DEPARTMENT OF TRANSPORTATION

COAST GUARD

MARINE CASUALTY REPORT

SS EDMUND FITZGERALD; SINKING IN LAKE SUPERIOR

ON 10 NOVEMBER 1975 WITH LOSS OF LIFE

U.S. COAST GUARD
MARINE BOARD OF INVESTIGATION REPORT

AND

COMMANDANT'S ACTION

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15. Supplementary Notes

16. Abstract – On the evening of 10 November 1975, the SS EDMUND FITZGERALD, while in a severe storm, with a full cargo of taconite pellets, sank in eastern Lake Superior at 46° 59.9' N, 85° 06.6W, approximately 17 miles from the entrance to Whitefish Bay, Michigan. All of the 29 crewmen on board at the time of the casualty are missing and presumed dead.

This report contains the U. S. Coast Guard Marine Board of Investigation report and the Action taken by the Commandant to determine the probable cause of the casualty and the recommendations to prevent recurrence.

The Commandant concurred with the Marine Board that the most probable cause of the sinking was the loss of buoyancy resulting from massive flooding of the cargo hold. This flooding most likely took place through ineffective hatch closures. The vessel dove into a wall of water and never recovered, with the breaking up of the ship occuring as it plunged or as the ship struck the bottom.

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SS EDMUND FITZGERALD; SINKING IN LAKE SUPERIOR ON 10 NOVEMBER 1975 WITH LOSS OF LIFE

TABLE OF CONTENTS

Page

ACTION BY THE COMMANDANT - U.S. COAST GUARD

Remarks..... i
Action Concerning the Recommendations..... ii

MARINE BOARD OF INVESTIGATION

Findings of Fact..... 1
Figure 1..... 10
Figures 2 & 3..... 11
Figure 4..... 12
Figure 5..... 33
Figure 6..... 56
Figure 7..... 57
Figure 8..... 58
Figure 9..... 59
Figure 10..... 60
Figure 11..... 61
Figure 12..... 88
Conclusions..... 89
Recommendations..... 105

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26 JUL 1977

Commandant's Action

on

The Marine Board of Investigation convened to investigate the circumstances surrounding the sinking of the SS EDMUND FITZGERALD in Lake Superior on 10 November 1975 with loss of life

The record 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 subject to the following comments.

REMARKS

1. This casualty presented the Board unique investigative challenges which delayed the submission of the report. Since there were no survivors or witnesses to be questioned, the Board went to considerable lengths to examine wreckage located soon after the casualty. In the spring of 1976, an underwater examination of the wreckage, utilizing highly sophisticated remotely controlled TV and photographic equipment, positively identified the wreck of the SS EDMUND FITZGERALD. The equipment was used to develop a detailed survey and photographic record of the structural damage and position of the wreckage. The sketches of the wreckage in the Board's report, showing the inverted stern section, loose hatch covers, and bow section, were made from this video tape and photographic record.

A further delay in the completion of the final report was due to the time needed to complete the sounding survey, conducted by Canadian authorities, of the water between Michipicoten Island and Caribou Island and adjacent waters.

2. The Commandant concurs with the Board that the most probable cause of the sinking was the loss of buoyancy resulting from massive flooding of the cargo hold. This flooding most likely took place through ineffective hatch closures. As the boarding seas rolled over the spar deck, the flooding was probably concentrated forward. The vessel dove into a wall of water and never recovered, with the breaking up of the ship occurring as it plunged or as the ship struck the bottom. The sinking was so rapid and unexpected that no one was able to successfully abandon ship.

With regard to opinions as to the causes of damage and the final sequence of events, an analysis has been made which demonstrates a possibility of capsizing and/or foundering. The analysis of various stages of flooding indicates that bending moment magnitudes and distribution would not support a conclusion of general structural failure as a primary cause of the casualty.

ACTION CONCERNING THE RECOMMENDATIONS

1. The following Board recommendations relate to load line regulations and weathertight integrity and are addressed jointly.

Recommendation 1: That Part 45 of Title 46 of the United States Code of Federal Regulations (Great Lakes Load Lines) be amended immediately to rescind the reduction in minimum freeboard brought about by the 1969, 1971, and 1973 changes to the Load Line Regulations.

Recommendation 3: That the owners and operators of Great Lakes ore carrying vessels undertake a positive and continuing program of repair and maintenance to insure that all closures for openings above the freeboard deck are weathertight, that is, capable of preventing the penetration of water into the ship in any sea condition. This program should include frequent adjustment of hatch clamping devices and vent closures and prompt repair of all hatches, coamings, covers, and clamping devices found damaged or deteriorated.

Recommendation 4: That Part 45 of Title 46 of the United States Code of Federal Regulations be amended to require closing and securing of hatches when underway in open waters and closing of vent caps when underway in a loaded condition. A visual inspection of the closure of hatch covers and vent caps should be conducted and logged by a licensed officer prior to sailing in a loaded condition.

Recommendation 5: That the Coast Guard undertake a program to evaluate hatch closures presently used on Great Lakes ore carriers with a view toward requiring a more effective means of closure of such deck fittings.

Action: Assignments of freeboard are based upon, among other things, a presumption of the ability to achieve the weathertight integrity necessary to prevent significant flooding.

The mutually dependent areas of safety which are an integral part of all Load Line Regulations are:

a. That the hull is strong enough for all anticipated seaways;

b. That the ship is designed and operated with proper stability;

c. That the hull is watertight to the freeboard deck;

d. That the hull has sufficient reserve buoyancy for seaworthiness;

e. That the topside area is properly fitted so as to be capable of being made weathertight for all anticipated seaways; and,

f. That protection for the movement of the crew on the weather decks at sea is provided.

None of these can be eliminated by additions to freeboard within practical limits. Freeboard, or its increase, is not by itself an adequate substitute for properly designed, maintained and operated hatches, coamings, gaskets, and securing attachments. Such substitution unduly penalizes good design, maintenance, and operations. Since the fall season of 1976, the Coast Guard has been conducting a Great Lakes Coast Guard ship-rider program to evaluate the overall effectiveness of the combination of freeboard, hatch closure, and ventilator closure effectiveness during the Intermediate (Oct 1-31) and Winter (November 1 - March 31) freeboard seasons. This program has confirmed the evidence found by the Board of Investigation indicating that it is not a singular occurrence that the hatch covers on the EDMUND FITZGERALD may not have been properly secured. Several ships have been found to suffer in varying degrees from a lack of weathertight integrity due to the inability to make hatch covers weathertight and due to the inattention to ventilator covers prior to a winter season voyage.

Accordingly, the Commandant is initiating action to:

a. Continue the ship-rider program in 1977 and in succeeding years as necessary in order to prevent sailing or severely restrict the voyage weather limits of any ship found to lack sufficient weathertight integrity. Extra seasonal freeboard requirements may also be assigned to supplement weather limitations by the Commander, Ninth Coast Guard District to vessels on an individual basis.

b. Bring to the attention of the owners and operators the fact that weathertight closures which are not effective when battened down void both the LOAD LINE CERTIFICATE and the CERTIFICATE of INSPECTION.

c. Firmly bring to the attention of ships' masters their operational responsibilities for weathertight integrity before and during weather conditions as outlined in operational regulations in 46 CFR 97.

d. Direct the Merchant Marine Technical Division at Coast Guard Headquarters, in cooperation with Commander, Ninth Coast Guard District, to immediately undertake a critical evaluation of the effectiveness of those hatch closures presently in use on Great Lakes bulk carriers utilizing information from the shipboard Coast Guard inspections. If this evaluation shows the present designs to be either not effective or requiring such maintenance as to be difficult to assure weathertight integrity, regulatory notices will be published stating their design or maintenance shortcomings and including a requirement that ships modify or change hatch covers to correct the deficiencies.

e. Direct the Merchant Marine Technical Division to reassess the existing INTERMEDIATE and WINTER Season freeboard corrections utilizing wave analysis information on Great Lakes wave spectra to be gathered during an ongoing research program (1977-1979).

2. The following recommendation concerns vessel subdivision and is relevant to the preceding Action.

Recommendation 2: That any subsequent amendments to the Great Lakes Load Line Regulations, as they apply to ore carriers such as FITZGERALD, reflect full consideration of the necessity for a means of detecting and removing flooding water from the cargo hold and for watertight subdivision of the cargo hold spaces. Such an appraisal should take due cognizance of:

a. The severe weather and sea conditions encountered by these vessels and the resulting high degree of deck wetness; and,

b. The inherent difficulty in meeting and maintaining a weathertight standard with the system of hatches, coamings, covers, gaskets, and clamps used on FITZGERALD and many other Great Lakes vessels.

Action: The Commandant intends to develop a federal regulation establishing a minimum level of subdivision for inspected Great Lakes cargo ships for two reasons directly related to this casualty. First, the sudden catastrophic foundering of the vessel apparently allowed no time for radio messages nor for individual survival. Second, the SS EDMUND FITZGERALD survived for several hours after indicating by radio message that some damage had occurred and the ship was about one hour from a safe harbor when it sank.

It is possible that even a minimum degree of watertight subdivision within the cargo hold could have effected a great change on the ultimate fate of both the ship and her crew. It is possible that the flooding, which is presumed to have occurred through ineffective hatch covers, might have occurred through only 1 or 2 hatches, but the subsequent flooding was able to penetrate the entire cargo hold. Subdivision bulkheads in the cargo space would have limited this flooding, possibly enough to allow the ship to make it to safe harbor. If they had realized the extent of damage, the provision of subdivision calculations and damage control instructions might have at the least allowed the crew more time to escape prior to the sinking.

An additional concern is raised by the report of minor side damage incidents. Bulk carriers are now being built which do not have the crew passage, ballast tank combination at the sides which provided some protection in cases of minor penetration. The arrangements on these new vessels are such that a penetration of the hull near the waterline might cause flooding over 90% of the ship's length. An incident could occur such that little chance of preventing sinking of the vessel would exist and the crew might have a very short time to escape. Subdivision standards will be directed toward this type of casualty. As the benefits of subdivision apply also to oceangoing cargo ships, international discussions toward an increase of subdivision safety for all cargo ships will be further pursued.

3. The following recommendations concern lifesaving equipment and crew training and are addressed jointly.

Recommendation 6: That the owners and operators of Great Lakes vessels, in cooperation with the maritime unions and training schools, undertake a program to improve the level of crew training in the use of lifesaving equipment installed on board the vessels and in other emergency procedures. This program should specifically include training in the use of inflatable life rafts and afford crews of vessels the opportunity to see a raft inflated.

Recommendation 7: That Part 97 of Title 46 of the United States Code of Federal Regulations be amended to require crew training in launching, inflation and operation of inflatable life rafts.

Recommendation 8: That the Coast Guard institute a continuing program of inspections and drills for Great Lakes vessels prior to each severe weather season. The severe weather season should correspond to the Winter Load Line season, i.e., 1 November through 31 March. Under this program, just before the severe weather season began, there would be an inspection to verify that the crew had been trained in the use of the lifesaving equipment and drills would be conducted with the crew

then on board the vessel. There would be a physical inspection of the spar deck and all critical structural and non-structural members exposed to damage from cargo loading and off-loading equipment including, but not limited to, hatch coamings, hatch covers, vent covers, tank tops, side slopes, hatch-end girders, arches, spar deck stringers, and spar deck plating. Additionally, all emergency drills would be witnessed, and alarms, watertight closures, navigation equipment, and required logs would be inspected.

Recommendation 10: That the Coast Guard complete, as soon as possible, the studies currently underway, which concern primary lifesaving equipment, its launching, and disembarkation from stricken vessels. And, that the measure be implemented promptly to improve the entire abandon ship system, including equipping and training personnel, automatic launching of equipment, and alerting rescue forces.

Recommendation 13: That the Coast Guard promulgate regulations which require vessels operating on the Great Lakes during the severe weather season to have, for each person on board, a suit designed to protect the wearer from exposure and hypothermia.

Recommendation 15: That the Coast Guard foster and support programs dedicated to increasing awareness, on the part of all concerned with vessel operations, inspection, and maintenance, of the hazards faced by vessels in Great Lakes service, particularly during the severe weather season. The programs should make maximum use of company safety programs, safety bulletins, publications, and trade journals.

Action: The intent of these recommendations is concurred with and the need for improved and periodic meaningful training in the use of lifesaving equipment and a vessel readiness inspection program prior to severe weather sailing is supported. The following action has been taken or will be taken relative to these recommendations:

a. In October 1976, the Coast Guard instituted a continuing program of inspections and drills for Great Lakes vessels prior to the severe weather season. The scope of the program includes the specific items listed in Recommendation 8 and the inspections are conducted while the vessels are underway and under actual operational conditions.

The requirements for conducting emergency drills and crew training are contained in 46 CFR Parts 97.15-35 and 97.13-20. Emergency fire and boat drills are required at least once every week and the master is responsible to assure that they are conducted. Assuring adequate drills are conducted is not unique to Great Lakes vessels, therefore the operations sections of 46 CFR, Parts 35, 78, 167, 168, and 185 will be amended to incorporate crew training in the launching, inflation, and

operation of inflatable life rafts. The Coast Guard recognizes this lack of training is of international magnitude and is working within IMCO in the preliminary stages of such a program.

b. Owners, operators, labor organizations, and training schools will be encouraged to develop a training program of the type indicated in Recommendation 6. To support this effort, the Merchant Vessel Personnel Division will work with the Maritime Administration to develop such training programs. The Coast Guard will set qualification standards requiring all licensed officers and able seamen be trained in the operation of inflatable life rafts as well as other lifesaving equipment. Input from the owners and operators of Great Lakes vessels, along with their crews' labor organizations and training schools, will be solicited.

c. The Coast Guard is expanding its public awareness program to provide useful information to seamen and aid operators and unions in the conduct of their training programs. In September 1975, a pamphlet on hypothermia, CG-473, was published and distributed on the Great Lakes and other areas where cold weather survival could be a problem. A proposal has been submitted within the Coast Guard to the Office of Research and Development to develop a means by which the public, specifically those on board commercial vessels, will be made aware of various safety factors, regulations, and safe operating procedures that apply to their particular commercial operation. For example, pamphlets may be developed and distributed (i.e., via labor unions, commercial fisherman organizations, vessel documentation officers, professional and business organizations) for each class of commercial operation. Great Lakes vessels would be an appropriate area for such a public awareness program.

A summary of the Board's report and an article, directed at increasing the mariner's awareness of the hazards of the Great Lakes, will be prepared for publication in the Proceedings of the Marine Safety Council.

Concerning Recommendations 10 and 13, a Notice of Proposed Rulemaking based on an Advance Notice of Proposed Rulemaking, published 7 June 1976 in the Federal Register, is being prepared for Great Lakes cargo, tank, and passenger vessels which will propose that:

a. All lifeboats on vessels be totally enclosed to provide protection from exposure and to lessen the danger of swamping and subsequent capsizing.

b. All lifeboats be diesel engine driven with the ability to start the engine in temperatures as low as $-22^{\circ}F$.

c. Sufficient lifeboats be provided to accommodate 100% of the persons on board the ship with additional lifeboats and life

rafts provided and located so as to provide accommodation for an additional 100% in the event that a casualty renders the other lifeboats unusable.

d. All survival craft be provided with launching devices which will be launched from their stowed positions with all persons onboard, eliminating the need for lengthy pre-launch preparation, a deck crew to stay aboard to control the launch, and in the case of life rafts, the need to enter the water before boarding.

e. Automatic float-free launching be required for life rafts.

f. An exposure suit be required for each person on board that will protect the wearer from exposure and hypothermia.

One lifeboat manufacturer is developing a float-free launching system for lifeboats which are also launched conventionally. This will be given further consideration as a requirement upon completion of a prototype system and an evaluation of its feasibility.

The remainder of the Board's recommendations are addressed individually.

4. Recommendation 9: That the Coast Guard take positive steps to insure that the Masters of Great Lakes vessels are provided with information, as is required by the regulations, concerning loading and ballasting of Great Lakes vessels, and that the information provided include not only normal loaded and ballasted conditions, but also details on the sequences of loading, unloading, ballasting, deballasting, and intermediate stages thereof, as well as information on the effect upon the vessel of accidental flooding from damage of other sources.

Action: The Coast Guard will develop performance criteria for loading manuals which will cover all the items in this recommendation except flooding conditions. Flooding conditions will be addressed in conjunction with the casualty control efforts discussed in the action on Recommendation 2.

5. Recommendation 11: That the Coast Guard schedule maintenance status for buoy tenders and icebreakers located in the Great Lakes so as to maximize surface search and rescue capability during the severe weather season, consistent with their primary missions.

Action: Commander, Ninth Coast Guard District has implemented this recommendation by issuing a District Directive on 9 September 1976. This Directive contains the requirements and guidelines for scheduling maintenance and underway periods of Coast Guard vessels on the Great Lakes.

6. Recommendation 12: That Subpart 94.60 of Title 46 of the United States Code of Federal Regulations, which requires emergency position indicating radio beacons (EPIRB), be amended to include requirements for such beacons on vessels operating on the Great Lakes during the severe weather season.

Action: Action is being taken to permit the operation of EPIRB's in the VHF-FM marine band. There is at present virtually complete shore station coverage on the Great Lakes on this band and constant monitoring of Channel 16 by stations in both the United States and Canada. A prototype EPIRB for testing is now being developed by the Transportation Systems Center. When the VHF-FM EPIRB's become available, regulations will be proposed requiring that they be installed on board inspected Great Lakes vessels during all seasons.

7. Recommendation 14: That navigation charts, showing the area immediately north of Caribou Island, be modified to show the extent of the shoals north of the island and that this modification be given the widest possible dissemination, including Notices to Mariners.

Action: A copy of the completed marine casualty report will be forwarded to the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, with a request that they coordinate the correction of the applicable charts with their counterparts in the Canadian Government.

[redacted]

Admiral, U. S. Coast Guard
Commandant

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UNITED STATES COAST GUARD

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16732/S.S. EDMUND
FITZGERALD
15 April 1977

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

Subj: S. S. EDMUND FITZGERALD, O.N. 277437; sinking in Lake Superior on 10 November 1975, with loss of life

FINDINGS OF FACT

1. In the early evening on 10 November 1975, the S. S. EDMUND FITZGERALD, while in a severe storm, with a full cargo of taconite pellets, sank in eastern Lake Superior at 46°59.9'N, 85°06.6'W, approximately 17 miles from the entrance to Whitefish Bay, MI. FITZGERALD had left Superior, WI, on the afternoon of 9 November enroute Detroit, MI, and was in communication with other vessels periodically throughout the voyage. At approximately 1530, 10 November, FITZGERALD reported some topside damage and a list but did not say what caused this damage or express any urgency in the report. The Master of FITZGERALD did request that the Steamer ARTHUR M. ANDERSON, which was following, provide navigational information to FITZGERALD and as the two vessels proceeded towards Whitefish Bay, FITZGERALD disappeared from ANDERSON's radar screen.

No distress message was received from FITZGERALD. The notification from ANDERSON of the suspected loss precipitated an extensive air and surface search. A large quantity of debris, including lifeboats, life rafts and other flotsam, was found, but no survivors or bodies were recovered. All of the twenty-nine crewmen on board at the time are missing.

After taking testimony, members of the Marine Board observed the underwater survey of the wreckage, which was conducted during late May 1976. Since FITZGERALD had passed between Michipicoten Island and Caribou Island in eastern Lake Superior and since charts of this area indicated that soundings last were taken in 1919, the Marine Board requested that Canadian authorities conduct a hydrographic survey of the area between Michipicoten Island and Caribou Island in eastern Lake Superior. The final field report of this survey was received on 25 March 1977.

2. Vessel Data

Name:	EDMUND FITZGERALD
Official Number:	277437
Service:	Freight
Gross Tons:	13,632
Net Tons:	8,686
Length (bp):	711 ft.
Length (oa):	729 ft.
Breadth:	75 ft.
Depth:	39 ft.
Propulsion:	Steam Turbine
Horsepower:	7,500
Home Port:	Milwaukee, WI
Owner:	Northwestern Mutual Life Insurance Company, 720 East Wisconson Ave., Milwaukee, WI 53202
Operator:	Columbia Transportation Div., Oglebay Norton Co., 1210 Hanna Bldg., Cleveland, OH 44115

Master:	Ernest M. McSORLEY [redacted] License [redacted] Master and First Class Pilot Steam and Motor Vessels any GT, Master Great Lakes, Connecting and Tributary Waters, First Class Pilot between Duluth, Gary, Buffalo, North Tonawanda and Ogdensburg, Issue 7,9, 29 Oct 1973, Toledo, OH.
Last Inspection for Certification:	9 April 1975, Toledo, OH
Last Spar Deck Inspection:	31 Oct 1975, Toledo, OH
Cargo:	Taconite Pellets, 26,116 long tons
Draft (at departure on last voyage)	27'02" forward 27'06" aft
Propeller Diameter: Pitch (on .7 radius)	 19'6" 15.86'

FITZGERALD was a conventional "straight decker" Great Lakes ore carrier. The vessel was arranged with cargo holds in the

center of the ship, and ballast tanks outboard of and below the holds. There was a forward deckhouse containing accommodations and the pilothouse and an after deckhouse above the engineroom with accommodations and messing facilities. The weather deck between the deckhouses was called the Spar Deck. Above the Spar Deck, forward, were the Forecastle Deck, which contained the Captain's office and stateroom and two additional staterooms, and, above that, the Texas Deck. The navigating bridge and chart room were in the elevated pilothouse with a void separating it from the Texas Deck. Above the Spar Deck, aft, was the Poop Deck with a lifeboat port and starboard, and the galley, mess room, dining rooms and accommodations within the house. Access between forward and aft could be accomplished topside or through "tunnels" located port and starboard, outboard, immediately below the Spar Deck. FITZGERALD was fitted with a collision bulkhead separating the forepeak from the No. 1 ballast tank and with watertight bulkheads forward and aft of the engineroom. Figures (1) through (4) (pp. 10, 11 and 12) show the general arrangement and midships section of the vessel.

Cargo was loaded and discharged through twenty-one cargo hatch openings, each eleven feet longitudinally and forty-eight feet transversely, arranged on twenty-four foot centers along the Spar Deck. The cargo hatches were numbered from No. 1 forward to No. 21 aft. The total molded volume of 860,950 cubic feet of cargo space was divided into three cargo holds by non-watertight screen bulkheads located between hatches No. 7 and No. 8 (frame 69) and between No. 13 and No. 14 (frame 117). The No. 1, or forward cargo hold, was 177'0" long, No. 2 (amidships) was 144'0" long and No. 3 (aft) was 198'0" long.

Each cargo hatch was fitted with a vertical coaming all around the opening, the top of which measured 24 inches above

the Spar Deck. The Spar Deck had 18 inches of camber, thus the coaming at the centerline was 3'6" above the deck at the side. The longitudinal sections of the coamings were located three feet outboard of the hatch openings, providing a vestibule at each side of each hatch. Each cargo hatch was closed by a single piece (11'7"x54'0") 5/16" stiffened steel hatch cover, with a gasket all around the underside of its perimeter. The gasket landed on a 3"x3"x9.4# angle iron which was welded all around the top of the coaming. Hatch covers for hatches No. 4, 10 and 17 had 18 inch circular, bolted scuttles in the middle of the covers. Each hatch cover was secured by sixty-eight manually positioned "Kestner clamps," i.e., double pivot, adjustable, tension clamps, which were arranged on approximately two-foot centers around the coaming. Each Kestner clamp had an adjustment bolt, one end of which landed on a dished "button" on the hatch cover. Thus, there were sixty-eight "buttons" around the perimeter of each hatch cover. Adjusting the bolts increased or decreased the force required to position the clamps and this determined the deflection of the hatch cover, the compression of the gasket and the tightness of the closure. There was no company requirement concerning routine maintenance of the clamps or gaskets.

