMENT	PERCENT BY WEIGHT
Carbon	0.19
Managanese	0.97
Phosphorus	0.012
Sulphur	0.019
Silicon	0.04
Nickel	0.02
Chromium	0.03
Molybdenum	0.01
Copper	0.05

TRAMP ELEMENT SURVEY (Amounts are approximate)

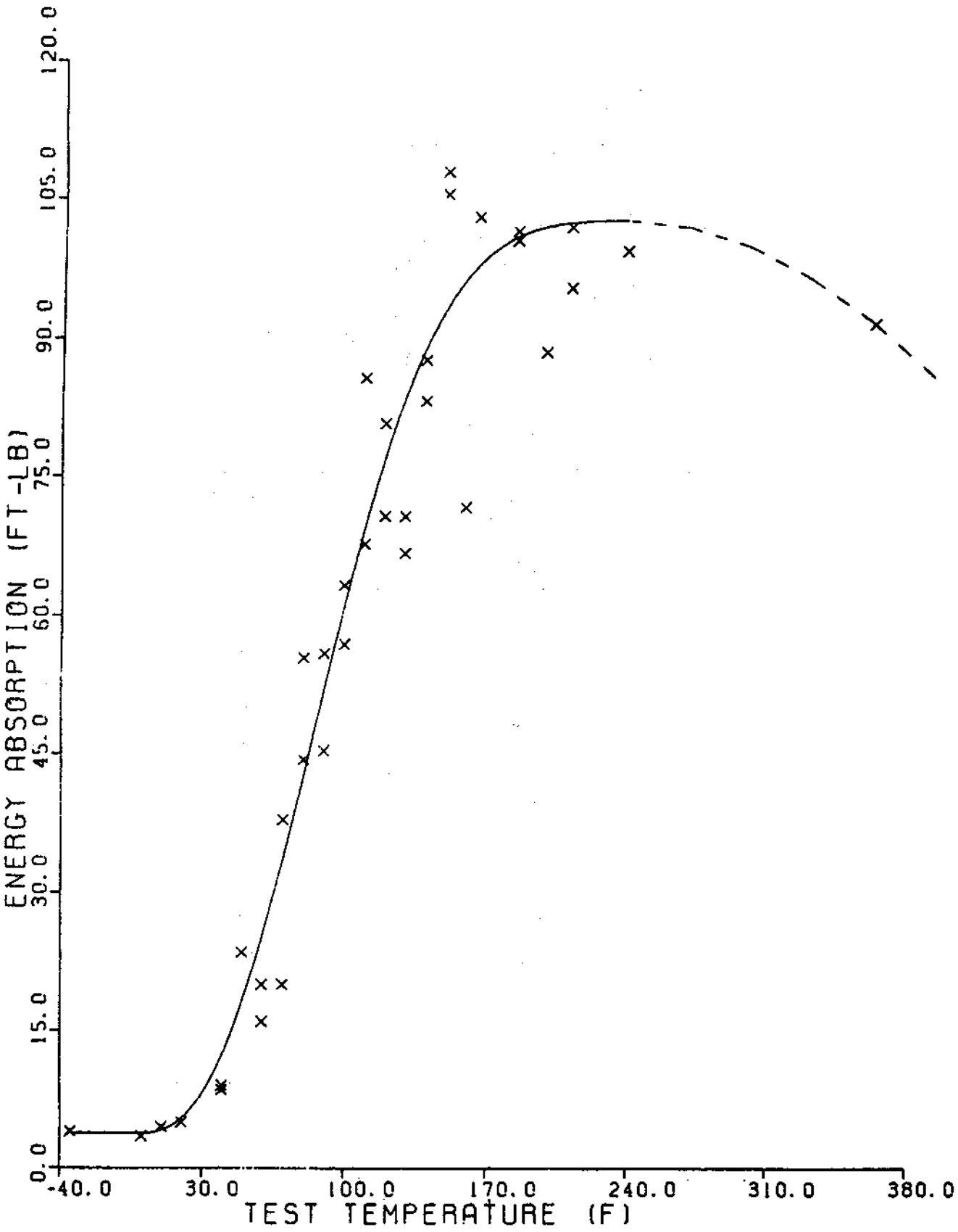
Aluminum	0.007
Vanadium	0.005 (trace)
Titanium	0.005 (trace)
Tin	0.006
Cobalt	0.008

444. The charpy V-notch specimens were machined to meet ASTM Standard E23-82. Tests were run on 35 specimens over a temperature range of -35 to +365 degrees Fahrenheit. The results are tabulated below, and then expressed in a transition curve.

445. The charpy specimens were aligned longitudinally, with the V-notch cut so as to simulate a crack proceeding transversely across the hull. Polished and etched portions of the plate confirmed that the steel from which the samples were taken was rolled in the fore-and-aft direction. It can be seen that the steel exhibited ductile behavior at 37 to 44 degrees Fahrenheit, the approximate water temperature at the time of the casualty.

RESULTS OF CHARPY V-NOTCH IMPACT TESTS

Specimen	Temperature Degrees F.	Energy Absorbed Ft - Lb	Specimen	Temperature Degrees F.	Energy Absorbed Ft - Lb.
28	-35	4.0	19	110	86.0
2	0	3.5	20	120	71.0
5	10	4.5	21	120	81.0
7	20	5.0	22	130	67.0
11	40	8.5	23	130	71.0
27	40	9.0	14	140	83.5
13	50	23.5	15	140	88.0
1	60	16.0	6	150	106.0
4	60	20.0	9	150	108.5
3	70	20.0	34	160	72.0
31	70	38.0	12	166	103.5
32	80	44.5	16	185	102.0
33	80	55.5	17	185	101.0
29	90	56.0	35	200	89.0
30	90	45.5	8	212	96.0
25	100	57.0	10	212	102.5
26	100	63.5	36	240	100.0
18	110	68.0	24	365	92.5



Charpy V-Notch Transition Curve

446. An additional study of the steel samples was made by EMTEC Corporation, of Norman, Oklahoma, in the area of Crack Tip Opening Displacement (CTOD) testing. This criteria attempts to define the minimum crack size that the steel could sustain at a specified stress level and temperature before brittle fracture occurs. Two samples were made - one in the starboard B strake, and the other from the starboard A strake. The testing revealed that the critical crack size was 2.5 inches for dynamic loading, and 40 inches for slow loading at 40 degrees Fahrenheit, and a stress of 20,000 psi. The metallurgists who prepared this report stated the actual loading on the MARINE ELECTRIC probably fell somewhere between the dynamic and static loading cases. They also noted that the appearance of the metal samples examined showed the metal had exhibited good ductile behavior when the hull broke apart.

RECOVERED PORT LIFEBOAT INSPECTION

447. According to the Chief Mate, the starboard lifeboat was stripped and cleaned on a trip through the Mediterranean in April 1982. Repairs were made in Haifa to a wasted plate on the starboard boat. The port boat was stripped and cleaned in May 1982.

448. The permanent Master said he thought the boats were exercised in June 1982 for the Coast Guard inspection. He did not put a boat in the water between September 1982, when he rejoined the ship after vacation, and February 1983, when he was relieved by Captain Corl.

449. After the casualty, a Coast Guard Inspector in Portsmouth,Virginia, performed an inspection of the MARINE ELECTRIC's lifeboat No. 2 that was recovered by the CGC CHEROKEE. It was a 24 foot galvanized steel lifeboat, with no motor or Fleming gear, built in May 1966. Some damage to the forward retaining bail that keeps the boat falls from coming out of the releasing gear was sustained when the boat was transferred to the boat shop at Support Center, Portsmouth,Virginia. He said this piece had extensive corrosion on it, however.

450. The boat had suffered considerable damage due to the sinking of the ship - there were punctures and gashes in the sides, and portions where the grab rail was torn off. The port side was banged, dented and set in.

