UNITED STATES COAST GUARD

INVESTIGATION INTO THE CIRCUMSTANCES SURROUNDING THE EXPLOSION AND FIRE ABOARD THE TANKSHIP

OMI CHARGER

ON OCTOBER 9, 1993, AT BOLIVER ROADS INNER ANCHORAGE NEAR GALVESTON, TEXAS, WITH INJURIES AND MULTIPLE LOSS OF LIFE

U.S. Department of Transportation
United States Coast Guard

Commandant
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16732/OMI CHARGER

MAR 6 1997

COMMANDANT'S ACTION

ON

THE MARINE BOARD OF INVESTIGATION

CONVENED TO INVESTIGATE THE CIRCUMSTANCES SURROUNDING THE EXPLOSION AND FIRE ON BOARD THE T/S OMI CHARGER, O.N. D522864, ON 9 OCTOBER 1993, AT BOLIVAR ROADS INNER ANCHORAGE NEAR GALVESTON, TEXAS, WITH INJURIES AND MULTIPLE LOSS OF LIFE

ACTION BY THE COMMANDANT

The record and the report of the Marine Board of Investigation convened to investigate the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations, are approved subject to the following comments.

CAUSE OF THE CASUALTY

I concur with the Board's conclusion that the apparent cause of this casualty was the ignition of explosive gasoline vapors in the No. 5 port cargo tank by a welder's arc in the adjacent port saddle ballast tank which undercut into the common transverse bulkhead.

PREVENTION THROUGH PEOPLE

LESSONS LEARNED

In keeping with the Coast Guard's Prevention Through People program, the analysis of this accident shows there are many lessons that can be shared to <u>prevent</u> similar accidents. The investigation reinforces the importance of consistently following well established safety procedures and not "cutting corners." Had proper safety procedures been followed, this accident would have been prevented. For example, had the No. 5 port cargo tank been properly gas freed or inerted, this casualty could not have occurred. A key lesson is that "overflowing" a tank with ballast water does not guarantee the tank is gas free. Another lesson is proper testing of tanks for explosive vapors immediately before starting welding or hot work. If the No. 5 port cargo tank had been properly tested before welding started, explosive vapors would have been detected and precautions taken to prevent the explosion. In addition, had there been effective shoreside management oversight of operations on board the vessel, as will soon be required by the International Safety Management Code, proper procedures would most likely have been followed and the casualty prevented. The results of this casualty strongly emphasize the need for active safety management and for strict adherence to safety procedures.

COMMENTS ON FINDINGS OF FACT

Finding of fact 102: Although the chief mate testified that he calibrated the gas detector prior to testing the tanks, there is no evidence or testimony to indicate whether the chief mate maintained records of the calibrations as required by the provisions of "Standard for the Control of Gas Hazards on Vessels to be Repaired", the National Fire Protection Association publication No. 306.

ACTION ON RECOMMENDATIONS

Recommendation 1: This casualty reemphasizes the inappropriate use of doublers for cargo tank repairs. It is recommended that all Coast Guard marine inspectors be reminded of the criticality of following Coast Guard guidance provided in NVIC 7-68 regarding the use of doublers, particularly in way of cargo tank boundaries. Additionally this information should be widely disseminated to class society surveyors and marine industry personnel involved with such repairs.

Action: I concur. A message will be sent to all Marine Safety Offices and Marine Inspection Offices to reinforce the importance of the guidance in NVIC 7-68. Also, the Marine Safety School will be directed to place special emphasis on disseminating the guidance of NVIC 7-68 during steel hull welding and repair instruction using this casualty's findings as an example to show the importance of good marine practice in steel hull repair.

Recommendation 2: In as much as uncoated ballast tank boundary bulkheads are a high corrosion area it is recommended that detailed inspections with gaugings be required periodically in conjunction with dry docking or ABS special surveys.

Action: I concur. These requirements will be incorporated into international and national regulations. Internationally, actions have been taken at the International Maritime Organization (IMO) to have these requirements incorporated into the new survey program requirements for existing vessels under Chapter XI of the

International Convention for the Safety of Life at Sea (SOLAS). The requirements have already been incorporated by the American Bureau of Shipping in the Rules for Building and Classing Steel Vessels (Part 1, Appendix 1/B - Hull Surveys for Oil Tankers).

Recommendation 3: Because of the potential serious consequences of cargo boundary leaks, it is recommended that such failures be required to be reported to the Coast Guard prior to their repair.

Action: I concur with the intent of this recommendation. Since a weep in a cargo tank boundary has the potential for serious consequences, the operating requirements for tank vessels in 46 CFR Part 35 will be reviewed in light of the circumstances of this casualty to determine any necessary additional reporting requirements.

Recommendation 4: In as much as testimony indicated that OMI's Fleet Standing Orders were misinterpreted, it is recommended that OMI Corporation, and other tanker operating companies, establish procedures, including formal training, for shipboard personnel who, in the absence of a certified marine chemist, may be called upon to approve hot work.

Action: I concur with the intent of this recommendation. However, requirements to follow NFPA 306 were already contained in 46 CFR 35.01-1(a), and the company should have established the procedures necessary (including training) to ensure that this regulation was followed.

Recommendation 5: It is recommended that wide dissemination be given to the dangers associated with "overflowing" tanks as a means of gas freeing. As this incident demonstrates, "overflowing" may not rid a tank of all combustible vapors. At best, this practice is a violation of the pollution prevention regulations.

Action: I concur. Our actions under recommendation 1 will include the provisions of this recommendation to disseminate information on the proper means of gas freeing cargo tanks.

Recommendation 6: It is recommended that other vessels of similar age, service and construction be examined for the presence of doublers and wastage where side shell longitudinals originally passed through cargo tank bulkheads. Operators of similar vessels operating under specific trade exemptions allowed by 33 CFR 157.300 should examine their operating procedures to ensure that inappropriate practices such as "overflowing" are not being condoned.

Action: I concur. Our actions under recommendation 1 will also consist of instructions to take special care to inspect for side shell longitudinal doublers and wastage in way of cargo tank bulkheads during normally required tank vessel cargo tank internal examinations.

Recommendations 7, 8, and 9: That the crew and captain of the TIM MCCALL and GAL-TEX be commended for their fearless rescue efforts of persons on board the OMI CHARGER and that the crew and captain of the TALLAHASSEE BAY be commended for their valiant fire fighting efforts.

Action: I concur. Appropriate action will be taken to commend the captains and crews of the M/V TIM MCCALL, M/V GAL-TEX, and M/V TALLAHASSEE BAY.

Recommendation 10: That copies of this report be given wide dissemination throughout the tank vessel industry and be provided to the International Maritime Organization, Nautical Institute, tanker operating companies, maritime schools and training facilities, publishers of the International Safety Guide for Oil Tankers and Terminals (ISGOTT), the American Bureau of Shipping and the National Transportation Safety Board. Training programs for seamen whose responsibilities include testing spaces for hazardous atmospheres should be reviewed.

Action: I concur. This report will be widely distributed.

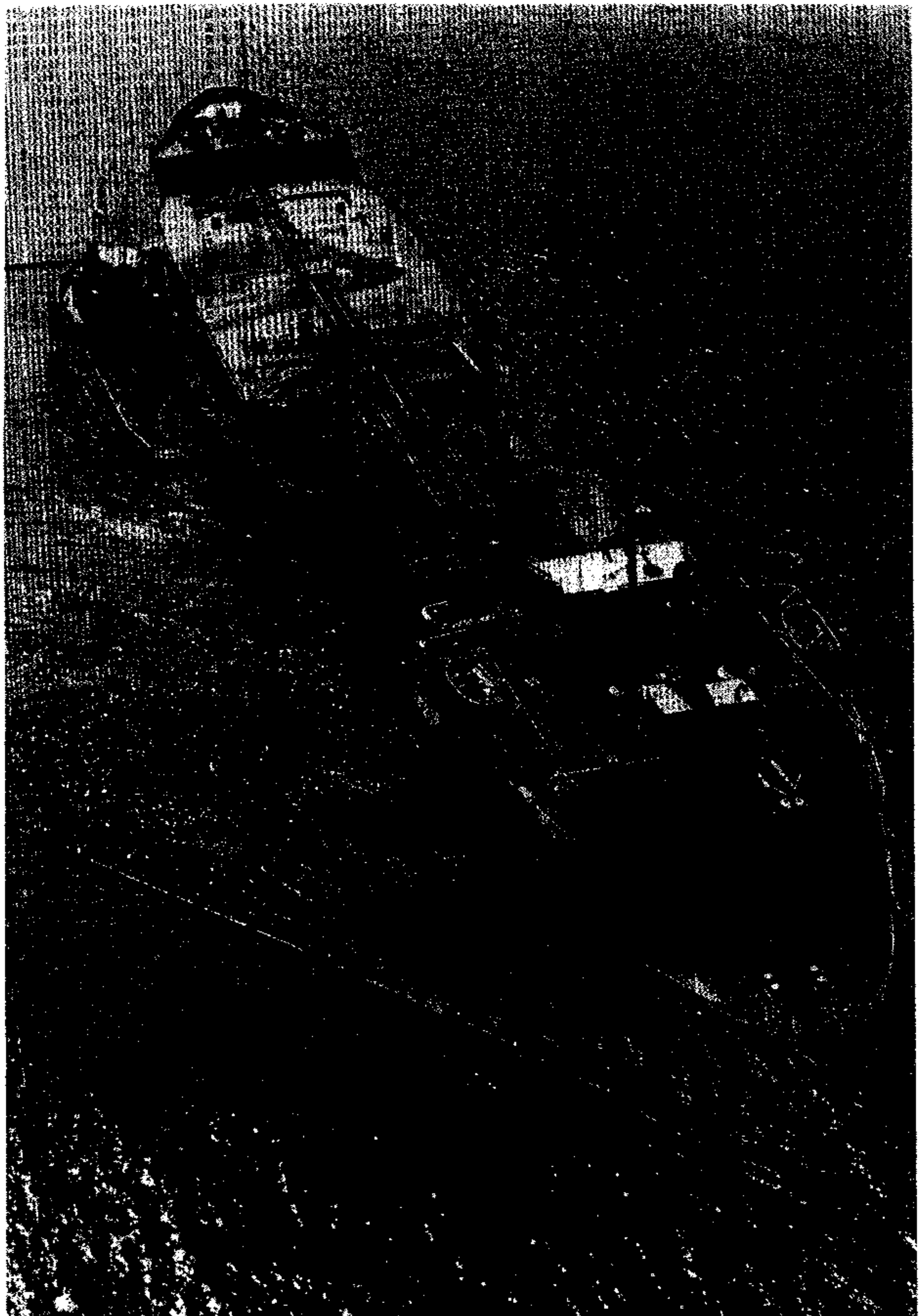
Recommendation 11: That this investigation be closed.

Action: I concur. This investigation is closed.

[redacted]

6 March 1997.

ROBERT E. KRAMEK
Admiral, U.S. Coast Guard
Commandant



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United States Coast Guard

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16732/OMI CHARGER
MSIS MC93019413
30 November 1994

From: U.S. Coast Guard Marine Board of Investigation
To: Commandant (G-MMI)

Subj: MARINE BOARD OF INVESTIGATION CONCERNING THE EXPLOSION AND FIRE ON BOARD THE TANKSHIP OMI CHARGER (US) ON 9 OCTOBER 1993 AT BOLIVAR ROADS INNER ANCHORAGE NEAR GALVESTON, TEXAS, WITH INJURIES AND MULTIPLE LOSS OF LIFE

FINDINGS OF FACT

1. On 9 October 1993 at approximately 2000 (all times are indicated as local, Z+5 = R), the 632 foot long U.S. tankship OMI CHARGER suffered a major explosion and fire in the No. 5 port cargo tank while anchored in the Bolivar Roads inner anchorage near Galveston, Texas. The fire burned for approximately 5 hours. There were 3 fatalities and numerous other injuries. The damage loss resulting from this accident was approximately $15,000,000.00. The explosion peeled open the main deck in way of the No. 4 port and No. 5 port wing cargo tanks, laid it forward and above the main deck in way of the No. 3 port cargo tank. The explosion caused the bulkhead between No. 5 port cargo tank and the port saddle (aft ballast) tank to be blown aft into the port saddle tank. The bulkhead between the port saddle tank and engine room was breached by the force from the explosion, causing flooding of the engine room. The explosion also caused the side shell in way of the Nos. 5 port and 4 port cargo tanks to be blown away. Following the explosion the vessel was engulfed in a major conflagration in way of the No. 5 port and No. 4 port cargo tanks and also in way of the port cargo manifold. The vessel took on a list to port due to flooding and settled on the bottom of the 32 foot deep anchorage, leaving her decks above the waterline and her port stern quarter awash. Fearing subsequent explosions from the fire on deck, the master ordered his crew, except five officers and a deck cadet, to abandon ship. The pumpman was found on deck, fatally injured, and was taken off the ship with the crew. The crew was able to step off the fantail to the waiting crewboat TIM McCALL which had come to their rescue. The master and six officers searched unsuccessfully for the missing welder and his fire watchman before they themselves abandoned the vessel and boarded the pilot boat GAL-TEX, which came to their aid. The Coast Guard and several other vessels searched unsuccessfully for the missing welder and his fire watchman, whose bodies were later located by divers in the port saddle tank. The vessel burned on deck at the port cargo manifold, and in the Nos. 4 port, 5 port, 5 center and 5 starboard cargo tanks. The vessel suffered a subsequent explosion at approximately 2110 in way of No. 5 starboard cargo tank. The fire was extinguished at about 0120 on 10 October 1993. The vessel was declared a total constructive loss and sold to Saber Steel Corporation of Brownsville, Texas.

2. VESSEL DATA

Name:	OMI CHARGER
Official Number:	D522864
Call Sign:	KMLK
Service:	Oil Tanker
Gross Tons:	20,877
Net Tons:	16,420
Deadweight Tons (DWT):	38,485
Length Overall:	631 ft, 1 in
Register Length:	632.3 ft
Register Breadth:	90.1 ft
Register Depth:	48.9 ft
Propulsion:	Steam Turbine
Horsepower:	15,000
Homeport:	New York, NY
Owner:	Rio Grande Transport, Inc. 90 Park Avenue New York, NY 10016
Operator:	OMI Corporation 90 Park Avenue New York, NY 10016
Date Built:	December 15, 1969
Built By:	Bethlehem Steel Corporation
Last Biennial Inspection:	November 29, 1991
Certificate of Inspection Expiration Date:	November 29, 1993
Coast Guard Inspection Zone:	Mobile, Alabama
Master:	[redacted]
License & Document:	Master of Ocean Steam or Motor Vessels of any Gross Tons; also Radar Observer–Unlimited (Expires December 1997). License Number [redacted] Issue No. 7, Issued on 15 December 1992 at Boston, Massachusetts. Merchant Mariner's Document

3. RECORD OF DEAD AND INJURED

a. DEAD

Name:	Roger P. Boutwell, Jr.
License (or Document):	NA – Riding gang
Age:	[redacted]
Next of Kin:	[redacted] (mother)
Home Address:	[redacted]
Employer:	C. M. Maritime, Inc.
Position:	Fire watchman for welder, painter

Length of Service:	1 month
Time of Death:	October 9, 1993, 2000
Cause:	Extensive mutilating injuries to head

Name:	Keith Leon Kelly
License (or Document):	NA – Riding gang
Age:	[redacted]
Next of Kin:	[redacted] (mother)
Home Address:	[redacted]
Employer:	International Marine Services, Inc.
Position:	Field Supervisor(Welder 1–1–A)
Length of Service:	2 years, 1 month
Time of Death:	October 9, 1993, 2000
Cause:	Multiple skull fractures

Name:	Milton Roberto Williams
License (or Document):	Merchant Mariner's Document
Age:	[redacted]
Next of Kin:	[redacted] (wife)
Home:	Beaumont, Texas
Employer	OMI Corporation
Position:	Pumpman
Length of Service:	1 month
Time of Death:	October 9, 1993, 2100
Cause:	Deep mutilating injury to right groin region with laceration of multiple large blood vessels

b. INJURED

Name:	[redacted]
License (or Document):	NA – Riding gang
Age:	[redacted]
Home:	[redacted]
Employer:	International Marine Services, Inc.
Position:	Machinist
Beginning Service:	January 1, 1993
Time of Injury:	October 9, 1993, 2000
Type of Injury:	Upper back spasm between shoulder blades

Name:	[redacted]
License (or Document):	NA – Riding gang
Age:	[redacted]
Home:	[redacted]
Employer:	International Marine Services, Inc.
Position:	Helper

Beginning of Service: January 1, 1993
Time of Injury: October 9, 1993, 2000
Type of Injury: 3rd degree burns to face & arms

Name: [redacted]
License (or Document): Merchant Mariner's Document
Age: [redacted]
Home: [redacted]
Employer: OMI Corporation
Position: Chief Cook
Beginning Service: September 1993
Time of Injury: October 9, 1993, 2000
Type of Injury: Leg abrasions

Name: [redacted]
License (or Document): NA – Riding gang
Age: [redacted]
Home: [redacted]
Employer: International Marine Services, Inc.
Position: Pipe fitter
Beginning Service: January 1991
Time of Injury: October 9, 1993, 2000
Type of Injury: Lower back/spine spasm, contusions to right arm, slight burn to forearm

Name: [redacted]
License (or Document): Merchant Mariner's Document
Age: [redacted]
Home Address: [redacted]
Employer: OMI Corporation
Position: Steward Assistant
Beginning Service: September 1993
Time of Injury: October 9, 1993, 2000
Type of Injury: Knee trauma, eye irritation and back spasm

Name: [redacted]
License (or Document): NA – Riding gang
Age: [redacted]
Home Address: [redacted]
Employer: C. M. Maritime Service Co.
Position: Helper
Beginning Service: September 1993
Time of Injury: October 9, 1993, 2000
Type of Injury: Right shoulder pain radiating to lower back

Name:	[redacted]
License (or Document):	Master NMT 1600 GT, 726630 Merchant Mariner's Document
Age:	[redacted]
Home Address:	[redacted]
Employer:	OMI Corporation
Position:	Third Mate
Beginning Service:	September 1993
Time of Injury:	October 9, 1993, 2000
Type of Injury:	Lumbar spasm and knee trauma

4. WEATHER. At the time of the initial explosion at about 2000, the wind was from the north at 12 knots, and seas were 1 to 2 feet. Air temperature was 80 degrees Fahrenheit. Visibility was unlimited. Weather forecasts predicted winds to increase to 20 to 25 knots and seas to build to 4 to 6 feet with scattered showers and thunderstorms.

5. DRUG AND ALCOHOL TESTS. Specimens were taken from the officers, crew and riding gangs including the deceased. All were [redacted] for illegal drugs except Mr. [redacted] who was positive for morphine which was administered at the hospital. Some had traces of alcohol and admitted they took alcohol between the rescue and the time they were tested, some 12 to 16½ hours later.

6. LIFE SAVING EQUIPMENT:	NUMBER	PERSONS
Total equipment for		40
Motor lifeboats (port)	1	41
Motor lifeboats (starboard)	1	48
Inflatable life rafts	3	65
Life preservers	46	
Ring buoys	24	

7. FIRE FIGHTING EQUIPMENT:

Total hose length	1500 feet
Number of fire axes	5
Number of fire pumps	2
Fixed systems	2
Deck Foam	1300 gallons
Emergency Gear	
Fireman's outfits	15

8. The OMI CHARGER was a single skin tankship of ordinary welded steel construction and had a modern tankship configuration with the deck house aft and above the machinery space. The vessel was owned by Rio Grande Transport, Inc., and operated by OMI Corp., both of the same address. The OMI CHARGER was chartered with Coastwise Trading Company, a subsidiary of AMOCO, in dedicated trade, loading gasoline at the AMOCO facility in Texas City, Texas and discharging at AMOCO facilities in Port Everglades and Tampa, Florida.