Hatch covers were removed and replaced by use of an electrically powered hatch crane which straddled the hatches and traveled fore and aft on tracks located outboard of the hatch coamings, port and starboard.

In addition to the twenty-one cargo hatches, access from the Spar Deck to the cargo holds was provided through two 30" by 60" access hatches, each with a 24" coaming on the Spar Deck. One access hatch was located between hatches Nos. 7 and 8, immediately forward of the forward screen bulkhead on the starboard side providing access to the No. 1 hold. The other was located between hatches Nos. 13 and 14, immediately aft of

the after screen bulkhead on the port side providing access to the No. 3 hold. Each screen bulkhead was fitted with a door at the Main Deck which provided access to the No. 2 cargo hold from either access hatch and there was also a door providing access to or from the tunnel at these locations. Access to the cargo holds was also provided through a door in the forward bulkhead of the No. 1 hold, port side, Main Deck, and through a door at the after bulkhead of No. 3 hold, port side, Main Deck.

Outboard of and below the cargo holds were eight ballast tanks, divided at the centerline into port and starboard tanks. Each ballast tank was fitted with two eight-inch vent pipes, one at each end of each tank. Each vent extended 18 inches above the Spar Deck and was fitted with a screw-down, "mushroom" closure cap, 14-1/2" in diameter and 9-1/4" high, over the top of the 8" vent pipe. Rotating the cap by use of the handle on top of it caused the cap to ride up or down on threads on the top of the vent pipe, opening or closing the vent. There was no external indicator to show whether the cover was in the open or closed position. The port and starboard access tunnels were provided with similar covered vents, one forward and one aft, extending thirty inches above the Spar Deck. Ballast tanks were sounded through sounding tubes terminating on the Spar Deck and the soundings were recorded on chalk boards called "sounding boards" located in the pilothouse and the engineroom. Remote reading gauges (King Gauges) in the lower engineroom near the ballast pumps also provided a check on ballast tank water levels. There were neither sounding tubes nor remote reading gauges for the cargo holds.

The ballast tanks were filled and drained by four electrically driven 7000-gpm main ballast pumps and two electrically driven 2000-gpm auxiliary ballast pumps. The pumps, valves and

manifolds and the remote reading level indicators for the ballast tanks were located in the forward section of the lower engineroom. Any ballast pump could be used to drain No. 3 cargo hold through the ballast manifold and through the single suction well ("rose box") located aft in No. 3 cargo hold, although it was common practice to use the 2000-gpm auxiliary pumps for this purpose. There were no suction wells in the No. 1 or No. 2 cargo holds. Water in these holds drained aft along the length of the holds and through sluices fitted in the lower portions of the screen bulkheads separating the holds, to the suction well at the after end of No. 3 hold. When the vessel was loaded with cargo, water entering the hold would have to filter through the cargo before it could be pumped. Experienced Great Lakes mariners testified that the cargo would restrict the flow and that the holds could not be pumped when loaded with cargo. Coast Guard regulations require a bilge pumping plant capable of pumping from or draining any watertight compartment. As an antipollution measure, the discharge from the engineroom bilges was pumped onto the cargo.

FITZGERALD was fitted with two 400-KW ship's service steam turbo generators, and one 200-KW auxiliary diesel generator, located in the engineroom. A 30-KW emergency diesel generator located on the Poop Deck, starboard side, forward, was fitted with an automatic starting mechanism, and provided power only for emergency lighting.

Radiotelephone equipment on board FITZGERALD was located in the pilothouse and chart room and consisted of the following:

(1) VHF/FM, 12-channel, 25-watt radiotelephone, Model RF-457, Serial No. 5825, installed May 17, 1974. This set operated from ship's power.

(2) VHF/FM, 12-channel, 25-watt radiotelephone, Model RF-457, Serial No. 6273, installed October 22, 1974. This set operated from rechargeable battery power, with the batteries installed in the pilothouse.

(3) Automatic, 12-channel, 25-watt, full duplex, Model RF-150-D, Serial No. 3850, VHF/FM dial radiotelephone, installed September 13, 1975. This set operated from ship's power.

(4) AM medium frequency and high frequency, eight-channel, 100-watt, Model LC-100-M8CL. This set had channel 51 (2182 Khz) capability and operated from ship's power.

(5) AM 50-watt, medium frequency, emergency radiotelephone, Model KR-102, included channel 51 (2182 Khz). This set operated from rechargeable battery power.

It had been the practice on FITZGERALD to use the battery-powered radiotelephones regularly.

The FCC station license was issued on September 30, 1971, expiring September 30, 1976. The call sign WJ9721 was assigned to FITZGERALD. The last FCC inspection certificate was issued by the Detroit Office of the Federal Communications Commission on April 9, 1975.

On 10 November, FITZGERALD had requested a radio serviceman to meet the vessel on arrival in Detroit. The service contractor believed that this request was for service on the duplex dial radiotelephone which had been recently installed.

FITZGERALD was also fitted with a McKay type 4003A radio direction finder.

FITZGERALD was not required to have a fathometer and none was installed. Soundings, if needed, would have been taken by a hand lead.

FITZGERALD was fitted with two surface scan radar sets, one a Sperry Mark 3 and the other a Sperry Mark 16. Maintenance records for 1975 indicated only routine maintenance on each radar set. There is no evidence that the radar sets were not operating properly when FITZGERALD left Superior, WI, on 9 November.

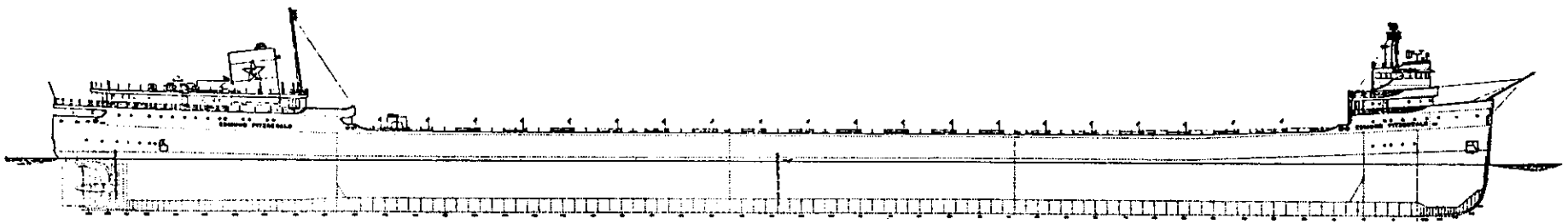


FIG. (1)

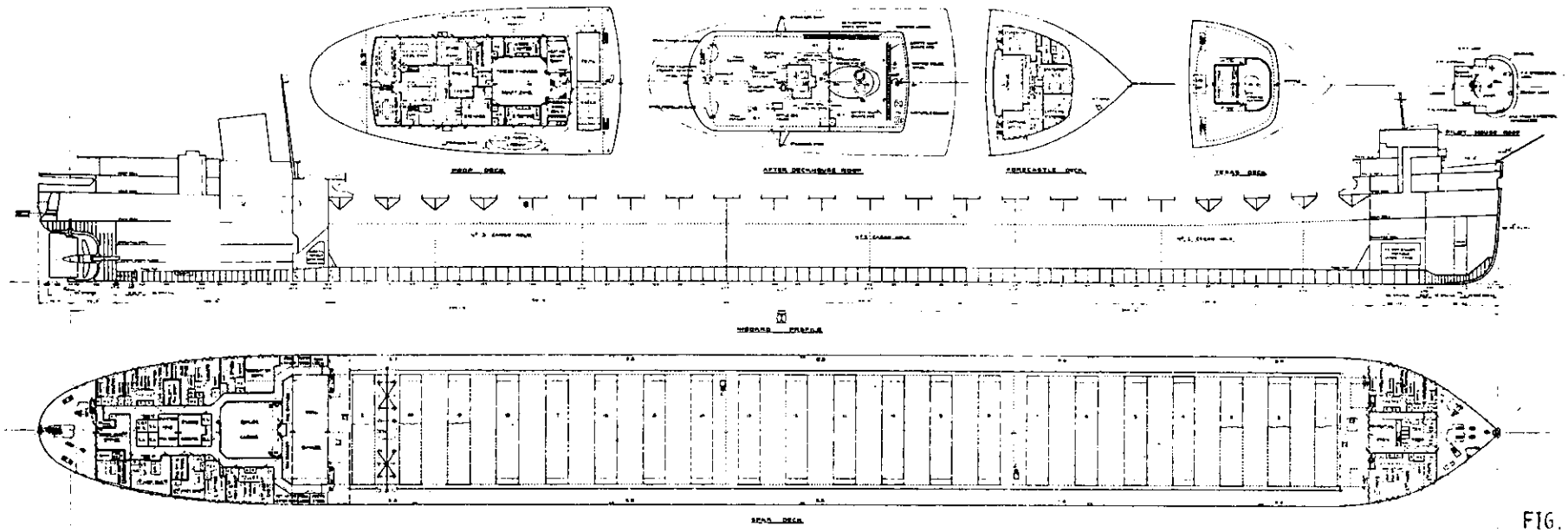


FIG. (2)

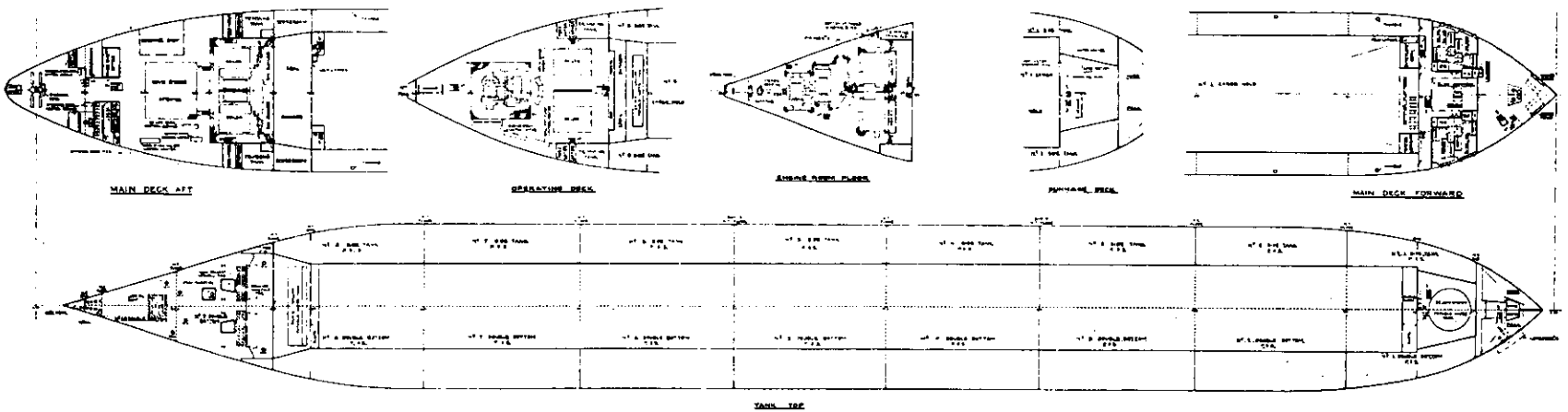


FIG. (3)

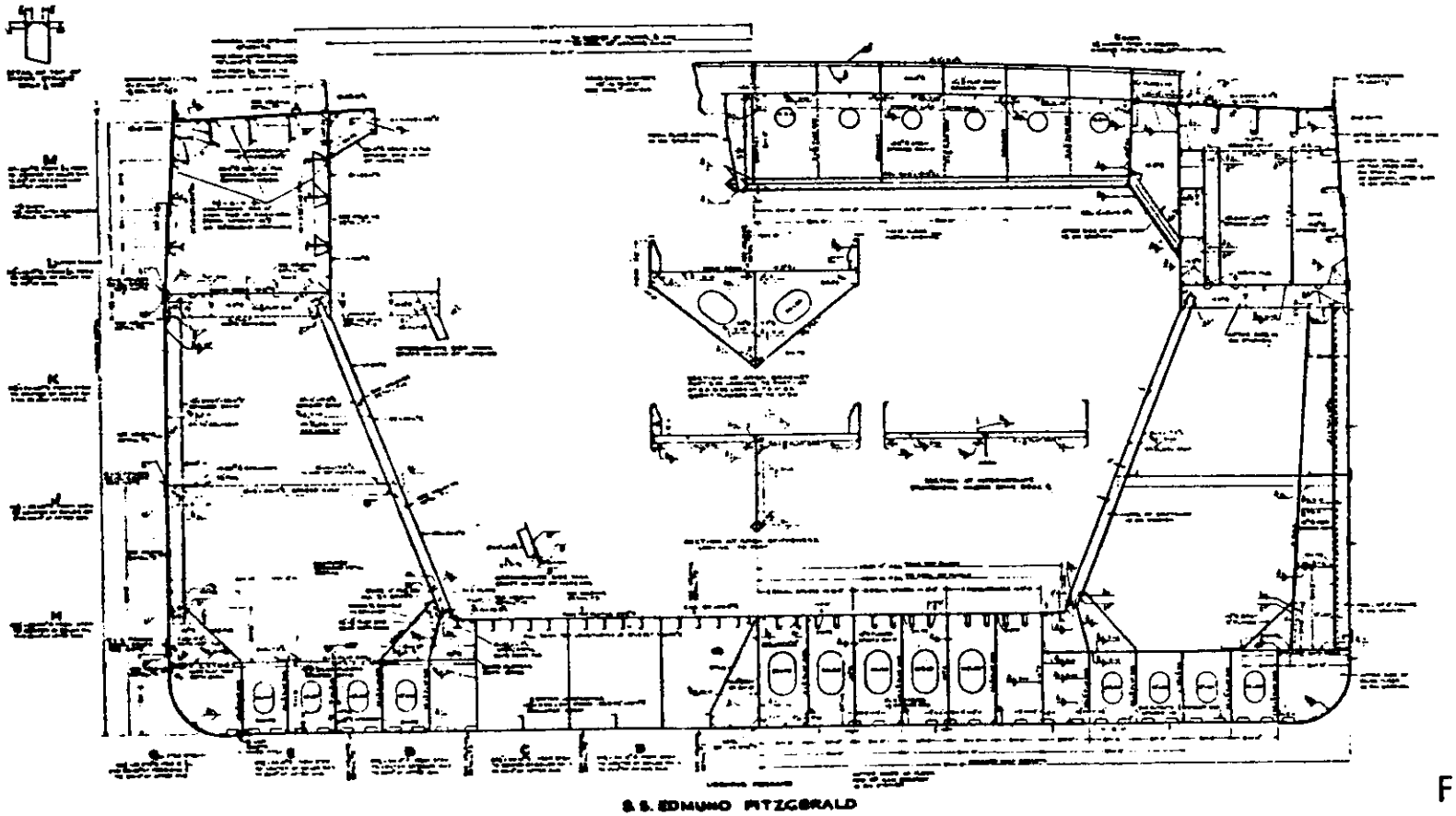


FIG. (4)

3. Record of Missing Crewmen

a. The following crewmembers are missing:

McSORLEY, Ernest M., Lic. No. [redacted] BK [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Master

McCARTHY, John H., Lic. No. [redacted] BK [redacted]
Address: [redacted]
Next of Kin: Wife, same address
First Mate

PRATT, James A., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Second Mate

ARMAGOST, Michael E., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Third Mate

HOLL, George J., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Brother, [redacted]
Chief Engineer

BINDON, Edward F., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Wife, same address
First Asst. Engineer

EDWARDS, Thomas E., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Second Asst. Engineer

HASKELL, Russell G., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Second Asst. Engineer

CHAMPEAU, Oliver J., Lic. No. [redacted]
Address: [redacted]
Next of Kin: Daughter, [redacted]
Third Asst. Engineer

BEETCHER, Frederick J., [redacted]
Address: [redacted]
Next of Kin: Son, [redacted]
Superior, WI
Porter

BENTSEN, Thomas, [redacted]
Address: [redacted]
Next of Kin: Parents, [redacted] and [redacted]
Same address
Oiler

BORGESON, Thomas D., [redacted]
Address: [redacted]
Next of Kin: Children, [redacted] and [redacted]
AB Maintenance Man

CHURCH, Nolan F., [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Porter

CUNDY, Ransom E., [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Watchman

HUDSON, Bruce L., [redacted]
Address: [redacted]
Next of Kin: Parents, [redacted] and [redacted]
Deckhand

KALMON, Allen G., [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Second Cook

MacLELLAN, Gordon F., [redacted]
Address: [redacted]
Next of Kin: Parents, [redacted] and [redacted]
Wiper

MAZES, Joseph W., [redacted]
Address: [redacted]
Next of Kin: Brother, [redacted]
Special Maintenance Man

O'BRIEN, Eugene W., [redacted]
Address: [redacted]
Next of Kin: Son, [redacted]
Wheelsman

PECKOL, Karl A., [redacted]
Address: [redacted]
Next of Kin: Parents, [redacted] and [redacted]
Watchman

POVIACH, John J.,
Address:
Next of Kin: Wife, same address
Wheelsman

RAFFERTY, Robert C.,
Address:
Next of Kin: Wife, same address
Steward

RIIPPA, Paul M.,
Address:
Next of Kin: Mother,
Deckhand

SIMMONS, JOHN D.,
Address:
Next of Kin: Wife, same address
Wheelsman

SPENGLER, William J.,
Address:
Next of Kin: Wife, same address
Watchman

THOMAS, Mark A.,
Address:
Next of Kin: Father,
Deckhand

WALTON, Ralph G., [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Oiler

WEISS, David E., [redacted]
Address: [redacted]
Next of Kin: Father, [redacted]
Cadet (Deck)

WILHELM, Blaine H., [redacted]
Address: [redacted]
Next of Kin: Wife, same address
Oiler

4. Weather

A storm, which was described by a National Weather Service forecaster as "a typical November storm," was generated over the Oklahoma Panhandle on 8 November (all dates referred to hereafter in this report will assume the year 1975 and all times referred to will be Eastern Standard Time unless specifically identified otherwise), and by 0700, on 9 November, this well-defined storm was located over south-central Kansas, moving to the northeast, with a minimum barometric pressure of 29.53" Hg. The National Weather Service issued 12-, 24- and 36-hour Surface Weather Forecasts at 0700, on 9 November, predicting that the storm center would travel in a northeasterly direction and pass just south of Lake Superior by 1900 on 10 November.

The storm was centered over the northeast corner of Kansas by 1300 on 9 November with a minimum barometric pressure of 29.40" Hg and an average speed of advance of 19 knots. The National Weather Service issued 12- and 24-hour Surface Weather Forecasts Maps at this time which predicted that the storm would shift to a more northerly direction, pass over Lake Superior east of Michipicoten Island and increase in speed. The storm center was predicted to be over James Bay, Canada, by 1900 on 10 November.

The storm intensified rapidly as it passed over east central Iowa and, by 1900 on 9 November, it had a minimum barometric pressure of 29.33" Hg and an average speed of advance of 37 knots. At this time, the National Weather Service issued Gale Warnings for all of Lake Superior. Winds in the eastern half of the lake were predicted to be "East to Northeast, increasing to 25 to 37 knots during the night, and Northeasterly 28 to 38 knots, shifting to Northwest to Northerly 30 to 40 knots by Monday (10 November) afternoon, waves 5 to 10 feet.

The National Weather Service revised the forecast at 2239 on 9 November, the next scheduled broadcast, predicting "Easterly winds 32 to 42 knots becoming Southeasterly Monday morning, and West to Southwest 35 to 45 knots Monday afternoon, rain and thunderstorms, waves 5 to 10 feet increasing to 8 to 15 feet Monday."

Wave heights in National Weather Service forecasts refer to the distance from peak to trough and are "significant wave height." Significant wave height is a statistical evaluation, roughly equivalent to the average height of the highest one-third of the waves. The actual distance from peak to trough of the highest wave could be as much as twice the significant wave height. Officials of the National Weather Service stated that significant wave height is very close to the wave height shipboard personnel report in weather observations.

The storm continued to intensify and to move to the northeast, and, as its center passed over central Wisconsin at 0100, 10 November, it had a minimum barometric pressure of 29.24" Hg and an average speed of advance of 29 knots. The Gale Warnings were increased to Storm Warnings at 0200 on 10 November, when a special warning was issued with a prediction of "Northeast winds 35 to 50 knots becoming Northwesterly 28 to 38 knots on Monday, waves 8 to 15 feet."

The storm continued on its northeasterly track and its center had passed over Marquette, MI, by 0700, 10 November, with a minimum barometric pressure of 29.00" Hg and an average speed of advance of 22 knots. The National Weather Service revised the forecast for Eastern Lake Superior at 1034, 10 November, predicting "North to Northwest winds 32 to 48 knots this afternoon becoming Northwesterly 25 to 48 knots tonight and Westerly 20 to 30 knots Tuesday, waves 8 to 16 feet decreasing Tuesday."

The storm center crossed Lake Superior to the west of Michipicoten Island and was over White River, ONT, at 1300, 10 November, with a minimum barometric pressure of 28.95" Hg and an average speed of advance of 21 knots. As predicted, a line of shifting winds followed the storm center, with winds hauling from the northeast, decreasing to less than 10 knots when out of the south, then continuing to haul and increasing rapidly to 35 to 50 knots from the northwest. The windshift line extended from north-northeast to south-southwest, and, at 1300, 10 November, was approximately 20 miles west of Caribou Island, ONT, moving eastward at 20 to 25 knots.

At the next regular broadcast, at 1639, the National Weather Service revised the forecast for Eastern Lake Superior, predicting "Northwest winds 38 to 52 knots with gusts to 60 knots early tonight and Northwesterly winds 25 to 35 knots diminishing Tuesday, waves 8 to 16 feet tonight decreasing Tuesday." The storm continued on its northeasterly track and by 1900 on 10 November its center had passed over the southern tip of James Bay, Canada, and by 0100, 11 November, the storm center was over eastern Hudson Bay as the effects of the severe storm abated on Lake Superior.

At 0100, 10 November, FITZGERALD was approximately 20 miles due south of Isle Royal and reported winds from 030°T at 52 knots, overcast, visibility two to five miles in continuous heavy rain, temperature 37°F, waves 10 feet. At 0700, FITZGERALD was approximately 35 miles north of Copper Harbor, MI, and reported winds from 050°T at 35 knots, overcast, visibility two to five miles in continuous moderate rain, temperature 41°F, waves 10 feet. The 0700 report was the last weather report received from FITZGERALD.

The SS ARTHUR M. ANDERSON filed 0100 and 0700 weather reports from approximately the same positions as reported by FITZGERALD and the reports from ANDERSON substantially agreed with those from FITZGERALD. At 1300, 10 November, ANDERSON was approximately 20 miles northwest of Michipicoten Island, near the center of the storm, and reported winds from 150°T at 20

knots, visibility 10 to 25 miles, no precipitation, and waves 12 feet. At 1900, ANDERSON reported winds from 300°T at 50 knots, visibility 10 to 25 miles in light rain and snow, and waves 16 feet.

The Motor Vessel SIMCOE (Canadian), approximately 15 miles to the southwest of the ANDERSON at 1300, 10 November, reported winds from 270°T at 44 knots, visibility 10 to 25 miles, no precipitation, and waves 7 feet. At this time, the remote weather reporting station at Stannard Rock was reporting winds from the WNW at 50 knots, gusting to 59 knots, and the station at Whitefish Point was reporting SSW at 19 knots, gusting to 34 knots. At 1900, Stannard Rock was reporting WNW at 40 knots, gusting to 65 knots, and the Whitefish Point Station was inoperative.