451. Some of the conditions he noted that must have existed before the casualty were as follows:

a. The lifeline bights had been cut from the inside, perhaps to get them out of the way to paint the interior, since paint covered the cut ends.

b. The rowlocks would not drop into their positions on the gunnel, due to corrosion and build-up of paint.

c. He noted that the releasing gear arm had not been moved. The releasing gear operated properly, but showed considerable corrosion. The preventer bars at the boat falls hook-up did not perform their function. The bars were found frozen in the up position. For this reason, the lifeboat released itself from the vessel without the releasing gear being tripped.

d. Provision lockers were painted shut in the boat, and required extra effort to open them. Two provision lockers had no gaskets, and another had a painted gasket which rendered it an ineffecive seal and allowed water to soak the distress flares.

e. The flashlight batteries were dated 10-81. They should have been replaced in 10-82.

f. Two repairs had been made on the port side - one a patch 10 inches by 10 inches, and another 14 inches by 7 inches.

g. An extensive build-up of paint, scale and corrosion was readily noticeable through the exterior of the shell plates. In areas the plating was paper thin. A large number of rivet heads were wasted to the point they were ineffective.

452. The overall condition of the boat was poor. There was a lot of rust and corrosion beneath the paint. The thin plates and deterioration he witnessed on the port side of the boat most likely existed at the time of the Midperiod inspection. The lifeboat, in its condition prior to the sinking of the MARINE ELECTRIC, failed to meet the Coast Guard standards, and was not satisfactory for its intended use.

NO. 3 HOLD HATCH PANEL INSPECTION

453. On 15 February 1983, a Coast Guard Inspector surveyed the hatch panel from No. 3 hatch of the MARINE ELECTRIC, which had been removed in November 1982, and deposited at the Tidewater Construction Company yard in Norfolk, Virginia. There were 36 doublers over the top portion, two insert patches and two small

"Red Hand" epoxy patches. The condition of the plating on top and underneath was highly deteriorated, with considerable amounts of scale. Thickness ranged from paper thin to roughly 1/4 inch. It is estimated that 50% of the hatch panel was 1/8 inch thick, and 20% was paper thin. Stiffening beams were twisted or distorted. Some doublers had pulled away from the original plate, leaving gaps between the top plating of the cover and the doubler. The dogs appeared to have been used occasionally, but not steadily due to the build-up of scale. All dogs sighted appeared to be in the same condition. The gasket appeared to be in good condition, except where a three inch gap existed in the gasketing. It is felt that the three months the panel had laid in the yard had negligible effect on the deterioration noted.

SION

CONCLUSIONS

THE CAUSE OF THE CASUALTY

1. At or about 0415 on 12 February 1983, while in the approximate position Latitude 37-52.8 North; Longitude 74-46.0 West, the MARINE ELECTRIC capsized and subsequently sank in approximately 120 feet of water, resulting in the loss of 31 crew members. The Chief Mate, [redacted] Third Mate, [redacted] and Able Seaman, [redacted], were the sole survivors of the casualty.

2. The cause of the casualty was due to progressive flooding of the vessel's forward spaces. The sequence of events most likely commenced with flooding through sections of the deteriorated and wasted top plating of the dry cargo hatch and wasted main deck plating subjected to the dynamic effects of the striking sea, resulting in filling the dry cargo spaces, stores spaces, and the deep tanks. The chain locker may have filled to some degree as a result of water entering through the spill pipe- a non water-tight deck fitting. The additional weight from flooding forward significantly reduced the freeboard at the bow, allowing greater amounts of sea water to board the vessel. Eventually, the force and weight of the boarding sea striking the top plating of No. 1 and No. 2 cargo hatch covers exceeded the strength of the deteriorated and wasted sections of the unsupported plating, resulting in the collapse of these plates, wholly or in part. Sea water then entered No. 1 and No. 2 cargo holds. The vessel settled into the water to a point where its righting arm was so reduced that the MARINE ELECTRIC became unstable, and capsized. A starboard list commenced about twenty minutes before the vessel capsized. The list was most likely produced by a cargo shift, or wind heel on the port side as the stability became increasingly tender.

3. Significant flooding of the forward spaces most likely occurred between 2000-2400 on 11 February 1983. The vessel lost most of its 13 foot freeboard at the bow during this watch. Since flooding through the hatches would be very gradual, it is likely the change in trim was imperceptible at first. The 12-4 AB noted the bow was not rising as before, and the ship was plowing through the waves when he took the lookout watch at midnight.

4. A contributing cause to the casualty was the failure on the part of Captain [redacted], Relief Master of the MARINE ELECTRIC, to take into consideration the effects of heavy boarding seas on the hatch covers, and to maneuver his vessel accordingly.

CONCLUSIONS REGARDING THE VESSEL'S DEPARTURE CONDITION

5. Prior to reaching the open seas on 11 February 1983, the ship's force, under the direct supervision of the Chief Mate, secured all the weather deck hatch covers and weather deck openings, using all available securing devices.

6. Belowdecks at the bow, at least one of the manhole covers to the deep tanks was not in place when the ship left Norfolk, since diver Becroft described putting his body into a hole fitting the description and location for one of these manhole locations. Had the cover been bolted, it is unlikely it would have dislodged after the sinking.

7. The MARINE ELECTRIC, on its departure from Norfolk, Virginia, on 10 February 1983, was not overstressed or overloaded. Although the sag numeral was exceeded by 6-7%, the detailed and conservative stress calculations made in the Coast Guard's Technical Report showed the hull was operated within its design limits.

8. At the time of the casualty, the MARINE ELECTRIC failed to meet the applicable Coast Guard Load Line Regulations, as well as the ABS Rules. Based upon records of the manufacturer's surveys, reports and testimony by the ship's officers, and the owner's repair records, the hatch covers had not been weather-tight since the 1981 Jacksonville overhaul, and did not meet the ABS Rule strength requirements. The hatch covers were wasted, holed, deteriorated, epoxy patched, deflected, weakened, and missing securing devices and cross-joint wedges. In addition, the main deck plating was wasted between the hatches, and was repaired improperly at times with epoxy patches. The hatch covers were not considered to have been fit or satisfactory for their intended use from 1981 to the time of the casualty, therefore, the vessel was in violation of its Certificate of Inspection.

9. The vessel did not meet the Coast Guard Marine Engineering Regulations or ABS Rules applicable to an effective cargo bilge pumping system. Solid plates had been installed over the bilge wells in the holds, which precluded pumping water out of the cargo holds. Consequently, the vessel was in violation of the provisions of the Certificate of Inspection.

10. The questionable condition of the ballast piping is not considered to have contributed to this casualty.

CONCLUSIONS REGARDING OTHER FAILURE POSSIBILITIES

11. The extensive damages noted during the diving expeditions are concluded to have occurred subsequent to the capsizing and did not contribute to the casualty.

STRUCTURAL FAILURE

12. There was insufficient evidence in the Technical Studies, Metallurgical Studies or witness statements to support a theory of a structural failure occurring prior to the capsizing and sinking.

a. No list appeared until about one-half hour before the ship capsized. Since the bow was noted down as much as four hours before this time, and it is unlikely that multiple structural failures would occur so as to create symmetrical flooding, the damaged stability cases which indicate hull failure conditions (specifically cases 12, 14, and 16) are not likely to have initiated the trim.

b. An assumption of a structural failure through the mid-depth shell plating into a cargo hold (which results in symmetrical flooding) assumes a failure near the neutral axis of the structure. The assumption is then unlikely since this area is away from the highly stressed plating at the turn of the bilge or the deck edge.

c. When a list of five degrees was noted, at about 0355 on 12 February 1983, it was immediately detected by the crewmembers. It is likely, then, that the starboard lists resulting from Damaged Stability Cases 12, 14 or 16 would also have been quickly recognized had they occurred.

d. On many occasions, the foredeck was pounded by green seas boarding the vessel. Seawater flooding through the dry cargo hatch cover into the forward stores spaces, would have relieved the sagging stresses on the hull, and produced lower levels of hogging stresses. Thus, with the stress levels lowered, structural failure became less likely.

e. With conservative assumptions made for the vessel's condition, based on gauging reports, vessel speed and the sea conditions, the hull stresses stayed below about half the maximum allowable stresses provided by the ABS Rules. No evidence of excessive pitting, stress cracking, or "working" areas was found during the 1981 drydocking or at any time subsequent to the casualty. The metallurgical studies revealed the hull steel failed in a ductile manner, and not a brittle fracture.

f. The testimony the engineers were pumping No. 1 and No. 2 starboard wing tanks, and perhaps No. 1 port wing tank does not necessarily indicate a hull fracture. Pumping started between 0250 and 0300 on 12 February 1983. At 0300 on 12 February 1983, six feet of water covered the focsle. Water could have entered the wing tanks through vents which may have carried away, or had their check valves malfunction when submerged. Since the forward bow spaces could not be pumped from the engine room, and the cargo hold bilge wells were covered by blank plates, it was logical for the engineers to attempt suction on the only forward spaces they could. It is unknown how much water was in the ballast tanks, and it is unknown how long the engineers continued to pump a particular tank. Recovery of the port ballast manifold revealed that the suction valves to No. 1 and No. 2 port wing tanks were closed, indicating that pumping of these forward tanks was ceased or never commenced at some time before the casualty. Poor or incomplete repairs on the sloping wing-tank longitudinal bulkheads were also possible sources of leaks from a flooded cargo hold into the wing ballast spaces.