9. Gasoline is a petroleum distillate with a complex mixture of hydrocarbons. It is lighter than water (specific gravity of 0.72–0.76) and insoluble in water. Its vapors are heavier than air. Gasoline vapors are normally flammable in air in concentration of 1.4% to 7.6% by volume with an ignition temperature of 495 degrees Fahrenheit. It is a colorless to straw–white liquid.

10. The OMI CHARGER was fitted with a single screw and a steam turbine main propulsion engine. The deck house contained the navigation bridge, the radio room and quarters for the entire

complement of officers and crew. The vessel had 15 cargo tanks (5 center tanks, 5 port wing tanks and 5 starboard wing tanks), and forepeak and afterpeak ballast tanks. The No. 2 port and starboard and the No. 4 port and starboard were previously used for segregated ballast, but had been converted back to carry cargo. The vessel qualified for, and was granted an exemption from the segregated ballast or dedicated clean ballast requirements and the cargo monitor and control system requirements of the pollution prevention regulations. Under this exemption, tank washings, cargo residue and dirty ballast was required to be retained on board, or pumped to a shore side reception facility. The No. 5 center normally also served as a slop tank when not carrying cargo. There were also 2 ballast tanks (port and starboard saddle tanks) aft of the No. 5 cargo wing tanks which had not been used for the last couple of years.. All 15 cargo tanks were epoxy coated. An inert gas (IG) system was installed for the cargo tanks.

See Figure 1, GENERAL ARRANGEMENT DRAWING

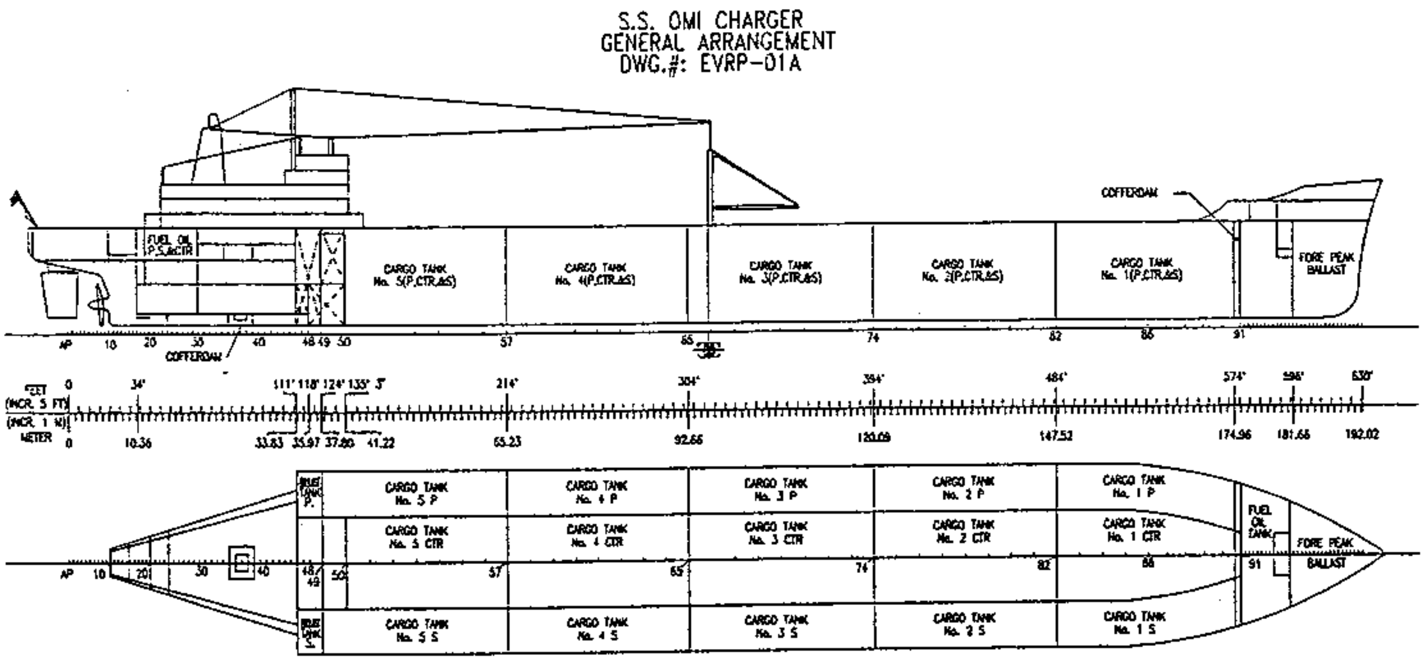
11. The 5P cargo tank was rectangular and measured 90 feet long, 22.5 feet wide and 48 feet deep. The stripping line was located at the aft end of the tank at approximately frame 50 as counted from the stern and was the lowest point in the tank. It had a rectangular mouth and was approximately 1/2 inch above the bottom of the tank. The tank had 3 Butterworth openings, 1 IGS opening, 1 gaging opening and 1 access trunk opening. On the date of the incident the epoxy coating was in good condition. The transverse bulkhead separating No. 5 port cargo tank from the port saddle tank was located at frame 49. The side shell served as the port side of the tank and contained L-shaped side shell longitudinals. The spaces which shared a common bulkhead with 5 port were 4 port, 5 center and the port saddle tank. At the time of the casualty all tanks were empty of cargo. However, No. 5 port had approximately 15 feet of seawater in it. The Nos. 4P, 4C and 4S were inerted.

12. The port saddle tank, also referred to as the "Port Ballast Tank-Aft", was a ballast tank which wrapped the port side and top side of the pumproom. The tank had access only through a man hole in the steward's dry stores. This tank, along with the starboard saddle tank, had not been used since 1991 because of problems with leaks from it into the pumproom and engine room. These problems were the subject of extensive repair work during the recent, regularly scheduled shipyard period. These tanks were being chipped of scale, in anticipation of painting them out, during the first voyage after the shipyard, when the casualty occurred.

13. The master, Mr. [redacted] graduated from Maine Maritime Academy in 1970 and has been sailing ever since. He has spent the majority of his career sailing on tank vessels. He has held an unlimited Master's License since 1983, and has been employed by OMI since 1987. Information in his personnel file with OMI indicates that he did not have any formal IGS or competent person training (for testing spaces for hazardous atmospheres). He has served also as chief officer on the OMI CHARGER. The master has sailed with chief officer [redacted] on the same schedule, for approximately a year and one-half prior to the incident.

14. The chief officer, Mr. [redacted] holds a Merchant Mariner's Document and has several years of experience sailing on tank vessels. He also holds an unlimited Master's license, issued in 1989. Information in his personnel file with OMI indicates that he has no record of having attended IGS or competent person training. He is a 1981 graduate of the U.S. Merchant Marine Academy. He has served as chief officer on three previous vessels and has been chief officer on the OMI CHARGER since 1990.

15. The chief engineer, one first assistant engineer, one second assistant engineer, one third assistant engineer, two second mates and two third mates completed the complement of officers on the OMI CHARGER.



PRINCIPAL DIMENSIONS		
ITEM	(METER)	(FT-IN)
LENGTH OVER ALL	198.05	660'2"
LENGTH BETWEEN P.P.	189	630'
BREADTH MOLDED	27	90'
DEPTH MOLDED	14.625	48'9"
DRAFT TO ASSIGNED WATERLINE	11	36'7 3/4"

DEADWEIGHT, DRAFT, ETC.									
ZONE	FREEBOARD		DRAFT		T.P.I.	DISPLACEMENT		DEADWEIGHT	
	(METER)	(FT-IN)	(METER)	(FT-IN)	(L. TONS)	(METRIC TON)	(L. TONS)	(METRIC TON)	(L. TONS)
TROPICAL FRESH WATER	3.321	10'9-[illegible]	11.481	38'3-[illegible]	117.895	49018.92	48245	40710.815	40068.7
FRESH WATER	3.463	11'6-[illegible]	11.250	37'6"	117.395	47955.2	47200	39824	39000
TROPICAL	3.481	11'7-[illegible]	11.231	37'5-[illegible]	117.333	47904.4	47150	39538.198	38915.55
SUMMER	3.713	12'4-[illegible]	11.0	36'8"	116.87	46949.36	46210	38479.984	37874
WINTER	3.944	13'1-[illegible]	10.769	35'10-[illegible]	116.536	45872.4	45150	37421.769	36832.45

Figure 1 General Arrangement Drawing

CHRONOLOGY

16. The explosion occurred at the end of the first round trip voyage, after a routine shipyard availability at Atlantic Marine in Mobile, Alabama. The OMI CHARGER sailed from the yard on Tuesday afternoon, September 28, 1993, enroute Texas City, Texas to load cargo. In addition to the vessel's normal complement of officers and crew, the OMI CHARGER carried two riding crews of contract workers: four C.M. Maritime (C.M.) Company workers to prepare and paint the saddle tanks, and four International Marine Service (IMS) company workers to install and complete non–vital piping work in the engine room.

17. The vessel arrived and was made fast to the dock at the AMOCO facility in Texas City at about 0130 September 30th. Deballasting commenced immediately, discharging over the side. Only clean ballast was on board because the vessel had sailed from the shipyard, and the company had received permission from the Coast Guard to discharge clean ballast directly over the side. The deballasting continued until about 1230, at which time cargo loading began.

18. Three different blends of gasoline were loaded. At about 0330 on October 1st, the third mate, Tara Ziegler, making rounds in the pumproom, discovered a leak coming from the forward bulkhead between the pumproom and the 5 Center (5C) cargo tank. The leak was located on the starboard side, upper portion of the bulkhead, in between two horizontal plates that formed the overhead of the pumproom. This small space was created in the shipyard, as a result of modifications to the pumproom overhead, in an effort to correct problems in the saddle tanks (ballast) directly above the pumproom.

19. The third mate informed the chief mate, who assessed the situation and in turn, informed the master. The chief mate testified that cargo was leaking at a rate of about "a gallon every five minutes, maybe less. It was a leak to be concerned about." Temporary repairs were proposed, loading 5C halted, and the cargo in 5C was gravitated into the 5 wing cargo tanks (5P & 5S), until the level was below the leak. The chief mate had rigged a ladder in the pumproom to gain access to the area where cargo was leaking, so that a temporary, epoxy patch could be applied. The chief mate slipped while descending the ladder and cut his finger, requiring stitches. He was sent ashore at approximately 0400. Meanwhile, the master notified the chief engineer and the first assistant engineer about the leak, and the first assistant engineer applied an epoxy patch and strongback as a temporary repair. The chief mate returned to the vessel about 0700 and was informed by the first engineer to delay loading 5C long enough to allow time for the patch to set up. Later that afternoon, loading in 5C continued and the repair in the pumproom was checked to determine if it was holding. The leak was still dripping, but was significantly less than before the repair.

20. Sometime that afternoon, a second leak was discovered in the same bulkhead, in a similar location as the first, but on the port side of the pumproom. The rate of this leak was "just a drip" and the master was so notified.

See Figure 2, LOCATIONS OF LEAKS

21. Mr. [redacted], a consultant to OMI, and superintendent engineer during the recent yard period, visited the vessel in Texas City where he and the master assessed the leaks and developed a repair plan involving a "cold patch" after cargo was discharged in Tampa. It was determined that they could finish loading, and monitor the leaks until arrival at Port Everglades, where the cargo would be discharged to a level below the leaks.

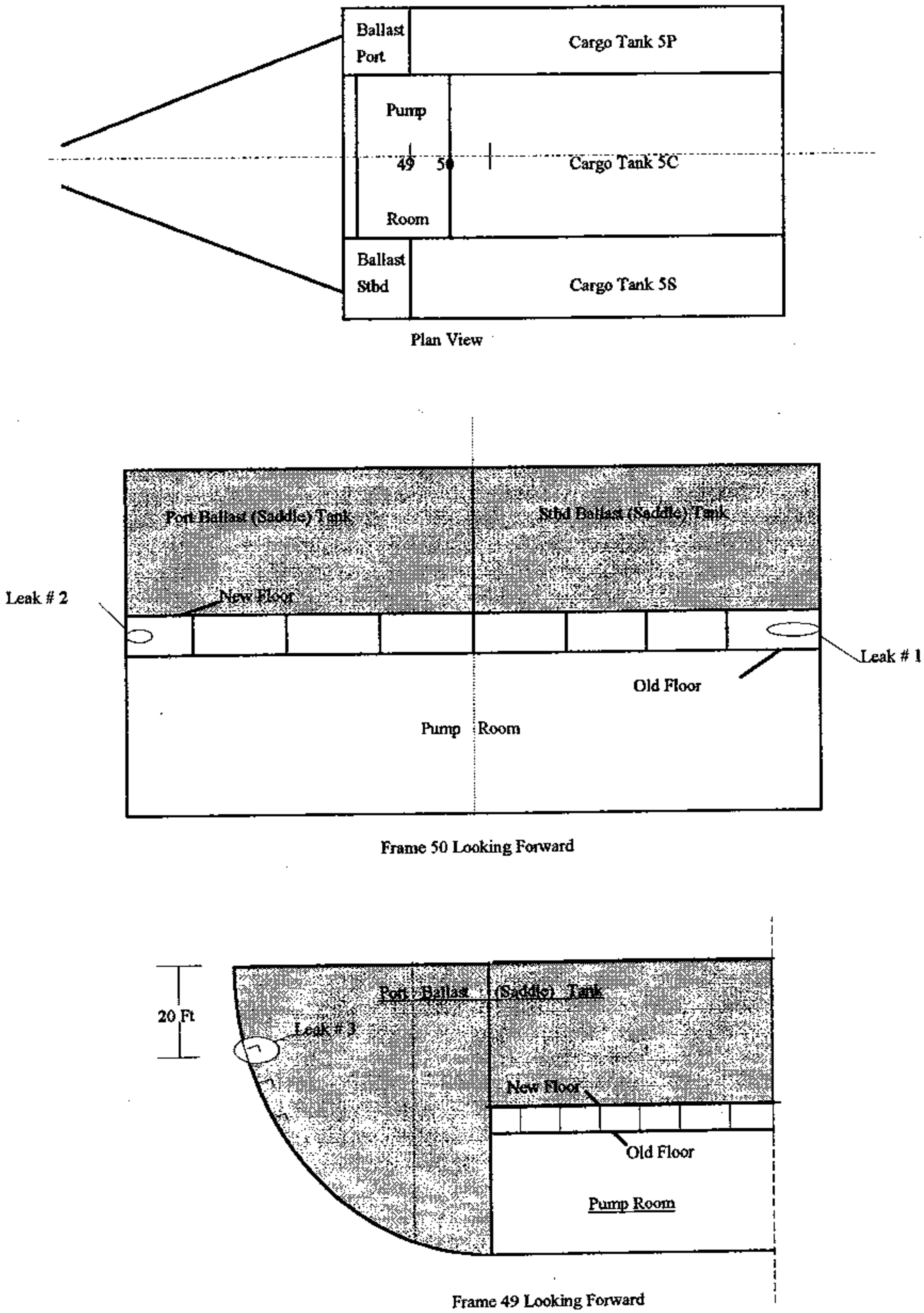


Figure 2, Location of Leaks (not to scale)

22. The OMI CHARGER sailed from Texas City at about 2100 October 1st, enroute Port Everglades, discharging the pilot at about 2300. That evening, while departing, the chief mate learned from the deck cadet that the C. M. Maritime riding gang, on board to paint the saddle ballast tanks, had mentioned gas fumes in the port saddle tank. Initially the complaint was attributed to the loading operations in Texas City or paint fumes themselves.

23. The morning of October 2nd, the master called OMI's Vice President for Operations, Mr. [redacted] to discuss the two leaks in the pumproom and the repair he and Mr. [redacted] had proposed.

24. At about 0800 October 2, the chief mate talked with the C. M. foreman, then entered the port saddle tank to further investigate the complaints. Using a gas detection meter he tested various locations in the tank without indication until reaching the outboard side of the tank, at the bottom, where the meter detected a rise in the percent lower explosive limit (%LEL). At this point the mate knew there was a problem, but still did not see any visual indication. Upon further investigation he noted a "weep" on the bulkhead adjacent to No. 5 port cargo tank, in an area around a 8 inch by 12 inch "landing plate," abutting one of the upper sideshell longitudinal stiffeners, which had recently been repaired in the shipyard. The chief mate informed the master, notified the C. M. gang to take their equipment out of the tank, and had a blower put over the manhole to ventilate the space. Meanwhile, the master called Mr. [redacted] on the cellular phone to discuss the latest development with respect to the leak discovered in the No. 5 port cargo tank "weeping" into the port saddle tank. Mr. [redacted] proposed to meet the ship in Tampa, because there was nothing they could do until the vessel discharged cargo. The morning of October 3, the chief mate checked the "weep" in the port saddle tank and determined it was not worsening, but the dampness had increased to about 3 feet below the weld, where the source seemed to be. No standing gasoline was found. Ventilation of the space continued with a copus blower over the manhole in the steward's storage locker and the butterworth opening on deck, port side, open.

See Figure 3, LOCATION OF LEAK #3

25. At about 1042 on October 4, the OMI CHARGER arrived at Port Everglades, FL, docking at AMOCO at about 1200. Cargo discharge began that afternoon at about 1430, lowering the 5P, 5C and 5S to a level below the leaks. On Tuesday, October 5, the vessel sailed for Tampa.

26. The OMI CHARGER arrived Tampa, FL late Wednesday evening, October 6, and docked at the AMOCO facility about midnight. At approximately 0218 October 7th, the vessel began discharging cargo. Later that morning, Mr. [redacted] visited the ship and discussed a revised proposal to repair the leaks with the master and chief mate. He also reviewed the repair proposal with the chief engineer and Mr. Keith Kelly, a welder and foreman of the IMS workers, since the repairs involved hot work. On the leak in the forward pumproom bulkhead, starboard side (leak #1), the proposal was to gouge and weld the crack, then weld a "reinforcing plate" over the repair. They thought the other leak in that bulkhead, on the port side of the pumproom (leak #2), was just a bad weld and proposed to gouge and reweld it.

27. The "weep" in the saddle tank (leak #3) was also thought to be a bad weld from the shipyard, and the proposal was to simply reweld it.

28. The master, chief mate and Mr. [redacted] also discussed preparations necessary before hot work, and decided to butterworth and wash the 5C cargo tank and pumproom. The 3's across (P, C, & S) and 5P & 5S were to be overflowed to purge the hydrocarbons, and left full. The 4's across were to be purged with inert gas (IG). The master mentioned he had intended to leave the 5P full during the repair in the saddle tank, but was told by Mr. [redacted] that it would have to lowered to a level below the leak to make a proper weld.