5. Last Voyage

At approximately 0830, on 9 November, FITZGERALD commenced loading taconite at Burlington Northern Railroad Dock No. 1, in Superior, WI. Fuel was also taken on at this time. FITZGERALD completed loading and fueling at approximately 1415 and crewmembers were observed replacing the hatch covers. There were no unusual incidents or occurrences and this appeared to be a routine loading and departure.

FITZGERALD departed for Detroit immediately and proceeded at full speed of 99 r.p.m., approximately 16.3 mph. (It is conventional on the Great Lakes to describe distances in statute miles (mi) and speeds in statute miles per hour (mph), and distances and speeds referred to hereafter in this report will follow this convention unless specifically identified otherwise.) After about two hours, FITZGERALD reached the area near Two Harbors, MN. The SS ARTHUR M. ANDERSON, one of the vessels

of the United States Steel Corp., had departed Two Harbors at 1630. ANDERSON, with a cargo similar to FITZGERALD's, was bound for Gary, IN, and the two vessels proceeded eastward on similar courses, separated by 10 to 20 miles.

FITZGERALD made routine radio weather reports at 0100 and at 0700, 10 November, and at 0720 made the normal radio morning report to the company office. This report indicated that the ETA at Sault Ste. Marie was indefinite due to weather.

Because of the storm, FITZGERALD departed from the recommended Great Lakes shipping lanes at the southern shore of the lake, and headed northeastward, approximately half way between Isle Royal and the Keewanaw Peninsula, turning eastward to parallel the northern shore of Lake Superior and then southeastward along the eastern shore. By 1300, 10 November, FITZGERALD was approximately 11 miles northwest of Michipicoten Island.

FITZGERALD passed to the west of Michipicoten West End Light, and changed course to pass north and east of Caribou Island, heading generally southeastward towards Whitefish Bay, MI. FITZGERALD sank sometime after 1915 at a position of 46°59.9'N, 85°06.6'W, near the International Boundary Line.

Figure (5) (p. 33) is a chart of Lake Superior, showing Michipicoten and Caribou Islands, Whitefish Bay and the position where the wreckage of FITZGERALD was located.

The SS ARTHUR M. ANDERSON, making turns for a speed of 14.6 mph, which it maintained during the entire transit of Lake Superior, joined FITZGERALD at approximately 1700, 9 November. Shortly thereafter, ANDERSON received notice of Gale

Warnings. Sometime after 0200 on 10 November, CAPT [redacted] Master of ANDERSON, contacted CAPT McSorley, Master of FITZGERALD, on VHF-FM radiotelephone. CAPT [redacted] had just received the notification of Storm Warnings which predicted northeast winds to 50 knots. During this conversation, both Captains expressed concern over the deteriorating weather. They agreed to depart from the normal shipping lanes which are at the southern shore of the lake and proceed on a more northeasterly course in order to be in the lee of the Canadian shore.

At 0300, ANDERSON changed course to 055°T and logged winds from 034°T at 42 knots while FITZGERALD headed 060°T. Up until now, FITZGERALD had been close behind ANDERSON, now she was pulling ahead slightly because of her faster speed.

At 0400, the First Mate, [redacted] came on watch on ANDERSON, and the two vessels proceeded along together throughout his watch. The First Mate was relieved for the 8-12 watch by the Third Mate, [redacted] At 0953, [redacted] changed course and headed due east, and at 1030, when approximately 25 miles from shore, he changed course to 125°T, heading southeastward along the Canadian shore. Watch officers on board ANDERSON observed that FITZGERALD went closer toward the shore before heading south. Because ANDERSON was, in effect, cutting corners, it was able to keep up with the faster FITZGERALD.

At 1152, the Third Mate changed course to 149°T. The weather recorded at this time was overcast with winds from 158°T at 30 knots. The barometer had dropped rapidly and was now 28.84, waves 10 to 12 feet.

The Second Mate, [redacted], assumed the 1200-1600 watch on board ANDERSON and sent the 1800Z weather report at 1240 (weather reports were made in Greenwich Mean Time, designated Z; 1800Z corresponds to 1300 Eastern Standard Time).

At 1252, the Second Mate, steering 148° to make 149°T, recorded a beam bearing 10.8 miles off Otterhead. He changed course at this time to 154°T, intending to clear Michipicoten Island West End Light by 2 to 2-1/2 miles. At this time, FITZGERALD was 7 or 8 miles ahead and to the east of ANDERSON's heading, and the two vessels appeared to be on slightly converging courses.

At approximately 1340, CAPT [redacted] talked with CAPT McSorley and said that he anticipated that the wind would shift to the northwest. He told CAPT McSorley that he intended to "haul" (i.e., change course) to the west, before passing Michipicoten Island, in order to insure that the seas were astern. CAPT McSorley, whose vessel was just past Michipicoten, indicated that he would continue on, although his vessel was "rolling some." CAPT [redacted] observed that FITZGERALD changed course after passing Michipicoten Island. Since no plot of FITZGERALD was maintained, this was the only course change that the Master or Watch Officers of ANDERSON were sure that FITZGERALD made after passing Michipicoten. At 1350, ANDERSON logged a course change to 230°T and steered it without "holding up" any for the wind. The Second Mate observed that just before this course change, FITZGERALD was about 9 or 10 miles ahead and slightly to the starboard. He assumed that FITZGERALD was steering a course of 141°, and estimated that FITZGERALD would have passed off the western end of Michipicoten Island at a distance of 3 miles. CAPT [redacted] estimated the distance to be approximately 2-1/2 miles. The weather was logged as overcast, winds 5 knots from 304°T, visibility fair.

After ten minutes on the new course of 230°T, at 1400, the Second Mate took a radar range and bearing which he did not record in the ship's log. This placed ANDERSON on the trackline drawn for 230°T. At 1425, the Second Mate took another "fix" by radar, which again he did not log. This one placed the vessel on the trackline, 3.9 miles beyond the 1400 position.

At 1445, ANDERSON logged a course change to 130°T. The Second Mate "held up" one degree for wind, and ordered the Wheelsman to steer 131°. This course was set in order to pass clear of the 6-fathom shoal approximately four miles north of Caribou Island. By the time ANDERSON was steady on the new course, FITZGERALD was observed to be approximately 16 miles ahead, winds had increased to 42 knots from 315°T, and it had started snowing. As a result, ANDERSON lost sight of FITZGERALD and it was never seen again.

At 1520, the Second Mate logged ANDERSON abeam of Michipicoten Island West End Light at a distance of 7.7 miles. The seas were beginning to build rapidly from the northwest and on the 130° course, CAPT [redacted] thought his ship was being set down too close to Caribou Island, so the course was changed to 125°T. This new course was "shaped up" to clear the 6-fathom shoal north of Caribou Island and to reach a point 6 miles off the island. After ANDERSON steadied on the 125° course, the Mate on watch observed that FITZGERALD was a little over 16 miles ahead of ANDERSON and a "shade" to the right of dead ahead. CAPT [redacted] estimated the angle as a point to a point and a half to the right. FITZGERALD's position then was observed to open further to the right of ANDERSON's heading flasher. Watch officers on ANDERSON stated that no plot of FITZGERALD was maintained and they did not know whether the change in the relative position of FITZGERALD resulted from the divergent courses of the two vessels or whether FITZGERALD had made

another course change. While ANDERSON was on this course, FITZGERALD was observed to have passed north and east of Caribou Island. CAPT [redacted] testified that he estimated that FITZGERALD had passed close to the six-fathom shoal north of Caribou Island. He also testified that he told the Mate on watch on ANDERSON that FITZGERALD was closer to this shoal than he wanted ANDERSON to be. At 1520, ANDERSON recorded steady winds of 43 knots from the northwest and it was still snowing. The seas were 12 to 16 feet, and ANDERSON was shipping a considerable quantity of water on deck.

The First Mate relieved the Second Mate of the watch at 1520, and between 1530 and 1535, while the Second Mate was still in the pilothouse and at a time when the Captain was there also, FITZGERALD called ANDERSON. CAPT [redacted] on ANDERSON, answered the call and the two watch officers listened. Reports of this conversation varied, but it was generally agreed that FITZGERALD reported a fence rail down, two vents lost or damaged, and a list. Both the Master and the Mates who heard this report testified that they understood this to mean the loss of ballast tank vents and a small list. FITZGERALD told ANDERSON that she would "check down," i.e., reduce speed, to allow ANDERSON to close the distance between them. Whoever it was that was speaking on FITZGERALD did not identify himself, although everyone on the bridge of ANDERSON believed that it was CAPT McSorley. CAPT [redacted] asked CAPT McSorley if he had "his pumps going" and the reply was: "Yes, both of them." CAPT [redacted] noted that at this time the radar indicated that FITZGERALD was approximately 17 miles ahead of ANDERSON and a point to a point and a half to the right of ANDERSON's heading. CAPT [redacted] agreed to keep track of FITZ-GERALD. None of the officers on ANDERSON who heard this conversation felt that it indicated any real concern about the welfare of FITZGERALD.

Shortly after this, ANDERSON received a Coast Guard broadcast that the Sault Ste. Marie locks had been closed and that all ships should seek a safe anchorage.

Between 1610 and 1615, ANDERSON was informed by FITZGERALD that her "radars weren't working." CAPT [redacted] was not in the wheelhouse at this time. FITZGERALD asked if ANDERSON would keep track of them and provide navigational assistance, and the First Mate on watch on ANDERSON agreed.

At a time that CAPT [redacted] estimated to be between 1600 and 1630, FITZGERALD was observed to pass approximately three to five miles east of Caribou Island, its closest point of approach to the island.

At 1620, on ANDERSON, the Second Mate relieved the First Mate for dinner. At 1630, it grew dark and the Second Mate noted that the radar showed FITZGERALD was approximately 16 miles ahead and "possibly between one to two degrees, maybe" to the right of ANDERSON's heading. At 1652, the Mate on ANDERSON logged a position abeam of the north tip of Caribou Island at a distance of 6 miles, and the course was changed to 141°T. The wheelsman was ordered to steer 142° because of the expected eastward drift. The 1652 position was not plotted on the chart in use in the pilothouse of ANDERSON. CAPT [redacted] later testified that the course change was made at a point north-northeast of the northern tip of Caribou Island at a distance of approximately 7-1/2 miles, and that five minutes later, at 1652, ANDERSON passed abeam of Caribou on the 141° course at a distance of 6 miles. On the chart he plotted during his testimony, the point of the course change and the point of passing abeam of Caribou are 4 miles apart. On the new course, FITZGERALD was observed to be about one mile to the right of ANDERSON's heading flasher and 14 to 15 miles ahead. At the time of this course change, ANDERSON logged winds of 58 knots from 304°T, the highest winds recorded during the voyage. It was still snowing lightly, limiting visibility, and seas were 12 to 18 feet.

The First Mate returned from the dinner relief and resumed the watch just as the course was being changed. Sometime later, FITZGERALD called ANDERSON and requested a position. The First Mate took a radar range and bearing which showed that ANDERSON was 10.5 miles on a bearing of 088°T from Caribou Island Light. The First Mate testified that he received the call from FITZGERALD and took the fix at 1701. He also noted that the radar showed FITZGERALD was 15 miles ahead of ANDERSON and "just a shade" to the left of the heading marker. He informed FITZGERALD that Whitefish Point was 35 miles on a bearing of 144°T from FITZGERALD's position. FITZGERALD replied, "Thanks," and that (they) "wanted to be 2 to 2-1/2 miles off of Whitefish Point." The Mate on ANDERSON estimated that with the drift, FITZGERALD was probably headed for that point.

CAPT [redacted] testified that at around 1800, when approximately 15 miles southeast of Caribou Island, and just out of its lee, ANDERSON encountered heavy seas with some waves which were as high as 25 feet. At 1810, CAPT [redacted] left the wheelhouse and went below. At 1820, the First Mate called FITZGERALD again and asked what course they were steering because they appeared to be working to the left of ANDERSON. They replied they were steering 141°T. At 1849, the First Mate sent the 0000Z weather to the Coast Guard at Grand Marais. ANDERSON's position on the weather report was approximately two miles to the west of the trackline presented when the Master and Mates testified.

At 1900, the Mate informed FITZGERALD that they were 10 miles ahead and 1-1/2 to 2 miles to the left of ANDERSON's heading flasher, and that FITZGERALD was thus 15 miles from the Highlands at Crisp Point. At 1910, the Mate called FITZGERALD again and told them, "There is a target 19 miles ahead of us, so the target is nine miles on ahead." FITZGERALD asked, "Well, am I going to clear?" and the Mate said, "Yes, he

is going to pass to the west of you." FITZGERALD replied, "Well, fine." As the Mate started to sign off, he asked, "Oh, by the way, how are you making out with your problems?" and FITZGERALD replied, "We are holding our own." The Mate replied, "Okay, fine, I will be talking to you later." This was the last transmission heard from FITZGERALD. Just as this conversation ended, at around 1910, CAPT [redacted] returned to the pilothouse, and he testified that at that time ANDERSON was 25 miles north-northwest of Whitefish Point, with the radar showing FITZGERALD 9 miles ahead and a mile to a mile and a half to the east of the heading flasher. This was the last time that anyone on ANDERSON observed a target on the radar that they were certain was FITZGERALD.

Shortly thereafter, it stopped snowing and visibility improved considerably. At this time the Wheelsman on ANDERSON thought that he saw a red and a white light on the port bow, with the white one forward of the red one. He concluded that the red light was on the shore and then mentioned the white light to the rest of the bridge watch, but no one else was able to see it. The Mate could now see lights which he believed to be those of one of the upbound, saltwater ships, NANFRI, BENFRI and AVAFORS, which were 17 to 18 miles ahead. Because FITZGERALD should have been closer, he was surprised that he could not see her lights. CAPT [redacted] thought that FITZGERALD might have had a blackout and told everyone on the bridge to look for a silhouette on the horizon. At this time the First Mate believed that FITZGERALD should have been 13 to 14 miles due west of Coppermine Point. CAPT [redacted] recalled it as 15 miles north of Crisp Point and 14 miles west of Coppermine Point.

At 1920, after adjusting the radar, ANDERSON had three distinct targets, but none was FITZGERALD. CAPT [redacted] then

tried to call FITZGERALD on VHF-FM, and there was no response. The Mate then tried to call FITZGERALD, and then one of the saltwater vessels, without success. He then called the SS WILLIAM CLAY FORD, which was anchored in Whitefish Bay. FORD replied to ANDERSON that his signal was good. CAPT [redacted] stated he then tried to call the Coast Guard at Sault Ste. Marie on Channel 16 and was told to shift to Channel 12, but received no follow-up. CAPT [redacted] then called NANFRI, which was upbound near Whitefish Point, and talked with the Great Lakes Registered Pilot, CAPT [redacted] CAPT [redacted] told CAPT [redacted] that he had no contacts on his radar which could be FITZGERALD. CAPT [redacted] stated that this call was at 2000 or later. CAPT [redacted] then called the Coast Guard again and expressed concern for the FITZGERALD. CAPT [redacted] stated that the Coast Guardsman told him to watch for a lost 16-foot boat. Approximately ten minutes later, he called the Coast Guard at Sault Ste. Marie again, feeling that by this time it was "pretty evident that the FITZGERALD was gone." This time the Coast Guard tried calling FITZGERALD. CAPT [redacted] later stated that he was down around Whitefish Point before he "got to thinking for sure that FITZGERALD was gone." ANDERSON was abeam of Whitefish Point at 2059 and at that time logged winds of 48 knots.

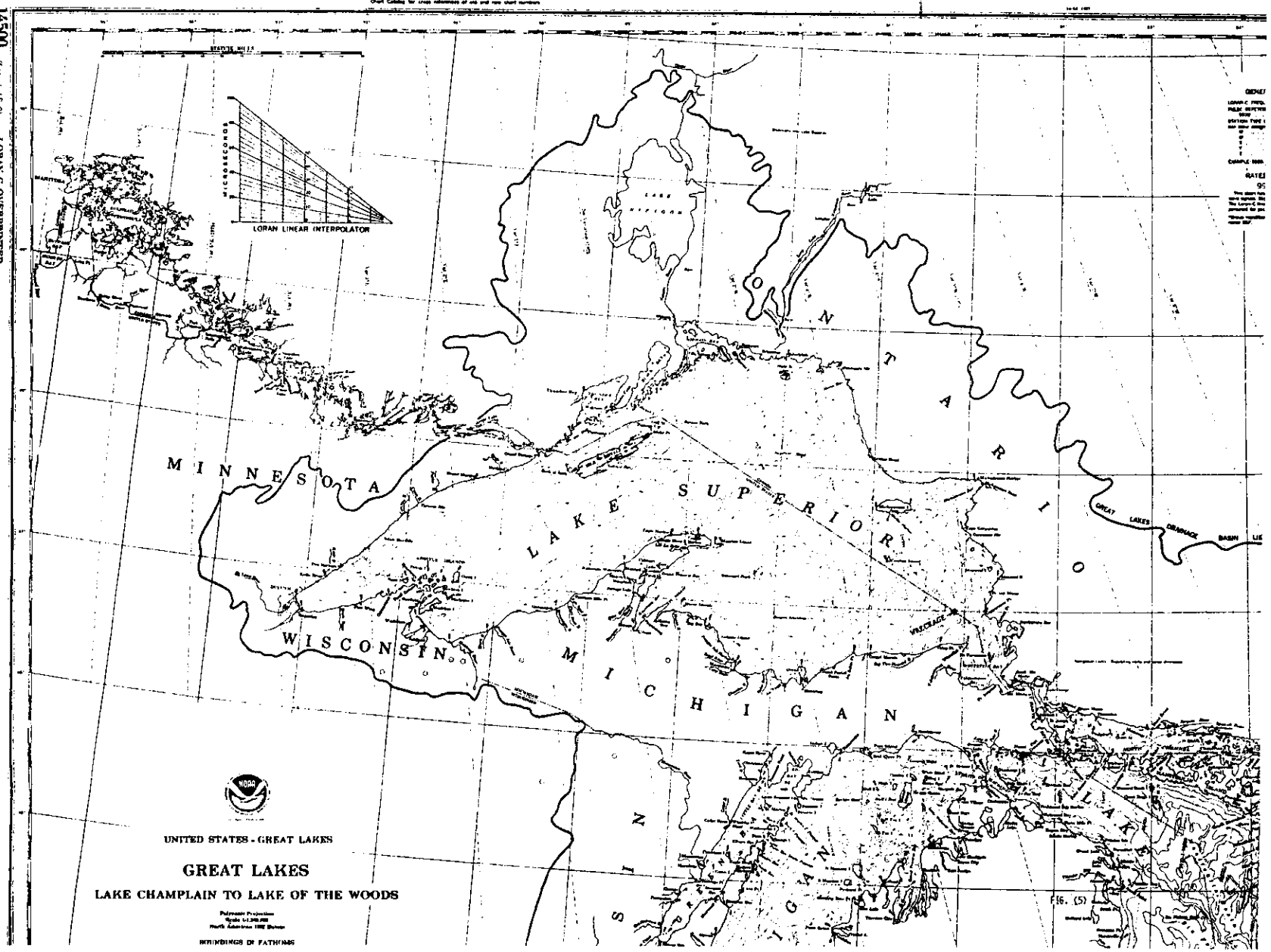
Coast Guard Group Sault Ste. Marie logged a call from the ARTHUR M. ANDERSON on Channel 22 at 2032 in which CAPT [redacted] said, "I am very concerned with the welfare of the Steamer EDMUND FITZGERALD. He was right in front of us experiencing a little difficulty. He was taking on a small amount of water and none of the upbound ships have passed him. I can see no lights as before and don't have him on radar. I just hope he didn't take a nose dive." This is the first recorded call from ANDERSON and the station log makes no mention of a broadcast concerning a lost 16-foot boat.

At approximately 1639, the Coast Guard Station at Grand Marais, MI, received a call from FITZGERALD asking if Whitefish Point radio beacon was operating. The watch-stander at Grand Marais called Group Sault Ste. Marie on the teletype asking if the radio beacon was out. Group Sault Ste. Marie told him that there had been a power failure and that the equipment showed that Whitefish Radio beacon was not operating. Grand Marais called FITZGERALD back immediately and told them the beacon was not operating.

Sometime between 1600 and 1630, CAPT [redacted] a Great Lakes Registered Pilot on board the Swedish vessel AVAFORS, upbound near Whitefish Point, answered a call from FITZGERALD for any vessel in the vicinity of Whitefish Point. FITZGERALD asked if Whitefish Point beacon or light was on. CAPT [redacted] replied that he could neither see the light nor receive the beacon. Somewhat later, CAPT [redacted] overheard FITZGERALD call the Coast Guard at Sault Ste. Marie and then at Grand Marais. He did not hear whether or not the Coast Guard answered.

Approximately one hour after his first conversation, CAPT [redacted] called FITZGERALD and, after confirming that he was speaking to CAPT McSorley, told him that Whitefish Point Light was on but the beacon was still off. At one point in this conversation, CAPT McSorley paused and, apparently in response to a question by someone on his ship, said, "Don't allow nobody on deck," and something else about a vent which CAPT [redacted] was unable to understand. He then returned to his conversation with CAPT [redacted], saying that FITZGERALD had a "bad list," had lost both radars, and was taking heavy seas over the deck in one of the worst seas he had ever been in.

CAPT [redacted] stated that during the time between his two conversations with FITZGERALD he overheard two conversations between FITZGERALD and ANDERSON. He did not recall the subject of the first conversation, but in the second one ANDERSON told FITZGERALD that it was about 20 miles above Whitefish "as near as he could tell," and ANDERSON was "about 10 miles behind you and gaining about a mile and a half an hour on you."



14500 (formerly 15 0) LORAN-C OVERPRINTED

33 (FIG. (5)

FIG. (5)

6. Search Effort.

Following CAPT [redacted] call at about 2025, expressing his concern about FITZGERALD, the Coast Guard radio watchstander attempted to contact FITZGERALD on VHF/FM and requested that the commercial radio station, WLC, at Rogers City, MI, attempt to contact FITZGERALD. Neither attempt was successful. At 2040, Coast Guard Station Sault Ste. Marie informed the CG Rescue Coordination Center (rcc) in Cleveland, which coordinates search and rescue efforts for the Great Lakes, that there was an uncertainty concerning FITZGERALD.

At 2103, ANDERSON called CG Station Sault Ste. Marie again, and this time reported that FITZGERALD was missing. This was relayed to rcc Cleveland at 2110, and, at 2115, rcc directed CG Air Station Traverse City, MI, to dispatch an aircraft. At 2116, the Canadian Rescue Center at Trenton, ONT, was advised. At 2125, rcc directed the Coast Guard Cutter NAUGATUCK (WYTM 92) to get underway from Sault Ste. Marie, MI, and, at 2130 the Coast Guard Cutter WOODRUSH (WLB 407) was also directed to get underway from its home port of Duluth, MN, approximately 300 miles from the scene.

Under the Search and Rescue Plan, Annex I to CCGDNine Operation Plan NR1-(FY), the Coast Guard Air Station at Traverse City, MI, provides fixed wing air coverage for all of the Great Lakes and rotary wing coverage for Lake Superior and the northern parts of Lake Huron and Lake Michigan. Under this plan, USCG Air Station Traverse City is required to have one HU-16 fixed wing search aircraft and one HH-52 helicopter in status Bravo-O (capable of being launched in 30 minutes) or ALFA (airborne) at all times, and personnel on board immediately available and capable of launching either the HU-16 or the HH-52.