13. The testimony and diving information on the wreck revealed no evidence of pounding damage prior to the time the MARINE ELECTRIC capsized. Characteristically, pounding damage on a vessel is likely to occur in light loaded conditions, and cause dished-in bottom plating aft of the bow where it becomes flat enough to absorb the impact of the wave. The MARINE ELECTRIC was fully loaded, and no dished plating at the bow section was observed on the wreck.

GROUNDING

14. No evidence was found to indicate that the vessel had suffered any grounding damages prior to the casualty. The Loran fixes taken by the MARINE ELECTRIC showed that at all times while escorting the THEODORA she had sufficient water under her keel and was clear of any shoal areas. Underwater examination of the wreck revealed no evidence of indentation or scrape marks on its bottom plating that could be attributed to a grounding.

ANCHOR DAMAGE

15. The starboard anchor was secured when the vessel put out to sea on 10 February 1983. The devil's claw was in place. The recovery of the devil's claw turnbuckle showed it opened nearly the full extent, but still sufficiently tightened to provide fully threaded holding strength of the unit. Since steam was used to free-wheel the windlass when the temperature reached 28 degrees F., the windlass was out of gear and the brake engaged. The chain stopper was engaged on the chain.

16. It is most probable the starboard anchor let go when the ship rolled and capsized. On its starboard side, the devil's claw would have fallen off, the chain slacked over the wildcat, and the chain stopper opened, allowing the anchor to run free. The Chief Mate heard a rumbling when the vessel capsized; this may have been the anchor letting go. The pounding of the hull on the bottom while the stern was partially buoyant could account for the eventual fouling and parting of the anchor and chain.

CONCLUSIONS REGARDING RESPONSIBILITY

COAST GUARD

17. The Coast Guard inspector failed to insure that the requirements of the Load Line Regulations were met during the February 1981 overhaul. Given the knowledge of major repairs to the hatch covers, it was incumbent upon him to insure the repairs were sufficient and proper, that ABS was complete in its inspections, and the vessel complied with the Load Line Regulations. Since the vessel did not meet the regulations, the inspector should have taken steps to revoke the Load Line Certificate. The ABS has no authority to revoke a Load Line Certificate once issued by them.

18. The deteriorated condition of the hatch covers should have been apparent to the Coast Guard inspectors at the Inspection for Certification in June 1981, and the Mid-Period Inspection in June 1982. Corrective action should have been initiated. They failed to properly examine and test the hatch covers, or cause such examinations and tests to be conducted, to assure compliance with the applicable regulations, apparently relying solely on the fact the vessel possessed a Load Line Certificate. The inspections made were incomplete and misleading. Inspectors cited certain examinations as being made and found to be satisfactory, when, in fact, they were never made, and indicated that the vessel was in full compliance with the applicable regulations.

19. In the course of the examinations in June, 1981, and June, 1982, the Coast Guard inspectors failed to take notice that the cargo bilge wells were covered with solid metal plates and require their removal. There is evidence that confusion existed in the minds of the Coast Guard inspectors as to when metal hatch covers were to be examined.

20. The deteriorated condition of the No. 2 lifeboat existed at the time of the Coast Guard Mid-Period examination in June 1982. An experienced inspector would most likely have detected this condition and ordered corrective action at that time.

21. The Coast Guard examinations made of the MARINE ELECTRIC during the drydock and overhaul completed in February 1981, the Inspection for Certification in June 1981, the midperiod inspection in June 1982, and the drydock extension inspection in December 1982, were performed by Coast Guard personnel who lacked the experience to conduct safety examinations of a vessel the size, service, and configuration of the MARINE ELECTRIC. The incompleteness of these inspections as to the dictates of regulations and policy was attributed to the lack of training and experience on the part of the Coast Guard inspectors.

22. The extension of the drydock interval from February, 1983, to April, 1983 had no bearing on the casualty, but the Coast Guard examination to authorize that extension was insufficient to justify that extension. The absence of a policy or criteria with respect to an inspection for extension contributed to that insufficiency.

23. The Coast Guard had no firm regulations, policy or guidelines which addressed a valid reason for honoring a request for a drydock extension. Nor had it any regulations, policy or guidelines which outlined specific areas to be examined or tests to be made, prior to granting an extension of drydock.

AMERICAN BUREAU OF SHIPPING

24. The ABS surveyor issued the Load Line Certificate in Jacksonville, 1981, without inspecting the hatch covers - a major component of the Load Line Survey. The ABS surveyor had the opportunity and duty to be aware of the repairs, testing and material condition of the hatch covers. After the major repairs were made to the hatch covers during the overhaul period, and also as a part of the Special Hull Survey, the surveyor should have required the weather-tightness test prescribed in Section 18 of the Rules. No hose testing of the hatch covers was done, however. The reliance of the surveyor on the mistaken vessel computer record entry that the hatches had been hose tested in 1980 was improper and no excuse in light of the comprehensive repairs made to the covers. In spite of the surveyor's recollection of examining the hatch covers, the covers were not placed aboard until the day before the ship sailed from the yard, and the day after the surveyor's last visit to the vessel. The crew worked all night to get the covers in a closed position, and the owner found it necessary to call the hatch manufacturer to the ship two weeks after leaving the yard, to spend twelve days bringing the hatches to an operable state. Even then, it was necessary to use sealing tape to make them weather-tight. The attending ABS surveyor should not have endorsed the Load Line Certificate with the hatch covers in such poor condition. The inspection made was incomplete and misleading in that the records show the vessel to meet all applicable load line regulations when in fact it did not.

25. The ABS surveyor during the 1981 Jacksonville repair period should have been cognizant of the fabrication and installation of blank plates over the bilge wells in the cargo holds, a violation of the ABS Rules, and taken appropriate action. He did not review the yard specifications provided to him to note the item concerning this unauthorized modification. The Coast Guard inspector also had the opportunity to be aware of the bilge system modification regarding the blank covers on the cargo drain wells, and the duty to require their removal, since it did not meet the Coast Guard regulations.

26. The attending Bureau Surveyor in February 1982 was remiss in the discharge of his responsibilities as to the Load Line Regulation, as well as the Bureau Rules, by failing to properly examine the cargo hatch covers. Further, he failed to take appropriate action when he was made aware of the many doubler plates and epoxy patches over holed and wasted plating on the hatch covers and the main deck between hatches. Ignoring these conditions, he endorsed the Load Line Certificate, attesting that the vessel was in full compliance with the Load Line Requirements, as well as Bureau Rules. The surveyor may have spent as little as one-half hour for this survey, too short a time to perform an adequate survey. He was an exclusive surveyor to the ABS with over 30 years experience. His inspection was incomplete, and his report was inaccurate, in that the cargo holds were noted as satisfactory, and they were never entered, and the hatch covers met the Load Line Regulations and ABS Rules, when they were in a deteriorated, non weather-tight state.

27. Basically, ABS surveys and visits are oriented toward protecting the best interest of marine insurance underwriters, and not for the enforcement of Federal safety statutes and regulations. Since the cost of these surveys and visits is borne by the owners, or other interested parties, the attending surveyor is subject to the influence of such persons.

