U.S. Department
of Transportation
**United States
Coast Guard**

MARINE CASUALTY REPORT

S/S EXXON HOUSTON

GROUNDING NEAR BARBERS POINT, HAWAII

ON 2 MARCH 1989

WITH POLUTION AND SUBSEQUENT CONSTRUCTIVE LOSS OF VESSEL

U.S. COAST GUARD

MARINE BOARD OF INVESTIGATION REPORT

AND

COMMANDANT'S ACTION

REPORT NO. USCG 16732/01 HQS 92

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16. Abstract

On 2 March 1989, the U.S. tankship EXXON HOUSTON broke away from the Hawaiian Independent Refineries (HIRI) Single Point Mooring (SPM) during cargo transfer oprerations and subsequently grounded near Barber's Point, Oahu, Hawaii. Approximately 400 barrels of crude oil spilled from a ruptured cargo transfer hose and an additional 200 barrels of bunker oil entered the water due to hull damage sustained in the grounding. While there were no deaths or injuries, the vessel was damaged extensively and was eventually declared a total constructive loss.

The Commandant concurred with the Marine Board's determination that the cause of the grounding was that the Master maneuvered the vessel without accurate and recorded navigational fixes to determine his position. Contributing factors included improper trim, adverse weather conditions and an 840 foot section of cargo transfer hose which remained attached to the vessel after the breakaway and hampered maneuvering.

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SS EXXON HOUSTON; GROUNDING NEAR BARBERS POINT, HAWAII ON MARCH 2, 1989, WITH POLLUTION AND SUBSEQUENT CONSTRUCTIVE LOSS OF VESSEL

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U.S. Department of Transportation
United States Coast Guard

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16732/EXXON
HOUSTON

Commandant's Action FEB 3 1992

on

The Marine Board of Investigation convened to investigate the circumstances surrounding the breakaway and grounding of the SS EXXON HOUSTON near Barber's Point, Hawaii on 2 March 1989 with subsequent pollution

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

CAUSE OF THE CASUALTY

I concur with the Board that the cause of the casualty was the master's maneuvering of the vessel without accurate and recorded navigational fixes. While the report indicates that the master used "parallel indexing," i.e., using radar ranges to rapidly determine position relative to the shoreline, this technique is not an acceptable substitute for accurate plotting of the vessel's position. If timely and sufficient fixes had been plotted after 1830, it would have been clear that the vessel was moving into a dangerous area of shoal water, and the master could have maneuvered to avert the grounding.

COMMENTS ON CONCLUSIONS

Conclusion 4: Hawaiian Independent Refineries, Inc. (HIRI) removed camlock type quick connect/disconnect fittings on the manifold to hose connections shortly after the Single Point Mooring (SPM) installation and did not replace these fittings with devices or procedures offering equivalent levels of safety. Providing an additional bolt type spool piece connected to the cargo hose by a quick release type fitting may have eliminated alignment problems at the ship's manifold, while ensuring emergency quick release capability.

Comment: I concur with this conclusion. I note that the SPM was originally fitted with camlock type quick connect/disconnect fittings to speed connections of the hose to ships' manifolds. These fittings were removed shortly after installation, however, because HIRI found them difficult to align and considered them to be a safety hazard. HIRI will be informed of the Board's suggestion for installation of an alternate quick release mechanism.

Conclusion 13: The chafe chain as tested met the specifications of the American Bureau of Shipping (ABS), for mooring chain. This ABS standard used for conventional mooring chains may not be adequate to account for the various dynamic forces encountered by chafe chains used for SPM mooring applications.

Comment: I do not concur with this conclusion. The referenced ABS standard is found in the "Guide for the Certification of Offshore Mooring Chain 1986" and applies to long continuous flash welded stud link chain. The chafe chain in question was type C, (Oil Companies International Marine Forum (OCIMF), "Standards for Equipment Employed in the Mooring of Ships at SPM") integral stud link chain, which is manufactured by a significantly different method than flash welded stud link chain. The link weld of an integral stud link is inherently weaker than a flash welded stud link due to the different directional mechanical properties at the weld. Laboratory reports (enclosure 65) apparently show that the chafe chain met the testing requirements for type C, OCIMF integral stud link chain, not the ABS standard. While the evidence indicates that the chafe chain had manufacturing defects and suggests that the OCIMF standard is inappropriate for this application, there is no evidence to indicate that the ABS standard is deficient.