The first Coast Guard aircraft, an HU-16, was launched at 2206 after a minor delay to put flares on board, and was on scene at 2253. An HH-52, fitted with a Night Sun, an externally mounted, remote controlled, focusable, 3.8 million candlepower, Xenon arc searchlight, was launched at 2223, and was on scene at 0100, 11 November. A second HH-52 was launched at 2249 and was on scene at 0005, 11 November. A Canadian C-130 was launched at 0037.

Under the Vessel Employment Schedule then in effect, NAUGATUCK was in a maintenance status for the period 1 November through 16 November, but because of the bad weather it had been ordered to upgrade to a standby status at 1947, 10 November. This class of vessel is restricted from operating in open water when winds exceed 60 knots, and because of the severe weather and sea conditions which existed in eastern Lake Superior on the evening of 10 November, at 2125, when NAUGATUCK was directed to get underway it was also directed not to proceed beyond the entrance to Whitefish Bay. After the order to get underway was received, NAUGATUCK suffered a failure of a lube oil line and repairs were begun immediately. By the next morning, repairs were completed and the weather had moderated. NAUGATUCK got underway at approximately 0900 and was on scene at 1245.

The Coast Guard Cutter WOODRUSH had been in a BRAVO-6 Standby Status, i.e., ready to proceed within six hours. WOODRUSH got underway at 0008, 11 November, and arrived on scene approximately twenty-four hours later.

A Coast Guard 40-foot patrol boat (CG 40573) was directed to proceed from CG Base Sault Ste. Marie on the morning of the 11th and searched until late afternoon. The rescue coordination center evaluated the

possibility of using the 36-foot motor lifeboat stationed at Grand Marais, MI, and concluded that it would not be effective due to the 35 to 40 mile distance, the slow speed of the boat and the severe weather. In addition, rcc concluded that the 40 foot patrol boats stationed at Marquette, MI, Bayfield, WI, and Duluth, MN, were too far from the scene to be effective.

The Coast Guard Icebreaker MACKINAW was at its home port of Sheboygan, MI, but was in a repair status preparing for its winter ice operations and was unable to get underway. The Coast Guard Buoy Tender SUNDEW was at its home port of Charlevoix, MI, also in a repair status.

The 40 foot patrol boat and 44 foot motor lifeboat at St. Ignace, MI, were evaluated as being too far from the scene to be effective.

There were no other Coast Guard SAR vessels available nearby in any of the adjacent Great Lakes which were evaluated as capable of responding in the weather conditions which existed.

The Canadian Coast Guard Vessel VERENDRYE was made available on 12 and 13 November and searched the area along the Canadian Shore.

At approximately 2100, 10 November, the Commanding Officer of the Coast Guard Group Sault Ste. Marie, MI, requested the Steamer ANDERSON, which by then had reached Whitefish Bay, to reverse course and assist in the search. ANDERSON turned around and was on scene at approximately 0200. At approximately 2230, the Commanding Officer of Coast Guard Group Sault Ste. Marie contacted the U. S. vessels WILLIAM CLAY FORD, WILLIAM R. ROESCH and BENJAMIN F. FAIRLESS and the Canadian vessels FRONTENAC, MURRAY BAY, HILDA MARJANNE and ALGOSOO, which were anchored in or near Whitefish

Bay, and requested that they get underway to assist in the search. Of these, only the WILLIAM CLAY FORD (Ford Motor Co.) and the HILDA MARJANNE (Upper Lakes Shipping, Ltd.) responded that they would get underway. FORD got underway and proceeded to the area, arriving at approximately 0200, and searched throughout the night and into the next day. HILDA MARJANNE got underway but in approximately 20 or 30 minutes determined that the weather conditions were too severe for that vessel, and, accordingly, returned to anchorage in Whitefish Bay.

The Commanding Officer of the Coast Guard Group Sault Ste. Marie also called BENFRI, NANFRI and AVAFORS, foreign flag saltwater ships which were upbound, in or slightly beyond the area where FITZGERALD was lost, and asked them to reverse course and assist in the search. All three replied that they did not believe that they could reverse course without hazard to their vessels, because of the severe weather conditions. NANFRI did reduce speed, change course slightly to the north and maintain a lookout.

Coast Guard Station Sault Ste. Marie, MI, made Urgent Broadcasts on the Steamer FITZGERALD at 2145 and at 2200. An Urgent Broadcast was initiated by the Ninth Coast Guard District at 2238 and was rebroadcast regularly until 2127, 13 November, after the search was terminated.

In addition to the commercial vessels ANDERSON, FORD and HILDA MARJANNE which undertook the search on the night of the 10th, the following vessels responded to the Urgent Broadcast and assisted in the search:

U. S. Vessels

ARMCO (Columbia Transportation Div., Oglebay-Norton Co.)
ROGER BLOUGH (United States Steel Corp.)
RESERVE (Columbia Transportation Div., Oglebay-Norton Co.)
WILFRED SYKES (Inland Steel Co.)
WILLIAM R. ROESCH (Columbia Transportation Div., Oglebay-Norton Co.)

Canadian Vessels

FRONTENAC (Canada Steamship Lines, Ltd.)
JOAN O. McKELLAR (Scott Misener Steamships, Ltd.)
MURRAY BAY (Canada Steamship Lines, Ltd.)
F/V JAMES D.

Throughout the night of the 10th the fixed-wing aircraft and helicopters and the vessels ANDERSON and FORD searched the area where FITZGERALD was reported lost and along the shoreline, utilizing lights and flares.

During the 11th, 12th and 13th, the search area consisted of the eastern end of Lake Superior from the eastern shore of the lake, westward to a north-south line approximately fifteen miles west of Crisp Point and from the southern shore of the lake, northward to an east-west line approximately at Caribou Island.

The search which began at daylight on the 11th utilized a C-130 from the Michigan Air National Guard, a Canadian C-130, a Coast Guard HU-16 and two HH-52 helicopters from Coast Guard Air Station Traverse City, and a Coast Guard C-130 from Coast Guard Air Station Elizabeth City, NC. The latter was designated On Scene Commander. All aircraft searched throughout the daylight hours on the 11th. During the 12th and 13th, the search continued, utilizing the Coast Guard C-130, the National Guard C-130, the Coast Guard HU-16,

the Canadian C-130 and the Coast Guard helicopters. On the 12th, the launching of the aircraft was delayed because of the low ceiling. Helicopters were able to proceed first at a low altitude and later in the afternoon the ceiling rose and the HU-16 joined the search. During this same period, the Coast Guard Cutter NAUGATUCK and the Coast Guard Cutter WOODRUSH conducted various surface searches coordinated with the aircraft.

Active search was suspended at 2212, on November 13th, although Coast Guard Air Station Traverse City was directed to conduct daily flights over the area, and this was done for approximately one more week. After that, Coast Guard Air Station Traverse City conducted weekly flights over the area until the end of the year.

On 14 November, a U. S. Navy aircraft joined the search, and utilizing MAD (Magnetic Anamoly Detection) equipment located a strong single magnetic contact at 47°00.5'N, 85°06'W. A slight oil slick was observed at the contact position. This contact was later determined to be the sunken hulk of FITZGERALD.

Ontario Canadian Provincial Police conducted numerous shoreline searches during the active search period, and helicopters from CG Air Station Traverse City also searched the Michigan and Canadian Shores.

7. Search Results

Despite the intensive search, no survivors were found, nor were any bodies recovered. Only one lifeboat, one-half of another lifeboat, two inflatable life rafts, twenty-one life jackets or life jacket pieces and some miscellaneous flotsam identified as being from FITZGERALD were found.

One piece of a lifeboat was first sighted by ANDERSON at 0807, 11 November, at a location approximately nine miles east of where FITZGERALD sank. The other lifeboat was sighted by ANDERSON at 0905 approximately four miles south of the first

one. The severely damaged piece of No.1 lifeboat was recovered on 11 November by the Steamer WILLIAM R. ROESCH at a position approximately 2 miles northwest of Coppermine Point, Ontario. The No. 2 lifeboat, also severely damaged, was recovered on 11 November in the vicinity of Coppermine Point by the F/V JAMES D. Both lifeboats were delivered to the U. S. Coast Guard Base, Sault Ste. Marie, MI, where a survey of them was conducted on 25 November 1975.

The remains of the No. 1 lifeboat consisted of the forward sixteen feet of the boat with the starboard side badly damaged. The words "EDMUND FITZGERALD NO. 1" were painted in three-inch letters on both bows and the words "500 CU. FT. 50 PERSONS" were painted in one and one-half-inch letters below that. There was no name plate attached and there were no air tanks, buoyancy material, or boat equipment present, however, a substantial amount of this was found floating nearby. The plating was heavily buckled and holed over a four foot by four foot area, port side, forward. This damage was centered in the turn of the bilge area. The forward section of the port grab rail was torn free and sharply rolled back. The grab rail was missing from the starboard side. The life line and seine floats for this portion of the boat were present. There was a sharp indentation in the plating over a one foot by six inch area on the starboard side, forward, at the turn of bilge. The bow ring was missing and the thwarts and side benches were damaged throughout. The forward Rottmer Releasing gear, consisting of the hook, preventer bars, lock, upper and lower guide bearings, universal joints and the complete portion of the shafting to the after universal, was present. The shaft was twisted and distorted. The plate attachment to the stem was in place. The releasing lever was torn loose from its secured position and the hold-down brackets were severed. Data on the name plate for the Rottmer Releasing Gear was:

Marine Safety Equipment Corp., New Jersey,
Approval No. 160.033/52/0

The hook lock was in the position in which it would be with the boat stowed, that is, it was in the locked position. However, the base of the hook was not inside the hook lock and as a result, the hook was free to rotate about the horizontal pin.

The entire No. 2 lifeboat was recovered. The words "EDMUND FITZGERALD NO. 2" were painted in three-inch letters on both bows and the words "500 CU. FT. 50 PERSONS" were painted in one and one-half-inch letters below that. There was no name plate attached. The plating along the port side of the stem was split open from the gunwale to about 2 feet above the keel. The bow plating was buckled from gunwale to keel from the stem to 12 feet aft on the port side, and to 9 feet aft on the starboard side. The plating was holed on the port side forward, at the turn of the bilge, over an area of two and one-half by one and one-half feet. The rivets fastening the stern sheet to the port side of the boat were missing. The forward half of the grab rail was buckled and the forward shell fastening were pulled out (there were a total of 6 such fastenings). The starboard grab rail was distorted throughout its 12-foot length, and the third (from forward) of the six grab rail to shell connections was pulled out. The shell connection of the first thwart was torn loose on the starboard side. The first and third side bench brackets were torn loose at the upper connection to the gunwale. The forward and after air tanks on the port side were missing and the other four were distorted. The forward air tank on the starboard side was adrift and the other five tanks were in place. The thwarts and side benches were generally damaged. The Rottmer Releasing gear, consisting of the hook, preventer bars, lock, upper and lower guide bearings and universal joints,

was intact at both ends. The plates securing the gear to the stem and stern were present. The shafting was twisted. The releasing lever was in the closed position. Legible data on the after releasing gear name plate stated:

> Marine Safety Equipment Corp., New Jersey,
> Approval No. 160.033/52/0

Both of the hook locks on boat No. 2 were in the same condition as the hook lock on boat No. 1, i.e., the hook lock was closed but the hook was outside of the lock and free to rotate about the horizontal pin. No boat equipment was found in No. 2 boat.

A SWITLIK, 25-man inflatable life raft, identified as being from FITZGERALD, was found inflated and floating upright, near the shore, in the vicinity of Coppermine Point. This raft was recovered by the M/V ROGER BLOUGH at 0942 on 11 November. The second SWITLIK, 25-man inflatable life raft from FITZGERALD was found south of Coppermine Point at 1100 on 11 November and was recovered, partially deflated, by an Ontario, Canada, Provincial Police Shore Party, later that day. Both rafts were delivered to the U. S. Coast Guard Base Sault Ste. Marie, MI, and a survey of them was conducted there, and at the U. S. Steel, Great Lakes Fleet Warehouse, Sault Ste. Marie, MI, on 24 November 1975, by U. S. Coast Guard Inspectors and a Canadian government Marine Surveyor.

The first raft inspected was the one recovered by the M/V ROGER BLOUGH. This raft was a SWITLIK inflatable life raft manufactured by the Switlik Parachute Co., Inc.,

Trenton, NJ., Approved by U.S.C.G. for 25 persons, Lot No. 3, Approval No. 160.051/20/1, Serial No. Spec. MM 13, Original Inspection: 12/5/67.

When first examined, it was in a deflated condition and it was fully inflated during the inspection. The raft and canopy were found to be in serviceable condition. There was a small tear in the after section of the floor, a slight air leak at the lower half of the separation buoyancy tube and a small tear in the forward part of the top of the canopy cover. The outside light was in operating order but the light cable had been cut. The submersible batteries were dated September, 1974. The after section of the inflatable floor was missing. The inflation bottle and all valves of the inflation system were operational. The full 100 foot painter was properly secured to the raft and to the CO2 release wire. The weak link that secures the painter to the vessel was missing. The following equipment was found in the raft:

(1) Part of sea anchor line

(2) Heaving line

(3) Two paddles - one handle

(4) One hand pump

(5) Two spare flashlight batteries

(6) Patch kit and glue

(7) Two relief valve plugs

(8) Life Raft Instruction booklet

(9) Water storage bag

Boarding ladders and lifelines outside and inside the raft were in good condition.

The second raft inspected was the one recovered by the Ontario Provincial Police. This raft was also a SWITLIK inflatable life raft manufactured by the Switlik Parachute Co., Inc., Trenton, NJ., Approved by U.S.C.G. for 25 persons, Lot No. 2, Approval No. 160.051/20/1, Serial No. Spec. MM 47, Original Inspection 2/5/67.

The raft had a 12 inch gash in a flotation tube and the nylon straps were badly tangled around the rubber inflating tube leading to the CO2 cylinder. The blue nylon cover was badly torn. The lower buoyancy chamber had three holes. These had been punched with a pocket knife by the Ontario Provincial Police shore party to allow the water in the raft to escape when the raft was recovered. The inflation bottle and valves were operational. Only 30 feet of the 100 foot painter remained and it appeared to have broken under tension. The painter was properly secured to the raft and to the CO2 release wire. The inspection report stated that it appeared that the upper buoyancy chamber inflation valve had been torn from the fabric in an attempt to deflate the buoyancy chamber. The valve was in operating order. The nylon canopy covers were ripped off the starboard side and the covers were partially ripped off the upper chambers. Other than this damage, the condition of the material of the chambers and canopy was good. Both manually inflatable floor sections were found uninflated near the raft.

A CO2 inflation cylinder was found in the water beside the raft. The only other equipment found was an orange nylon bag, 3' by 4" by 6" in size, found tangled in the nylon straps, which contained sodden flares and the life raft instruction booklet and patch kit. The lights for inside and outside were broken but the wiring was intact and in order. The submersible batteries were dated September, 1974. The raft was covered in several places with heavy bunker fuel. It was not possible to identify which raft had been stowed forward or which aft.

The additional items recovered consisted of the following:

(1) 20 cork float life preservers or life preserver pieces.

(2) Eight oars or oar pieces.

(3) One piece of a Sounding Board, identified as the type which had been on FITZGERALD. There were no chalk markings on the Sounding Board.

(4) Eight flotation tanks, identified as having come from the lifeboats.

(5) One large built-up wooden fender block with line.

(6) Two propane cylinders, one with valve cover. Propane was used for galley fuel on board FITZGERALD and tanks such as these were stowed on deck, aft on the Poop Deck.

(7) Thirteen life rings, with pieces of line attached. Two had carbide "water light" cannisters attached and two other life rings had threaded circular plastic discs attached to the lines. These discs were identified as end caps of electrically operated water lights.

(8) One piece of a life ring.

(9) One piece of line approximately 8 feet long.

(10) Two 2" by 12" planks, one approximately 12 feet long, the other approximately 5 feet long. One 6" by 8" plank approximately 15 feet long.

(11) One wooden stool, identified as similar to the type used on FITZGERALD.

(12) One heaving line.

(13) One stepladder.

(14) One-half of a boat cover, identified as the type which had been on the lifeboats on FITZGERALD.

(15) One rudder from a lifeboat.

(16) One lifeboat boat box, empty.

(17) One floodlight, identified as the type that was installed on the pilothouse and after deck of FITZGERALD.

(18) One plastic spray bottle, white, marked "Pilothouse Window."

(19) One broken extension ladder.

(20) Pieces of assorted broken scrap wood.

The end caps of the electrically operated water lights had been separated from the lights without damage to the caps. The caps were examined at Coast Guard Headquarters and were identified as having come from lights manufactured by the Automatic

Lite Company, Baltimore, MD. Representatives of Columbia Transportation Division, the operators of FITZGERALD, confirmed that the lights on FITZGERALD had been SAVE-U-LIGHTS, manufactured by the Automatic Lite Company under Approval No. 161.010/3/1. Records at Coast Guard Headquarters indicate that this approval number was superseded on 25 May 1976, when the manufacturer redesigned the water light cap attachment because the caps on the prior design loosened and fell out or pulled out too easily.

Once the flotsam had been examined, it was turned over to Columbia Transportation Div., Oglebay-Norton Co., the operator of FITZGERALD, for disposition.

One additional cork float life preserver was found on the beach, approximately 5 miles north of Coppermine Point on 20 April 1976. This life preserver was in the same general condition as those which had been found during the November search.

8. Pollution

On the morning of 11 November 1975, when it became apparent that there was some discharge of oil in the area where FITZGERALD was lost, the Commander, Ninth Coast Guard District, activated the Joint U.S.-Canadian Pollution Contingency Plan and the Joint Response Team (JRT), with U. S. and Canadian representatives on scene at Sault Ste. Marie that evening. A representative of the Coast Guard Atlantic Strike Team was also present. The JRT remained on scene in an observation and advisory capacity until Friday, 14 November 1975, at which time it was concluded that the diesel oil on board the vessel (bow thruster fuel) had vented and that the Bunker C (main propulsion fuel) had reached a sufficiently low temperature that the viscosity had increased enough to preclude further venting. Thus, it

was determined that the pollution potential was negligible and the JRT was deactivated. The oil which had been observed on the surface had dissipated and there was no cleanup effort.

9. Underwater Search and Survey

An extensive sequence of underwater search and survey activities was undertaken to locate and identify the wreckage of FITZGERALD. The first of these was a side-scan sonar search conducted using equipment and personnel from the U. S. Coast Guard Research and Development Center during the period 14 November through 16 November 1975. The equipment used was an Egerton, Germershansen and Greer (E.G.&G.) Model 250 side-scanning sonar deployed from the Coast Guard Cutter WOODRUSH. Wreckage, which was later proven to be FITZGERALD, was located within the first half day of the sonar search. Using a Coast Guard owned Mini-Ranger Navigation System, the center of the wreckage was shown to be located at a position 46°59.8'N, 85°06.7'W.

Continuing search activity disclosed two large objects lying close together on the lake floor in approximately 530 feet of water. Although bad weather in the area resulted in poor sonar trace quality, preliminary calculations showed that each of the objects was approximately 300 feet in length. In addition, a "sonically rough" area near these objects was observed and this was tentatively identified as spilled cargo.

Because the first side-scan sonar search was conducted under conditions of adverse weather and because the equipment used was not fully adapted to operations at the depth at which the wreckage of FITZGERALD was found, the Marine Board recommended that a second, more detailed side-scan sonar search be conducted.

The second side-scanning sonar search was conducted by a commercial contractor, Seaward, Inc., of Falls Church, VA, during the period from 22 November through 25 November. This survey was performed from the USCGC WOODRUSH, using equipment similar to that used in the first survey. During this survey, horizontal surface positioning was maintained by the use of the same Coast Guard Motorola Mini-Ranger Navigational System used in the first survey.

Sonar operations were conducted almost continuously during the three-day period under severe wind and sea conditions. A total of 80 sonar traces were made, each of which recorded a transit of several hundred yards of continuous sonar searching. In connection with these 80 runs, nearly 300 navigational fixes were obtained. The purpose of the numerous runs was to obtain the maximum amount of data from as many different sonar aspects as possible.

Initial interpretation of the sonar traces indicated that the wreckage found was probably that of FITZGERALD. The side-scan sonar traces were taken to Seaward's facility and subjected to an intensive analysis, including the construction of a small model of the wreckage which was used to verify the interpretation of the side-scan results. Based on this analysis, the Marine Board determined that the wreckage was very probably that of FITZGERALD but that positive identification was necessary, and that the configuration and arrangement of the wreckage and the bottom conditions were such that a detailed visual survey was both feasible and necessary.

During the period 12-16 May, a third side-scan sonar survey was made. The survey was conducted to reestablish the accurate position of the wreckage for the photographic survey and to define the planned mooring radius for anchor placement clear of the wreck. This survey, like the second one, was conducted by Seaward, Inc., using Seaward equipment, from the USCGC WOOD-RUSH. This survey resulted in good quality traces which were interpreted to contain information which, for all practical purposes, was identical to that obtained at the second survey, in November.

Immediately following the third side-scan sonar survey, a visual survey of the wreckage was conducted using the U. S. Navy CURV III system contracted for by the Coast Guard.

The CURV III system is composed of an unmanned underwater vehicle, an umbilical control and power cable, and surface equipment operated from any suitable support ship. The vehicle is capable of making visual observations, recovering small objects, and performing other light work tasks at depths to 7,000 feet. The vehicle consists of a frame, approximately 6 feet by 6 feet by 15 feet, which supports two horizontal propulsion motors, one vertical propulsion motor, one 35 mm still camera, two black and white TV cameras, lights, a manipulator arm, and other machinery. The vehicle operates on electric power supplied from special generators placed on the support vessel and is operated from a control van also placed on the support vessel. In addition to the remote control mechanism and sonar presentation, the control van contains video tape recording equipment.

From 12 to 19 May 1976, while the third side-scan sonar survey was being conducted, the CURV III was being transported to Sault Ste. Marie, MI. The CURV III system and

operating and observation personnel were loaded on board WOODRUSH on 18 and 19 May 1976, and underwater operations began on 20 May 1976. Between 20 and 28 May 1976, CURV III made twelve dives, logging a total of 56 hours, 5 minutes of "bottom time" and recording 43,255 feet of video tape and 895 color photographs.

The results of the three side-scan sonar surveys and of the CURV III visual (television and photographic) survey were assembled and reviewed by an independent research contractor. Based upon all the information available, this contractor prepared sketches of a plan of the wreckage, Fig. (6) (p. 56), and artists' conceptions of the wreckage from several different views, Fig. (7)-(11) (pp. 57-61).

The wreckage of FITZGERALD lies at 46°59.9'N, 85°06.6'W, in 530 feet of water in eastern Lake Superior, approximately 17 miles northwest of Whitefish Point, MI, and just north of the International Boundary, in Canadian waters. The wreckage consists of an upright bow section, approximately 276 feet long, lying on a heading of 125°T, an inverted stern section approximately 253 feet long, lying on a heading of 075°T, and debris in between. At its closest point, the stern section is approximately 170 feet from the bow section, and the overall distance from the rudder post, at the end of the stern section, to the stem, at the opposite end of the bow section, is approximately 540 feet. An area of distorted metal lies between the two pieces and to both sides over a distance of some 200 feet. Both the bow and the stern sections and all of the wreckage appear to be settled into the bottom mud, and a great deal of mud covers the portion of the Spar deck attached to the bow section. The bottom mud in the area of the wreckage shows extensive disruption and, in some locations, the bottom mud is in large mounds. The mud appears to be plowed up both at the bow and stern sections. The mud which is against the hull shows no regular

pattern. The presence of the mud hampered the visible survey considerably, both because it obscured the details of the wreckage and because the passage of the CURV III vehicle caused the mud to swirl up, reducing the visibility. The name of the vessel was clearly visible, both on the stern section and on the bow section, and the identity of this wreckage as that of the SS EDMUND FITZGERALD was thus positively confirmed. During the survey, no bodies were found, nor were any items seen which could be identified as personal effects of the crew.