THE OWNERS

28. The ship was poorly managed and horribly maintained with respect to repairs to the hatch covers, main deck, and holes in the cargo hold area caused during off-loading. When the patchwork repairs performed during the 1981 drydocking proved to aggravate the covers' conditions, the hatch manufacturer was called in, but not permitted to restore the weather-tightness or strength originally designed into the covers. On completion of his work in March 1981, and on three other occasions before the vessel's accident, the manufacturer's representative notified the owners, in writing, of his concern that the hatches were not weather-tight or structurally sound. Reports to officials of the Marine Coal Transportation Corporation, or the parent company, MTL, of the exacerbating deterioration of the panels came not

only from the manufacturer, but from the vessel's repair requisitions and reports from attending Port Engineers and Agents. Repairs to the hatch covers were being made on a monthly, even weekly basis, using doublers or epoxy patches. Doublers were also the standard means of repairing the "stevedore" damages from off-loading the coal, and for repairing main deck wastage between the hatches.

29. As the Marine Superintendant, and later the Fleet Director, Mr. Joseph Thelgie was the senior corporate official having intimate knowledge of the MARINE ELECTRIC's material condition and was the individual most capable of initiating action to correct the unseaworthy conditions of the hatch covers and main deck. He had the duty to notify the regulatory agencies or insure such notification was made when repairs were performed on the hull and hatch covers, but failed to do so.

30. Records show that, in the last two years of her life, the MARINE ELECTRIC had upward of 400 doublers or patches placed on the hatch covers, and over a dozen doublers on the main deck between the hatches. No tests were performed after the patch repairs were made to affected areas on the hatch covers, beyond a localized hose test of the doubler. Tests to prove the weather-tightness or the strength of the covers were never performed. Instead, to insure weather-tightness, the owners resorted to tar paper and roofing tar to seal the hatches during grain voyages, but took insufficient steps to restore the required strength of the covers.

31. At no time was the Coast Guard notified by the owners, agents or Master of the vessel of the hatch cover or hull repairs made after February 1981, as required by 46 CFR 42.09-50 and 91.45-1. Similarly, the ABS was not officially notified of the doubler or patched repairs. At no time did the owners, their agents, or the master notify the regulatory bodies of the approximately 95 wasted areas on the hatch covers that were noted in the Chief Mate's sketches, and existed at the time of the casualty.

32. The MARINE ELECTRIC's owners were remiss in not submitting the modification to use blank plates over the cargo hold bilge wells to the Coast Guard for plan approval. The Permanent Master knowingly and wrongfully permitted the use of these blank plates in the coal trade without Coast Guard or ABS approval, and in contradiction to good marine practice, as described by the National Cargo Bureau in its publication, "Code of Safe Practice for Solid Bulk Cargoes." The publication was endorsed by the Coast Guard, and was available on board the vessel.

33. There is evidence of a violation of 46 USC 404 (46 USC 497) and the regulations in 46 CFR 90 on the part of the

owners, Marine Transport Lines. This matter will be referred to the Commander, Fifth Coast Guard District for further investigation under the civil penalty proceedings.

34. Throughout the inspection and repair history of the MARINE ELECTRIC's hatch covers, MacGregor was the only participant to recognize the importance of maintaining the strength of the covers. All other parties seemed concerned only with weather-tightness. As a result of this state of mind, the owners were content to use doublers or epoxy and tape, and the crew did not recognize the danger to the vessel's seaworthiness posed by seas striking the hatch covers.

THE CREW

35. The Permanent Master, Captain [redacted] in spite of his disclaimer concerning the handling of repairs aboard the vessel, was knowledgeable of the deteriorated conditions of the hatch covers and main deck plating between the hatches and was cognizant of the MacGregor Company's report of 30 November 1982. He ordered the use of epoxy patches over holed and wasted portions of the hatch covers and main deck, without insuring that proper, permanent repairs were made. In addition, he failed to notify the Coast Guard when the hole was discovered in the side shell at No. 1 port upper wing tank on 2 February 1983. Instead, after he was cognizant of it, he ordered a temporary repair of a cement box. He allowed the vessel to go to sea with blanks over the cargo hold bilge wells, and with uncovered holes in the top of the No. 5 hatch covers. At no time did he make these conditions known to the Coast Guard, American Bureau of Shipping, or Captain [redacted], his relief.

36. There is evidence of misconduct and/or negligence on the part of the permanent master, Capt. Farnham, for knowingly putting to sea in an unseaworthy vessel in violation of 46 USC 390d (46 USC 10908). This matter will be forwarded to the Commander, Fifth Coast Guard District for further investigation under the suspension and revocation proceedings.

37. A number of officers and crewmembers were aware of the condition of the hatch covers, and at times expressed their concerns among themselves. However, due to the lack of seagoing employment, and the desirable nature of the voyages being made by the MARINE ELECTRIC, they were content to sail the vessel on coastwise voyages without further complaint. They were largely under the belief that should a serious casualty occur, they would be evacuated in a timely manner.

LIFESAVING ASPECTS

38. The EPIRB failed to function, and did not transmit its signal. The unit may have tangled in the wreck as it capsized to

starboard, and become trapped under the hull. A manufacturer's defect is also possible, since, in 1980, a high failure rate was detected in the water-activated switch installed in this type EPIRB. Though a remote possibility, the battery may have failed. The expiraton date for the battery was January, 1983.

39. There is evidence that the chemical lights supplied with the lifejackets were not energized by several crewmembers. Two survivors said they knew how they operated, but did not think to activate them. There is no evidence, however, that the lack of such lights hindered the rescue operations. One helicopter pilot testified to the effectiveness of the retro-reflective tape on the lifejackets, and did not recall noticing the small lights on the jackets.

40. With the exception of the Master and six engineers, the crew complement of the MARINE ELECTRIC has been accounted for.

41. Had the crew been provided with exposure suits, it is probable more would have survived the accident. An exposure suit would typically extend survival time in 40 degree Fahrenheit water from two to three hours beyond that expected for an individual without such protection. The regulations promulgated subsequent to the casualty requiring exposure suits for crewmembers address this issue adequately. Having exposure suits aboard is no substitute, however, for thorough vessel inspections and compliance with other Coast Guard safety regulations.

42. There is evidence that the boarding ladders for the liferafts, consisting of synthetic fabric web-belt ladders, were inadequate to permit successful boarding from the cold, stormy seas. The victims were unable to get a hand hold on the boarding ladder since it became compressed against the side of the inflation chambers.

43. Though the material condition of the lifeboats was poor, and the davit arrangement old, there is no evidence these factors contributed to the loss of life in this casualty. However, launching a lifeboat under the adverse conditions the MARINE ELECTRIC was encountering is much more difficult to perform with quadrantal davits than with gravity davits.

GENERAL CONCLUSIONS

44. The examination of vessels made for the purpose of enforcement of Federal Statutes and Regulations should be conducted by an impartial governmental agency having expertise in that field, with no other interests and/or obligations other than assuring compliance with applicable requirements. By virtue of its relationship to the vessel owners, the ABS cannot be considered impartial (in spite of the many years experience of

the surveyors). Their failure to note and require correction of the deteriorating hatch covers on the MARINE ELECTRIC constituted negligence on their part. The assertion on the part of the surveyors in their written reports and their testimony before the Board that the hatch covers were in satisfactory condition and met the Load Line Regulations, raises questions about the professional integrity of their surveys. The Coast Guard is an impartial agency, but the inexperience of the inspectors who went aboard the MARINE ELECTRIC, and their failure to recognize the safety hazard imposed by the deteriorated, weakened and non-tight hatch covers, raises doubts about the capabilities of the Coast Guard inspectors to enforce the laws and regulations in a satisfactory manner.

45. At the time of the casualty, the Coast Guard had no policy or guidelines as to the type of examination, tests, or time interval for such tests to determine the material condition and weather-tight or water-tight effectiveness of metal hatch covers. Confusion existed in the minds of the attending Coast Guard inspectors as to when metal hatch covers were to be examined. However, policy clearly dictated that judgments of the material condition and tightness of hatches should be made at the Inspection for Certification, Mid-Period and Drydock Inspections.