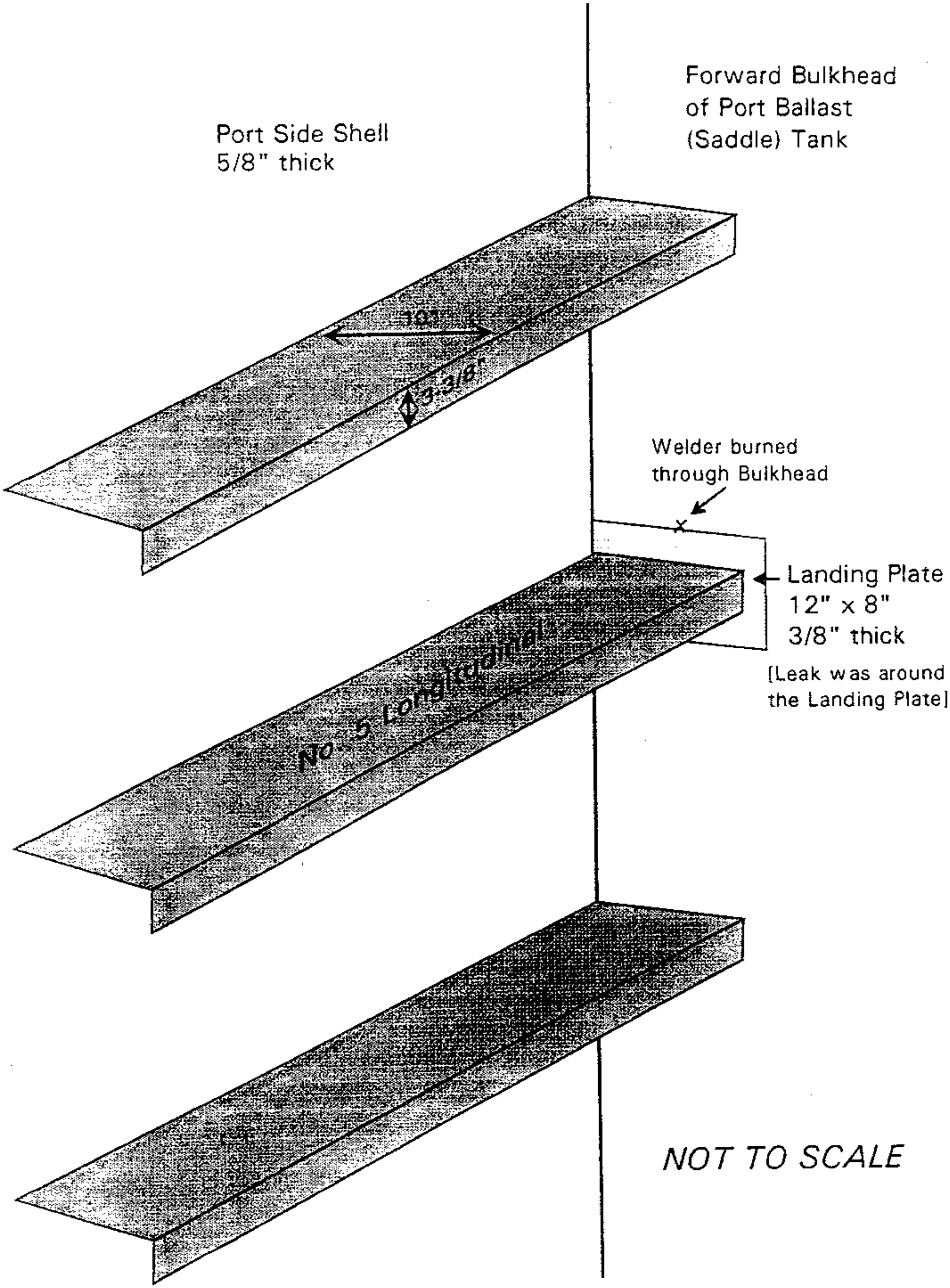


Figure 3, Location of Leak #3

29. That morning, a Coast Guard Boarding Officer visit[redacted]MI CHARGER while she was discharging cargo. The Boarding Officer, Petty Officer [redacted] from Marine Safety Office Tampa, conducted a routine cargo transfer monitor on board the vessel. The master accompanied him during his visit, which took about an hour and a half. He discovered some leaking gaskets at the cargo manifold and noted this on a boarding form which he left with the master. He also questioned, in his own mind, the operation of the vessel's inert gas system and noted one of the manifold lines had a bucket underneath, catching a slow drip. Not being familiar with IGS, he returned to his office and informed the Chief, Inspection Department, who sent a marine inspector to investigate further. CWO [redacted], boarded the vessel and discussed the petty officer's findings with the chief mate. Together, they quickly inspected the cargo deck where he discovered some butterworth covers leaking IG vapor, a leaking flange on a gauge fitting, and the leaking flanges on the replenishment crossover at the cargo manifold. His boarding took about 20 minutes. CWO [redacted] wrote these items on a CG–835, to be corrected prior to loading the next cargo, and delivered it to the chief mate at 1315. During the boardings, neither PO [redacted] nor CWO [redacted] entered the cargo pumproom. However, neither the master nor chief mate volunteered information concerning the leaks from the cargo tanks during these boardings.

30. Cargo discharge was completed at about 1300, and ballasting began about 1400. At about 1420 the chief mate started washing 5C with a butterworth machine. This work took about two and a quarter hours. The 4P, 4C, and 4S were purged with IG from around 1500 until about 2000. At about 1730, the pumproom was washed for two hours, using reduced pressure on a butterworth machine (to protect pump gauges, etc.) and hand held hoses. Slops created during washing were transferred to the 4C cargo tank. The ship got underway at about 1800 and departed Tampa around 2300 October 7, 1993. At this time the tank conditions were as follows:

- o 1 wing (P&S) cargo tanks were ballasted;
- o 1C was empty of cargo, with IG in the tank, but not "purged;"
- o The 2's across were empty of cargo, with IG in the tank, but not "purged;"
- o 3's across were ballasted full;
- o The 4's across were purged with IGS and had been tested at four percent oxygen;
- o 5C was washed and gas free;
- o 5 wings were ballasted full.

31. The ballasted tanks had also been isolated from the IGS system by their individual IGS valves, and vented through their individual purge pipes during the ballasting operation.

32. The 5C cargo tank was ventilated with two blowers overnight, from 1700 on the 7th, until 0830 on the 8th.

FRIDAY, 8 OCTOBER 1993

33. The chief mate woke at about 0400 October 8th and rousted out the second pumpman. They met at about 0450 in the crew's mess to discuss the plan to run ballast over the top of 3's across and 5 wings to "purge" the hydrocarbons from those tanks. At 0515 they began, overflowing each tank for about one half hour. At about 0700 they finished, leaving each tank full, with water up to the top of the tank trunks.

34. At 0830 the chief mate tested the atmosphere in 5C with the gas meter. He also tested the pumproom. In each case he obtained readings of 21% oxygen, 0% LEL. At 1030 he and Mr. Kelly entered the 5C with the gas meter in continuous operation, and, as required by the company's policy, he issued the hot work permit for the welding repairs to the two leaks in 5C. Also in accordance with company policy and good marine practice, a continuous fire watch was maintained on the opposite side, in the pumproom, and the Bosun was stationed at the top of 5C

at the access opening, during welding in 5C. Welding repairs in 5C were completed at 1900. The master testified that the first leak (starboard) was repaired with a "reinforcing plate" (doubler) because the bulkhead plate was too thin in that area to gouge. The second leak was in a weld and was gouged and rewelded.

SATURDAY, 9 OCTOBER 1993

35. Saturday morning, 9 October, the water level in 5P cargo tank was dropped in preparation for welding repairs on the third leak in the port saddle tank. The level of 5S was dropped simultaneously to keep an even keel. Deballasting was completed at approximately 1100, with the water level brought down 36 feet (ullage) to about the 14 foot level. Prior to that, the chief mate entered the port saddle tank with the oxygen/explosive meter to test the atmosphere. He found a reading on the meter of about 10% LEL and discovered water, with some gasoline on top, at the bottom of the tank. At that point he ordered a fire hose and pump into the saddle tank to flush it out. He also ordered an additional blower, to move air from the bottom of the tank. Another was already supplying fresh air from the outside. After flushing and pumping the saddle tank the chief mate also discovered scale and other material at the bottom, and ordered the tank to be mucked out. This occurred from about 1030 till 1230. At about 1300 the chief mate reinspected the tank and found it clean and dry, but the %LEL was still "a little high." The air blowers appeared to be doing their job, but more time was necessary.

36. At about 1336 the vessel arrived at the Galveston sea buoy. She anchored at about 1448 in 32 feet of water in the Bolivar Roads Inner Anchorage, approximately 1.5 miles from Galveston Island, since her berth in Texas City was not available. The chief mate testified that at about 1505, during coffee break, he opened the cover to 5P cargo tank and tested that tank with the oxygen/gas meter. He tested the atmosphere at four locations, all from the ladder leading down to the water level at about the 14 foot level. He also inspected the surface of the water with a flashlight and did not see a sheen nor smell any gasoline. He left the tank at about 1515, securing the tank cover. He did not open or test from any butterworth openings. At 1520 he retested the port saddle tank and found the atmosphere satisfactory with a reading of 0% LEL and 21% oxygen. At 1600 he also tested the pumproom and received 0% LEL, 21% oxygen. After dinner, at about 1750, the chief mate and the welder, Keith Kelly entered the port saddle tank to begin repairs. The chief mate tested the port saddle tank once again, at several locations, and gave the okay to begin welding at about 1800, but did not retest 5P. Welding continued until about 1915, when the welder ran out of rods. Both the chief mate and the welder left the tank to get more welding rods. The welder informed the chief mate that he had only one more side of the "landing plate" to weld, anticipated the job would take no longer than a half hour to finish, and he would get someone else to be his fire watch. About that time the chief mate ran across the pumpman on deck and gave him the okay to "swing" the blank flange on the IG system going to the 5C cargo tank. This was necessary to put IG into that tank, while taking on cargo later that evening. The individual IG valves on 5C and 5 wings remained closed. The mate then went to his room to answer questions of the deck cadet. Meanwhile, Mr. Kelly had obtained additional welding rods. He and Roger Boutwell, a worker with the C. M. Maritime riding gang, entered the saddle tank to finish the repair.

37. Mr. [redacted], an IMS riding gang member, was at the top of the ladder leading into the saddle tank standing by. He testified by phone from the hospital that he saw the chief pumpman, Mr. Milton Williams, right outside the pumpman's locker at the open trunk of No. 5 center. Mr. Williams told him that Mr. Kelly was in the saddle tank. Mr. [redacted] testified that he then saw a fellow IMS employee named '[redacted] at the door of the pumpman's locker. When asked by Mr. [redacted] who was in the saddle tank with Mr. Kelly, [redacted] could not give an answer, but said Mr. Kelly was "Okay." Mr. [redacted] surmised that Mr. Kelly was welding alone without an assistant and therefore, entered the saddle tank to assist Mr. Kelly.

38. Mr. [redacted] climbed down the ladder from the manhole access, which was on the main deck in the steward's dry stores, into the port saddle tank. He testified that he went down the ladder with a flashlight but couldn't see Mr. Kelly. Mr. [redacted] hen asked Mr. Kelly to "pop a light on." Mr. [redacted] then asked "Where are you at?" Mr. Kelly replied, "Over here." Mr. [redacted] then said "Where?" Then Mr. Kelly struck the arc and the explosion took place. Mr. [redacted] testified that the explosion was "quick" and not a "real long procedure." Mr. [redacted] clung to the ladder which he was on.

39. At about 2000 the OMI CHARGER exploded.

40. The conditions of the tanks immediately prior to the explosion were as follows:

1 P/S – in ballast, 39 feet ullage, inerted, closed
1 C – empty, inerted, closed
2 P/C/S – empty, inerted, closed
3 P/S – in ballast, 25 feet ullage., closed
3 C – in ballast, 23 feet ullage, closed
4 P/S – empty, inerted, purged, closed
4 C – slops up to 43 feet ullage, inerted, purged closed
5 P/S – in ballast with 36 feet ullage, gas free, closed
5 C – empty, washed, gas free, open

41. The initial explosion took place in No. 5 port. The explosion blew up the weather deck which served as the tank top for Nos. 5 port and 4 port. The port side of the weather deck was blown up and then bent over forward on top of No. 3 port. The initial explosion on the vessel also blew off the port side shell from frame 49 forward to frame 65 and also blew the bulkhead common to No. 5 port and the port saddle tank, aft into the saddle tank.

42. About 1 hour later a second explosion occurred in No. 5 starboard tank which upset the weather deck above it and also severed the longitudinal bulkhead common to No. 5 starboard and No. 5 center at its aft end and blew it into No. 5 center while still attached at its forward end.

43. Chief Engineer [redacted] testified that at the time of the explosion he was in his stateroom on the boat deck. He heard a tremendous blast followed by violent shaking of the ship which knocked him out of his chair and against the bulkhead. He looked out his port hole and saw a large glow and flames. While running down to the engine room he met the first assistant engineer, Mr. [redacted] When they arrived at the engine platform, they found Mr. [redacted] a third assistant engineer, on watch at the log desk. Mr [redacted] was very dazed but did not appear to be injured. Mr. [redacted] stated that the forward bulkhead of the engine room, at the platform level, was compromised and water was coming through. The deck below was receiving a heavy influx of water on the port side. He saw a large cascade of water pouring down on the deck below near the evaporator, foam pump and butterworth pumps. In his opinion flooding in this vicinity made it too dangerous to place either the foam or butterworth pumps on line to help control the flooding. He testified that the rate of flooding was beyond the capacity of any of the ship's pumps to dewater the engine room.

44. Third Mate Mr. [redacted] had just come on to his 8–12 watch and was alone on the bridge. He was thrown to the deck.

45. The master was in his cabin and the chief officer was in his stateroom at the time of the explosion.

46. Mr. [redacted], who sustained third degree burns while clinging to the ladder 20 feet down in the saddle tank, groped his way back up the ladder. He was helped out of the manhole by

someone he did not know, into the steward's dry stores, and eventually to the fantail with the rest of the crew.

DESCRIPTION OF DAMAGE

47. A survey conducted by Smit American Salvage on the day after the explosion reported the damage to the OMI CHARGER. The vessel was heeled to port about 10 degrees and down by the stern, with the stern awash and sitting on the bottom. The extent of longitudinal contact with the sloping bottom was not determined. Drafts were:

	port	starboard
forward	8'	8½'
amidships	37'	21'
aft	awash	awash

Photo 1, Stern Awash

Photo 2, Stern Awash

48. Cargo tanks numbers 4P, 4C, 5P, 5C and 5S were severely damaged and in free communication with the sea. Number 3P cargo tank was assumed intact because it still contained gasoline residue, and there was no visible pollution in 4P. The cover of the access trunk was, however, blown off. Other cargo tanks were determined to still be intact.

49. The pumproom, engine room, steering room and shaft alley were flooded. Extent of damage to engine room and pumproom bulkheads could not be immediately determined.

50. Major damage was evident on deck. The deck plating, with associated underdeck stiffeners, above the 5P and 4P cargo tanks was peeled forward from the front of the house and laid over the deck above the 3P and 2P tanks. The deck plating above the 5C and 5S cargo tanks was bulged up approximately 2 to 2½ feet.

51. The side shell in way of number 5P cargo tank, from the deck down about 30 feet, was blown away exposing both the 5P and 4P cargo tanks. This section of side shell was later recovered, in one piece, from the bottom of the anchorage.

52. In way of the number 4 and 5 cargo tanks, the port longitudinal bulkhead was breached above the waterline, and deformed into the 5P cargo tank. The starboard longitudinal bulkhead in 5C cargo tank was blown to port, peeled forward, and laid transversely across the forward bulkhead, the after section of the longitudinal bulkhead resting to port.

Photo 3, No. 4P & 5P Cargo Tanks

53. The transverse bulkhead between the numbers 4 and 5 cargo tanks was severely damaged in way of the port and center tanks. The transverse bulkhead between the 5P and port saddle tank (at frame 49) was blown aft, into the saddle tank and was separated at its upper end from the underside of the main deck.

Photo 4, Tanktop of 5P Cargo Tank

Photo 5, Main Deck Port Side

Photo 6, Main Deck Starboard Side

Photo 7, Bulkhead at Frame 49 Port Side

Photo 8, Longitudinal Bulkhead Between 5P & 5C Cargo Tanks

Photo 9, Longitudinal Bulkhead Between 5C & 5S Cargo Tanks

Photo 10, Bulkhead at Frame 49 Port Side

54. The members of the Board examined the OMI CHARGER's deck, port side, Nos. 5 port, 5 center, 5 starboard and the port saddle tank. The deckhouse, including the bridge and the machinery spaces were also entered and examined. The starboard saddle tank was also entered in order to obtain a pre-casualty idea of the layout of the port saddle tank.

55. The fire damage on deck was limited to the port side of the main deck from the manifolds, which were approximately amidships, back to the deck house.

56. The IGS branch line to 5P cargo tank was severed, but the valve was in the closed position.

57. The accommodation spaces were mostly intact but in disarray due to the violent explosions. The port side window facing to port in the chart room on the bridge was imploded and the floor was covered in shards of glass.

58. The forward engineroom bulkhead was split open in way of the port saddle tank, which allowed the engineroom to flood. The bulkhead was largely intact, which ultimately permitted temporary repair and dewatering of the engineroom.

59. The estimated value of the vessel prior to the casualty was 15 million dollars. It was sold as scrap to Saber Steel Corporation after the casualty.

<u>CHARTER and SHIP's SCHEDULE</u>

60. The OMI CHARGER was on the fourth year of a five year time charter with Coastwise Trading Company, in dedicated trade, loading gasoline at the AMOCO facility in Texas City, Texas and discharging at AMOCO facilities in Port Everglades and Tampa, Florida. Occasionally she would also discharge cargo in Jacksonville, Florida. The return leg of each voyage was made in ballast. Because of the dedicated trade route, the vessel qualified for, and was granted an exemption under 33 CFR 157.306 from the segregated ballast or dedicated clean ballast requirements of 33 CFR 157.10a (or .10c) and the cargo monitor and control system requirements of 33 CFR 157.12. Under this exemption, the vessel was prohibited from discharging cargo in any port outside the jurisdiction of the United States. Also, the Charger was permitted only to load cargo at the AMOCO facility in Texas City, where the MARPOL Annex I shoreside reception facility was adequate to receive tank washing, cargo residue, and oily ballast required to be discharged prior to loading cargo. Otherwise, such oily waste was required to be retained on board, except in emergency.

61. Under the time charter the movement of the vessel was controlled by AMOCO, parent company of Coastwise Trading. The charter provided for penalties if the vessel did not perform.

62. The charter agreement provided the vessel with not more than 144 hours in any one year for loss of time due to breakdown of machinery, interference by authorities, collision, etc., as long as

each delay was no longer than 12 hours in duration. The 144 hours per year could be prorated for part of the year. Mr. [redacted] Assistant Vice President of Operations for OMI Bulk Management, testified that under the charter agreement the OMI CHARGER was allowed 12 hours delay per month for maintenance. During the last 4 years there were no performance claims against the vessel.

63. The charter also stipulated performance goals for speed between ports, fuel consumption, and time for cargo discharge.

64. The master testified that penalties were assessed at the end of the year, not on a voyage basis, so if there were delays on one voyage, they could make up for it on the next. He indicated they never had a problem meeting the speed or consumption targets, but pumping times were a problem, particularly in the first three years of the charter.

65. The charter agreement states that the "Master will contain on board the vessel all oily residue from consolidated tank washings, dirty ballast, etc."

66. The provisions of the charter were strict with respect to delays caused by weather, but none the less, the vessel was never penalized for weather delays.

67. The master was constantly protesting AMOCO's capability to receive cargo, particularly at the Tampa facility, where one particular cargo line was too small to allow the ship to meet its performance target. The three different grades of cargo, and amounts aggravated the situation, especially if discharge required use of the small line in Tampa. According to the master's calculations, the vessel was over by 177 hours in pumping the first year of the charter; 275 hours the second year; and 50 hours the third. The vessel was not always penalized for 100 percent of the delays, but was able to negotiate lesser penalties due to the records the master kept and the protests he had filed against the facilities' reception capabilities. The vessel had accumulated 116 hours pumping delay during the fourth year of the charter, which would have finished at the end of October. The master testified that these cargo delays cost the company between $800 and $900 an hour.

68. The master gave credit to the chief mate for improving the discharge times and reducing the penalties the ship received in the previous two years of the charter. They had installed a special crossover on the manifold while in the shipyard two years previous, which improved their ability to discharge cargo, but the mate's planning and constant monitoring of the cargo discharges were responsible for the majority of savings. In the master's experience, chief mate [redacted] performance with respect to cargo discharge was always better than other chief mates working the OMI CHARGER.