The bow section is sitting nearly upright on the bottom, inclined approximately 15°. The Spar Deck of the bow section extends to a location between hatch No. 8 and No. 9. At the separation, the starboard side of the hull is bent in toward the centerline and is folded under the deck, while the deck is bent upward from a point approximately two hatches forward of the separation. Mud is spread and piled all over the Spar Deck area, and the deck edge on the port side is completely covered with mud. At some locations it is possible to distinguish taconite pellets, or the mud-covered outline of them. The hatch covers are missing from No. 1 and No. 2 hatches. The forward coaming of No. 1 hatch is severely damaged. The after coaming of No. 1, and the forward and after coamings of No. 2 hatch show less damage. No. 3 and No. 4 hatches are covered with mud. The hatch covers for hatches Nos. 5, 6, 7 and 8 are missing. The forward coaming of No. 5 hatch is laid down and damaged. The degree of damage to the deck and hatch coamings increases from No. 1 to the separation. The access hatch, located between cargo hatches Nos. 7 and 8, is present, with the cover on and dogged. No fence rail stanchions are present. The sockets into which the portable stanchions were fitted are undamaged. The 28-foot draft mark is visible just above the

mud line, and the hull beneath that is buried in the mud. The bow above the mud is damaged on both sides immediately adjacent to the stem. On the starboard side, slightly aft of the stem, the hull immediately below the Spar Deck level is holed and badly distorted. The shell plating between the Spar Deck and Forecastle Deck is badly damaged and distorted, and aft on the starboard side this plating is badly bent and laid in towards the centerline. Throughout this area the plating is heavily wrinkled, and the white paint which had been on the hull in this area has broken away and the plating beneath it has rusted. The steering jib is bent completely back and the end of it lies up against the forward section of the Texas Deck bulwark. The plating of the bulkhead of the forward house between the Forecastle Deck and the Texas Deck is badly damaged. The forward section of the pilothouse is damaged on both the port and starboard sides and the forward section of the sunshade above the pilothouse windows is damaged on the port side. Most of the pilothouse windows are missing. The radar and r.d.f. antennas and the ship's bell, which had been installed on top of the pilothouse, are also missing. Foundations for the radar antennas are visible but no antennas can be seen.

The stern section is upside down, inclined approximately 10°. All of the bottom plating and the side shell plating which is visible above the mud line is intact. The separation is estimated to be at frame 155, which would correspond to the after end of hatch No. 18. At the separation, approximately 12 to 15 feet of the hull extends above the mud. At the after end, the overhead of the Spar Deck, i.e., the underside of the Poop Deck, is lying approximately even with the mud level. The aft superstructure is buried in the mud. The rudder and propeller are clearly visible and undamaged. The rudder appears to be at the midships position. There is no hole or rupture in the exposed stern section of the hull other than at the separation.

One dent was found slightly to port of centerline, approximately 50 feet forward of the rudder post. A large inward dent, which appears to be a buckle, was found on the starboard side of the stern section at a position approximately 20 feet from the separation, extending vertically from the mud line to the turn of the bilge and across the hull for 10 or 15 feet. There was no breach of the hull at either dent. At the separation on the starboard side, the plating is twisted outward from the hull, while on the port side, the plating is, in general, twisted inward.

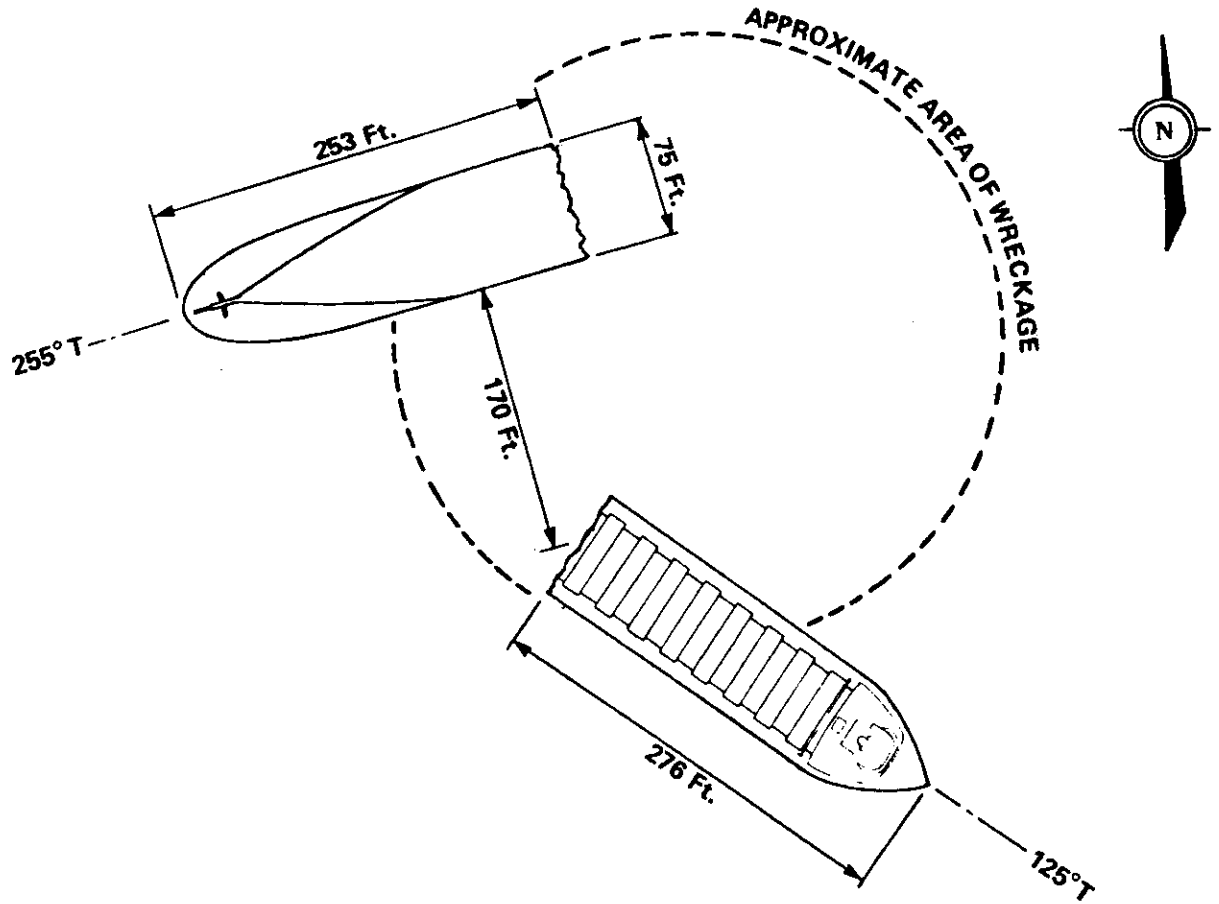
Extending outward from the separation at the bow section and at the stern section is an extensive area of debris. For the most part, this debris cannot be identified as coming from a particular part of the vessel, although much of it appears to be pieces of interior structure. This debris is covered with mud and, in some cases, taconite pellets are visible within or on top of the mud. A set of three damaged but regularly spaced hatch coamings and a hatch cover are located adjacent to the inverted port side of the stern section. One of these coamings has the numeral "11" on it. Although a systematic survey of this debris was attempted, no regular order to it could be determined by visual examination.

All of the areas of the separations, which were examined in detail, show curving, twisted edges such as is associated with ductile failure. No separations were seen which appeared to be the sort of straight or flat separations common to brittle fracture. All of the hatch coamings found have hatch clamps attached, and the great majority of the hatch clamps observed appear to be undamaged. One coaming, which could not be identified by number, has a line of clamps, with one distorted and several completely undamaged clamps on either side. One

distorted piece of structure, which was identified as a badly damaged corner of a hatch coaming, was observed to have undamaged hatch clamps attached to it. This general pattern, i.e., that nearly all of the hatch clamps found appeared to be undamaged and only a few were distorted, was seen at every location where a hatch coaming was found.

A few pieces of debris were found which were identified as hatch covers. One of these was folded to a right angle and another was protruding from the No. 6 hatch opening. There was no sign of scrape mark or other damage at the button on which the hatch clamps land on these covers.

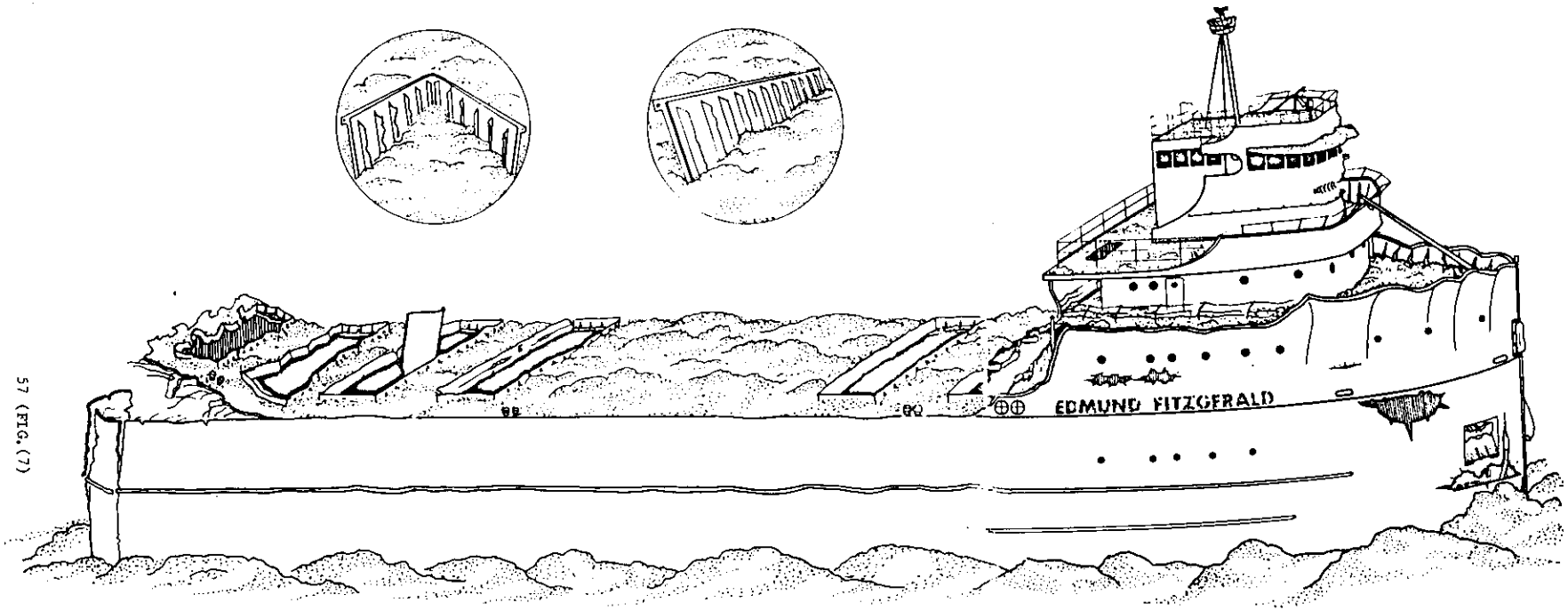
A few deck vents were observed, primarily on the starboard side of the bow section. It was not possible to determine whether the vent covers were in the open or closed position. One vent was observed torn away from the deck, and an opening in the deck at the base of the vent pipe could be seen.



WRECK LOCATED AT

LAT 46° 59.9' N
LONG 85° 06.6' W

FIG. (6)



57 (FIG. (7)

FIG. (7)

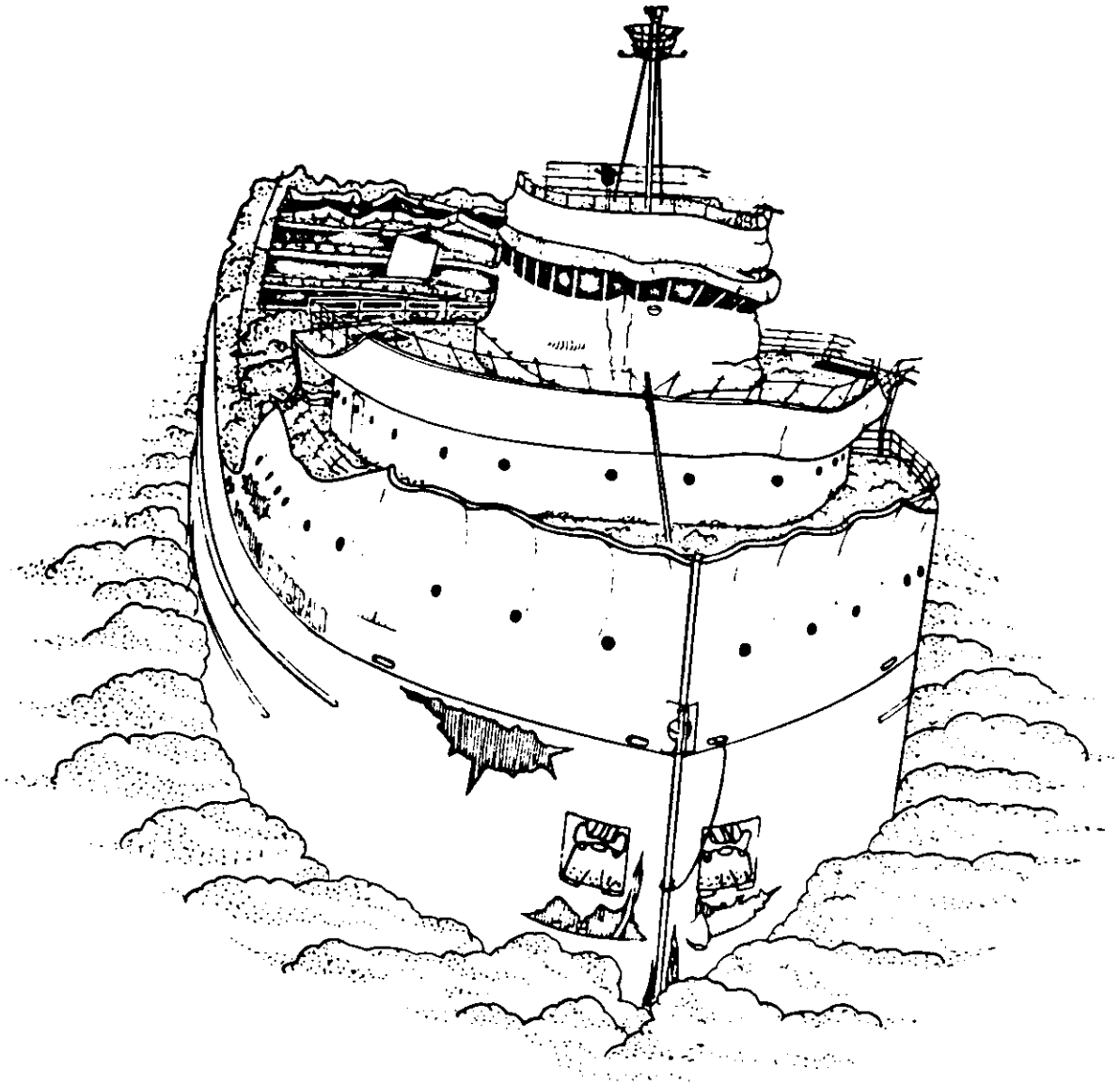


FIG. (8)

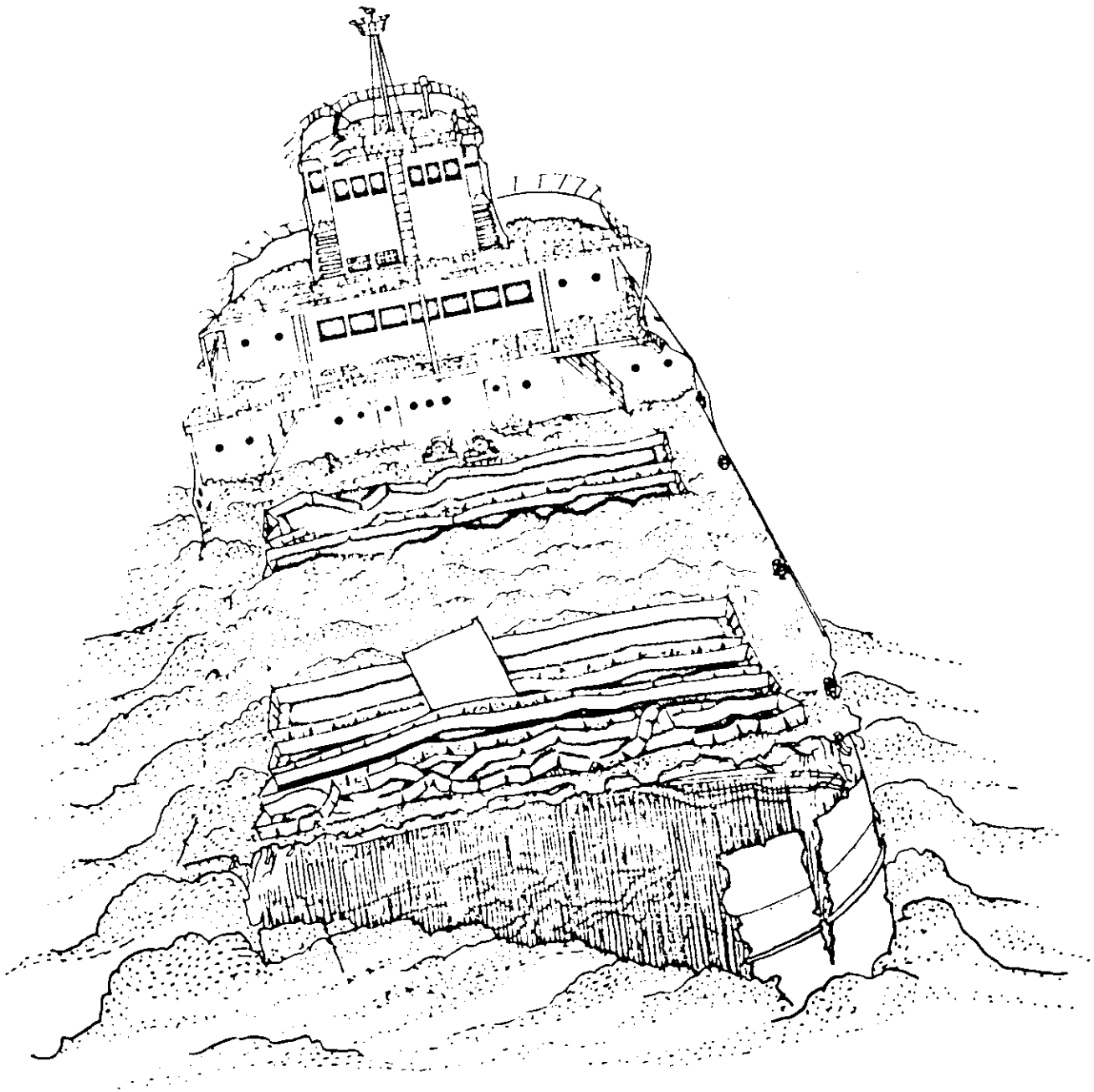


FIG. (9)

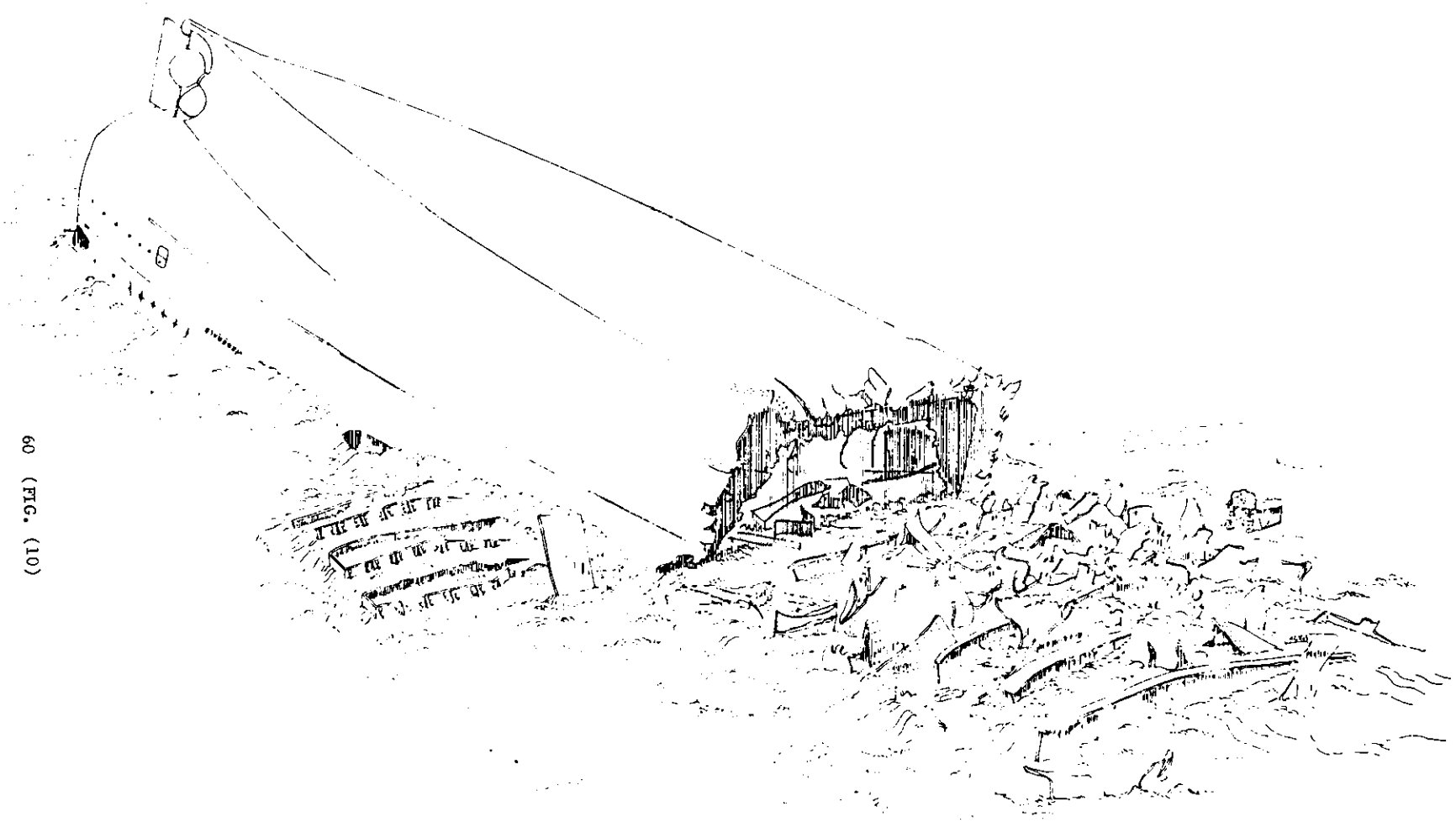


FIG. (10)