46. The inspection records produced by the Coast Guard marine inspectors on the MARINE ELECTRIC were misleading and incomplete. The conventions used by the inspectors for notations in the inspection books were inconsistent, producing vague and incorrect records of their inspections.

47. The regulations clearly give the ABS the duty to inspect any weather deck closures and insure they meet the regulations. The enforcement of these load line regulations however, is the responsibility of the Coast Guard. Accordingly, Coast Guard inspectors must be trained and knowledgeable in the proper operation and upkeep of hatch covers and other weather deck closures. This policy is stated in the Hull Inspection portion of the Merchant Marine Safety Manual (Part 30-6-25), but no specific guidance concerning inspection of hatch covers is given.

48. The ability to pump the cargo holds through the bilge system played no part in this casualty; however, an ability to pump them could have given the crew an earlier indication of a flooding condition. Further, had the bilge piping system extended from the engine room to the bow spaces, the crew could have detected the presence of flooding in those spaces.

49. Had the MARINE ELECTRIC been equipped with high level bilge alarms in the unmanned focsle spaces and the cargo holds, an early detection of the ingress of water would have been made. Automatic bilge level alarms forward would also provide the crew

with reports of watertight integrity during times of rough weather when no one can be sent forward to check conditions or sound tanks.

50. Had the Master found a favorable heading, and ordered periodic examination of the foredeck and hatch covers, as well as sounding bilge wells of the forward spaces and cargo holds, the ingress of water would then have been discovered at an early stage.

51. In the case of the MARINE ELECTRIC, the observation in NVIC 7-68 that where doublers are permitted they tend to "proliferate as randomly-placed patches" proved woefully true. The guidance permitting doublers is overly broad and does not specifically provide for periodic re-evaluation of the efficiency of the doubler or the conditions of the defect the doubler was intended to remedy.

RECOMMENDATIONS

1. That the examination of U. S. merchant vessels to assure their compliance with the applicable Federal safety statutes and regulations be conducted and determined by knowledgable members of a U.S. Government agency. The responsibilities for these functions should not be delegated or entrusted to the private sector.

2. That the Commandant commission a panel to conduct an indepth review of the entire Coast Guard Commercial Vessel Safety Program and make recommendations to him. The panel should consist of no less than fifty percent retired Officers in Charge, Marine Inspection recognized for their vessel inspection expertise, and recognized for their Merchant Marine background. The Program's overall structure and the Coast Guard's ability to continue with such a program should be studied, with emphasis placed on:

a. The present and projected experience level of the program administrators, program and project managers, Officers in Charge, Marine Inspection, and field inspectors, and the distribution of such expertise within the program.

b. The present and projected procurement and training programs, and identification of the requirements and qualifications needed of a marine inspector.

c. The review of all Headquarters, District, and field office policies and practices to detect any variation from statute or regulation.

3. That the Coast Guard publish a policy to define the reasons and vessel inspection criteria that must be followed before granting a vessel an extension of its drydocking date. Requests for such an extension should not be entertained unless the reasons are beyond the owner's or operator's control.

4. That the Commandant publish a policy concerning the examination, repair, and testing of metal hatch covers with emphasis not only on the watertight or weathertight integrity of the covers, but the strength of them as well. The policy should address gauging and hose testing the covers periodically.

5. That the drydocking and Inspection for Certification be combined inspections for vessels over 100 gross tons.

6. That all vessels currently fitted with quadrantal davits be required to install gravity davits for the launching of their lifeboats.

7. That a regulation be promulgated to require any vessel which holds a Load Line Certificate to have on board a shell expansion plan annotated to display the hulls' required and as-built scantlings. This plan is to be made available to the Marine Inspector during times of drydocking and hull repairs.

8. That the actions of the Permanent Master, Capt. James K. Farnham, be referred to the U. S. Attorney for prosecution under 46 USC 10908, in that he took the MARINE ELECTRIC to sea with unseaworthy and improperly repaired hatches and main deck areas, and with no effective cargo bilge pumping system on numerous occasions, and, on two occasions in February, 1983, with a hole in the port sideshell.

9. That the actions of Mr. Joseph Thelgie with respect to managing the repairs and maintenance of the MARINE ELECTRIC while serving as MTL's Fleet Director be referred to the U. S. Attorney for prosecution under 46 USC 658 (46 USC 10908).

10. That the Coast Guard propose regulations requiring improved boarding arrangements into inflatable liferafts by persons afflicted by injuries or cold. Modifications of existing liferafts should be required to improve the hand-hold arrangements of the boarding ladders.

11. That the Coast Guard propose regulations to insure that vessels so constructed and operated with spaces which become inaccessible due to heavy weather or conditions of loading are fitted with flooding alarms capable of notifying the control station of such condition.

12. That the Coast Guard and Federal Communications Commission reopen or conduct further investigation into the reliability of the Martech Whaler EB-2BW EPIRB.

13. That the guidance found in the Coast Guard's "Notes on Inspection and Repair of Steel Hulls" (NVIC 7-68) be amended to further restrict the use of doublers as a permanent repair to vessel structures or fittings contributing to the ship's strength or watertightness. Doubler repairs, when permitted, should be a matter of permanent record and be subject to periodic re-evaluation.

14. That this investigation be closed.

[redacted]

P. C. LAURIDSEN
Captain, U. S. Coast Guard
Chairman

[redacted]

D. A. CALICCHIO
Captain, U. S. Coast Guard
Member

[redacted]

Lieutenant Commander
U.S. Coast Guard
Recorder

APPENDIX 1: CREWMEMBER INFORMATION:

Survivors

1. [redacted]

2. [redacted]

3. [redacted]

Dead Recovered

4. John B. ABRAMS, [redacted]
   Position: Steward Utility
   SSN : [redacted]
   Address : [redacted]

   NOK :
   DOB :

5. Clayton L. O. BABINEAU, License No. [redacted]
   Position: Second Mate
   SSN : [redacted]
   Address :

   NOK :
   DOB :

6. Eric M. BODDEN, [redacted]
   Position: Utility
   SSN : [redacted]
   Address :

   NOK :
   DOB :

7. Peter DELATOLLA, [redacted]
   Position: Bosun
   SSN : [redacted]
   Address : [redacted]

   NOK :
   DOB :

8. Jose M. FERNANDEZ, [redacted]
   Position: Deck Utility
   SSN : [redacted]
   Address : [redacted]

   NOK :
   DOB :

9. Celestino R. GOMES, [redacted]
   Position: Utility
   SSN : [redacted]
   Address : [redacted]

   NOK :
   DOB :

10. Malcolm E GRAF, Jr., [redacted]
    Position: Engine Mechanic
    SSN : [redacted]
    Address : [redacted]

    NOK :
    DOB :

11. Robert C. HARRELL, [redacted]
    Position: Ordinary Seaman
    SSN : [redacted]
    Address : [redacted]

    NOK :
    DOB :

12. Robert L. HERN, [redacted]
    Position: Ordinary Seaman
    SSN : [redacted]
    Address : [redacted]

    NOK :
    DOB :

13. Charles J. JOHNSON, [redacted]
Position: Able Seaman
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

14. Albion E. LANE, License No. [redacted]
Position: Radio Officer
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

15. Edward W. MATHEWS, [redacted]
Position: Able Seaman
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

16. Richard MORGAN, [redacted]
Position: Wiper
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

17. William A. MULBERRY, [redacted]
Position: Engine Mechanic
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

18. John J. O'CONNELL, [redacted]
Position: Able Seaman
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

19. Richard J. POWERS, License No. [redacted]
Position: Chief Engineer
SSN :
Address :

NOK :
DOB :

20. Jose O. QUINONES, [redacted]
Position: Steward Baker
SSN :
Address :

NOK :
DOB :

21. Thomas E. REYES, [redacted]
Position: Utility
SSN :
Address :

NOK :
DOB :

22. Richard W. ROBERTS, License No. [redacted]
Position: Third Mate
SSN :
Address :

NOK :
DOB :

23. Raul R. RUIZ, [redacted]
Position: Wiper
SSN :
Address :

NOK :
DOB :

24. Norman W. SEVIGNY, [redacted]
Position: Able Seaman
SSN :
Address :

NOK :
DOB :

25. David SHEPERD, [redacted]
Position: Utility
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

26. Richard TORRES, [redacted]
Position: Able Seaman
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

27. John B. WOOD, [redacted]
Position: Able Seaman
SSN : [redacted]
Address : [redacted]

NOK : [redacted]
DOB : [redacted]

Missing, Presumed Dead

28. [redacted]

29.