69. The 5 wing cargo tanks were "overflowed" in an effort to purge them of hydrocarbons. During overflowing, only hatch covers were opened, no butterworth openings. The chief mate testified that after "experimenting" with overflowing prior to the yard period, that it seemed he got a better flow through the hatch openings than through the butterworth openings.

70. The vessel normally arrived at Texas City with approximately 68,000 barrels of ballast on board. This was calculated to match AMOCO's MARPOL (Annex I) reception facility capacity. It took approximately 20 hours to discharge the normal ballast. Discharging ballast took more time than loading ballast. To load the 68,000 barrels it took about 7 hours.

71. When the vessel departed Tampa the ballast on board was located as follows:

- 1 wing cargo tanks (P&S) were ballasted ;
- 3's across were ballasted full;
- 5 wings were ballasted full.

72. The amount of ballast corresponding to this arrangement is more than the ballast normally carried and more than the AMOCO facility can receive at one time. The excess ballast was used to overflow the 5P & 5S cargo tanks.

73. The mate indicated saving time was not a consideration in choosing "overflowing" vice other cleaning methods for 5 wings.

74. The master and mate both testified that the 5 wings could not have been cleaned by butterworthing because they were in ballast. The ballast was necessary to keep the propeller immersed. Other tanks would have to be ballasted before the 5's could have been washed by butterworthing.

75. The 5 wing tanks were deballasted to a level of 14 feet (36 foot ullage) prior to the repair in the port saddle tank. This level was well below the level of the repair and was decided on based on the amount of ballast the master wanted on board upon arrival at Texas City. The vessel could not go to Texas City with more than 70,000 barrels of ballast.

76. During this operation the ballast water was discharged over the side in the Gulf of Mexico as the vessel was approaching Galveston, and was completed about 1100 on the morning of the explosion.

77. The master testified that had the explosion not occurred, the remaining ballast would have been discharged as slop to AMOCO's reception facility and that no other options were available as to the disposition of the ballast.

78. The master testified that he was under no pressure from the company or the charterer to bring the vessel to the dock on the day of the explosion. He said the vessel was waiting availability of a berth at the AMOCO facility due to another vessel's delay, but he could have taken all the time necessary to effect the repairs while at anchor. He also testified that had they been called to the dock, they would have stopped the welding repairs and settled for a temporary epoxy repair.

79. After cargo discharge in Tampa, all tanks were stripped using the installed stripping system. The stripping suction in 5P cargo tank is located in the after part of the tank, only about one half of an inch from the bottom.

80. Inert gas was introduced, as normal practice, to the following cargo tanks during cargo discharge in Tampa: 1P, 1C, 1S, 2P, 2C, 2S, 4P, 4C, and 4S. Although inert gas was introduced into these tanks, the inert gas system was not in operation after the cargo was discharged. The inert gas valves to the 3's across and 5's across remained closed. The 3's across and 5 wing tanks were ballasted upon departure from Tampa. Inert gas was not considered as a means to gas free the 5P tank because it was planned to enter the tank after the repair in the saddle tank to hose test from the opposite side of the bulkhead. An inert atmosphere would preclude tank entry.

81. The preparations for hot work in 5C cargo tank included water washing and ventilating both 5C and the pumproom, and filling the adjacent cargo tanks, 5P & 5S, with ballast water.

82. The 5C cargo tank was gas freed by a combination of water washing and ventilation. The 5C was butterworthed at the 20 and 40 foot levels from the forward and after butterworth openings. Slops were transferred to 4C. The 5C was ventilated overnight with two blowers the night before it was repaired.

83. The 5P and 5S cargo tanks, adjacent to 5C, were not "cleaned" by traditional means. Instead they were pressed full and overflowed in an effort to purge the hydrocarbons from the vapor

space in the tanks. The vessel was trimmed by the stern 12 feet. Only the tank hatch covers were open; all butterworth openings remained closed during this operation. The 5P and 5S cargo tanks, adjacent to 5C, were pressed full during repair work in the 5C.

84. The pumproom, an adjacent space to 5C, was butterworthed with one machine, and also hand washed with hoses. The slops were transferred to 4C. The pumproom was ventilated with the installed ventilation system.

85. The chief mate testified that before hot work began in 5C he tested the tank with the combination gas/oxygen meter. He began at the top of the tank by dropping a 50 foot length of hose connected to the meter all the way to the bottom of the tank. He tested in several locations in the tank. He removed the sampling hose and was continuously monitoring the atmosphere as he walked around the tank. He stopped at five general areas in the tank, at the bottom, after end, and mid–section, on both port and starboard sides of the tank, and at the location of the weld repair itself. He did not check portions all the way forward in the tank.

86. During the repairs in 5C, the chief mate posted a fire watch in both the pumproom and in 5C.

87. In preparation for hot work in the port saddle tank, the port saddle tank was hand washed, mucked out, and ventilated. Testing in the port saddle tank was done several times and at various locations before the chief mate was satisfied it was gas free.

88. The chief mate testified that when he detected gas vapors in the port saddle tank on the morning of the accident, the volume of liquid in the saddle tank was approximately 50 gallons. He indicated that only a thin layer of gasoline was on the surface of the liquid, that most of the liquid was water. He detected the gas by both his sense of smell and with the gas detection meter. He also indicated that once he reached the level where the gas was, it was detected throughout the area, not only in isolated or small pockets.

89. Prior to hot work in the port saddle tank the water level in 5P Cargo Tank was lowered. According to the master this was accomplished for two reasons. First, pressure was taken off the "weep" in the bulkhead, so a proper weld could be made; and second, to provide access to the other side of the bulkhead so it could be hose tested to verify the effectiveness of the repair. The level of 5S was lowered to keep the vessel on an even keel. 5S is not adjacent to the port saddle tank.

90. The chief mate testified that after dropping the level in the 5P cargo tank at about 1100, he waited until a little after 1500 to test the tank atmosphere. He believed that in four hours, if gas had been there, it would have circulated throughout the tank. He said he tested the tank from the aft end, all the way down the ladder, including at the surface of the water. He did not drop a sampling hose from the top through butterworth openings at the forward or mid–sections of the tank.

91. The chief mate testified that when he entered the 5P cargo tank at 1505, he went to the bottom of the ladder with his meter. He got good readings on the meter, inspected the surface of the water with his flashlight, and did not detect any residual cargo. He did not smell any fumes. He concluded these tests in about ten minutes and exited the tank at 1515, and closed the hatch. There was no ventilation on the 5P tank.

92. The chief mate stated he entered the No. 5 port cargo tank alone with the oxygen tester. He entered without a standby at the access trunk nor without any ventilation. The crew was on coffee break and there were no witnesses.

93. The mate testified that if gasoline vapors were present in the 5P cargo tank when he tested it, he would have smelled them and detected them on his gas meter, similar to his test in the saddle tank earlier that day. Since the quantity of gasoline in the saddle tank was so small and he detected that, he felt certain that there was no gas in the 5P cargo tank.

94. The pumproom, adjacent to the port saddle tank, remained clean, gas free and ventilated the same as the previous day.

95. The 5C cargo tank, catercorner to the port saddle tank, remained clean, gas free and ventilated the same as the previous day.

96. During repairs in the port saddle tank, the chief mate ensured there was a fire watch in the saddle tank, but there was no fire watch posted in the 5P cargo tank.

97. The master had discussed overflowing the 5 wings with the ship's port engineer, Mr. Henry Blaustein.

98. The mate observed a sheen emanating from the tanks during overflowing. The presence of a sheen on the surface of the water was an indication that the ballast water was not "clean" ballast. The mate testified he believed that overflowing did not violate pollution laws because they did not leave a sheen; it dissipated before going over the side of the vessel. The mate testified that the tanks were overflowed for about a half hour. He continued overflowing for about 15 minutes even after he no longer observed a sheen or air pockets bubbling up out of the hatch opening.

99. The "overflowing" of the cargo residue of the uncleaned No. 5 wings was a violation of the vessel's Certificate of Inspection (COI) which required tank washings, cargo residue, and all ballast except segregated ballast, to be retained on board or discharged to the AMOCO shoreside reception facility in Texas City, Texas.

100. The National Fire Protection Association (NFPA), in their "Standard for the Control of Gas Hazards on Vessels" (NFPA 306 1993 Edition) defines marine chemist as:

> "The holder of a valid Certificate issued by the National Fire Protection Association in accordance with the 'Rules for Certification of Maine Chemists,' establishing him as a person qualified to determine whether construction, alteration, repair, or shipbreaking of vessels, which may involve hazards covered by this standard, can be undertaken with safety."

101. Neither the master nor the mate were certified marine chemists and neither had any formal training as a marine chemist. The chief mate was qualified by the position he held. He testified that the only training he ever received related to the IG system or gas detection meter was on–the–job training.

102. The gas detector used by the chief mate was a Marine Safety Appliance (MSA) Combustible Gas and Oxygen Alarm, model 261. The instructions for calibration and proper use are printed on a label inside of the hinged door on the top of the unit. The chief mate testified that he did not have an instruction manual for this unit on board the OMI CHARGER, but did calibrate the meter prior to testing the tanks.

103. Mr. [redacted], a certified marine chemist from Delta Lab and Gas Testing in Prairieville, Louisiana, examined the oxygen detector and testified before the Marine Board. He concluded that the oxygen detector was calibrated and working properly.

104. The International Safety Guide for Oil Tankers & Terminals (ISGOTT), Revised Third Edition (June 1993), defines "purging" as the introduction of inert gas into a tank already in the

inert condition with the object of: (1) further reducing the existing oxygen content; and/or (2) reducing the existing hydrocarbon gas content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

105. The International Safety Guide for Oil Tankers and Terminals (ISGOTT), Revised Third Edition (June 1993), states in Section 7.5.3 that "Ships fitted with an inert gas system must replace ballast discharged from cargo tanks with inert gas so as to maintain the oxygen content of the tank's atmosphere at not more than 8% by volume."

106. Section 10.2 of the International Safety Guide for Oil Tankers and Terminals (ISGOTT), Revised Third Edition (June 1993), states that entry into a compartment where there could be gas should only be made after an investigation with approved gas testing equipment which has itself recently been checked against standard samples.

107. Title 46, Code of Federal Regulations, Part 35.01–1, states that while in port a marine chemist, certified by the National Fire Protection Association (NFPA), is to be employed to conduct inspections and issue certificates when making repairs involving welding. No marine chemist was called.

108. The OMI CHARGER Fleet Standing Orders, section 5.6 discusses Hot Work. The company policy states that before hot work commences at sea, a thorough inspection must be carried out by a responsible senior officer. Section 5.6.1.d. states that the inspection must ensure that "adjacent compartments have been washed and either gas freed to safe for hot work standard; or purged of hydrocarbons to less than 2% by volume and inerted; or completely filled with ballast water; *or any combination of these*" (emphasis added). These guidelines also refer to Section 5.4 for Gas Freeing and a Company Circular letter #434/F358 Hot Work Guidelines.

109. According to the OMI Fleet Standing Orders, section 5.6.1, inspection of tanks in port is to be done by a marine chemist. If a marine chemist is not reasonably available, the captain may appoint a competent person to test tanks for hazardous atmospheres. Prior to a person entering a tank, that tank must first be tested from the main deck.

110. The company circular #434/F358 is dated April 25, 1988, and is addressed to "All masters/chief engineers," subject: "Safety Procedures When Conducting Hot Work." The circular references "CFR46 Subpart 35.01 (Title 46 Code of Federal Regulations Subpart 35.01) Special Operating Requirements." In addition to the precautions laid out in the Fleet Standing Orders, the Circular requires that prior to hot work, and following the site inspection, the master or the chief mate issue a Hot Work permit specifying the extent of the inspection and the nature of work to be done. In port, the Circular guidance is superseded by the Marine Chemist's Certificate. The Circular requires copies of the hot work permit to be posted at or near the job site, kept with the vessel's files, and forwarded to the New York Office. Additionally a proper entry shall be made in the vessel's logbook regarding the inspection and summary of the work to be performed.

111. Fleet Standing Orders, section 5.5.2.c, "Entry Procedure" requires: "Standby – at least one crew member must keep a standby watch at the entrance to the space, even if the space is certified 'Safe for Men – Safe for Fire,' whenever a person is inside." Section 10.4.2 of the International Safety Guide for Oil Tankers and Terminals (ISGOTT), Revised Third Edition (June 1993), states that during cargo tank entry, a responsible member of the crew is to be in constant attendance outside the tank in the immediate vicinity of the entrance.

112. Fleet Standing Orders, section 5.4.2, paragraph (b) states: "Holds, tanks or other compartments should be tested at various levels and through several openings to ensure full representation of the atmosphere is obtained. Hydrocarbon gas is heavier than air and the highest concentration is likely to be found in the lower third of the space."

113. The master's interpretation of the company policy concerning preparing adjacent tanks for hot work was that overflowing was acceptable and complied with the policy because the tank was prepared to the same standard as for hot work. The master testified that in his opinion, if you've overflowed a tank through the butterworths and tank access until it is clean, displaced the atmosphere, pumped it back down, and checked the atmosphere and verified 0% LEL, 21% oxygen, then you have essentially cleaned the tank.

114. 46 CFR 35.01-1(a) states, "The provisions of 'Standard for the Control of Gas Hazards on Vessels to be Repaired,' NFPA No. 306...shall be used as a guide in conducting the inspections and issuance of certificated required by this section." This requirement applies when the vessel is in port and a Marine Chemist completes the work (46 CFR 35.01-1(c)(1)) and when the vessel is not in port and the senior officer present completes the inspection (46 CFR 35.01-1(c)(2)).

115. NFPA 306, paragraph 2-3.7 states, "Inerted means...The space has been flooded with water, provided that any hot work is performed at least 3 ft (0.9m) below the water level, and further, provided that the gas content of the atmosphere above the water does not exceed 10 percent of the lower explosive limit and such procedure is approved by the Marine Chemist."

116. NFPA 306, paragraph 2-2.1 states, "The calibration of all instruments used by the Marine Chemist shall be checked before and after each day's use. A record shall be maintained of all calibration checks."

117. The chief mate testified: "I'm responsible for the transfer of all cargo aboard the OMI CHARGER, for all ballast activities, for gas freeing, for tank washing, the deck maintenance of all deck machinery, for the painting, for--in general I'm in charge of the deck department." The chief mate's interpretation of the company's policy allowing "any combination" of the three methods of gas freeing a tank was "using water to fill a tank as well as gas freeing a tank, and gas freeing is not just using the blower. Gas freeing can be done by displacing the atmosphere in the tank with water. You're gas freeing, displacing the atmosphere that's in the tank." When asked the purpose of filling an adjacent tank with ballast prior to hot work, the mate replied "To gas free as well as provide fire protection. "

118. The master testified that he understood the company's policy required a marine chemist if repairs were to be conducted in port. He further stated that the anchorage would be "in port." However, the master also testified that it did not even occur to him to call the marine chemist because they had planned on finishing the repair work at sea, prior to entering port. Under these circumstances the mate could certify the tanks and issue the gas free certificate. However the work was delayed and they did not actually begin the repair on the saddle tank until after anchoring the vessel at Bolivar Roads.

119. The mate testified that he understood the company's policy required the use of a marine chemist if the vessel was in port. He also indicated that it was not his responsibility to call a marine chemist, but that of the master or the port captain. In his opinion the anchorage was not "in port," even though not at sea.

120. Captain [redacted], a British master with 24 years sailing experience, 18 years on tankers, testified before the Marine Board at the request of OMI Corporation. His testimony discussed three methods of cleaning gasoline tanks. The first two methods involve use of fixed or portable tank cleaning machines and rely on high pressure water to wash the tank. The third method is to flood the tank with water and overflow it on to the deck. Captain [redacted] indicated this method should only be used for cargoes such as gasoline when there is negligible clingage and very low quantities of cargo remaining on board. Captain [redacted] also testified that overflowing is a safe method for gas freeing a gasoline tank. This is accomplished by displacing

the gasoline vapors with inert gas or water, venting the gasoline vapors out through the tank openings. He indicated that once the tank in COMPLETELY full (emphasis added) of water, it should be overflowed to ensure it is absolutely filled with water. Using simple geometry Captain [redacted] indicated that the amount of cargo remaining in the 5P cargo tank after discharge at Tampa could have been as much as 1.1 barrels. This is based on the trim of the vessel, the tank dimensions, and location of the stripping suction. A similar amount of cargo would have remained in 5S because the tank dimensions and stripping line geometry are similar. Similarly, with the slight trim by the stern, and with only the hatch cover open, there may have been a small wedge of air trapped in the forward portion of the cargo tanks as the tanks were overflowed. He calculated that the volume of such a wedge may have been about 729 cubic feet.

121. In his own experience Captain [redacted] always opened all butterworths and hatch covers when overflowing tanks. His concern was to ensure all the oxygen was removed from the tank to reduce the effects of corrosion. He was also concerned about the pressure build up under the deck if flow was restricted. He testified he never used this method to clean and gas free a tank prior to hot work, as he never had to make hot work repairs while underway.

122. Mr. [redacted], a certified marine chemist called by the Marine Board, testified about tank cleaning, gas freeing and tank testing practices. Marine Chemists are guided by the standards laid out in NFPA 306, "Standard for the Control of Gas Hazards on Vessels." In his experience some tanks have effectively been gas freed by simply blowing down, while others required extensive washing. In his opinion, the method of cleaning and gas freeing a tank depends on the characteristics of the last cargoes carried and the condition of the tank. Mr. [redacted] testified that he normally does not know, nor does it matter, how a certain tank was cleaned, as long as it passed his inspection.

123. Mr. [redacted] testified that the tests and inspections he performs to certify a space for hot work include testing the atmosphere for oxygen (20.8%), Lower Explosive Limit (0% even though NFPA 306 only requires less than 10%), and toxicity. He also performs a physical inspection looking for cargo residues or scale, which could allow gases to regenerate in a confined space. Finally, when issuing a hot work permit, he requires fire protection be provided (a fire watch) and forced mechanical ventilation.

124. Mr. [redacted] testified that gasoline vapors are heavier than air and tend to stratify in the lower portions of a tank. When asked about a tank scenario similar to the 5P cargo tank on the OMI CHARGER, Mr. [redacted] testified he would test with his meter at the lowest portion of the tank, and would look at and feel the water for signs of gasoline floating on top. He indicated it would be relatively easy to detect. The odor threshold of gasoline is much lower than the lower explosive limit, so even if the meter was registering zero %LEL, you might still smell it. He cautioned that the nose is not a good indicator of LEL or toxicity. However, his inspection would not stop there. He would also check other portions of the tank for residual cargo that might later regenerate vapors. If other parts of the tank were inaccessible he would drop a hose through one of the butterworth openings in the forward portion of the tank. He indicated he would also require ventilation to reduce the possibility of gas regeneration from cargo residue. Mr. [redacted] indicated that it would take at least 15 to 20 minutes to adequately test a space the size as 5P cargo tank.

125. Mr. [redacted] testified that in his opinion the practice of overflowing the tanks to flush them of residual and vapor is not very effective, especially if the vessel has a drag on. This is due to the possibility of trapping some product under the deck and the reduced agitation caused by "short circulating." This is a particular problem when only one tank opening is used as an outlet for the water. The water tends to flow in a path of least resistance, directly from the inlet at the bottom to that opening.

126. The Chemical Data Guide, 1990, COMDTINST M16616.6A, indicates the odor threshold for gasoline is 0.25 parts per million by volume in air. This is the smallest concentration that can be detected by smell by most people. This is not an absolute value. It varies among individuals and from day to day, for any one person. The odor of a potentially dangerous vapor may be hidden by another odor. In addition, certain vapors are likely to produce olfactory fatigue, which is deadening of the sense of smell. Therefore the sense of smell alone is not reliable as an indicator of the presence or absence of a particular vapor.