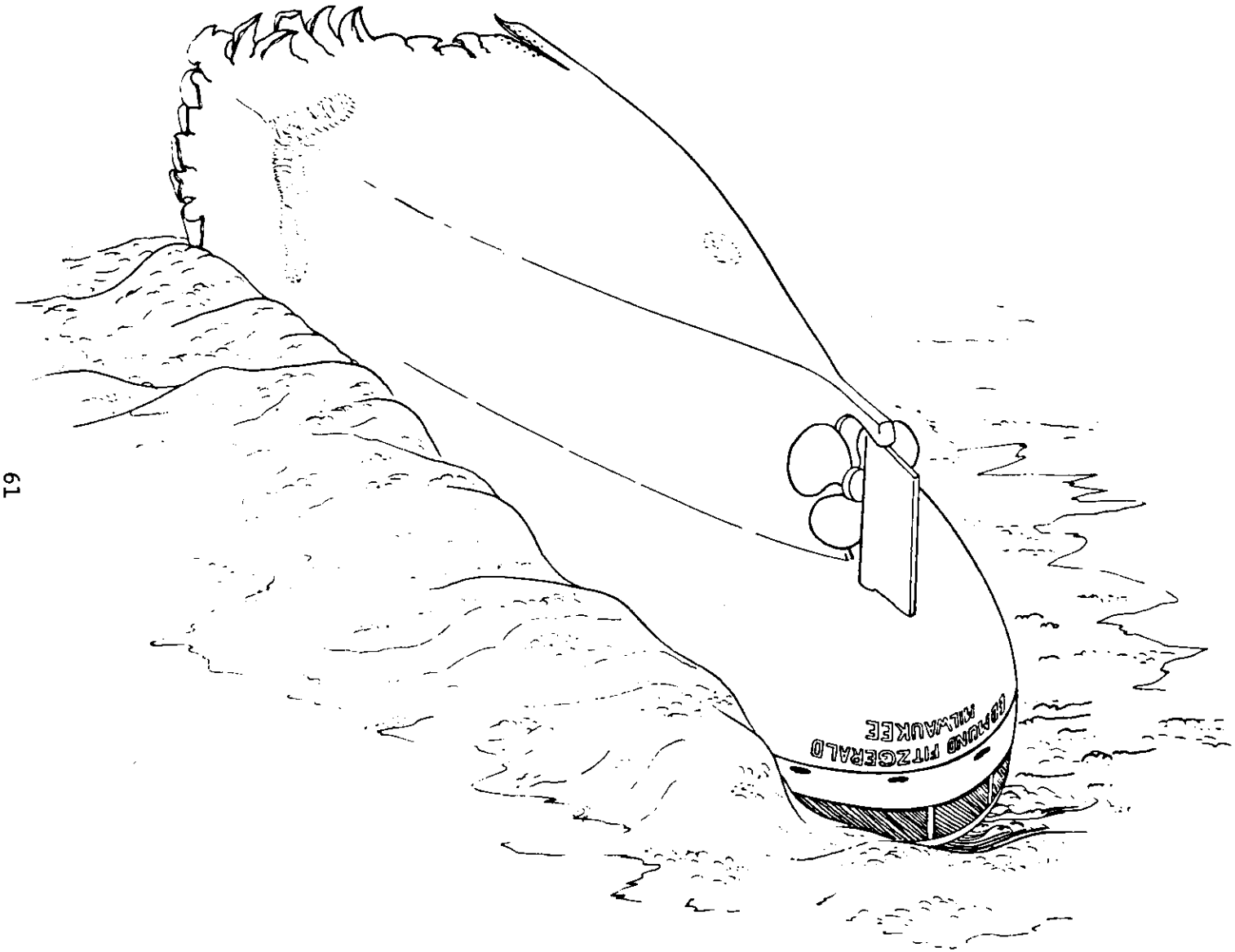


FIG. (11)

10. History and Maintenance

FITZGERALD was built in 1958 at Great Lakes Engineering Works, River Rouge, MI, Hull No. 301. Owned by Northwestern Mutual Life Insurance, of Milwaukee, WI, FITZGERALD was immediately chartered to the Columbia Transportation Division, Oglebay-Norton Corporation, and placed into service as a bulk carrier on the Great Lakes.

FITZGERALD continued in operation essentially unchanged until 1969, at which time a Byrd-Johnson, diesel powered bow-thruster unit was installed. During the 1971-72 winter lay-up, while at Duluth, MN, FITZGERALD underwent a coal-to-oil conversion. All of the coal fuel equipment and accessories were removed, and the plant was converted to burn oil. Incidental to this conversion was the installation of two fuel tanks in the space previously occupied by the coal bunkers. A Bailey Meter Digital System for automatic control of the boiler combustion system was also installed. This system, a Bailey Type 762, which consisted of a complete pneumatic combustion and feedwater control system, operated without incident from the time it was installed. At the same time of the coal-to-oil conversion and automation, the vessel was equipped with a sewage holding tank and additional CO2 firefighting equipment was installed.

No structural problems which were considered severe enough to cause the vessel to be removed from service during the operating season were reported by FITZGERALD during its 17 years of operation. The only notable structural modification, other than the conversion from coal to oil, took place during the 1969-70 winter lay-up. The vessel had experienced cracking at the keelson to shell connection and a naval architect recommended installing additional vertical stiffening on the keelsons. Following this modification, no further

circumstances of this cracking were found until the 1973-1974 winter lay-up and drydocking, and these were of sufficiently reduced scope that no more than simple rewelding repairs were necessary. During the same 1969-70 lay-up, the crew discovered a fracture in the vertical section of the gunwale bounding angle, portside, adjacent to hatch No. 14. This fracture, which began at the top of a rivet hole and propagated vertically, was determined to have been caused by a fault in the original construction of the vessel. The fracture was repaired by rewelding and there was no recurrence. Prior to the 1973-74 winter lay-up, the vessel had experienced some minor cracking, described as "hairline cracks one to one and one-half inches in length," in the vertical welds joining the hatch end girder and the transverse hatch coaming, beneath the Spar Deck. Each hatch had four such welded joints and of the eighty-four joints on the vessel, twenty were found with cracks. During the 1973-74 winter lay-up, these cracks were repaired and the radius of the cutout above this connection was increased to two inches. During the 1974 and 1975 operating seasons, no repetition of this cracking was observed. Because cracks had been found at Hatch 14 in the vertical butt weld of the longitudinal hatch end girder channels, this connection was modified, during this same lay-up, at the butt, by sniping away the lower and upper flanges of the channel, rewelding the webb and reriveting the upper flange. No recurrence of this cracking was observed after this modification.

The following is a list of hull structural casualties sustained by FITZGERALD since 1969. All structural damage was repaired. In most instances, this was accomplished by removing the damaged portions and replacing as original.

a. 6 September 1969. Grounding in the vicinity of the locks, Sault Ste. Marie, MI. Damaged areas were in the B

and C strakes (hull strakes were lettered from A at the keel to M at the deck edge), frames 156 to 198 (hatches 19-21 and after house) in the D strake, frames 131-148 (hatches 16 and 17) and frames 181-198 (after house), and in the E strake frames 156-165 (hatch 19). The hull plating was set up heavily, scored and gouged and the associated internal stiffeners were also damaged.

b. 30 April 1970. Collision with the SS HOCHELAGA. Damaged areas were in the J, K, L and M strakes, frames 117-165 (hatches 18 and 19).

c. 4 September 1970. Striking a lock wall at the locks at Sault Ste. Marie, MI. Damaged areas were in the L strake, frame 145-162 (hatches 18 and 19).

d. May 1973. Striking a lock wall, Sault Ste. Marie, MI. Damaged areas were in the K, L and M strakes, frames 20-70 (hatches 2-7) and in the Main (tunnel) deck. Plating and associated internal stiffeners were set it.

e. 17 June 1974. Striking a lock wall at Sault Ste Marie, MI. Damaged areas were in the L strake, frames 20-45 (hatches 2-4) and in the Main Deck and associated internal stiffeners.

In September 1974, the crew inadvertently started to lift the cover from No. 8 hatch without removing all of the hatch clamps. Four clamps, the coaming and the hatch cover and the stiffeners on the coaming and cover were damaged. Repairs were accomplished during the 1974-75 winter lay-up period.

Maintenance of the vessel during the operating season was the responsibility of the crew. The Master and Chief Engineer had the authority to contract for minor maintenance

items as well as supplies. Repairs of a substantial nature, that is, those for which the cost would be more than a few hundred dollars, had to be approved by the company office. During winter lay-up, repairs and maintenance were accomplished by commercial contractors and by a winter standby crew which provided maintenance for several of the vessels operated by the company. During the fall preceding the loss of FITZGERALD, a company representative had performed an inspection of the vessel and had consulted with the crew concerning their requested work items. The detailed Winter Work List had not yet been developed. The company representative testified that there were no items on the list of work requested by the ship's crew for the 1975-76 lay-up or in the notes of his inspection which he considered anything other than routine maintenance. These lists did include items to "check all hatch covers and coamings and straighten as found necessary (No. 21 fwd. starboard side)" with estimated cost of $2100,. and "V-out and weld all fractures in plating for tank top, side tank and bulkheads throughout cargo holds, as marked" with estimated cost of $6000. Identical work items appear on the 1974-75 work lists, with $1200 estimated for hatch cover and coaming repairs and approximately $3800 actually spent, and $2800 estimated for structural repairs and approximately $3200 actually spent.

11. Lifesaving Equipment

FITZGERALD was required by Coast Guard Regulations to have primary lifesaving equipment for 200% of the persons authorized to be carried on board. Of this primary lifesaving equipment, one-half, or facilities for 100% of the persons to be carried on board, was required to be in the form of lifeboats, and the other half was required to be in the form of inflatable life rafts. Because FITZGERALD had crew berthing and working spaces "widely separated," at least two

inflatable life rafts were required. Lifesaving equipment installed on board FITZGERALD consisted of two 50-person lifeboats and two 25-person inflatable life rafts. Each inflatable raft was installed in a rack from which it was designed to float free. Upon floating free, the raft would inflate automatically. One life raft was located aft of the forward house on the Texas Deck, starboard side, and the other raft was located aft of the after deckhouse on the Poop Deck.

Considerable testimony was received from both licensed and unlicensed Great Lakes Merchant Mariners concerning the use of primary lifesaving equipment. Without exception, the witnesses expressed considerable doubt that lifeboats could have been successfully launched by the crew of the vessel under the weather conditions which existed at the time FITZGERALD was lost. A Great Lakes Registered Pilot testified: ". . . I have said that if the damn ship is going to go down, I would get in my bunk and pull the blankets over my head and say, 'Let her go,' because there was no way of launching the boats."

Drills, in good weather, at the dock, show that a conventional lifeboat could not be launched in less than 10 minutes and testimony indicated that as much as 30 minutes might be required to launch a lifeboat in a seaway. Most witnesses expressed more confidence in the inflatable life rafts than in the lifeboats, although very few of them had ever seen a life raft inflated or launched. Coast Guard Regulations require training and drills in the use of lifeboats, but do not address life rafts. Testimony indicated that Oglebay Norton Co., the operator of FITZGERALD, had no training program in the use of life rafts.

The Coast Guard is involved in a research and development program dedicated toward improving lifesaving equipment and procedures. Much of this research is specifically directed toward Great Lakes shipping. The initial studies concluded

that improvement is needed in launching and embarking into primary lifesaving equipment. This research is continuing.

Coast Guard research has also included the development of a method of evaluating exposure suits. There are no requirements for exposure suits on Great Lakes vessels, and no suits were provided on FITZGERALD on its last voyage on 9 November.

On 15 June 1976, the Coast Guard published an Advance Notice of Proposed Rulemaking concerning increases in the requirements for lifesaving equipment on vessels operating on the Great Lakes. This notice stated that the Coast Guard was considering amendments to the regulations for Great Lakes vessels in the following areas:

a. Lifeboat exposure protection.

b. Lifeboat maneuverability.

c. Survival craft availability.

d. Launching of survival craft from stowed position.

e. Lifeboat capability to float free automatically from a sinking vessel.

f. Personal exposure protection.

g. Communications equipment on survival craft.

h. Lights and reflectorized materials.

i. Standards for equipment substituted for required equipment.

Comments were requested to be submitted to the Coast Guard by 7 September 1976, and a Notice of Proposed Rulemaking is in preparation.

Coast Guard Regulations require that fire and boat drills be conducted at least once each week on a cargo vessel such as FITZGERALD. Testimony from licensed officers who had previously served on FITZGERALD indicated that drills were held on a regular basis. Testimony of unlicensed mariners who had served on FITZGERALD at various times during the 1973 and 1974 seasons indicated that drills were not held. The regulations also require that an entry be made in the vessel's Official Logbook concerning each drill conducted. Logbooks for FITZGERALD were not available, having been lost with the vessel. Under a procedure established by the company which operated the vessel, extracts of the vessel's logbook and of the engineering logs were prepared and forwarded to the company office in Cleveland, OH. These extracts, known as Office Logs and Engineering Logs, respectively, were available from April 12, when the vessel began the 1975 season, through the end of October. These show a total of fourteen Fire and Boat Drills during that twenty-eight week period.

The Certificate of Inspection called for a total of eighty-three life preservers: one for each of the forty-nine crew, twenty-five for the required 50% excess, two in each lifeboat, three for the bow watch, and two in the engine-room. There were three types of life preservers on board FITZGERALD: Cork type, two in each boat and thirteen or fourteen in each lifejacket box near the boats; Horse-collar, foam type, in each stateroom; and several Kapok type.

FITZGERALD was required to have twenty-four 30-inch ring life buoys on board, twelve of which were provided with water lights. Testimony indicated that there were both electrical (battery) and chemical (carbide) water lights on board FITZGERALD at the time of the casualty. Although the Coast Guard approval for carbide water lights has been withdrawn, those on

board were allowed to be retained as long as they were maintained in good and serviceable condition. Coast Guard Regulations require that ring buoys be placed so as to be readily accessible to persons on board and "capable of being cast loose" and "not permanently secured in any way." There is no requirement that either battery or carbide water lights or the ring buoys to which they are attached be able to float free from the vessel in the event of sinking.

Coast Guard Regulations which require an Emergency Position Indicating Radiobeacon (EPIRB) for ocean vessels do not require such a device on vessels operating on the Great Lakes, and no EPIRB was installed on FITZGERALD.

12. Load Line and Stability

The requirements for load lines on merchant vessels engaged in voyages on the Great Lakes are based upon the Coastwise Load Line Act, as modified by agreements between the U. S. and Canadian governments. A comparison of the load line requirements for Great Lakes vessels and those for vessels operating on the oceans shows that, for vessels of similar dimensions, the freeboard required for a Great Lakes load line and that required for ocean service would be approximately the same. However, the longitudinal strength required for the Great Lakes vessel would be approximately one-half of that required for a vessel on an ocean voyage.

FITZGERALD was built in 1958, and was issued a Load Line Certificate at that time. In 1967, a joint U. S.-Canadian committee undertook a reevaluation of the load line requirements for operation on the Great Lakes. This study

resulted in extensive changes to the Great Lakes Load Line Regulations. The first of these changes was published in 1969 as an addition to the Load Line Regulations, which allowed "Reduced Freeboards for Steamers Having Superior Design and Operational Features Engaged on Great Lakes Voyages." In 1971, the regulations were amended by reducing the "factor for winter season," with the result that the minimum freeboard allowed during the winter season, i.e., after 1 November, was reduced. Finally, in 1973, the Great Lakes Load Line Regulations were completely revised. These revised regulations have become known as the 1973 Great Lakes Load Line Regulations.

The 1973 Great Lakes Load Line Regulations, which were in effect and applied to FITZGERALD at the time of the casualty, include requirements involving watertight integrity above the Freeboard Deck, details of hatch covers and doors, strength of superstructures, details of air pipes, ventilators, scuttles and manholes, and protection for the crew. Under the 1973 Great Lakes Load Line Regulations, for vessels with length in excess of 500 ft. greater length does not require a proportionally greater required freeboard. Also, under the 1973 Great Lakes Load Line Regulations, the winter penalty for Great Lakes Load Lines was reduced to be no greater than the winter penalty for a vessel operating on the oceans.

The following table shows the load lines assigned to FITZGERALD:

	Minimum Required Freeboard			
Date	Mid-Summer	Summer	Intermediate	Winter
Originally assigned when vessel was built	11'10-3/4"	12'6-3/4"	13'6-3/4"	14'9-1/4"
3 July 1969	11'4-1/2"	12'0-1/2"	13'0-3/4"	14'3-1/2"
17 Sept 1971	11'4-1/2"	12'0-1/2"	13'0-3/4"	13'2"
13 Sept 1973	10'5-1/2"	11'2"	11'2"	11'6"

Before the 1973 load line was issued, minor modifications of the vessel were required. These included modification of watertight doors by adding stiffeners and deadlight covers, installing an additional course of railing on the Forecastle deck and Poop deck, increasing the freeing port area aft, increasing the height of the tunnel vents and installing covers on the windlass room chocks.

Under the 1973 Load Line Regulations, Midsummer load lines applied May 1 through September 15, Summer load lines applied April 16 through April 30 and September 16 through September 30, Intermediate load lines apply October 1 through October 31 and April 1 through April 15 and Winter load lines apply November 1 through March 31. Thus, the Winter load line applied to FITZGERALD at the time of her last loading.

The last Load Line Certificate for FITZGERALD was issued by the American Bureau of Shipping at New York City on 1 July 1974.

The last Load Line Survey was conducted in connection with the American Bureau of Shipping annual survey in Toledo, OH, on 9 April 1975.

One of the significant changes included in the 1973 Great Lakes Load Line Regulations was the requirement that a vessel must have on board, in a form approved by the Commandant of the Coast Guard, sufficient information to:

a. Enable the Master to load and ballast the vessel in a manner that avoids unacceptable stresses on the vessel's structure, and

b. Guide the Master as to the stability of the ship under varying conditions of service.

The first of these established a new requirement for a Loading Manual. Before this, a Loading Manual had not been required on Great Lakes vessels.

The regulations do not include particulars on what should be included in the Loading Manual. Testimony of Coast Guard naval architects indicated that it should include information on all normal cargo and ballast loading conditions, instructions on how to ballast and deballast the ship and information on the sequence of loading and unloading.

Other testimony indicated that first attempts to develop Loading Manual for vessels operated by Oglebay-Norton Company included detailed theoretical analysis of the loading and unloading of vessels. These theoretical studies resulted in loading plans which varied markedly from those used in the practice of loading these ore carrying vessels. Experience with these earliest loading plans showed that the Mates in charge of the loading of the vessels strongly preferred the loading procedures which they had been using. These procedures were

analyzed by a naval architect employed by the operators of the vessels, and it was found that only small modifications were necessary to insure that stresses of the vessels as loaded were within acceptable limits. Based upon this analysis, the actual procedures were used to develop a new loading manual for FITZGERALD. This Manual was approved by the American Bureau of Shipping on 17 October 1973 and by the Coast Guard on 23 October 1973.

A detailed analysis of this Loading Manual for FITZGERALD shows:

a. The Manual contains information relating to the total load for each hatch, but there is no information provided on intermediate loads within the loading sequence or on any aspect of unloading.

b. The Manual was prepared for the two-belt loading system used at Silver Bay, MN, FITZGERALD's normal point of loading. It does not contain information directly applicable to a chute dock, such as the one at which FITZGERALD loaded on 9 November.

c. The Manual does not contain information on ballasting or deballasting or on fueling.

d. The Manual does not contain information on calculation of Stress Numeral.

Stability requirements for Great Lakes ore carriers of the straight deck type, such as FITZGERALD (i.e., not equipped with unloading machinery), are the same as those for ocean-going vessels; the Master of the vessel must be furnished with sufficient stability information to allow him, for any condition of loading, to obtain accurate guidance as to the stability of the

vessel. However, detailed studies have indicated that the typical Great Lakes ore carrier has a very high level of inherent stability because the cargo is dense (with a stowage factor of 10 to 18 cubic feet per ton), it is carried low in the vessel and there is little free surface effect from the ballast tanks (the width of the upper portion of the tanks is small compared to the beam of the vessel). Because of this high level of inherent stability, it has been determined by the Coast Guard that neither stability tests nor stability calculations are required for vessels of this type. Accordingly, no inclining experiment had ever been performed on FITZGERALD, and no stability calculations were available.

Coast Guard regulations do not require general service cargo ships, operating on the ocean or on the Great Lakes, to meet any damage stability standard. Accordingly, FITZGERALD had not been subjected to a damage stability assessment.

The Great Lakes Load Line Regulations require that when an air pipe to any tank extends above the freeboard or superstructure deck, it must be of steel and of substantial construction, have a permanently attached means of closing, and have a height, from the deck to a point where water may obtain access below deck, of at least 30 inches above the freeboard deck, 24 inches above raised quarter decks and 12 inches above other superstructure decks. However, the regulations also state that if this height ". . . interferes with working the ship, the Commandant may approve a lower height after considering the closing arrangements." Such approval had been granted in the case of the ballast tank vents on FITZGERALD, which, including the mushroom cap, extended only 18 in. above the spar deck. The vents for the fore and aft tunnels, located forward and aft on the Spar Deck, were of the same 8-inch pipe as the ballast tank vents, and had similar mushroom closures. The tunnel vents had been raised to 30 inches above the deck as part of the September 1973 load line assignment.

13. Cargo and Loading Procedure

FITZGERALD sailed on its last voyage with a cargo of 26,116 long tons of taconite pellets. Taconite pellets, a very common cargo for Great Lakes ore carriers, are manufactured by a process known as "oxide pelletizing." This process begins with the mining of taconite, a form of iron ore. The taconite is crushed and ground and the iron it contains is then oxidized and the silicon and waste materials removed. The iron ore concentrate remaining is essentially a fine powder which is dewatered to about 10% moisture, and rolled into balls approximately one-half inch in diameter, which, after being heated to release more of the moisture, are fired in a kiln to a temperature of 2200°F to 2400°F. The results are dark, reddish-brown spheres, which are cooled to approximately 200°F and stockpiled awaiting shipment. Because of the natural insulative quality of the material, it is not uncommon to have the interior of a stockpile remain at a temperature above ambient. As a result, vessel operators have observed what they described as "steam" rising from the material after it has been loaded on board. There are no known instances of structural distortion resulting from this elevated temperature either on vessels or on rail cars carrying taconite. The spheres, or pellets as they are called, contain approximately 65% iron oxide, and have a bulk density on the order of 130 lbs. per cubic foot. This is equivalent to a stowage factor of 17 cubic feet per long ton. Because of the small size and generally spherical shape of the pellets, the commodity is easily handled on conveyor belts, in hopper-type railroad cars and in chutes. Taconite exhibits an angle of repose, the angle between the horizontal and the slope of a free-standing pile of the material, of between 26° and 30°. There is some evidence to indicate that a slightly higher angle of repose could be achieved if the material were stacked

in high piles, due in part to the presence of a higher quantity of finer material. There is no evidence to indicate that the presence of surface or internal moisture significantly affects the angle of repose, nor are there any reported instances that any vessels have experienced shifting of taconite cargo in normal service. The compressive strength of taconite pellets is approximately five hundred to six hundred pounds per square inch. This strength, which results from the firing, is sufficient to withstand the weight of the material when stacked in open piles or in the holds of vessels. The pellets do not dissolve in water and they are essentially non-magnetic, i.e., they are not attracted to an ordinary magnet. They will absorb moisture up to about 7% by weight. Information on the surface friction characteristics of the material, either in the wet or dry condition, is not available.

Loading and unloading and the accompanying ballasting and deballasting of Great Lakes ore carriers is normally the responsibility of the Chief Mate, who is assisted by the regularly assigned deck watch officers and crew. The Chief Mate typically maintains a notebook which contains information on procedures used for loading and in which the exact amount of cargo and the loading sequence for each load is recorded. This notebook remains on board the vessel and is used as a guide for loading sequence and cargo quantity. This notebook is different from the Loading Manual required by the Load Line Regulations. (An officer who had served as Chief Mate on FITZGERALD during the 1973 and 1974 seasons testified that he had never seen the Loading Manual, and that he relied on the Chief Mate's notebook for loading information.)