30.

31.

32.

33.

34.

APPENDIX 2: WEATHER DATA FROM NOAA BUOYS

NOTE: Wave heights are expressed in terms of Significant Wave Heights, and not necessarily the highest waves experienced at the scene.

		BUOY 44085		BUOY 44004			BUOY 41001	
DATE	TIME (EST)	WAVE HT. (FEET)	WIND	WS(KTS) (&GUSTS)	WAVE HT. (FEET)	WIND	WS(KTS) (&GUSTS)	WAVE HT. (FEET)
FRI 2/11 83	NOON	14.7	ENE	29 G 39	7.9	SE	39 G 45	19.7
	1 PM	17.4	ENE	32 G 45	9.8	S	28 G 35	22.0
	2 PM	17.6	ENE	32 G 44	12.5	SW	28 G 35	22.3
	3 PM	19.1	ENE	32 G 47	MISSING	SW	28 G 36	19.4
	4 PM	18.6	ENE	37 G 50	13.8	SW	26 G 34	18.7
	5 PM	18.0	ENE	35 G 52	15.4	SW	28 G 36	16.4
	6 PM	18.8	ENE	36 G 51	MISSING	SW	30 G 38	17.1
	7 PM	20.5	ENE	35 G 51	20.3	WSW	31 G 38	16.7
	8 PM	19.9	ENE	35 G 50	22.0	WSW	31 G 39	18.4
	9 PM	MISSING	ENE	34 G 50	21.3	WSW	30 G 37	18.0
	10 PM	18.8	E	21 G 35	21.3	WSW	32 G 41	17.1
	11 PM	MISSING	SSW	15 G 22	22.3	W	28 G 37	18.0
SAT 2/12/ 83	MDNT	16.5	SW	21 G 31	MISSING	W	27 G 35	16.7
	1 AM	16.6	SW	24 G 37	21.0	W	28 G 37	16.1
	2 AM	17.0	SW	25 G 41	21.6	W	30 G 38	16.1
	3 AM*	13.2	SW	28 G 41	19.7	W	28 G 36	14.8

DATE	TIME (EST)	BUOY 44085 WAVE HT. (FEET)	WIND	BUOY 44004 WS(KTS) (&GUSTS)	WAVE HT. (FEET)	WIND	BUOY 41001 WS(KTS) (&GUSTS)	WAVE HT. (FEET)
SAT 2/12/83	4 AM	14.7	MISSING	MISSING	MISSING	WNW	30 G 39	14.4
	5 AM	13.4	SW	30 G 43	22.3	WNW	28 G 36	15.7
	6 AM	12.9	WSW	20 G 28	MISSING	WNW	28 G 36	15.7
	7 AM	11.4	WNW	28 G 38	MISSING	WNW	25 G 32	16.1
	8 AM	11.2	NW	34 G 46	20.3	NW	24 G 30	15.7
	9 AM	10.9	NNW	36 G 45	22.0	NW	24 G 34	14.8
	10 AM	10.9	NNW	31 G 45	MISSING	NW	24 G 33	13.8
	11 AM	9.6	NNW	28 G 38	19.4	NW	21 G 31	12.1
	NOON	10.4	NNW	25 G 35	20.7	NW	20 G 24	11.8
	1 PM	9.6	NNW	25 G 36	19.0	NW	18 G 26	10.8

* DISTRESS CALL AT 3:13 AM EST.

APPENDIX 3: PHOTOGRAPHS

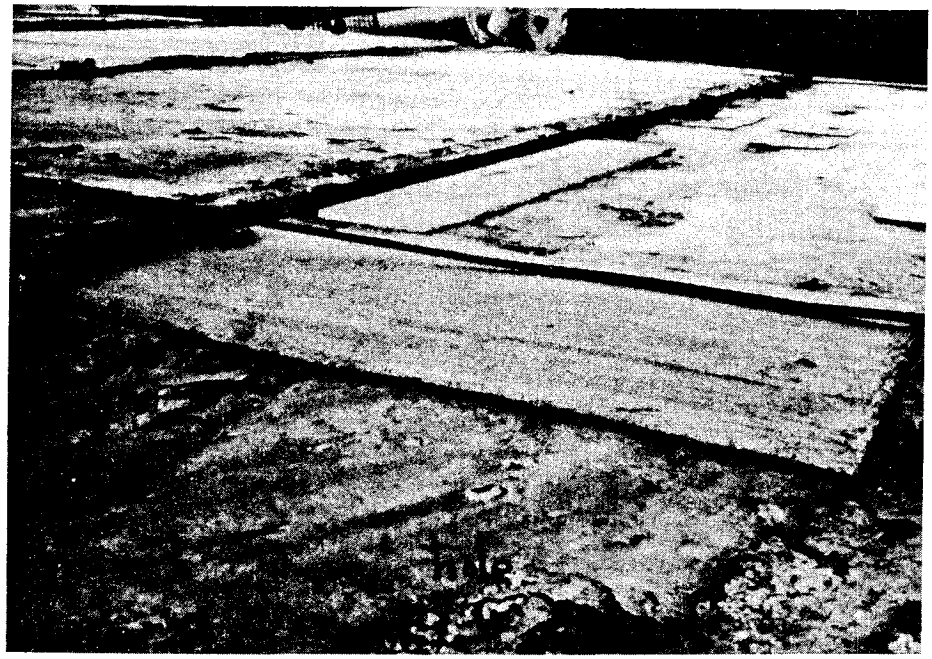


Photo of the No. 3 cargo hatchcover "a" panel (forwardmost) taken in February/March 1981 after the Jacksonville Shipyard period. MacGregor Company caption read: "#3a panel showing heavy patching and misalignment at cross joint. Note heavy corrosion and wavy distortions" (MacGregor Company Photo)