127. The mate testified that when the OMI CHARGER entered the shipyard, just a month earlier, he accompanied the marine chemist during the tank testing. He testified that the marine chemist did not sample multiple locations in each tank, but only from the ullage at the tank trunk. He indicated that his own testing of 5P cargo tank was consistent with that done by the marine chemist at the yard.

128. The chief mate had overflowed tanks in preparation for entering the shipyard. The 3P, 3C, 3S and 5P, 5C, 5S cargo tanks were cleaned prior the entering the shipyard by overflowing. Prior to the voyage entering the shipyard, the master and Mr. [redacted] discussed the possibility of cleaning certain tanks by overflowing and reached consensus that overflowing was an acceptable method to clean these tanks. The chief mate testified that the tanks were tested by a marine chemist upon arriving at the shipyard and tested safe except for the benzene content. Benzene concentration was above the allowable limits, but the LEL and oxygen levels tested satisfactorily.

129. The vessel was drydocked for a Coast Guard and ABS credit dry dock examination at Atlantic Marine Shipyard in Mobile, Alabama, from September 6 to September 28, 1993, a total of 22 days. The yard period was originally scheduled only for 16 days. Scheduled repairs during this yard period included hull painting, anchor chain work, rudder work, pumproom piping repairs and valve replacements, saddle tanks steel renewal, cargo tank repairs, deck and windlass repair, and boilers surveys. The entire cargo block area, including forepeak, cargo tanks, saddle tanks, and afterpeak were entered and examined by inspectors from the Coast Guard Marine Safety Office in Mobile, Alabama, and/or the local surveyors from the American Bureau of Shipping (ABS) in Mobile, Alabama, and all were found to be in satisfactory condition. Both the USCG and ABS credited the vessel with meeting their requirements. The previous drydock was on September 12, 1991.

PORT SADDLE TANK

130. The majority of the shipyard work in the saddle tanks was intended to repair leaks in the floor which were leaking into the pumproom below. Steel was being replaced also, in the after bulkhead between the saddle tank and the engine room. (Much attention was paid these areas during the shipyard period.) Shipyard workers were left on board as the vessel departed the shipyard to finish welding on these repairs. They were taken off the vessel as she departed the sea buoy enroute Texas City. Other, more routine, work was also accomplished inside the port saddle tank, while the vessel was in the shipyard. However, hydro testing of bulkheads and welds was accomplished to prove the work in the floors and bulkheads between the saddle tank and either the pumproom or the engine room, but not on the bulkhead between the saddle tank and the cargo tanks.

131. Several side shell longitudinal stiffeners were wasted and marked for renewal. Mr. [redacted] and the shipyard leaderman, Mr. [redacted] accompanied the ABS surveyor, Mr. [redacted] during the inspection of the saddle tank. The Coast Guard was not in attendance for this inspection. Mr [redacted] and Mr. [redacted] had a discussion regarding the correct way to repair the wasted longitudinals. Mr. [redacted] indicated that the longitudinals were continuous,

meaning they passed through the bulkhead. He recommended that they be inserted, as original. Mr.[redacted] wanted only to crop them flush at the bulkhead and use a "landing plate" on the renewed angles. Mr.[redacted] testified that he told Mr.[redacted] that similar repairs had previously failed on another ship, but Mr.[redacted] insisted on cropping them at the bulkhead. Inserting the angles would have required costly staging and work to be accomplished also in the 5P cargo tank on the other side of the bulkhead. M[redacted] recommendation avoided that.

132. Mr.[redacted] of ABS testified that repairs in the port saddle tank included a "landing plate" which brought the longitudinal and the bulkhead closer together since the longitudinal did not run through the bulkhead. Mr.[redacted] agreed with and accepted the method of repair which Mr. [redacted] proposed. Mr.[redacted] stated that he had no concerns related to the strength of this type repair because of a combination of the location, the fact adjacent longitudinals were still in good condition and did not require repair, and the longitudinals themselves did not add strength to the bulkhead, but to the sideshell. He had observed "landing plates" used before, though mostly on tank tops, not on oil tight bulkheads. He did not have a concern related to putting the "landing plate" on the bulkhead because he did not believe the integrity of the bulkhead was in question. This particular area was not tested, except a visual inspection was made after the longitudinal was repaired. Mr.[redacted] testified that he approved the repair method on the spot, and did not consult with his office, or the Coast Guard.

Photo 11, "Landing Plate"

133. Mr. [redacted] testified that he did not visually inspect the bulkhead between the time the longitudinal angle was removed and the time the 8" X 12" "landing plate" was attached. He indicated that although the saddle tank was hydrostatically tested after all repairs in the tank, no one checked the forward bulkhead in way of the "landing plates" because the welds were fillet welds which should have only penetrated the bulkhead from 1½ to 2 millimeters.

134. Mr. [redacted] testified that while the longitudinal stiffener was being cut from the side shell and transverse bulkhead, a small hole was inadvertently cut through the side shell. The hole was rewelded.

135. Gaugings conducted by Reid Ultrasonics for OMI in June 1991, indicated bulkhead at frame 49 had wastage between 4 and 28 percent, with an average gauging near the location where the doubler was later attached, of 25 percent. Post casualty gaugings conducted for this investigation revealed approximately 33 percent wastage in this location.

136. ABS reports dated May 1992 and August 1993 recommended "the port and starboard aft ballast (saddle) tanks be further examined and comprehensively gauged to the satisfaction of the attending surveyor, prior to the completion of the next drydocking survey."

137. There is no evidence in the ABS report of 27 September 1993 that gaugings of bulkhead 49 were accomplished at the drydocking in September 1993.

138. The ABS report states that the port ballast – aft tank was opened out, cleaned, internally examined including sounding tubes, striking plates, and found in satisfactory condition.

139. The ABS report describes repairs made to the "Port and Starboard Ballast Tanks – Aft" as "cropped out and renewed side shell longitudinal and end brackets as found necessary due to local wastage."

140. ABS responded by letter to several questions from NTSB regarding their policies. ABS indicated that their policy is that surveyors are expected to rely on their "judgement, training, and

experience when carrying out repair surveys." With respect to requirements for testing oil tight bulkheads to ensure they were oil tight after repair of intercostal longitudinals or installation of "landing plates," ABS wrote that a hydrotest or approved alternative test should be performed in either case. ABS policy regarding gauging and monitoring bulkheads common to ballast and cargo tanks requires special attention be paid to these areas because they are unprotected saltwater ballast tanks, one of several suspect areas, and are prone to rapid wastage or excessive corrosion.

141. The Coast Guard issued a requirement (CG–835) on 29 November 1991 which stated: "Permanent repairs are required to the port and starboard saddle tanks. Present gaugings to detail amount of plate wastage and renewal. The saddle tanks are to remain dry and not utilized until permanent repairs are completed at the next credit drydock, but no later than 30 November 1994."

142. The requirement was cleared as a result of the drydock exam in September 1993, however there is no evidence in the Coast Guard report that gaugings of bulkhead 49 were accomplished at that time.

143. Repair guidance in Navigation and Vessel Inspection Circular No. 7–68 (NVIC 7–68) allows for wastage of transverse bulkheads in a tankship of up to 35%, provided there is no evidence of deformation when subjected to a hydrostatic test.

144. Guidance in NVIC 7–68 indicates that when a doubler is attached to deficient plating, its very presence creates a discontinuity which may induce rather than prevent a structural failure. Furthermore, the interface between a doubler and a cargo tank bulkhead plate beneath can constitute a gas pocket which is inaccessible to gas freeing operations. "Doublers should not be permitted in such locations except as detailed on approved plans."

145. Undercutting in fillet welds near or at the end of discontinuous longitudinal members such as tanker longitudinal members has contributed to complete hull girder fractures.

146. Repair measures in Navigation and Vessel Inspection Circular No. 7–68 are considered general principles rather than specific "rules" to rigidly enforce in all cases.

VOYAGE REPAIRS

147. Originally, when only the two leaks were known to exist in the 5C cargo tank, the master considered repairing them temporarily by a "cold patch" method, not involving hot work. However, once the third leak was discovered and Mr. [redacted]visited the ship in Tampa, a decision was made to effect repairs by using hot work.

148. The Coast Guard was not notified of the leaks while the vessel lay loading at Texas City. The Coast Guard boarded the vessel for a routine safety check while it was in Tampa, but information regarding the cargo tank leaks, or the planned repairs, was not communicated to the Coast Guard inspector.

149. The master testified that he did not consider the leaks to be a "class" problem, and temporary repairs did not, in his opinion, warrant calling either the Coast Guard or the ABS.

POLLUTION

150. The Marine Board heard testimony that dirty ballast was discharged to the sea at the times indicated below. The approximate location corresponding to these times was obtained from the bridge log. These discharges were not logged in either the bridge log book nor the oil record book.

Date	Time	Tanks	Location	Operation
10/08/93	0515–0700	3P,3C,3S, 5P,5S	27–40N 84–46W	Overflowed
10/09/93	0600–1100	5P,5S	28–13.5N 92–53W	Lowered level to 36' ullage
10/09/93	1030	P saddle	28–13.5N 92–53W	Emptied dirty tank washings

RESCUE OPS

151. Immediately after the explosion, the master ran to the bridge to assess the situation and contacted the Coast Guard for assistance. Fearing subsequent explosions he ordered all hands, except five officers and a deck cadet, to abandon ship.

152. The starboard lifeboat could not be used since its gravity davit could not be swung out far enough due to the ship's list to port. The master abandoned the idea of putting over the port lifeboat because of the proximity of the fire on the port side.

153. The master and chief officer searched the house to ensure that everyone was out and told them to muster on the fantail. They also searched unsuccessfully for the missing welder and his fire watchman.

154. Several vessels in the vicinity responded to the MAYDAY in spite of the danger of further explosions. The first rescue vessel, the crewboat TIM McCALL, arrived on scene at approximately 2015, about 15 minutes after the initial explosion. Other vessels, including the Coast Guard, arrived and began searching the waters around the OMI CHARGER for missing persons. Some vessels started pouring water onto the flames, while the crewboat TIM McCALL took 27 officers and crew off the fantail.

155. One of the crewmen taken on board the TIM McCALL was the chief pumpman, Mr. Milton Williams, who was found by the chief mate severely injured, laying on a pipeline just inboard of No. 5P cargo tank. He was carried off the OMI CHARGER on a stretcher, to the crewboat TIM MCCALL. He was later pronounced dead at 2100 on the same date.

156. At about 2053 the pilot boat GALTEX embarked the master and 6 officers, after their failed attempt to locate the missing welder and fire watchman.

157. At approximately 2100 a second explosion occurred and the fire continued to burn on deck at the port cargo manifold, and in the Nos. 4P, 5P, 5C and 5S cargo tanks. At about the same time, the ocean going tug TALLAHASSEE BAY arrived on scene and attacked the fire with water, and then later with AFFF foam, from the starboard side, using the OMI CHARGER deck house as a shield against the intense heat. The master of the M/V TALLAHASSEE BAY, Captain [redacted] also directed the efforts of the other vessels already on scene, to coordinate the overall fire fighting endeavor. The fire was extinguished at about 0120 on the morning of 10 October 1993.

158. Divers located the remains of the welder, Mr. Kelly and his assistant Mr. Boutwell, on Monday and Tuesday, October 11 and 12 respectively. Mr. Kelly's body was found caught in a

Jacob's ladder in the port saddle tank just above the water. Mr. Boutwell's body was found submerged below the water in the port saddle tank.

159. Mr. [redacted] the second pumpman, later testified that he and another AB considered running a hose to fight the fire, but decided against it due to the fire's size and the master's orders to abandon ship.

<u>POST ACCIDENT TESTING</u>

160. Autopsies were conducted on the remains of the 3 fatalities by the Galveston County Medical Examiner. Based on the examination, death certificates were issued for the pumpman, Mr. Williams, the welder, Mr. Kelly and his assistant Mr. Boutwell.

161. The NTSB Materials Laboratory Division examined two sections of steel cut from the immediate area surrounding the "landing" plate which was being welded when the explosion occurred. The first section (about 6' X 2') was taken from the blown away side shell plate recovered from the bottom of the anchorage. This section had a small piece of the transverse bulkhead that separated the 5P cargo tank from the port saddle tank still attached. The other section examined was the mating section of transverse bulkhead removed from the OMI CHARGER.

NTSB Report Figure 1

NTSB Report Figure 2

NTSB Report Figure 3

162. The surface of the hull plating, longitudinals, and transverse bulkhead within the cargo tank were painted while the surfaces in the ballast tank were bare. Visual examination revealed severe surface corrosion on all surfaces that were not covered by paint. On the transverse bulkhead, general surface corrosion had reduced the plating's original nominal thickness from 0.5 inches, as measured at the hull weld, to values between 0.25 and 0.4 inches.

163. The "landing plate" and attachment welds were closely examined. The upper weld showed that the "landing plate" had been originally installed with a large gap (about 0.25") between it and the bulkhead at the top edge. During installation, the gap was partially filled with weld metal.

Photo 12, Gap behind "Landing Plate"

164. Almost the entire length of the weld bead on the top of the "landing plate" was accompanied by severe undercutting into the bulkhead material and moderate undercutting into the "landing plate". In at least one location, the undercutting reduced the bulkhead thickness by more than 70%. One metallographic section uncovered an area of weld where the fusion zone penetrated through the full thickness of the bulkhead.

NTSB Report Figure 6

NTSB Report Figure 8

NTSB Report Figure 9

165. The inboard, mating section of transverse bulkhead was examined and ultrasonic thickness measurement taken in three general locations: one at the same vertical level as the "landing plate"; a second location about two feet below the first; and the third directly above the "landing plate". The results indicated this portion of bulkhead plate had an average thickness of only 0.225 inches. Based on an original thickness of 7/16 (0.4375) inches, the average wastage was 49%.

166. On June 17, 1994, on board the OMI CHARGER, thickness gaugings were taken on the second strake of the transverse bulkhead at frame 49. This area was in the same general location as the sections sent to the NTSB lab. These gaugings revealed wastage, based on the original thickness of 7/16 inch plate, of between 22% and 47%.

167. Title 46, Code of Federal Regulations (CFR), Subpart 35.01-1(c)(1) states that the inspections and testing required when making repairs involving welding shall be performed by a marine chemist certified by the National Fire Protection Association when such repairs are made in port.

168. "Port" is defined in the regulations at Title 33 CFR, Subpart 160.023, and means "a port or place in which a vessel is anchored or moored". This definition is provided in the context of required notifications of arrivals and departures.

ANALYSIS

TANK CLEANING, GAS FREEING, TANK TESTING

1. The hot work on the OMI CHARGER was performed to repair three separate leaks. Two of the leaks were between the 5C cargo tank and the pumproom, the third between the 5P cargo tank and the port saddle tank. The leaks between 5C and the pumproom were repaired by hot work performed in the 5C. The third leak, 5P, was to be repaired by hot work in the port saddle tank. For comparison, the three leaks could be considered to be in only two locations: 5C and the port saddle tank.

2. The company (OMI) policy requires spaces where hot work is to be performed be adequately cleaned, gas freed and inspected, prior to the commencement of hot work. Spaces adjacent to hot work are also required to be properly prepared prior to start of hot work.

3. Spaces adjacent to the 5C tank include 4C, 4P, 4S, 5P, 5S, and the pumproom. Spaces adjacent to the port saddle tank include the pumproom, 5P cargo tank and the engine room (aft).

4. Cleaning in 5C was accomplished by butterworth and hand washing. The port saddle tank was washed and mucked out by hand.

5. To repair the first two leaks in 5C, the adjacent tanks were prepared as follows:

> 4C was the slop tank and was inerted to 4% oxygen,
>
> The pumproom was butterworthed and hand washed, and ventilated, and
>
> The 5P and 5S cargo tanks were completely full with ballast.

6. In preparation for hot work in the port saddle tank:

> The pumproom remained clean and ventilated from the prior day.
>
> The ballast water in 5P was lowered to a level well below location of the repair in the port saddle tank. Though not adjacent, ballast in 5S was lowered to keep the vessel on an even keel. The 5P cargo tank was not ventilated, but was closed, except when the mate entered to test with the combination gas/oxygen meter.

7. The mate indicated that when he tested the 5C, the pumproom, and the saddle tank with the meter, he did so in several locations in each space. In testing the 5P cargo tank, he only tested at one vertical location, down the ladder, since the tank contained ballast water and was otherwise inaccessible from below.

8. The master followed the company's policy as written in the Fleet Standing Orders, Section 5.6.1, on cleaning and gas freeing of adjacent tanks prior to hot work which allowed for completely filling the adjacent tank with ballast water. NFPA 306, paragraph 2–3.7(b) also allows for flooding with water. However, the master deviated from company policy when he allowed the ballast water to be pumped down without properly ensuring the gas free condition in the tank using the guidance provided in section 5.4.2, which requires sampling at several openings and various levels to ensure full representation of the tank atmosphere is obtained. Furthermore, NFPA 306, paragraph 2–3.7(b) requires that the hot work be performed at least 3 ft below the level of the water and that the gas content of the atmosphere above the water does not exceed 10 percent of the lower explosive limit.

9. The master seemed to understand the company's policy and regulatory requirements regarding when a marine chemist should be called. He even indicated that when in port he would not have any discretion in whether or not a marine chemist would be called. He further indicated that the anchorage was considered "in port." However, no chemist was called because they had originally planned to have the repairs completed prior to arrival at Galveston.

OVERFLOW/WEDGE

10. Considerable testimony was heard by the Marine Board regarding the overflowing of the 5P and 5S cargo tanks, and the efficiency of this method to completely clean and gas free a tank. Aside from the fact that overflowing was a violation of the vessel's conditions of operation stipulated on the Certificate of Inspection, testimony was heard that supported both sides of the issue regarding whether overflowing is adequate. In some cases, it was argued, overflowing might be sufficient to clean and gas free a tank. In this case the Marine Board believes it was not.

11. Captain [redacted] indicated that in the worst case there may have been as much as 1.1 barrels of gasoline remaining in the 5P cargo tank after discharge and stripping. This was based on the simple geometry inside the tank, the trim of the vessel, and applying a "wedge" formula to determine the volume of liquid remaining after the stripping line lost suction. Captain [redacted] calculations indicated that in the worst case, considering all of the 1.1 barrels of liquid cargo remaining on board vaporized and was contained in a wedge of air at the forward, top of the tank when pressed full, that after the water level was lowered, the concentration of gas would be only 0.9% by volume, which is below the lower explosive limit of 1.4%.

12. Calculations performed by the NTSB, working backward from the volume of vapor space in 5P cargo tank indicate that an explosive mixture would have existed if between 21 to 121 gallons of gasoline had vaporized in the tank. The 1.1 barrels of liquid Captain [redacted] calculated is equivalent to 46.2 gallons.

13. Both calculations were performed assuming an ideal case, one showing an explosive mixture could not have existed, one showing it could, based on only 46 gallons of gasoline remaining in the tank.

14. In as much as the tank exploded, an explosive mixture, in fact, did exist. Less than ideal conditions existed on the OMI CHARGER. With the trim by the stern and no butterworth covers open, a wedge of vapor may well have been trapped under the deck in the forward portion of the tank. The deep transverse web frames would have acted as baffles to prevent much of the vapor from naturally migrating aft to the open tank hatch. Considering that both the tank opening and cargo line in which ballast water was entering are located in the after third of the cargo tank length, a "short circuit" effect (direct flow from the inlet to hatch opening) may have limited the effectiveness of the overflowing.

SHIPYARD REPAIRS

15. The repair involving the side shell longitudinals in the port saddle tank was considered to be rather minor compared to the extensive renewals going on in that tank. The vessel had experienced extensive problems in that tank in the past and had an outstanding requirement issued by the Coast Guard to refrain from carrying ballast in that tank until permanent repairs were made. Considerable work was planned to make the repairs necessary so that ballast could once again be carried.