Upbound voyages are made with water ballast used to obtain desired draft and trim. During a normal loading, the ballast water is pumped out at the same time the vessel is being

loaded with cargo. Since the ballast tank suctions are located at the after bulkhead of each ballast tank, trim by the stern is necessary to deballast completely. During a normal loading, it is not unusual to interrupt cargo loading for an hour or so to maintain this trim while ballast water is discharged. When the vessel is fully loaded with cargo, no ballast water remains on board.

The final cargo profile of a normal load has approximately 28% of the cargo in the center half length of the cargo hold; the forward and aft quarter lengths, or the "shoulders of the ship," are loaded with the remaining 72%, or about 36% on each end. Hatch covers are put in place as the loading into the hatch is completed.

The closures for ballast tank vents on many Great Lakes ore carriers are customarily left open during all conditions of operation in the belief that with a vent closed, it would not be possible to obtain suction to dewater a ballast tank which might be making water.

During loading, draft readings are monitored by members of the ship's crew. Final draft and trim are adjusted by adding small amounts of cargo. An ideal loading would result in a few inches trim by the stern. Midships drafts are checked at the end of the loading by hanging a portable draft gauge over the side. Final cargo adjustments are made to achieve no hog, however, one inch of sag, or "belly," is considered acceptable and an even keel is the most desirable.

For the last several years, FITZGERALD had fueled at the loading dock at the same time as cargo was being loaded. There were two fuel tanks located in the space previously occupied by the coal bunker, immediately aft of the cargo holds. Total fuel

capacity was 114,000 gallons. The vessel usually received approximately 50,000 gallons of fuel, which would be enough for the five-day round trip voyage.

FITZGERALD loaded its last cargo at the Burlington Northern Railroad Dock No. 1 East, in Superior, WI, on 9 November. The docks at Superior are equipped with storage bins, called "pockets," built into the dock, and chutes which are used to direct the cargo from the pockets into the hatches of the vessel being loaded. FITZGERALD usually loaded at the Reserve Mining Co. dock at Silver Bay, MN, where two conveyor belts are used to load ore vessels. During the 1975 season, FITZGERALD had loaded at the Burlington dock in Superior on two other trips.

The pockets on the dock were loaded prior to the arrival of the ship. Most of the pockets were loaded with approximately 300 tons of pellets, although there were a few 200-ton and 100-ton pockets which were used in the final phase of loading to trim the ship. Each ore pocket has its own chute, which was lowered to the hatch opening on the ship when the ship was ready for that pocket of ore. Communication between the Mate on the ship and the loading dock supervisor was accomplished by voice.

The vessel moored starboard side to, on the inner end of the eastern side of the dock. The forward hatch on the vessel was lined up with the furthest inshore pocket on the dock. Loading began at approximately 0730 CST, starting with Hatch No. 21 and working forward to Hatch No.1. Each hatch received one pocket of ore, approximately 300 tons. Once each hatch had received one pocket, a "run" was completed. Upon completion of a run, the vessel had to shift its position along the dock to line up for the next run. The chutes on the dock are on 12-foot centers and the hatch openings on the ship were on 24-foot centers, so the vessel was shifted aft 12 feet to line up with the next set of chutes and received another complete run, again starting

aft and working forward. Upon completion of the second run, the vessel shifted again and took 5 or 6 pockets in the hatches aft. This maintained the required trim by the stern. Loading proceeded in this manner until the total desired load was on board.

Loading was completed at approximately 1315 CST, on 9 November, and the Mate passed the final draft readings up to the loading dock personnel. The Bill of Lading shows these as 27'2" forward, 27'6" aft. The departure midships draft readings are not available. The Bill of Lading shows that 26,116 long tons of National Taconite pellets were received. This figure is, however, only approximate. About one-half of the cargo that FITZGERALD received was dumped into the pockets on the dock directly from ore cars. The exact amount of taconite in each ore car was not known. For purposes of cargo billing and the Bill of Lading, it was assumed that each car was loaded with the average load for that type of car, the average being based on the report from the taconite plant at which the ore was loaded into the cars. The other half of FITZGERALD's cargo was loaded into the pockets by conveyor belt, and for these pockets, the load was weighed before it reached the pockets. Details of the amount and distribution of cargo typically would have been entered in the Chief Mate's notebook but this was lost with the vessel. Little information is available on prior cargo loadings. Such information is in the Bills of Lading and in the Office Logs, and this consists of the total amount of cargo loaded and the fore and aft drafts at departure.

On 9 November, in addition to the taconite cargo, FITZGERALD took on 50,013 gallons of No. 6 fuel oil, delivered from a barge which came alongside while the cargo was being loaded.

No difficulty was experienced by cargo loading personnel nor was any report of difficulty from ships personnel received during this loading.

14. Inspections

The last inspection conducted on FITZGERALD was a Spar Deck Inspection which took place on 31 October 1975, in Toledo, OH, while the vessel was unloading. This inspection was conducted under guidelines set out in Commander Ninth Coast Guard District Instruction 5941.1C, 28 August 1970, which calls for an inspection during the operating season of the Spar Deck areas most susceptible to severe wastage and damage on those Great Lakes ore carriers which have a portion of the Spar Deck stringer enclosed within the hatch coaming. Inspections of Great Lakes vessels are normally performed during the winter lay-up period. However, during the winter lay-up, Great Lakes vessels are usually on shore power with only a watchman on board. Because it would be necessary to provide extra personnel and electrical power to remove the hatches and because the decks of the vessels are frequently covered with ice and snow during the winter lay-up, Spar Deck Inspections, which are considered part of the vessel's regular, annual inspection, are conducted during the operating season while a vessel is loading or unloading. In this way inspection can be performed while hatch covers are removed, allowing a detailed inspection of the deck and other structure within the hatch coaming. Typically, Spar Deck Inspections performed by the Coast Guard are coordinated with surveys performed by the classification society, and the 31 October inspection was conducted by a Coast Guard inspector, an ABS surveyor, an ABS surveyor trainee, and a representative of Oglebay-Norton Company, the operator of FITZGERALD.

The 31 October inspection disclosed discrepancies at No. 13 hatch, No. 15 hatch, No. 16 hatch, and at No. 21 hatch. The discrepancy in No. 13 hatch was a notch, less than one inch

in depth, in the inboard edge of the Spar Deck inner stringer on the port side of the hatch opening, approximately 3 ft. aft of the forward coaming. The discrepancy in the No. 15 hatch was a gouge, less than one inch in depth, in the inboard edge of the Spar Deck inner stringer on the port side of the hatch opening approximately 3 ft. aft of the forward coaming. The inspector stated that a notch was a defect which had been made by a sharp edge, while a gouge was made by a side blow or scraping motion. The discrepancy in No. 16 hatch consisted of an indentation and a crack in the port hatch end girder. The hatch end girder was an 18 inch deep channel beam which constituted the port and starboard extremes of the hatch opening. On Figure (4) (p. 12) this structural member is designated 18"x4.200x58# [. The Coast Guard inspector testified that the crack ran vertically and was eight to ten inches in length. He also testified that he believed that the channel, i.e., the hatch end girder, was 14 or 16 inches deep. The ABS surveyor thought that the indentation was approximately one and one-half inches deep and that the crack was more on the order of four to six inches in length. The discrepancy in No. 21 hatch was a crack in the weld at the intersection of the hatch coaming and the hatch end girder, on the starboard side, aft. This crack was approximately one inch in length. Both the Coast Guard inspector and the ABS surveyor testified that they believed that these four discrepancies were typical of damage noted on other ore carriers where dockside offloading equipment was used.

At the conclusion of this Spar Deck Inspection, the Coast Guard inspector telephoned the Marine Safety Office, Toledo, OH, and discussed the discrepancies with the Senior Inspector, Materiel. As a result of the telephone call, during the course of which the Commanding Officer was consulted concerning these discrepancies, the inspector obtained approval to prepare a Merchant Marine Inspection Requirement (Form CG-835) concerning these discrepancies, requiring that they be repaired prior to

the beginning of the 1976 season. It was anticipated that the discrepancies listed on the Form CG-835 would be repaired as soon as the ship laid up at the conclusion of the 1975 season. Following the Spar Deck Inspection, the vessel sailed, and, in follow-up, on 4 November, the Commanding Officer of the Marine Safety Office, Toledo, OH, sent a letter to the operators of the vessel concerning the results of the Spar Deck Inspection. This letter called for rewelding the discrepancies in hatches 13, 15 and 21, and for cropping and renewing the fractured section of the hatch end girder on the port side of hatch No. 16. It stated that FITZGERALD was authorized to operate until the repairs were made and that the repairs should be completed prior to 1 April 1976.

The Coast Guard Certificate of Inspection for the SS EDMUND FITZGERALD was issued in Toledo, OH, on 9 April 1975 to expire on 9 April 1976. The certificate was issued following an inspection which had been conducted during the period between 3 February 1975 and 9 April 1975 while the vessel was in winter lay-up in Toledo, OH. At the completion of this inspection, there were two requirements which remained outstanding. One of these involved lifting and setting safety valves and conducting operational tests of the automation safety devices on the auxiliary boiler. This requirement was completed on 18 July 1975. The other requirement called for posting a fire control plan in accordance with new regulations. The plan had not been posted prior to the loss of FITZGERALD, and the operator had anticipated that it would not be available during the 1975 operating season. The Spar Deck Inspection, completed on 17 October 1974, in Cleveland, OH, with the notation "Spar Deck was satisfactory," was considered part of the inspection for certification which took place in the Spring of 1975.

During the course of the inspection for certification, a weight test was performed on the No. 1 boat and the boat was launched and a boat drill was conducted with eight members of the crew being exercised at oars. Since the vessel was moored port side to during the lay-up period, the No. 2 boat was swung out but not put into the water.

The Certificate of Inspection calls for lifesaving equipment for 49 persons and requires a total of 83 adult life preservers. When the inspection for certification began, there were 95 life preservers on board. During the course of the inspection, 6 life preservers were rejected, leaving a total of 89 satisfactory life preservers on board, 6 in excess of the required 83.

The American Bureau of Shipping also conducted an Annual Survey of Hull, Machinery and Boilers, part of the Continuous Machinery Survey and an Annual Load Line Inspection during the 1974-75 winter lay-up. This survey was completed on 9 April 1975 with no outstanding requirements.

FITZGERALD was last drydocked in Cleveland, OH, in April 1974. At that time the accessible areas of the interior and exterior of the hull were inspected. This inspection was completed on 20 April 1974, with the satisfactory repairs of damage to the sheer strake, and of cracking in the welds in the hatch end girders and keelsons (see paragraph 10).

15. Outages to Aids to Navigation

At approximately 1630 on 10 November, the remote monitoring equipment (Moore Gear) at Coast Guard Station, Sault Ste. Marie, MI, which monitors the automated aids to navigation under the cognizance of Commanding Officer, Coast Guard Group, Sault Ste. Marie, indicated that the light and radio beacon at Whitefish Point were inoperative. Whitefish Point is an unmanned light, radio beacon, sound signal and weather collection station

remotely controlled by Coast Guard Station Sault Ste. Marie. At 1639, FITZGERALD called Coast Guard Station, Grand Marais, MI, and asked if the radio beacon at Whitefish Point Light was operating. Grand Marais determined from the Coast Guard Station, Sault Ste. Marie, that the monitoring equipment indicated that the light and radio beacon were not operating and passed this on to FITZGERALD.

Several attempts were made to restore the Whitefish Point navigational aids, using the remote controls on the monitoring equipment at the Coast Guard Station, Sault Ste. Marie. The light was observed to be operating at approximately 1700, but, sometime after that, the monitoring equipment again indicated a failure. For a while it was thought possible that the navigational aids were operating properly, with the trouble indication due to the fact that the telephone lines used in the monitoring system were down as a result of the weather. Finally, however, it was concluded that the Whitefish Point light and radio beacon were not operating and could not be restored immediately, and, at 1905, Coast Guard Group Sault Ste. Marie sent out a Safety Broadcast to that effect.

As soon as the weather subsided the next morning, Coast Guard Group Sault Ste. Marie sent a repairman to Whitefish Point. He found the aids not operating. The emergency generator was not running, but the engine was warm, which indicated to him that the emergency generator had been running only a short time earlier. The relay which switches the aids from normal power to emergency power was found to be stuck in an intermediate position. In this position, there would have been no power to the navigational aids. It was believed that the relay became stuck while efforts were being made to restore the aids through the use of the remote monitoring equipment. The navigational aids at Whitefish Point were restored to full operation at 0930, 11 November.

The aids to navigation monitoring equipment at Sault Ste. Marie Coast Guard Station is fitted with a paper tape recording mechanism, but there are no indicator recordings for 10 November. There is no requirement that a permanent record of the monitoring equipment be maintained.

The records of the Commander, Ninth Coast Guard District, indicate that Whitefish Point Light was automated and unmanned on 11 June 1970. This was one of the first aids in the area to be automated. Immediately following the automation, several outages were experienced, however these were attributed to the newness and complexity of the automation equipment. Between 1 June 1973 and 15 November 1975, outages were:

Year	Light	Radiobeacon	Fog Horn
1973	6	11	7
1974	1	0	3
1975	2	3	5

The lighthouse at Whitefish Point is also fitted with a battery powered, auxiliary light, with a range of nine and one-half miles, which would come on automatically if both the normal power and emergency generator power for the main light should fail.

The only U. S. navigational aids in eastern Lake Superior north or west of Whitefish Bay which were inoperative on the afternoon or evening of the 10th of November were those at Whitefish Point. There were no Canadian aids in eastern Lake Superior which were inoperative.

16. Hydrographic Survey

Testimony of the Master and Watch Officers of ANDERSON indicated that FITZGERALD had passed near the shoals north

of Caribou Island. Charts of the area, U. S. Chart L.S. 9 (September 1973) and Canadian Chart 2310 (1972) showed a least sounding in this area, denoted "North Bank" on Chart 2310, of 6 fathoms. Chart 2310 indicates that the soundings are based on surveys of the Canadian Hydrographic Service in 1916 and 1919, while Chart L.S. 9 contains a notation: "Canadian Areas. For data concerning Canadian areas, Canadian authorities have been consulted."

Following the taking of testimony and review of the charts, the Marine Board requested, through the Commander of the Ninth Coast Guard District, that Canadian authorities conduct a hydrographic survey of the area north of Caribou Island.

The hydrographic survey, Canadian Hydrographic Service, Central Region, Project 76-2, was performed by CSS BAYFIELD during the period 19 May - 8 July 1976 and 7 August - 30 September 1976. The area surveyed included the waters between Michipicoten Island and Caribou Island and all around Caribou Island and adjacent waters between 47°10'N and 47°45'N and between 85°33'W and 86°11'W. Soundings were obtained using an ATLAS DESO 10 Echo Sounder and horizontal positioning was obtained using a three-station Minifix system. Results were reduced to a datum of 182.88 meters (599.85 feet) above the International, Great Lakes Datum (IGLD) and plotted on Field Sheet 3908 (F.S. 3908), with soundings in meters. Chart L.S. 9 is plotted to a datum of 600.0 feet above IGLD, thus there is a difference of 0.15 feet between L.S. 9 and F.S. 3908. Canadian Chart 2310 is plotted to a datum based upon Mean Sea Level, and this datum is 0.53 feet above the datum used in plotting the BAYFIELD data on F.S. 3908. Figure (12) (p. 88) is a replica of a portion of F.S. 3908 which includes the waters surrounding Caribou Island and the shoals to the north of it.

L.S. 9 shows the 6 fathom (10.9 meters) sounding at 47°26.7'N, 85°50.8'W, while 2310 shows 6 fathoms at 47°26.8'N, 85°50.3'W. Analysis of F.S. 3908, Figure (12), shows two locations with soundings of 6 fathoms (10.9 meters) or less. These have been marked [1] and [2] on Figure (12).

[1] 47°26.8'N, 85°50.2'W 9.5 m (5.2 fathoms)

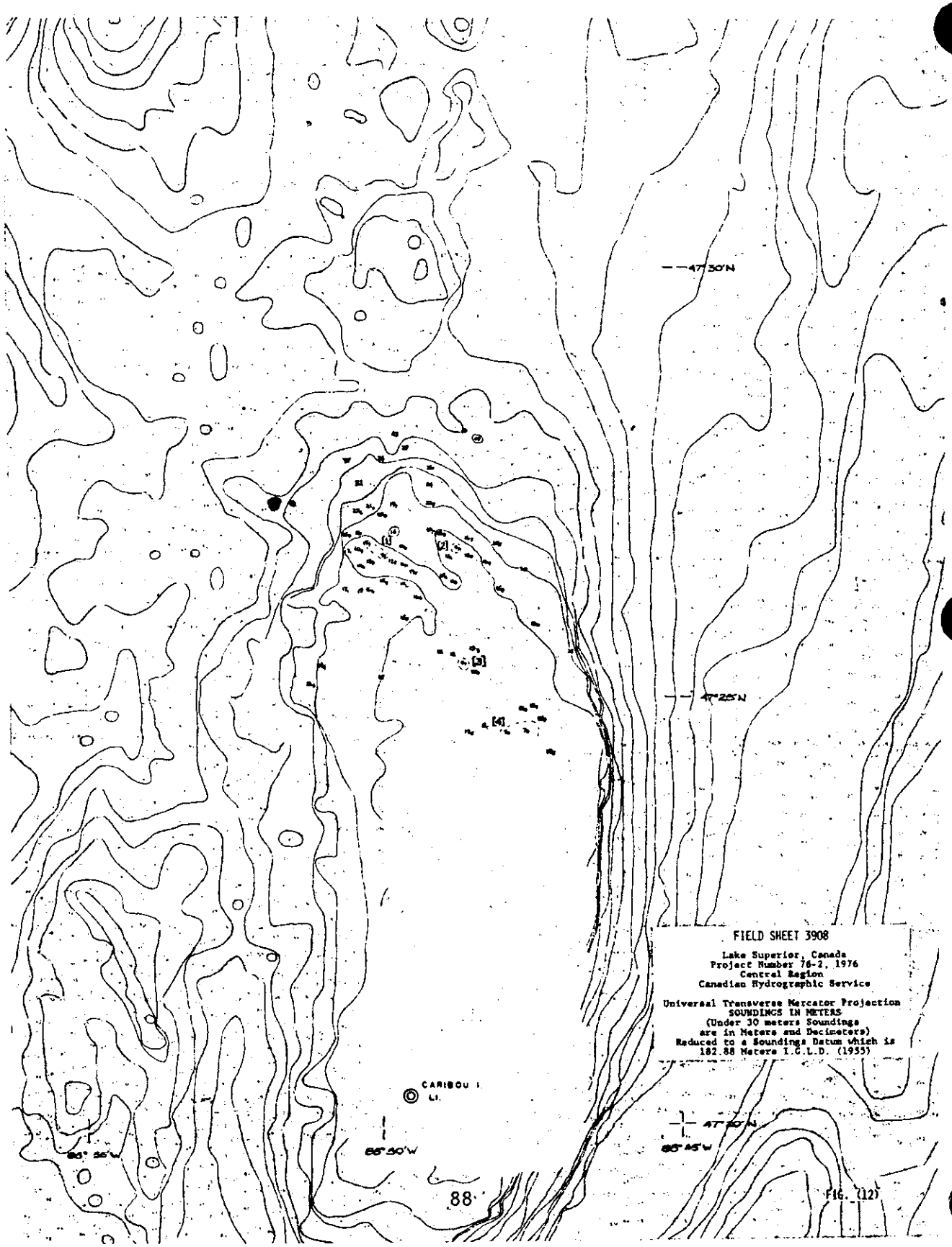
[2] 47°26.8'N, 85°48.7'W 9.7 m (5.3 fathoms)

Position [2] is slightly more than one mile due east of position [1] and Chart 2310 indicates soundings adjacent to this location of 8 and 9 fathoms.

F.S. 3908 shows two other soundings of less than six fathoms (10.9 meters) due north of and immediately adjacent to Caribou Island. These are marked [3] and [4] on Figure (12).

[3] 47°25.4'N, 85°48.6'W 9.7 meters (5.3 fathoms) (Chart 2310 shows 6 fathoms at 47°25.6'N, 85°48.7'W.)

[4] 47°24.6'N, 85°47.6'W 7.5 meters (4.1 fathoms) (Chart 2310 shows 4-1/2 fathoms at 47°24.5'N, 85°47.7'W.)



FIELD SHEET 3908

Lake Superior, Canada
Project Number 76-2, 1976
Central Region
Canadian Hydrographic Service

Universal Transverse Mercator Projection
SOUNDINGS IN METERS
(Under 30 meters Soundings
are in Meters and Decimeters)
Reduced to a Soundings Datum which is
182.88 Meters I.G.L.D. (1955)

FIG. (12)

CONCLUSIONS

1. Preface

The SS EDMUND FITZGERALD left Superior, WI, on the afternoon of 9 November 1975, enroute Detroit, Mi, with a full cargo of taconite pellets. That evening, and the next day, FITZGERALD proceeded eastward in Lake Superior, on a course north of the charted lanes due to the weather, heading towards Whitefish Bay and the Locks at Sault Ste. Marie, MI. At the same time, a severe November storm was crossing Lake Superior and, as a result, FITZGERALD encountered worsening weather throughout the early hours of the 10th of November, and by that afternoon, was experiencing winds in excess of 50 knots and seas approaching 16 feet. At approximately 1530, 10 November, FITZGERALD reported damage, but did not, at that time or in subsequent communications, indicate that it was of a serious nature or that there was any immediate concern for the safety of the vessel. No distress message was received. FITZGERALD sank sometime after 1910, 10 November 1975, at a position 46°59.9'N, 85°06.6'W, approximately 17 miles from the entrance to Whitefish Bay, MI.

There were no survivors and no witnesses to the casualty. Information available to the Marine Board consists of testimony of people who were on board other vessels in the area at the time FITZGERALD was lost, of people who had served on FITZGERALD prior to its last voyage, of employees of the company which operated the vessel, of other persons familiar with the vessel or similar vessels or its cargo, of personnel of the Coast Guard and of the American Bureau of Shipping who had conducted inspections and surveys on the vessel, of Coast Guard personnel who participated in the extensive search which followed the report of its loss, of personnel from the National Weather Service concerning weather at the time of the loss, of personnel at

the facility where the vessel loaded its last cargo, and of information from the several underwater surveys which were conducted on the wreckage which was found on the bottom of Lake Superior. Information available is incomplete and inconsistent in the following particulars:

a. Position. The only information available on the position and trackline of FITZGERALD is in the weather reports sent by FITZGERALD and in testimony of the Master and Watch Officers of the SS ARTHUR M. ANDERSON, which was following FITZGERALD, in voice radio communication with it, and observing it visually and on radar. The weather reports from FITZGERALD scheduled at 1300 and 1900, 10 November, were not received.

The position of FITZGERALD relative to that of ANDERSON cannot be reconstructed. Information available is based on the recollections of the Master and Watch Officers on ANDERSON, since the relative position of FITZGERALD was observed intermittently on the radar, but not recorded. Testimony on these observations is inconsistent. For example, the Officer on watch on ANDERSON recalled that FITZGERALD was "a shade to the right of dead ahead," as FITZGERALD passed northeast of Caribou Island, while the Master thought it was a point to a point and a half to the right at that time.