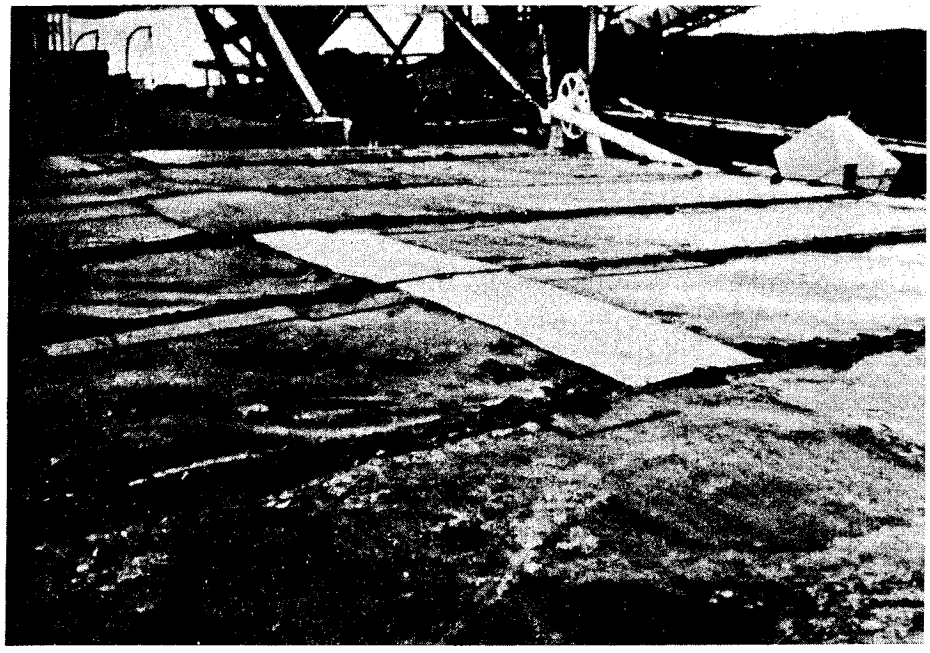
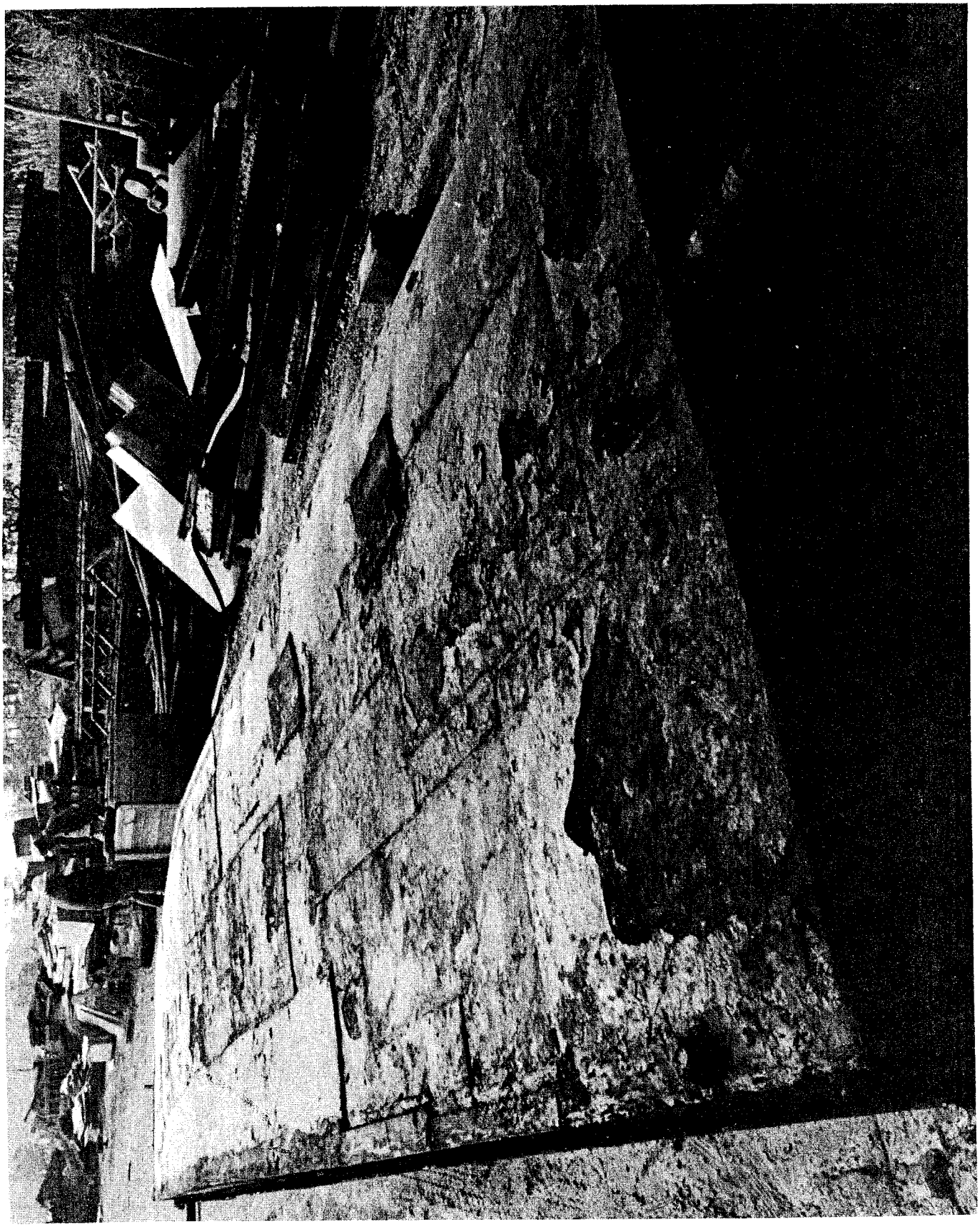
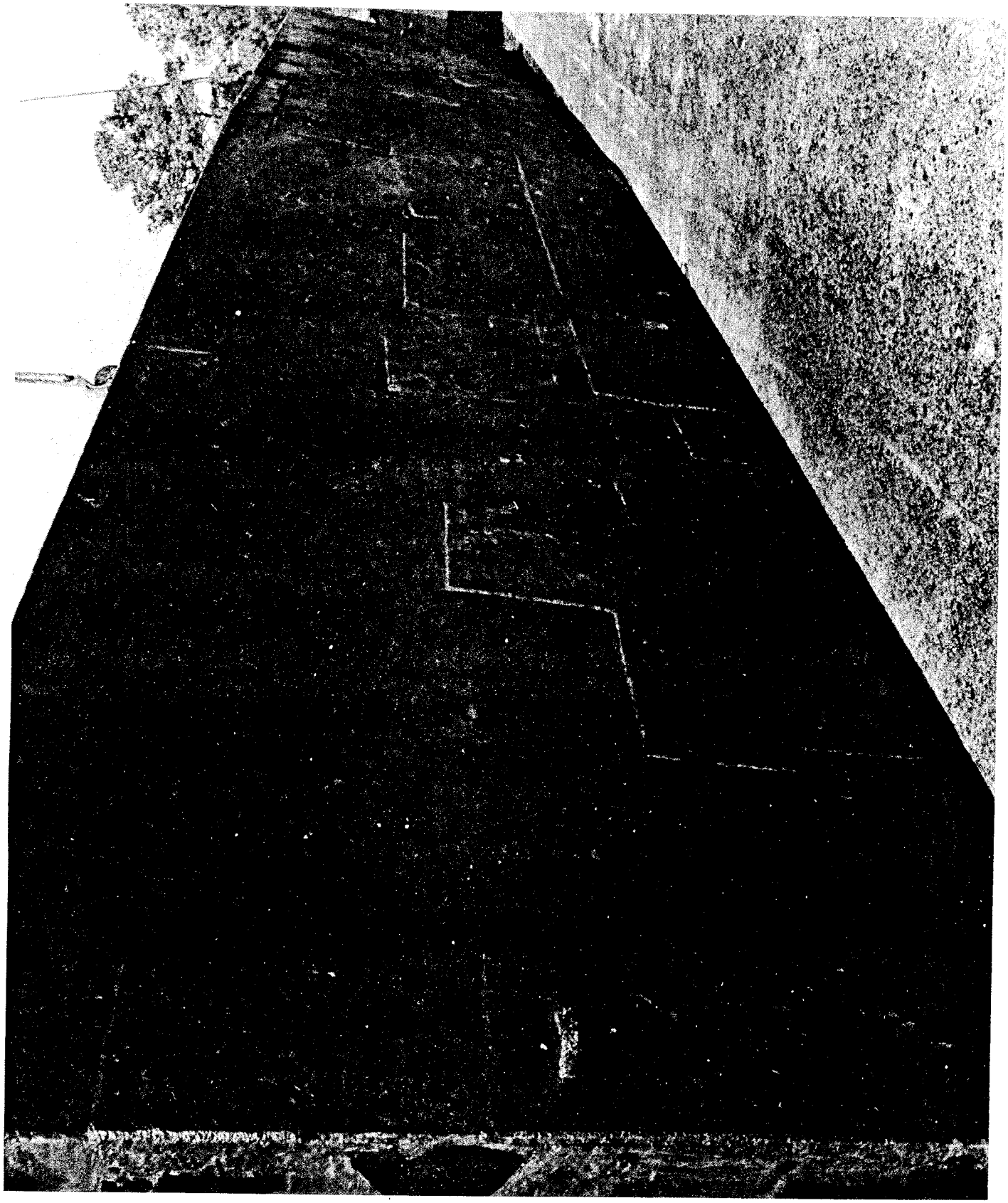