16. The side shell longitudinals in way of this area of the vessel were originally continuous through the bulkhead between the saddle tank and the 5P cargo tank. Replacing them as original

would have required additional work inside the 5P tank at considerable added expense. Strength was not considered important because of the combination of the location of the repair, the fact that adjacent longitudinals were still in good condition and did not require repair, and the longitudinals themselves did not add strength to the bulkhead, but to the sideshell. Using this same reasoning, the three longitudinal angles in the port saddle tank could have been sniped back at a 45 degree angle and left without attaching them to the bulkhead. At least one side longitudinal appeared to have been previously repaired in this manner in the starboard saddle tank.

17. Though both the Coast Guard and ABS had previously required gaugings to be performed in the saddle tank, there is no indication that they were done while the ship was in the yard. Given the extensive repairs in the saddle tanks involving plate renewal on the engine room and pump room bulkheads, it is likely that neither the Coast Guard nor ABS insisted that the gaugings actually be performed.

18. Though the longitudinal repairs were relatively small in comparison to other work in the tank, the method of repair was not good marine practice. Since the longitudinals had originally passed through the bulkhead, the integrity of the bulkhead itself was affected by washing the longitudinal flush on the saddle tank side. Mr. [redacted] indicated that while removing the longitudinal a small hole was inadvertently cut through the side shell. This should have been cause for concern to determine that integrity of the bulkhead was not also compromised during the repair.

VOYAGE REPAIRS

19. No attempt was made by the master or company representative to inform the Coast Guard about the leaks in the cargo tank bulkheads. While "cold work" is normally considered temporary in nature, as soon as "hot work" was considered, the Coast Guard and/or ABS should have been informed. It is very likely that had the Coast Guard been informed, an inspector would have issued a requirement to effect "permanent" repairs prior to carrying cargo in the affected tanks. This most likely would have had a negative affect on the vessel's ability to meet charter provisions regarding the quantity of cargo to be delivered on each voyage. Having just come from the shipyard, the vessel was back on charter and was expected to fully perform.

20. The vessel's crew was probably not qualified to permanently repair the leaks without assistance from an outside contractor. First repairs were accomplished by use of temporary, epoxy patches, which only slowed down the leaks. Since welders were already aboard the vessel, a decision was made to take advantage of this expertise to make permanent repairs.

21. Though the chief mate testified they had done repairs previously, these repairs were not routine. The mate indicated they had done hot work to repair some ladder hand rails in one of the cargo tanks.

22. The fact that these repairs affected the integrity of the cargo envelope in combination with the hot work method used to make the repair, certainly implies they intended these repairs to be "permanent."

23. The Marine Board considered the possibility that combustible vapors entered the saddle tank or 5P cargo tank after the atmosphere was tested by the chief mate at 1505. If this were the case, there are three possible sources: through the cargo pipelines, through the inert gas pipeline, or via one of the adjacent spaces.

24. Cargo evidently remained in portions of the cargo pipelines since the fire burned at the manifold for about 5½ hours after the initial explosion. The cargo lines were cross connected,

through a special fitting at the manifold, and through crossovers in the pumproom. The underway replenishment line was cross connected to the cargo line serving the 5's across and was known to leak. However, the cargo drop lines, between the pipelines on deck and the pipelines at the bottom of the cargo tanks, had been purged with water. The cargo line to 5P (and 5S) was used to ballast the tank during the overflow of these tanks, and the bottom cargo lines remained packed with water. After the water level was dropped in 5P (and 5S), there were no other operations involving the cargo line and 14 feet of water remained covering the cargo suction.

25. The pumpman was given permission by the chief mate to slip (remove) the blind (blank) flange on the inert gas system that isolated the 5C cargo tank at about 1920, but the inert gas valve on the 5P and 5S tanks were still closed after the explosion.

26. The only adjacent tanks from which vapors could enter 5P were 4P or 4C. The 5C tank was still clean and gas free from the repairs the day before. 4C cargo tank, located diagonally, was used for slops and had about 43 feet ullage; 4P was empty; and the 4's across were inerted. For a leak to exist between either of these tanks and the 5P cargo tank, there would have had to be a fracture between them. It is unlikely that liquid cargo or slops would have leaked into 5P, since 4P was empty, and level in the 4C slop tank was lower than the water level in 5P. Also since the 4C slop tank and 5P are diagonal from on another, it is unlikely a leak would develop through the intersection at both bulkhead plates. The vessel was just out of the shipyard, where all tank coating had been inspected and found to be in good condition.

27. Although the 5S cargo tank was not adjacent to the saddle tank where hot work was going on, it was treated and prepared in a manner similar to 5P. Both tanks were discharged of cargo and stripped at Tampa, overflowed, left pressed full for the repair in 5C, and partially emptied in preparation for work in the saddle tank. Ruling out vapor intrusion from an outside source, the atmospheric conditions in both the 5P and 5S would be expected to be about the same. The initial explosion took place in 5P, most likely ignited by the welding taking place in the saddle tank. An hour later a second explosion of similar magnitude took place in the 5S. These factors all taken together lead the Marine Board to conclude that the 5P (and 5S) cargo tank was never adequately gas free.

CONCLUSIONS

1. The apparent cause of this casualty was the ignition of explosive gasoline vapors in the No. 5 port cargo tank. The source of ignition was a welder's arc in the adjacent port saddle ballast tank which undercut into the common transverse bulkhead.

2. Contributing to the cause was the failure to properly gas free the No. 5 port cargo tank.

3. Contributing to the cause was the failure of shipboard personnel to detect the presence of explosive vapors in the No. 5 port cargo tank.

4. Contributing to the cause was complacency and failure to assess risk on the part of the master and chief mate, in that they improperly followed established procedures for gas freeing and tank testing.

5. Contributing to the cause was the inappropriate use of a "landing plate" or doubler to repair the port side shell longitudinal, which originally passed through the forward bulkhead of the port saddle tank. The use of doublers or "landing plates" on cargo tank bulkheads is not appropriate nor consistent with good marine practice.(NVIC 7-68, 130)

6. Also contributing to the cause was the decision of the master, chief mate, and owner's representative to stop a leak of questionable origin, by fillet welding around the improperly installed doubler plate.

7. It is a conclusion of this investigation that the oxygen detector was properly calibrated and operating satisfactorily when used to test No. 5 port cargo tank and the port saddle tank on the afternoon of the day of the explosion.

8. It is a conclusion of this investigation that an explosive atmosphere existed in the No. 5 port cargo tank, resulting from gasoline cargo residue and clingage.

9. It is also a conclusion that a similar atmosphere existed in the No. 5 starboard cargo tank.

10. This casualty has shown that "overflowing" did not adequately displace the cargo residues from the No. 5 port and starboard cargo tanks and is not good marine practice. Additionally, deballasting without inerting the No. 5 cargo tanks prior to the welding negated any benefit that may have resulted from "overflowing" those tanks with water.

11. The use of a certified marine chemist, required by regulation because of the vessel's location, would have been consistent with good marine practice. A certified marine chemist may have detected the explosive atmosphere in the No. 5 port cargo tank.

12. Use of inert gas in the vapor space or forced ventilation of the No. 5 port cargo tank may have prevented the explosion by replacing the explosive atmosphere.

13. The guidance provided in the OMI Standing Orders for gas freeing, was misinterpreted by the master and chief mate to allow "overflowing."

14. It is a conclusion of this investigation that certain areas of the bulkhead at frame 49 were significantly wasted, particularly in way of and near the location of the doubler. Although averaged readings appear to be within published guidelines, individual readings are significantly outside those parameters.

15. All deaths and injuries aboard the OMI CHARGER on the date of the incident were a result of the explosion.

16. There is evidence of violation of Title 46 U.S.C. 3315 on the part of the master and chief mate for failure to notify the Coast Guard marine inspector of the leaking cargo tank bulkheads when the vessel was boarded in Tampa, Fla.

17. There is evidence of violation of Title 46 U.S.C. 3306(a)(4), on the part of the master of the OMI CHARGER, for failure to have the proper inspections and testing performed by a certified marine chemist prior to conducting welding repairs in port, for failure to properly log that the tests and inspections were performed by shipboard personnel, and for failure to perform repairs under the direction of the Coast Guard Officer in Charge, Marine Inspection. These matters have been forwarded to the Commander, Eighth Coast Guard District for further investigation.

18. There is evidence of violation of Title 46 U.S.C. 3313, on the part of the master of the OMI CHARGER, for failure to comply with the provisions of the Certificate of Inspection. This matter has been forwarded to the Commander, Eighth Coast Guard District for further investigation.

19. There is evidence of violation of Title 33 U.S.C. 1321(b)(3), discharge of oil, on the part of the master of the OMI CHARGER. This matter has been forwarded to the Commander, Eighth Coast Guard District for further investigation.

20. There is evidence of violation of Title U.S.C. 1321(b)(5), reporting requirements of discharge, on the part of the master of the OMI CHARGER. This matter has been forwarded to the Commander, Eighth Coast Guard District for further investigation.

21. There is evidence of violation of Title 33 Code of Federal Regulation Part 151.25 (e)(4)-(6), (10) and (h), failure to ensure maintenance of the ship's Oil Record Book on the part of the master of the OMI CHARGER. This matter has been forwarded to the Commander, Eighth Coast Guard District for further investigation.

22. There is evidence of misconduct and negligence, on the part of the Chief Officer of the OMI CHARGER, for violation of the OMI Standing Orders with regards to entering cargo tanks without a standby and with regards to not testing the No. 5 port cargo tank from multiple openings. These matters have been forwarded to the Commander, Eighth Coast Guard District for further investigation.

23. With the above exceptions, 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 personnel; nor evidence that failure of inspected material or equipment, nor evidence that any personnel of the Coast Guard or of any other federal agency, or any other person, nor evidence that the use alcohol or drugs, contributed to this casualty.

RECOMMENDATIONS

1. This casualty reemphasizes the inappropriate use of doublers for cargo tank repairs. It is recommended that all Coast Guard marine inspectors be reminded of the criticality of following Coast Guard guidance provided in NVIC 7-68 regarding the use of doublers, particularly in way of cargo tank boundaries. Additionally this information should be widely disseminated to class society surveyors and marine industry personnel involved with such repairs.

2. In as much as uncoated ballast tank boundary bulkheads are a high corrosion area it is recommended that detailed inspections with gaugings be required periodically in conjunction with dry docking or ABS special surveys.

3. Because of the potential serious consequences of cargo boundary leaks, it is recommended that such failures be required to be reported to the Coast Guard prior to their repair.

4. In as much as testimony indicated that OMI's Fleet Standing Orders were misinterpreted, it is recommended that OMI Corporation, and other tanker operating companies, establish procedures, including formal training, for shipboard personnel who, in the absence of a certified marine chemist, may be called upon to approve hot work.

5. It is recommended that wide dissemination be given to the dangers associated with "overflowing" tanks as a means of gas freeing. As this incident demonstrates, "overflowing" may not rid a tank of all combustible vapors . At best, this practice is a violation of the pollution prevention regulations.

6. It is recommended that other vessels of similar age, service and construction be examined for the presence of doublers and wastage where side shell longitudinals originally passed through cargo tank bulkheads. Operators of similar vessels operating under specific trade exemptions allowed by 33 CFR 157.300 should examine their operating procedures to ensure that inappropriate practices such as "overflowing" are not being condoned.

7. That [redacted] captain of the crewboat TIM MCCALL and his crew be commended for their fearless rescue of 27 persons from the OMI CHARGER.

8. That [redacted] captain of the GAL-TEX and his crew be commended for their fearless rescue of 6 persons from the OMI CHARGER.

9. That [redacted], captain of the TALLAHASSEE BAY and his crew be commended for their valiant efforts in leading the fire fighting efforts to extinguish the fire aboard the OMI CHARGER.

10. That copies of this report be given wide dissemination throughout the tank vessel industry and be provided to the International Maritime Organization, Nautical Institute, tanker operating companies, maritime schools and training facilities, publishers of the International Safety Guide for Oil Tankers and Terminals (ISGOTT), the American Bureau of Shipping and the National Transportation Safety Board. Training programs for seamen whose responsibilities include testing spaces for hazardous atmospheres should be reviewed.

11. That this investigation be closed.

[redacted]

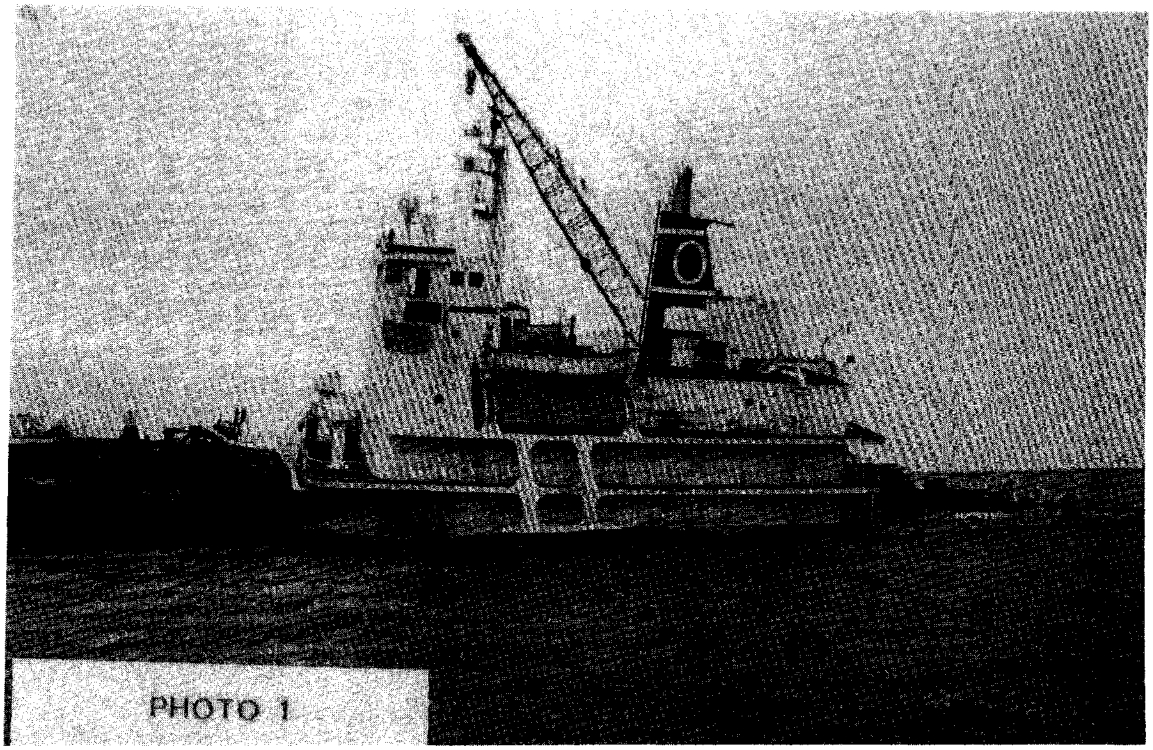
T. DALEY
CAPTAIN, U.S. COAST GUARD
CHAIRMAN

[redacted]

M. M. ASHDOWN
COMMANDER, U.S. COAST GUARD
MEMBER

[redacted]

M.D. RUSSELL
LIEUTENANT COMMANDER, U.S. COAST GUARD
MEMBER AND RECORDER



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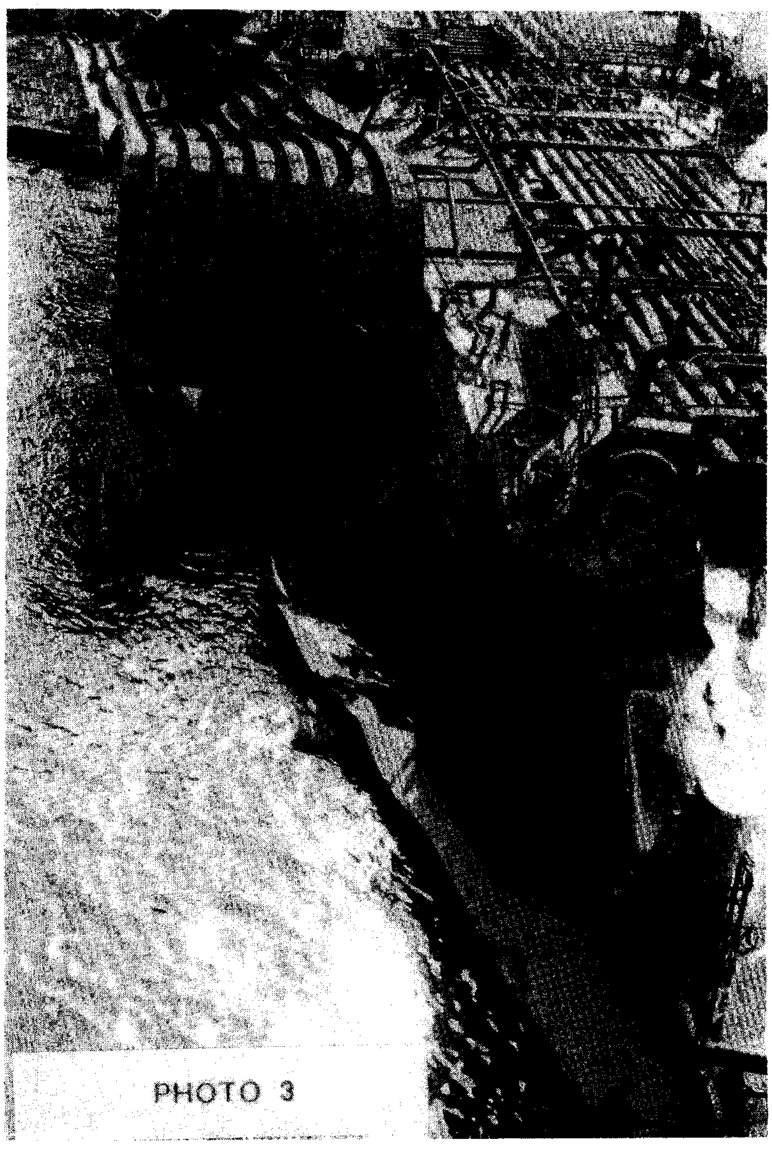

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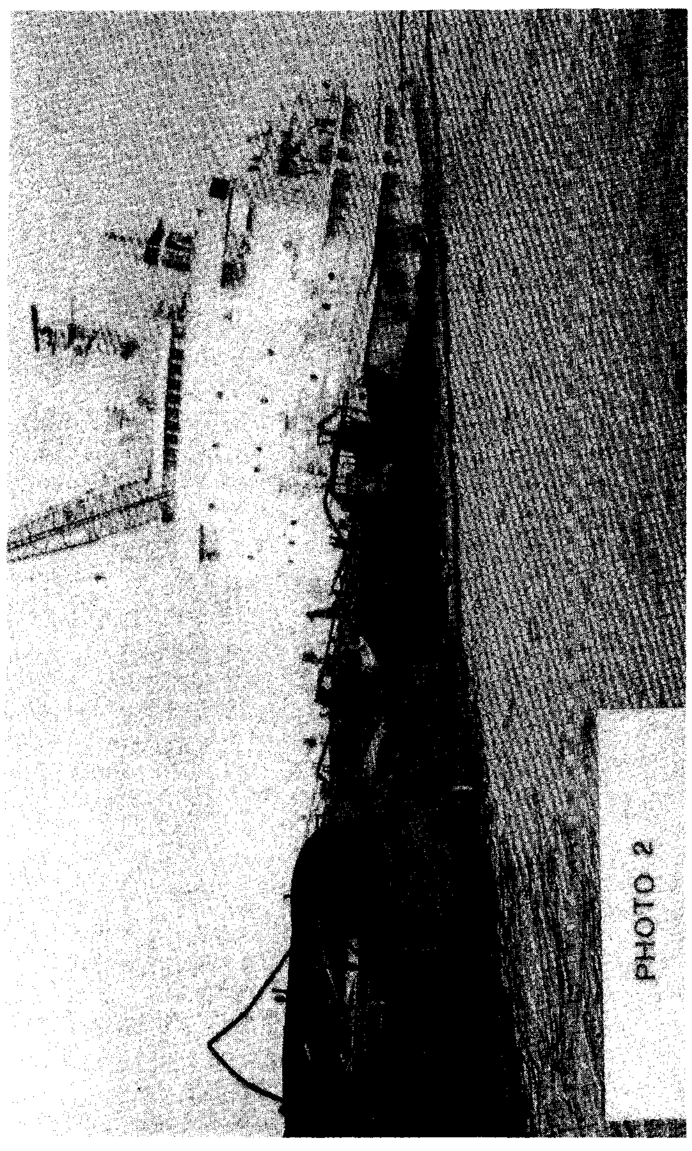