The Master and the Watch Officers on ANDERSON testified at length as to the position and trackline of ANDERSON in the afternoon and evening of 10 November. An analysis of this testimony shows that the vessel was navigated by radar ranges and bearings, that, at times, positions were determined but not logged, that course changes were made without simultaneous determination of position, that positions were determined as much as twenty minutes from the time that course changes were made, and that the courses steered varied from the

course logged because of the expected drift. The Marine Board attempted to reconstruct the trackline of ANDERSON and found that in order for the vessel to have steered the courses and have been at the positions at the times testified to, the speed of the vessel would have varied from a low of 5 mph to a high of 66 mph. But the Master testified, and the engineering log confirmed, that throughout the period, ANDERSON maintained a steady speed, turning for 14.6 mph. Accordingly, it is concluded that the times and positions reported by officers of ANDERSON were not sufficiently accurate to allow the trackline of either FITZGERALD or ANDERSON to be reconstructed.

b. Difficulties Reported by FITZGERALD. FITZGERALD reported the loss of two vents and some fence rail, indicating that topside damage had occurred to the vessel. The flooding which could be expected to result from the loss of any two tank or tunnel vents would not be serious enough, by itself, to cause the loss of the vessel.

FITZGERALD reported, at the same time, that it had developed a list. The existence of the list which would result from flooding of any two ballast tanks, a tunnel, or a tunnel and a ballast tank would not, of itself, indicate damage sufficiently serious to cause the loss of the vessel.

FITZGERALD reported that steps were being taken to deal with the flooding and the list, and that two pumps ("both of them") were being used. FITZGERALD had four 7000-gpm pumps and two 2000-gpm pumps available, indicating that the flooding was evaluated by personnel on board FITZGERALD as not sufficiently serious to create a danger of loss of the vessel.

FITZGERALD reported difficulties with its radars, and requested ANDERSON to provide navigational information.

FITZGERALD reported slowing down to allow ANDERSON to catch up. This action might have been taken because the Master of FITZGERALD knew or sensed that his problems were of a more serious nature than reported to ANDERSON.

c. Underwater Survey. The underwater survey showed that mud covered a majority of the wreckage, that the midships section of the hull was completely disrupted, and that the stern section was inverted. Movement of the survey vehicle disturbed the mud, which limited visibility and made it difficult to identify individual components of the wreckage. However, the survey provided the Marine Board valuable information with respect to the vessel's final condition and orientation.

2. In the absence of more definite information concerning the nature and extent of the difficulties reported and of problems other than those which were reported, and in the absence of any survivors or witnesses, the proximate cause of the loss of the SS EDMUND FITZGERALD cannot be determined.

3. The most probable cause of the sinking of the SS EDMUND FITZGERALD was the loss of buoyancy and stability which resulted from massive flooding of the cargo hold. The flooding of the cargo hold took place through ineffective hatch closures as boarding seas rolled along the Spar Deck. The flooding, which began early on the 10th of November, progressed during the worsening weather and sea conditions and increased in volume as the vessel lost effective freeboard, finally resulting in such a loss of buoyancy and stability that the vessel plunged in the heavy seas.

4. The following factors contributed to the loss of FITZGERALD:

a. The winter load line assigned to FITZGERALD under the changes to the Load Line Regulations in 1969, 1971 and

1973 allowed 3 feet, 3-1/4 inches less minimum freeboard than had been allowed when the vessel was built in 1958. This overall reduction in required freeboard also reflected a reduction in Winter Penalty for Great Lakes vessels. Not only did the reduction in minimum required freeboard significantly reduce the vessel's buoyancy, but it resulted in a significantly increased frequency and force of boarding seas in the storm FITZGERALD encountered on 10 November. This, in turn, resulted in an increased quantity of water flooding through loosely dogged hatches and through openings from topside damage.

b. The system of hatch coamings, gaskets, covers and clamps installed on FITZGERALD required continuing maintenance and repair, both from routine wear because of the frequent removal and replacement of the covers and from damage which regularly occurred during cargo transfer. That the required maintenance was not regularly performed is indicated by the fact that the crew of the vessel had no positive guidelines, in the form of Company requirements or otherwise, concerning such maintenance. That the required repairs were not regularly performed as damage occurred is indicated by the fact that significant repairs had been required during the previous winter lay-up period and by the fact that more repairs of the same nature were expected, since a general item to repair hatch covers and coamings had been included in the work list for the winter lay-up which FITZGERALD was approaching when it was lost. It is concluded that the system of cargo hatch coamings, gaskets, covers and clamps which was installed on FITZGERALD and the manner in which this system was maintained did not provide an effective means of preventing the penetration of water into the ship in any sea condition, as required by Coast Guard Regulations.

c. Whether all the cargo hatch clamps were properly fastened cannot be determined. In the opinion of the Marine

Board, if the clamps had been properly fastened, any damage, disruption or dislocation of the hatch covers would have resulted in damage to or distortion of the clamps. But, the underwater survey showed that only a few of the clamps were damaged. It is concluded that these clamps were the only ones, of those seen, which were properly fastened to the covers and that there were too few of these and too many unfastened or loosely fastened clamps to provide an effective closure of the hatches.

d. The cargo hold was not fitted with a system of sounding tubes or other devices to detect the presence of flooding water. It is not known whether any efforts were made to determine if water was entering the cargo hold. If the hold had been checked at a time when the level of the water was below the cargo surface, the extent of flooding could not have been determined. It is inconceivable that flooding water in the cargo hold could have reached a height to be seen, without a seasoned Master taking more positive steps for vessel and crew safety than were reported. Therefore, it is concluded that the flooding of the cargo hold was not detected.

e. The cargo hold was not fitted with transverse watertight bulkheads. As a result, the flooding water which entered could migrate throughout the hold, extending the effect of the flooding and aggravating any trim which existed.

5. At sometime prior to 1530 on 10 November, FITZGERALD experienced damage of sufficient magnitude to cause the Master to report topside damage and a list. Significantly, the Master of FITZGERALD reported the damage rather than the incident which caused it. It is the opinion of the Marine Board that the incident, while possibly of a serious nature, was not of such extent as to have caused, by itself, the loss of the vessel and,

further, that the full extent of the incident was not perceived by vessel personnel. The Master noted the list and topside damage and incorrectly concluded that the topside damage was the only source of flooding. He began what he believed were adequate, corrective measures - pumping spaces which would receive flooding from damaged vents - and thus felt the problems were under control.

The topside damage could have been caused by the vessel striking a floating object which was then brought aboard in the heavy seas. This also could have resulted in undetected damage opening the hull plating above or below the waterline and additional unreported damage to topside fittings, including hatch covers and clamps. Intake of water into the tunnel or into one or more ballast tanks through the damaged vents and opened hull would have produced the reported list and increased the rate of cargo hold flooding. The most likely area of damage would have been in the forward part of the ship. The vessel had entered a snow storm approximately one-half hour before the topside damage was reported. In addition, FITZGERALD's radars were reported inoperative shortly after the damage was reported, and may have been malfunctioning for some period before the report. Both the reduced visibility from the snow storm and the radar malfunction would, in the opinion of the Marine Board, have reduced the likelihood that the crew of the vessel could have detected the object in sufficient time to take effective action to avoid it.

The topside damage could have been caused by some unidentified object on board breaking away in the heavy seas. Flooding through such damage could have caused a list. While there were objects on deck which might have come adrift and knocked off a vent cap or damaged a hatch coaming, the only items on deck which had enough mass to do sufficient damage to the hull to

cause a sustained list were a hatch cover, the hatch cover crane, or the spare propeller blade. If such extensive damage had occurred, a seasoned Master would have reported it. Such a report was not received.

The topside damage and list could have been caused by a light grounding or near grounding on the shoals north of Caribou Island. Although their testimony is not fully consistent, both the Master and the Watch Officer on ANDERSON indicated that FITZGERALD passed within a few miles of Caribou Island and that they had a conversation concerning the closeness of FITZGERALD to the shoals north of the island. It is considered possible that a light grounding or near grounding on these shoals could have occurred. The vessel could have been damaged from the grounding, from the effect of the violent seas which would be expected near the shoals, or from the shuddering that the vessel would have experienced as it passed near the shoals. The damage could have been on deck, below the water line, or both, leading to the reported topside damage and list. The Marine Board is unable to reconstruct the trackline of FITZGERALD south of Michipicoten Island, however, FITZGERALD was observed to pass two to three miles off Michipicoten Island West End Light from which position a single course change to 141°T would have taken the vessel directly to Whitefish Point on a track well clear of the shoal areas off the northern tip of Caribou. Had there been a delay in making the course change after passing Michipicoten, FITZGERALD would have passed closer to the shoals. But, the distance between Michipicoten and the shoals is such that it appears that a delay in making the course change of upwards of an hour would have been required to cause FITZGERALD to have actually reached the shoals.

The list could have been caused by a localized hull structural failure, resulting in the flooding of a ballast tank or tanks. There is no correlation between such an occurrence and the reported loss of vents and fence rail. The survey of those parts of the wreckage which could be seen showed no evidence of brittle fracture.

The Marine Board concludes that the exact cause of the damage reported cannot be determined, but that the most likely cause was the striking of a floating object.

6. In the opinion of the Marine Board, the flooding from the damage reported, and from other damage which was not detected, most likely occurred in the forward part of the vessel, resulting in trim down by the bow. By the time the damage was reported by FITZGERALD, the flooding of the cargo hold had reached such an extent that the cargo was saturated and loose water existed in the hold. Because of the trim by the bow, this water migrated forward through the non-watertight screen bulkheads which separated the cargo holds, further aggravating the trim and increasing the rate of flooding.

7. Because there were neither witnesses nor survivors and because of the complexity of the hull wreckage, the actual, final sequence of events culminating in the sinking of the FITZGERALD cannot be determined. Whatever the sequence, however, it is evident that the end was so rapid and catastrophic that there was no time to warn the crew, to attempt to launch lifeboats or life rafts, to don life jackets, or even to make a distress call.

Throughout November 10th the vessel was subjected to deteriorating weather and an increasing quantity of water on deck. With each wave that came aboard, water found its way into the cargo hold through the hatches. As the vessel lost freeboard because of this flooding and as the sea conditions worsened, the frequency and force of the boarding seas increased, and so did the flooding. The Master of the vessel reported that he was in one of the worst seas that he had ever seen. It is probable that, at the time he reported this, FITZGERALD had lost so much freeboard from the flooding of the

cargo hold that the effect of the sea was much greater than he would ordinarily have experienced. Finally, as the storm reached its peak intensity, so much freeboard was lost that the bow pitched down and dove into a wall of water and the vessel was unable to recover. Within a matter of seconds, the cargo rushed forward, the bow plowed into the bottom of the lake, and the midships structure disintegrated, allowing the submerged stern section, now emptied of cargo, to roll over and override the other structure, finally coming to rest upside-down atop the disintegrated middle portion of the ship.

Alternatively, it is possible that FITZGERALD sank as a result of a structural failure on the surface, resulting from the increased loading of the flooding water. However, this is considered less likely because such a failure would have severed the vessel into two sections on the surface, and one or the other, if not both sections would have floated for a short while. With the weather conditions that existed at the time FITZGERALD was lost and, in particular, with the winds in excess of 50 knots, if either or both of the pieces had floated for any time, significant drifting would have occurred. But, the survey of the wreckage showed that the two main pieces were within a ship length, thus little or no drifting took place.

8. There is no evidence that the crew of FITZGERALD made any attempt to use any lifesaving equipment, or that lifesaving equipment or its performance contributed in any way to this casualty. The condition of the lifeboats recovered indicates that the boats were torn away from their chocks, grips and falls. The condition of the life rafts recovered indicates that they were released from their float-free racks and inflated as they were designed to. One raft was damaged, partly when it floated onto the rocky shoreline and partly by a search party

which punched holes in it to allow water to drain out during the recovery operation.

Testimony of witnesses indicates that a successful launching of a lifeboat would have been extremely difficult in the weather and sea conditions which prevailed at the time FITZGERALD was lost. This testimony also indicates that Great Lakes mariners have little confidence that lifeboats could be launched successfully in other than moderate wind and sea conditions, and given the choice, they would use the inflatable rafts as the primary means of abandoning a sinking ore carrier. Their confidence in the capability of the rafts was tempered by stated beliefs that a raft could not be boarded safely once it was launched and waterborne and that they would inflate it on deck and wait for it to float free from the sinking vessel. This illustrates that although Great Lakes mariners understand the difficulties inherent in disembarking from a stricken vessel their level of understanding of the use and capability of inflatable life rafts is inadequate. In the opinion of the Marine Board, the appraisal by crewmen that they have small chance of survival on abandoning a stricken vessel in a rough seaway could influence them to stay with the stricken vessel rather than attempt abandonment.

The present requirement for posting a placard containing life raft launching instructions is not considered sufficient to train crewmembers in the proper use of this primary lifesaving equipment. The placard is, however, considered a valuable aid in assisting and reinforcing other crew training.

Lifeboat drills were held on FITZGERALD during the 1975 season, but were not held on a weekly basis as required by regulations. The level of training of the crew in the use of lifeboats and life rafts is indeterminate.

There is no evidence to indicate that any of the crewmembers of FITZGERALD escaped from the vessel at the time of its loss. However, if they had, their chances of survival would have been significantly enhanced if they had been provided with equipment to protect them against exposure.

9. The twenty-nine crewmen on board FITZGERALD are missing and presumed dead.

10. It was fortunate that the Steamer ARTHUR M. ANDERSON was in the area of and in radiotelephone communication with FITZGERALD on the afternoon and evening of 10 November. Without the presence of this vessel, the loss of FITZGERALD would not have been known for a considerable period of time, possibly not until the following day, and, at the latest, when the vessel failed to arrive at the unloading dock.

11. The testimony of witnesses indicates a conflict as to the time that the Coast Guard was first notified of the problems with FITZGERALD. The Marine Board concludes that the first notification that the Coast Guard received of the problem with FITZGERALD was at approximately 2025 Eastern Standard Time on 10 November in a radiotelephone call from CAPT [redacted] Master of ANDERSON. At the time of this call, the actual loss of FITZGERALD was neither comprehended by CAPT [redacted] nor conveyed to the Coast Guard. The Coast Guard radio watchstander who received the call attempted to communicate with FITZGERALD, without success, and advised the Rescue Coordination Center. The second call from CAPT [redacted] to the Coast Guard, at approximately 2100, 10 November, did express a grave concern that FITZGERALD was lost, and rescue efforts were initiated. It is concluded that the time period which elapsed in evaluating and reporting the loss of FITZGERALD did not contribute to the casualty or high loss of life, because FITZGERALD sank suddenly, with all hands trapped on board.

12. In the opinion of the Marine Board, in a tragedy of this magnitude, occurring, as this one did, in extreme weather conditions, vessels in the area and SAR aircraft must be relied upon as the first source of assistance.

The response by the merchant vessels in the area to the Coast Guard's request for assistance was in keeping with the finest traditions of mariners. The response of the vessels ARTHUR M. ANDERSON and WILLIAM CLAY FORD is considered exemplary and worthy of special note. These vessels proceeded to the scene on the night of 10 November and searched under conditions of extreme weather and sea on 10 and 11 November. The response of the Canadian vessel HILDA MARJANNE, which got underway but was forced back by weather, is also worthy of note.

The response by Coast Guard SAR aircraft from Air Station Traverse City was timely. The first aircraft was not launched until 51 minutes after it was ordered because it was necessary to load flares for the night search. The launching of three aircraft within one hour and thirty-five minutes is within the response requirements called for by the Ninth Coast Guard District SAR Plan. The request for and dispatch of additional SAR aircraft from Coast Guard Air Station Elizabeth City, NC, from the U. S. Navy, from the Michigan Air National Guard, and from Canadian SAR forces was also timely.

The only Coast Guard surface unit in an SAR standby status which was close enough to respond within a reasonable time and was large enough to cope with the weather and sea conditions which prevailed at the time was the Buoy Tender WOODRUSH at its home port in Duluth, MN. WOODRUSH, on a six-hour standby status, was underway within two and one-half hours. The Marine Board concludes that the response by the WOODRUSH was timely. The wind and sea conditions precluded the use of the Harbor Tug

NAUGATUCK stationed at Sault Ste. Marie, which had operating limitations imposed on its use outside harbor waters. The small craft designed for coastal operations which were available in Lake Superior were unsuitable for search 15 miles offshore in the high sea state then existing. It is concluded that there is a need for additional surface forces with SAR capability to improve the overall search and rescue posture in Lake Superior.

13. Because ANDERSON was following FITZGERALD, providing navigational assistance and observing FITZGERALD to be on a trackline heading for the entrance to Whitefish Bay and because the wreckage was found on a trackline headed for the entrance to Whitefish Bay, it is concluded that the outages of Whitefish Point light and radio beacon did not contribute to the casualty.

14. The progress of the severe storm which crossed Lake Superior on 9 and 10 November was adequately tracked by the National Weather Service and the weather reports and weather forecasts adequately reflected its path and severity. Weather forecasts were upgraded in a timely manner and a special warning was issued. Estimates of wind velocity by persons on vessels in the storm were higher than those forecast and also higher than those reported by shoreside stations, however, the overall severity of the storm was generally as forecast and reported. It is concluded that mariners on Lake Superior on 10 November were adequately warned of the severe weather and that the Master of FITZGERALD was aware of the severity and location of the storm.

15. Testimony of licensed Great Lakes mariners indicates the cargo hold of a Great Lakes ore carrier cannot be dewatered if it is loaded with a cargo of taconite pellets. The Marine Board is unable to determine the validity of this as a general proposition or whether it affected the loss of FITZGERALD.

16. The Loading Manual which was developed for FITZGERALD did not comply with the requirements of the Load Line Regulations. Since the only loading information available to the Marine Board is the total cargo carried on down-bound voyages, whether FITZGERALD was ever subjected to unacceptable stresses cannot be determined.

17. The underwater survey of the wreckage and the detailed study of the photographs taken show no apparent relationship between the casualty and the discrepancies found and reported at the Spar Deck Inspection conducted on 31 October 1975.

18. The hydrographic survey performed by CSS BAYFIELD basically confirmed the data indicated on chart L.S.9 and Canadian chart 2310. In addition, this survey showed that the northern end of the shoals north of Caribou Island extends approximately one mile further east than indicated on Canadian chart 2310.

19. The nature of Great Lakes shipping, with short voyages, much of the time in very protected waters, frequently with the same routine from trip to trip, leads to complacency and an overly optimistic attitude concerning the extreme weather hazards which can and do exist. The Marine Board feels that this attitude reflects itself at times in deferral of maintenance and repairs, in failure to prepare properly for heavy weather, and in the conviction that since refuges are near, safety is possible by "running for it." While it is true that sailing conditions are good during the summer season, changes can occur abruptly, with severe storms and extreme weather and sea conditions arising rapidly. This tragic accident points out the need for all persons involved in Great Lakes shipping to foster increased awareness of the hazards which exist.

20. There is no evidence of actionable misconduct, inattention to duty, negligence, or willful violation of law or regulation on the part of licensed or certificated persons, nor evidence that failure of inspected material or equipment, nor evidence that any personnel of the Coast Guard, or any other government agency or any other person contributed to the cause of this casualty.

RECOMMENDATIONS

It is recommended:

1. That Part 45 of Title 46 of the United States Code of Federal Regulations (Great Lakes Load Lines) be amended immediately to rescind the reduction in minimum freeboard brought about by the 1969, 1971 and 1973 changes to the Load Line Regulations.

2. That any subsequent amendments to the Great Lakes Load Line Regulations as they apply to ore carriers, such as FITZGERALD, reflect full consideration of the necessity for a means of detecting and removing flooding water from the cargo hold and for watertight sub-division of the cargo hold spaces. Such an appraisal should take due cognizance of:

a. The severe weather and sea conditions encountered by these vessels and the resulting high degree of deck wetness, and,

b. The inherent difficulty in meeting and maintaining a weathertight standard with the system of hatches, coamings, covers, gaskets and clamps used on FITZGERALD and many other Great Lakes vessels.

3. That the owners and operators of Great Lakes ore carrying vessels undertake a positive and continuing program of repair and maintenance to insure that all closures for openings above the freeboard deck are weathertight, that is, capable of preventing the penetration of water into the ship in any sea condition. This program should include frequent adjustment of hatch clamping devices and vent closures and prompt repair of all hatches, coamings, covers and clamping devices found damaged or deteriorated.

4. That Part 45 of Title 46 of the United States Code of Federal Regulations be amended to require closing and securing of hatches when underway in open waters and closing of vent caps when underway in a loaded condition. A visual inspection of the closure of hatch covers and vent caps should be conducted and logged by a licensed officer prior to sailing in a loaded condition.

5. That the Coast Guard undertake a program to evaluate hatch closures presently used on Great Lakes ore carriers with a view toward requiring a more effective means of closure of such deck fittings.

6. That the owners and operators of Great Lakes vessels, in cooperation with the maritime unions and training schools, undertake a program to improve the level of crew training in the use of lifesaving equipment installed on board the vessels and in other emergency procedures. This program should specifically include training in the use of inflatable life rafts and afford crews of vessels the opportunity to see a raft inflated.

7. That Part 97 of Title 46 of the United States Code of Federal Regulations be amended to require crew training in launching, inflation and operation of inflatable life rafts.

8. That the Coast Guard institute a continuing program of inspections and drills for Great Lakes vessels prior to each severe weather season. The severe weather season should correspond to the Winter Load Line season, i.e., 1 November through 31 March. Under this program, just before the severe weather season began, there would be an inspection to verify that the crew had been trained in the use of the lifesaving equipment and drills would be conducted with the crew then on board the vessel. There would be a physical inspection of the Spar Deck and all critical structural and non-structural members exposed

to damage from cargo loading and off-loading equipment including, but not limited to, hatch coamings, hatch covers, vent covers, tank tops, side slopes, hatch-end girders, arches, spar deck stringers, and spar deck plating. Additionally, all emergency drills would be witnessed, and alarms, watertight closures, navigation equipment and required logs would be inspected.

9. That the Coast Guard take positive steps to insure that the Masters of Great Lakes vessels are provided with information, as is required by the regulations, concerning loading and ballasting of Great Lakes vessels, and that the information provided include not only normal loaded and ballasted conditions, but also details on the sequences of loading, unloading, ballasting, deballasting and the intermediate stages thereof as well as information on the effect upon the vessel of accidental flooding from damage or other sources.

10. That the Coast Guard complete, as soon as possible, the studies, currently underway, which concern primary lifesaving equipment, its launching, and disembarkation from stricken vessels. And, that measures be implemented promptly to improve the entire abandon ship system, including equipping and training personnel, automatic launching of equipment and alerting rescue forces.

11. That the Coast Guard schedule maintenance status for buoy tenders and icebreakers located in the Great Lakes so as to maximize surface search and rescue capability during the severe weather season, consistent with their primary missions.

12. That Subpart 94.60 of Title 46 of the United States Code of Federal Regulations, which requires emergency position indicating radio beacons (EPIRB), be amended to include requirements

for such beacons on vessels operating on the Great Lakes during the severe weather season.

13. That the Coast Guard promulgate regulations which require vessels operating on the Great Lakes during the severe weather season to have, for each person on board, a suit designed to protect the wearer from exposure and hypothermia.

14. That navigation charts showing the area immediately north of Caribou Island be modified to show the extent of the shoals north of the island and that this modification be given the widest possible dissemination, including Notices to Mariners.

15. That the Coast Guard foster and support programs dedicated to increasing awareness, on the part of all concerned with vessel operations, inspection and maintenance, of the hazards faced by vessels in Great Lakes service, particularly during the severe weather season. The programs should make maximum use of company safety programs, safety bulletins, publications and trade journals.

16. That no further action be taken and that this case be closed.

[redacted]

W. W. BARROW, Rear Admiral, USCG
Chairman

[redacted]

R. S. [illegible], Captain, USCG
Member

[redacted]

J. A. WILSON, Captain, USCG
Member

[redacted]

C. S. LOOSMORE, Commander, USCG
Member and Recorder