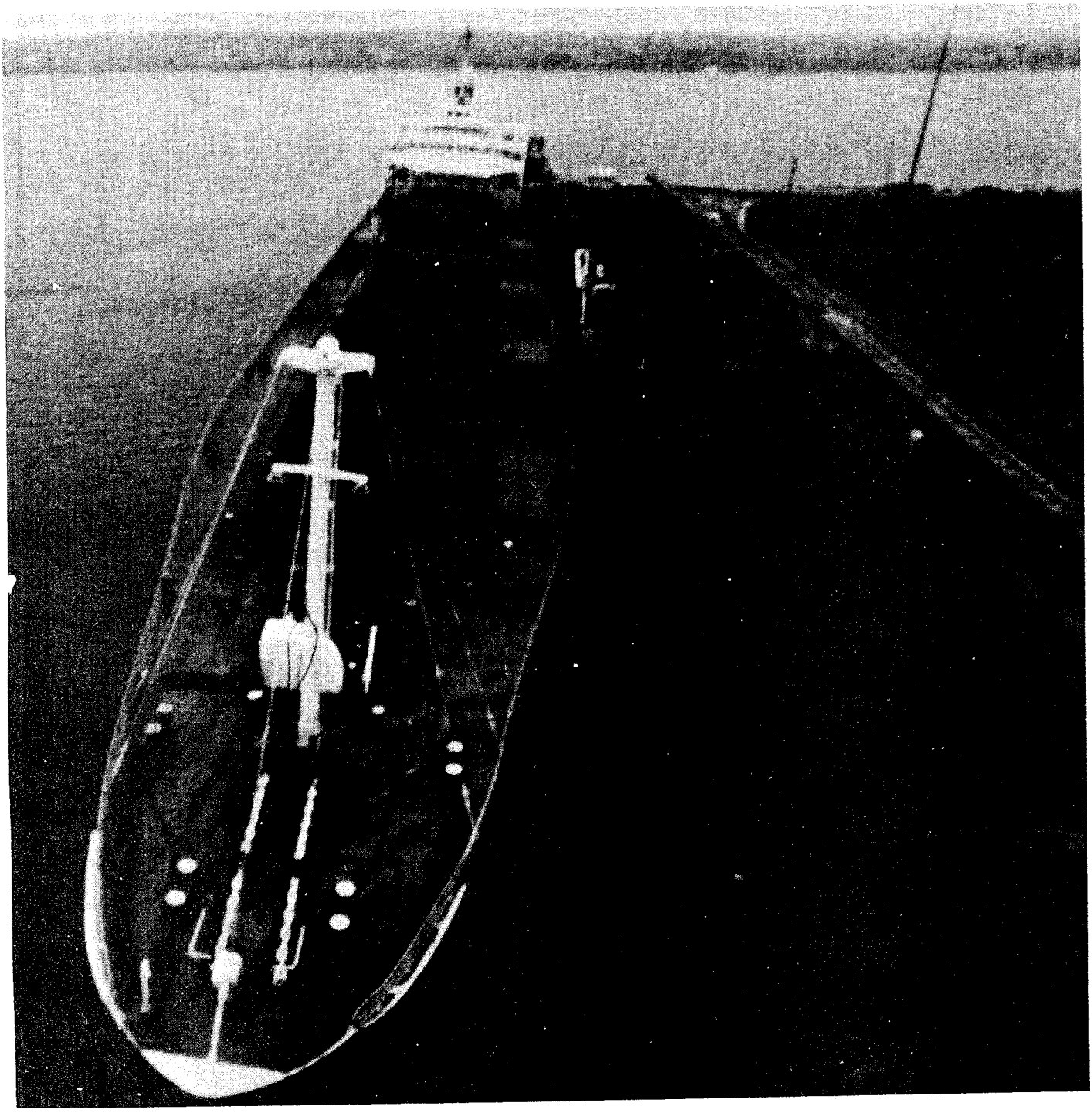
Photo of No. 3 hatchcover taken in February/March 1981. MacGregor Company caption read: "#3 looking aft showing b, c, d, e, f, and g panels. Note heavy patching and lack of cross joint wedges and misalignment at the cross joints." (MacGergor Company Photo)



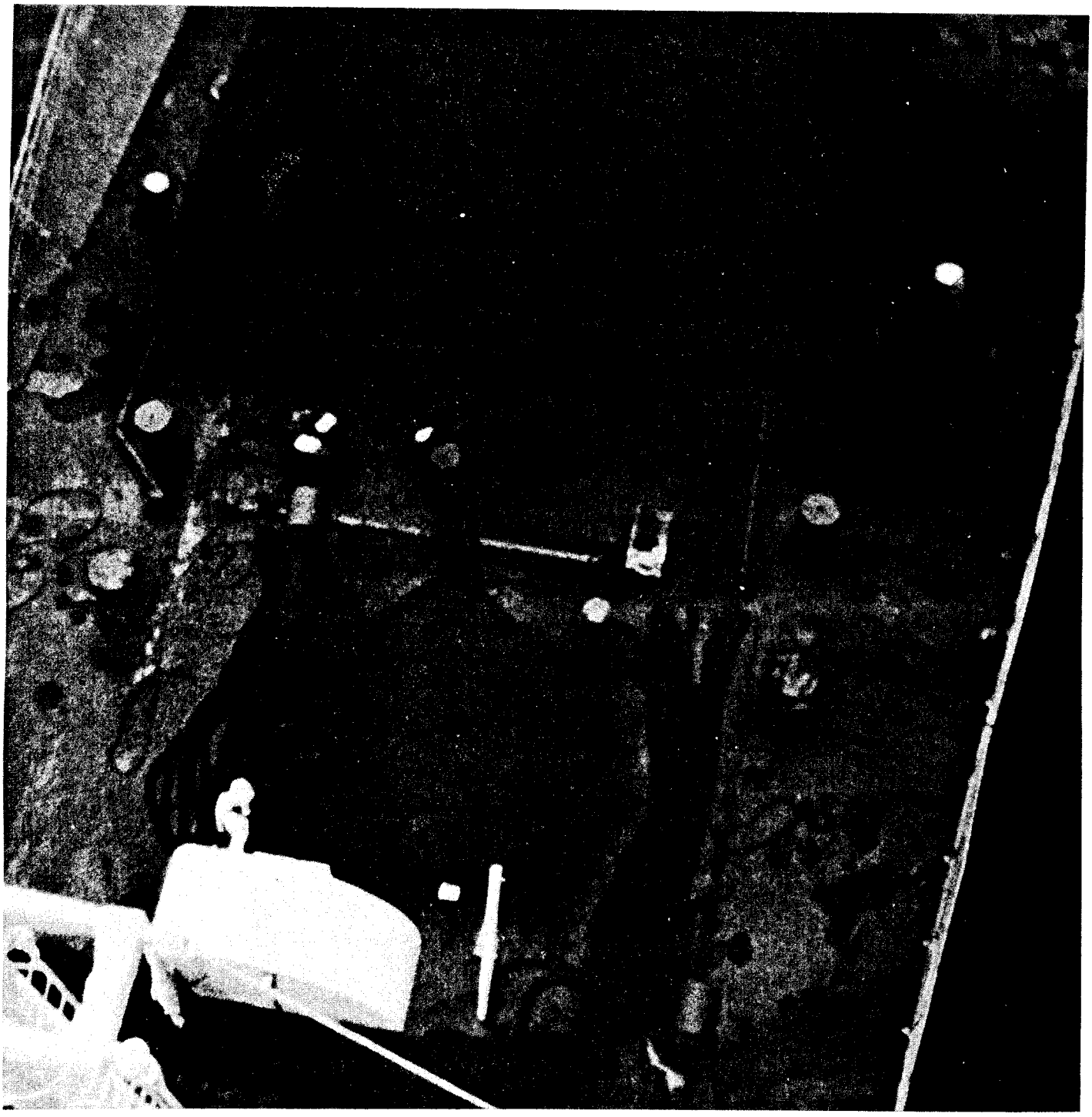
Forward panel on No. 3 cargo hatch cover removed from the MARINE ELECTRIC in November 1982. Photo taken in February 1983. (USCG Photo)



View of forward panel on No. 3 hatch cover removed from the MARINE ELECTRIC in November 1982. Photo taken in February 1983. (USCG Photo)



Frame of movie film taken of
MARINE ELECTRIC in November 1982
at Brayton Point, Ma.(film by Dugan
Rosalini Film Assoc.)



Frame of movie film of MARINE ELECTRIC taken in November 1982. The "doghouse", dry cargo hatch cover, and No. 1 cargo hatch opening are visible.(Film by Dugan Rosalini Film Assoc.)