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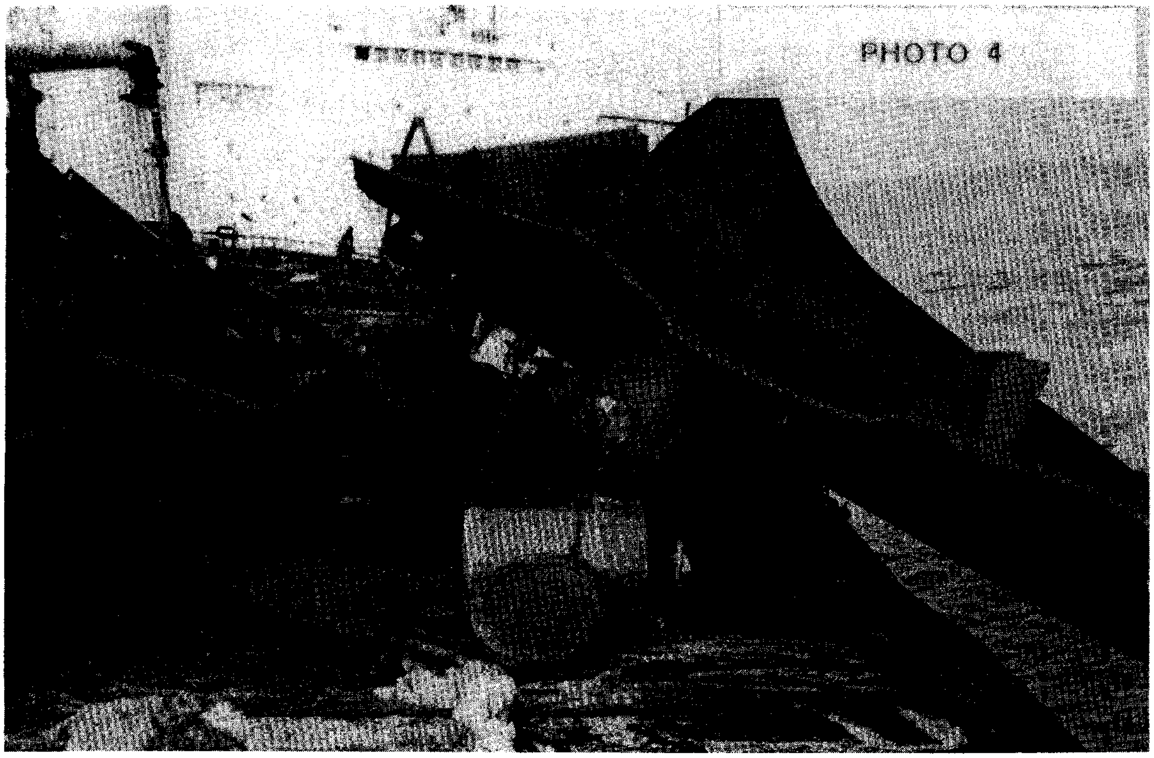
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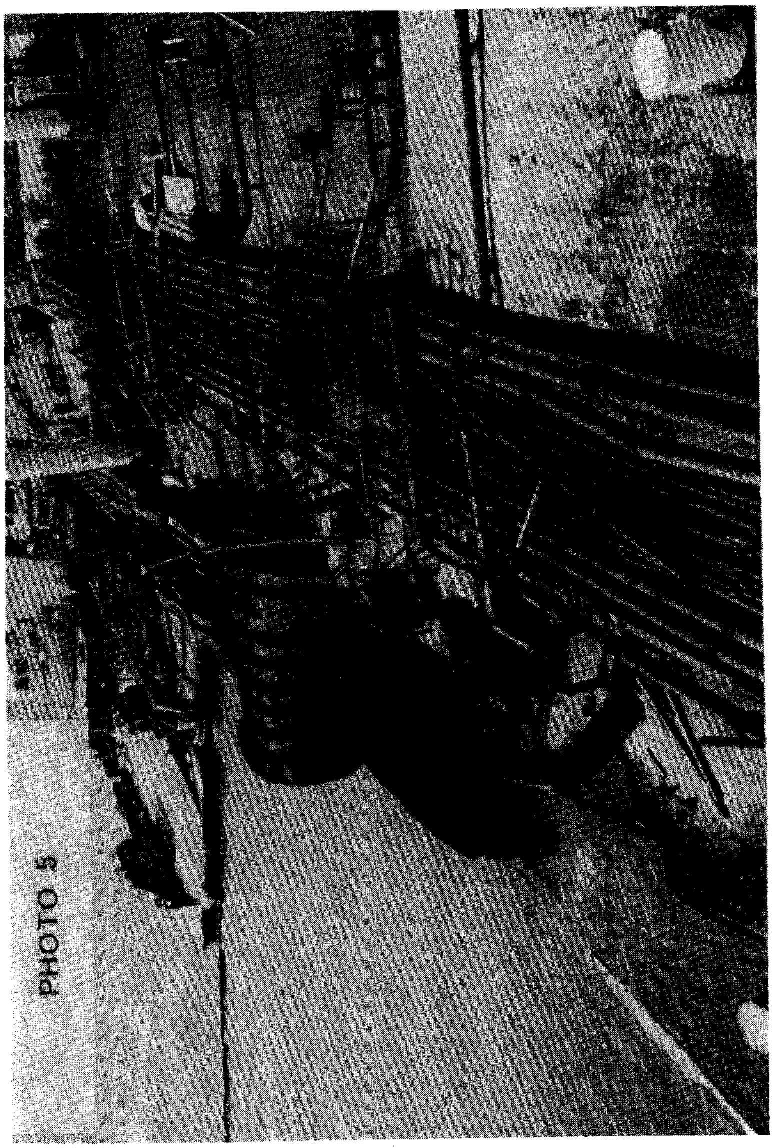
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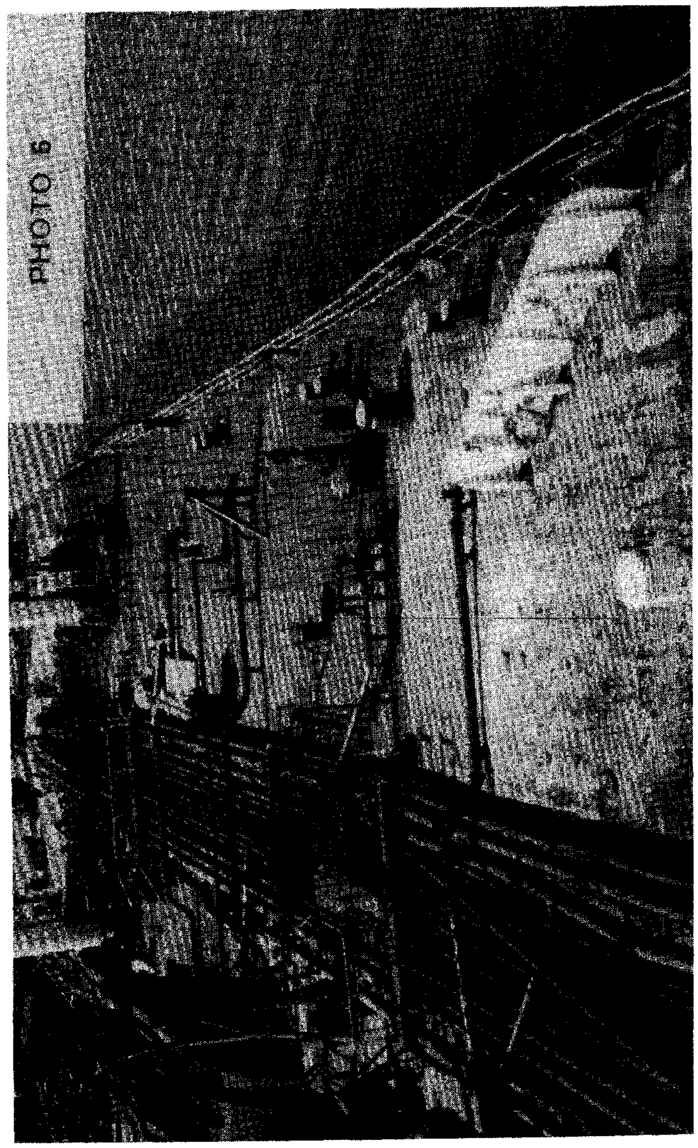
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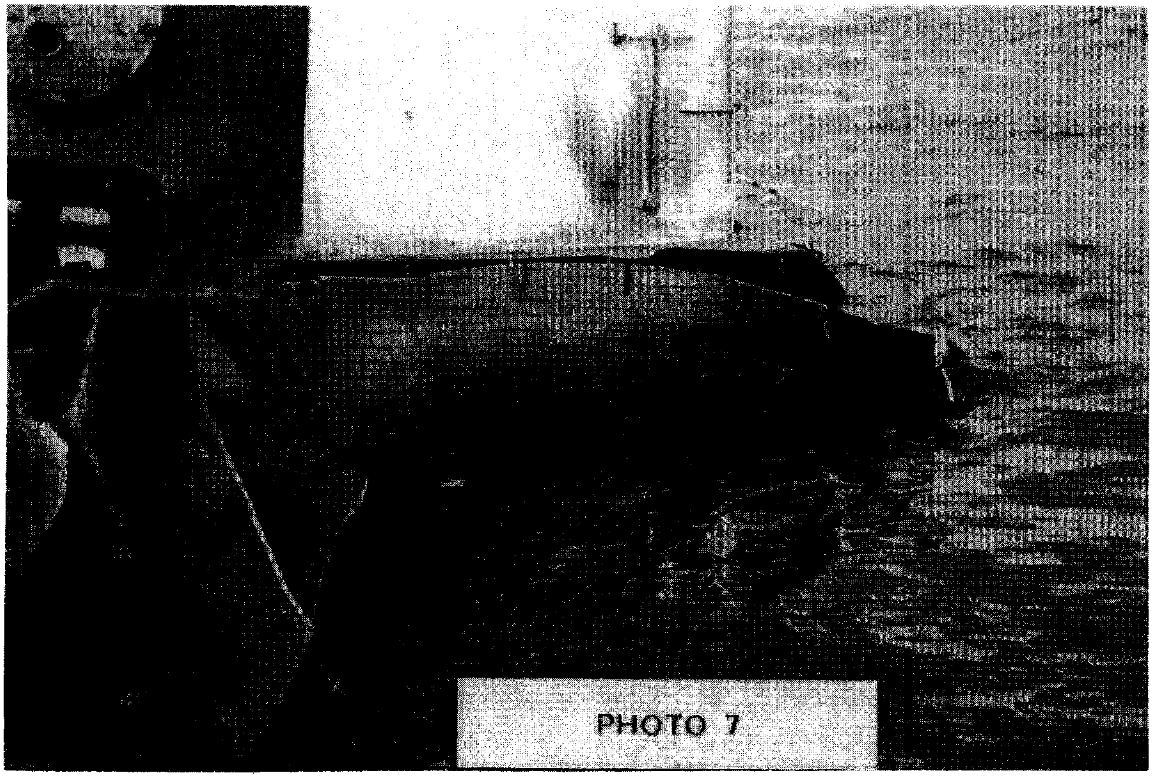

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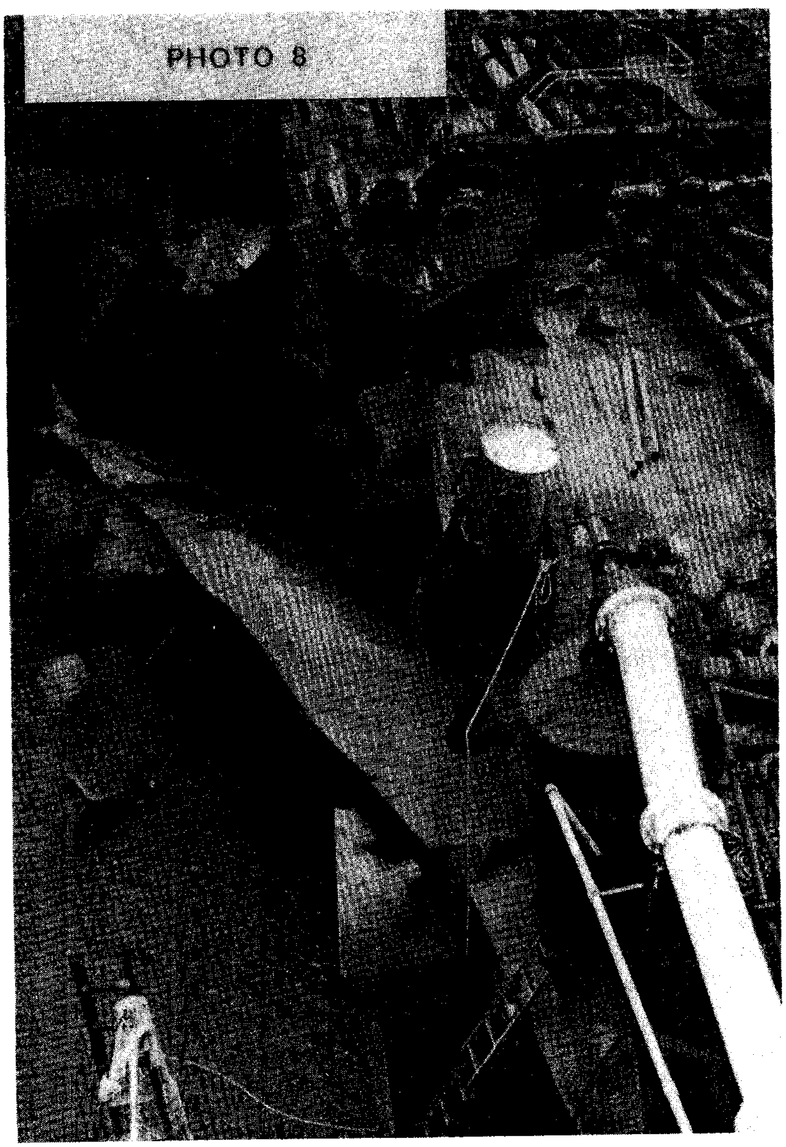

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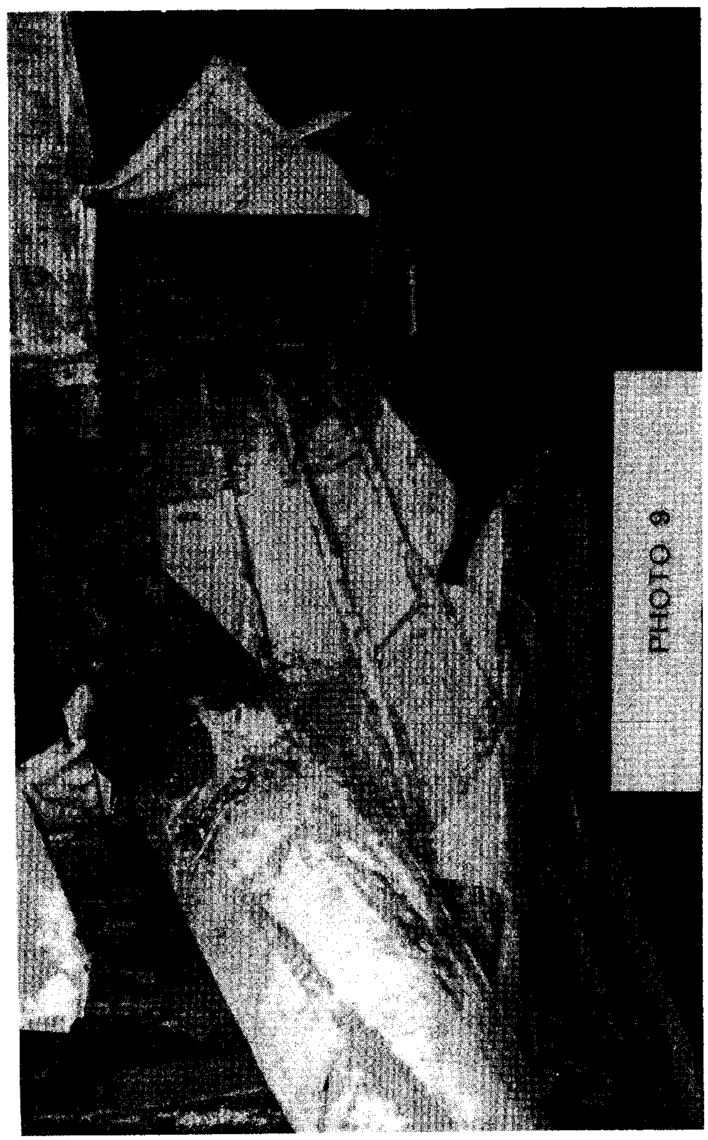

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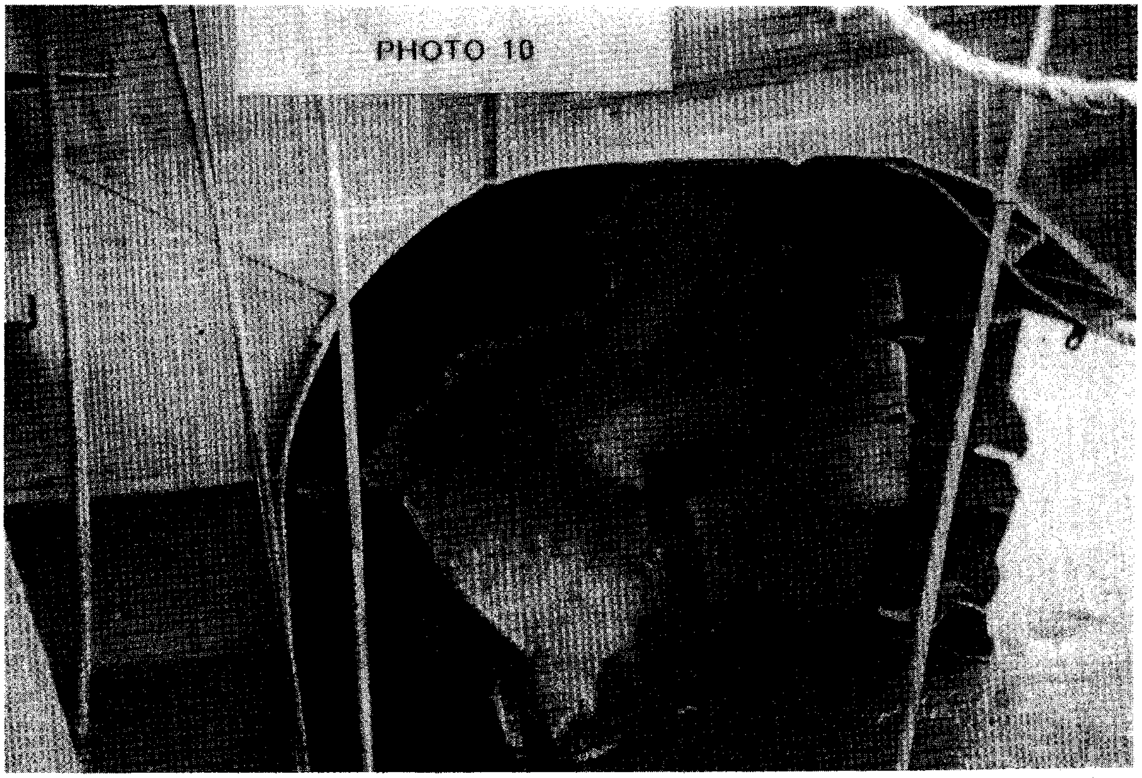

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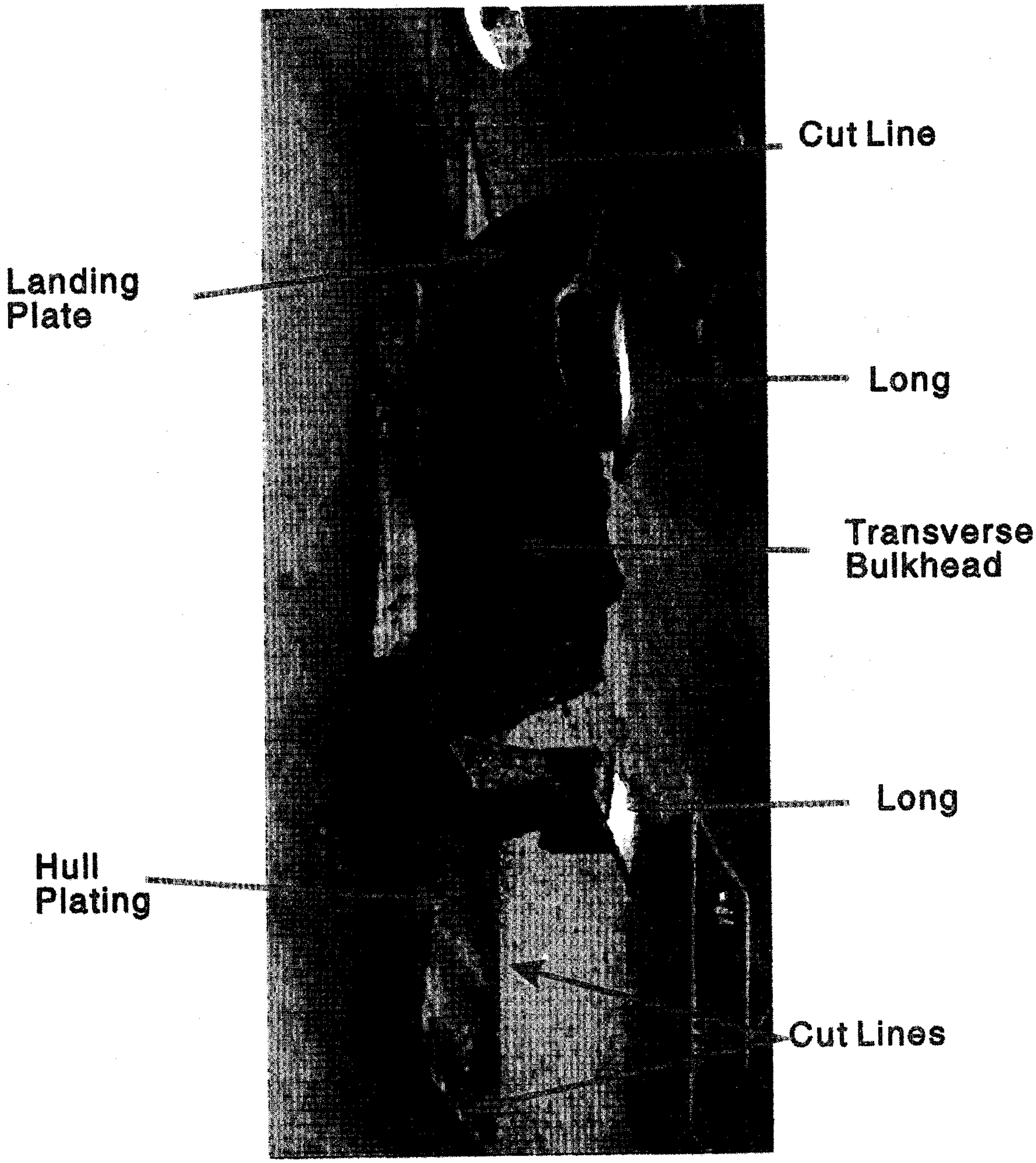


Figure 1 An overall view of the as-received hull section viewed looking forward and slightly upward.

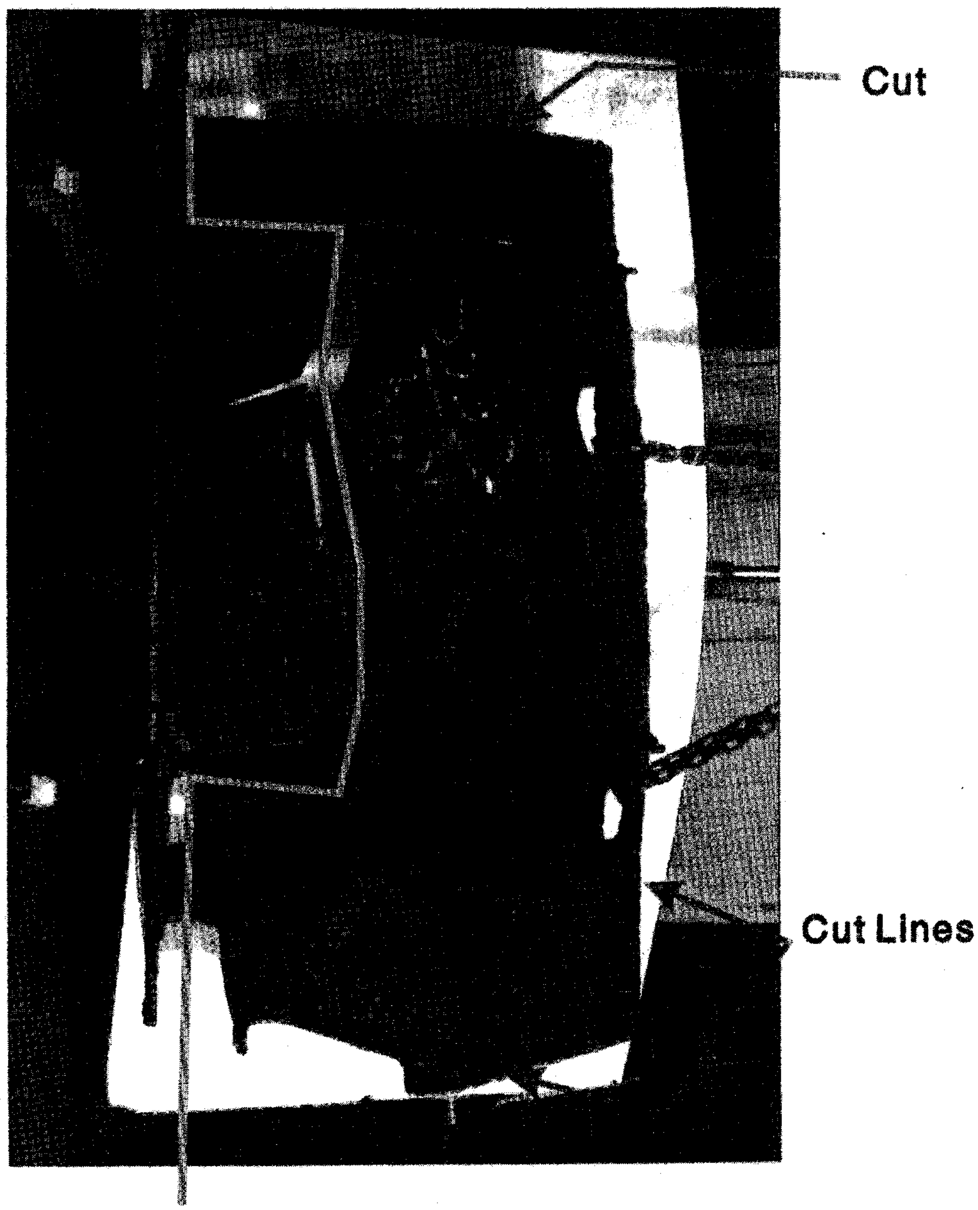


Figure 2 An overall view of the as-received hull section with the mating section of the transverse bulkhead, viewed from the aft side looking forward. The path of the main bulkhead fracture is denoted by the yellow line.

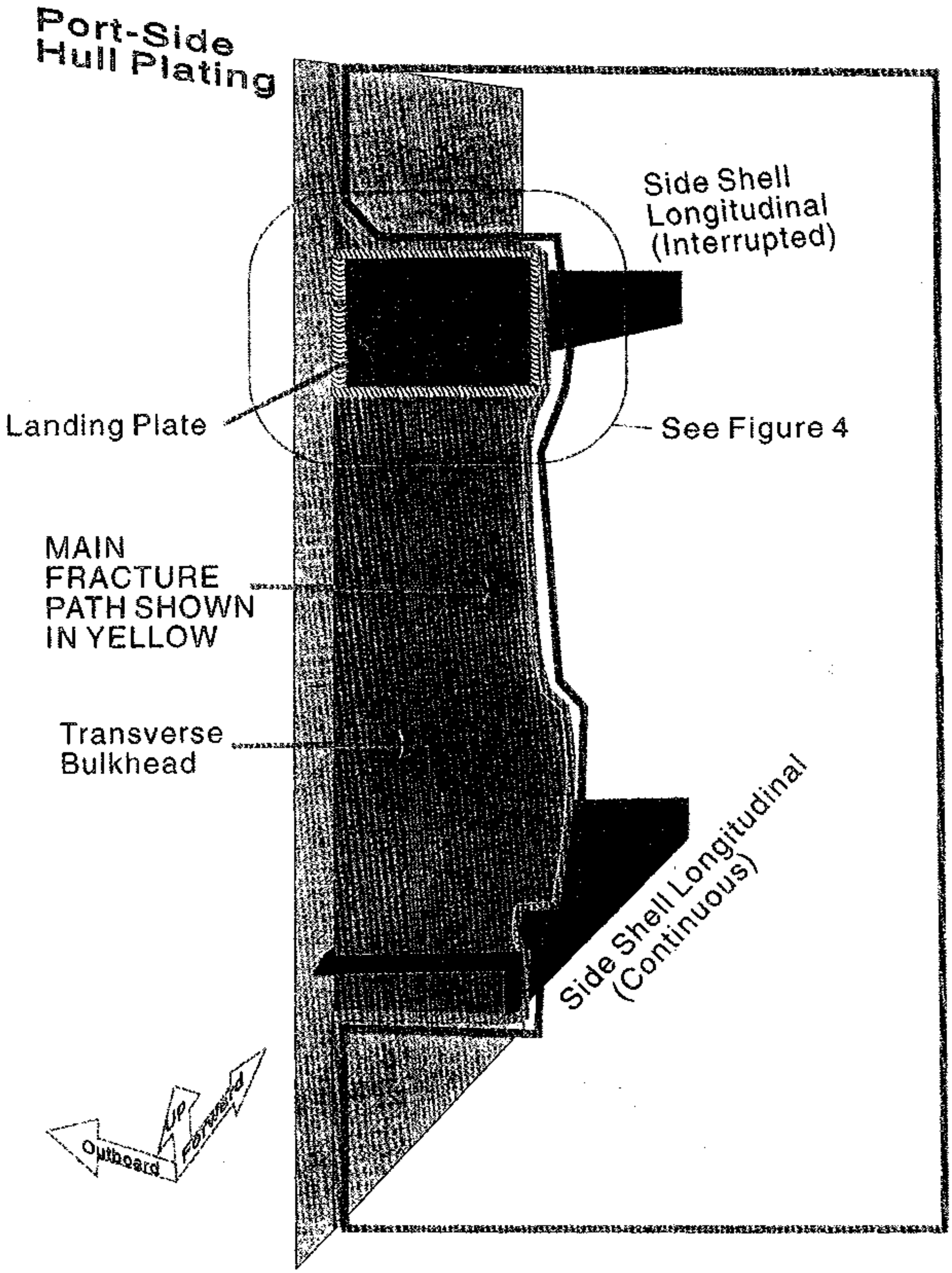


Figure 3 A drawing illustrating the arrangement of components. The main fracture path through the transverse bulkhead is denoted by the yellow line. The larger inboard piece of the bulkhead is shown as an outline for clarity. View is not to scale and shown without deformation.

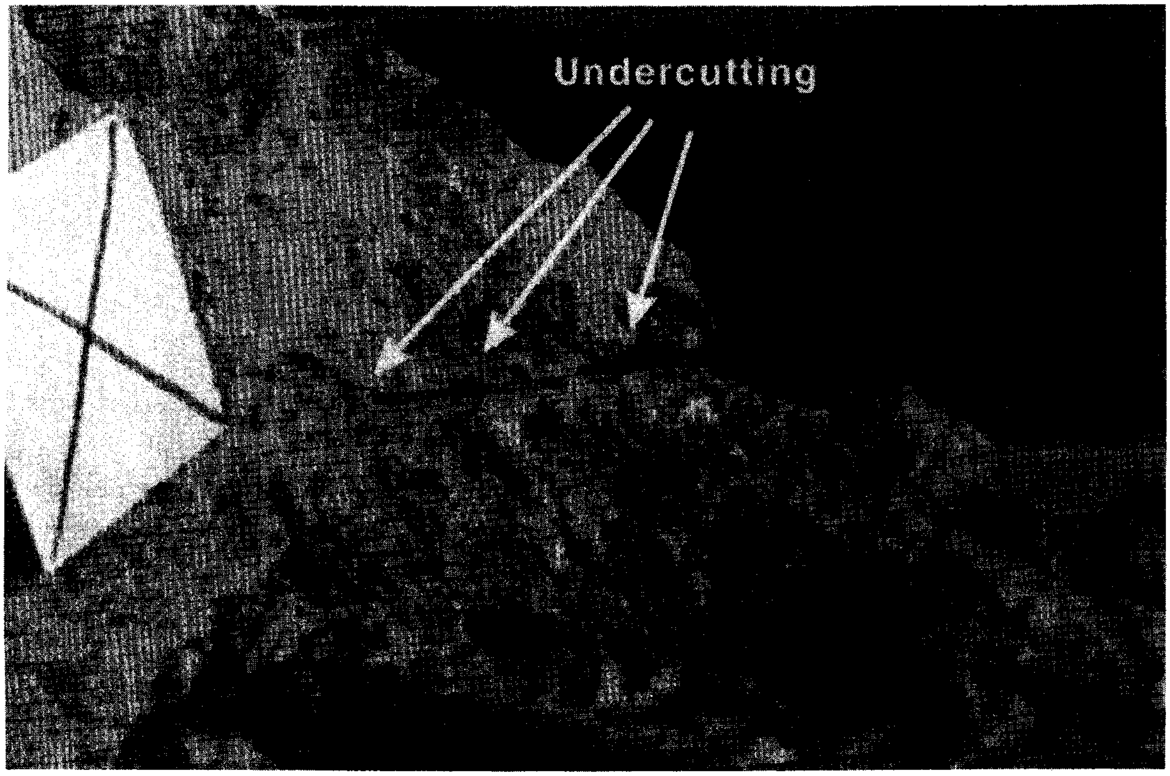


Figure 6 A close up view of the area of undercutting on the upper landing plate weld adjacent to the hull plating at left. Photograph taken prior to cutting or Endox cleaning.

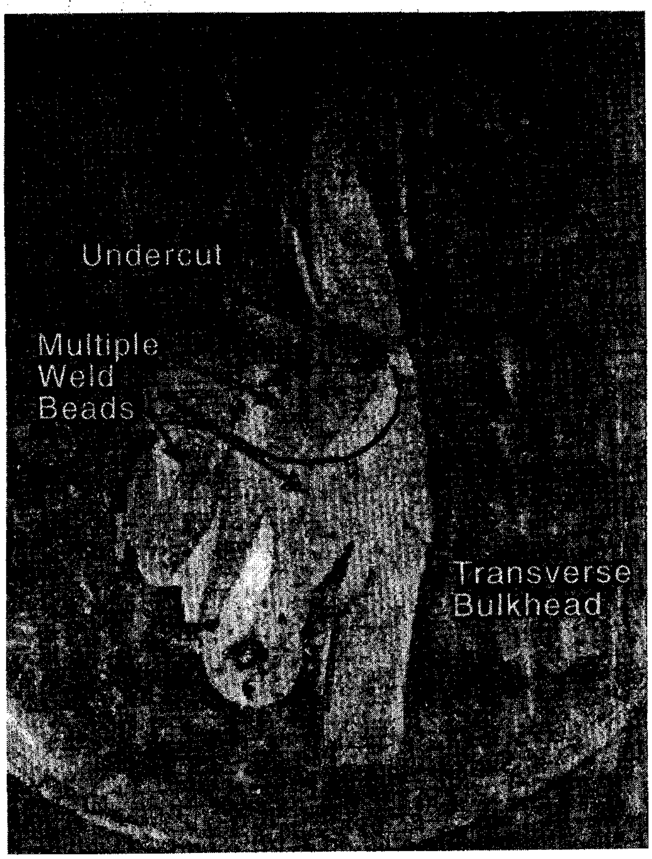
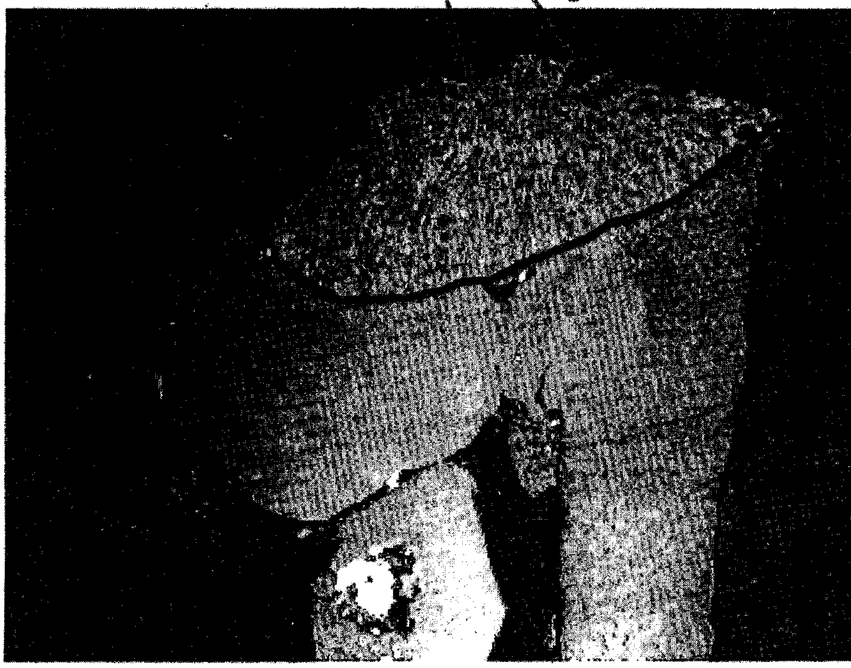


Figure 8 A 2x micrograph of a section through the fractured weld at the top edge of the landing plate and the transverse bulkhead. The section illustrates the extent of weld bead undercutting. Compare the remaining bulkhead thickness at the undercutting to the prewelded thickness

Fissuring



Forward Surface of Transverse Bulkhead

Figure 9 A 4X macrograph of a section through the top landing plate weld near the thin region showing the fissuring in the last weld bead. Also not that the fusion zone of the last weld bead, defined by the blue line penetrated through to the forward face of the bulkhead.