Conclusion 29: The location of the SPM subjects it to heavy weather and sea conditions and variable and shifting surface and subsurface currents. The close proximity of the SPM to the shore and shallow waters contributed to the vessel grounding. The SPM is relatively remote from available tug assistance.

Comment: I partially concur with this conclusion. I agree that the SPM is exposed to prevailing weather and sea conditions and is near shallow water. However, I do not agree with the inference that tug assistance could not be made available nearby due to the SPM's remote location. The workboat NENE (incorrectly described in the report as a "tug") was stationed 1 mile away and arrived on scene 15 minutes after its assistance was requested. However, the NENE had insufficient power to handle the EXXON HOUSTON after it broke away. A tug of sufficient horsepower to assist large vessels such as the EXXON HOUSTON could be operated from the NENE's present mooring and would be more appropriate for providing assistance in emergency situations.

ACTION ON RECOMMENDATIONS

Recommendation 1: Offshore mooring facilities, particularly HIRI, should conduct research into the availability of a mooring chafe chain that is more suitable for its intended use.

Action: I do not concur with this recommendation. As discussed in my comments on conclusion 13 above, the chafe chain which parted did not meet the ABS standard for offshore mooring chain. Chain meeting the ABS standard would be more suitable for use on the SPM.

Recommendation 3: OCIMF, or another recognized organization, should conduct research into establishing more specific maintenance and inspection procedures for SPM chafe chains which may include appropriate nondestructive testing and other measurement techniques. Standards should be developed to account for the unique stresses and demands on SPM chafe chains.

Action: I concur with the intent of this recommendation. A copy of this report will be provided to OCIMF for their information and action as they deem appropriate with regard to this recommendation. However, as noted in my comments on conclusion 13, chain meeting the ABS standard would be more suitable for SPM use.

Recommendation 2: HIRI should conduct periodic inspections of the chafe chain to existing standards and maintain accurate detailed records of inspection results.

Recommendation 4: HIRI should publish adequate contingency plans to cover appropriate response actions to be taken in the event of approaching heavy weather at the SPM, other casualties (i.e., fire, collision, etc.) requiring an emergency separation of a tankship from the SPM and cargo hoses.

Recommendation 5: HIRI should provide a means of rapid cargo hose removal and mooring line release to ensure emergency separation of a tankship from the SPM and cargo hoses.

Recommendation 6: Written guidance should be provided to each tanker master at the HIRI SPM regarding weather, sea state, and SPM equipment operating limitations.

Recommendation 7: HIRI should consider the installation of mooring system tension monitors.

Recommendation 8: HIRI should institute emergency response procedures which require that tug assistance will be requested by the vessel master immediately upon a breakaway from the SPM.

Recommendation 10: HIRI should adopt specific procedures to clarify communications and review communications equipment capabilities between tankers moored at SPM and attending work boats.

Recommendation 11: HIRI's personnel responsible for the determination of fitness of future employees should obtain the proper documentation to substantiate hiring requirements and initiate a program to ensure employees keep appropriate mariners' licenses current.

Action on recommendations 2, 4, 5-8, 10 and 11: I concur with these recommendations. MSO Honolulu will bring them to the attention of HIRI and will monitor the progress of the recommended changes to equipment and procedures.

Recommendation 9: The U.S. Coast Guard should review response policies and procedures regarding on-scene verification of vessel breakaways from offshore oil transfer terminals.

Action: I concur with this recommendation. Coast Guard district commanders with offshore oil transfer terminals within their areas of responsibility are reviewing their operations plans to ensure that they adequately address this scenario.

Recommendation 12: The U.S. Coast Guard should initiate a study to determine the need for promulgating a regulatory package addressing the design, construction, installation, operation, maintenance, and inspection of Single Point Mooring systems.

Action: I do not concur with this recommendation. The SPM was constructed in accordance with "Building and Classing Single Point Moorings, 1975" published by the ABS. This standard addresses SPM maintenance operations and inspection procedures, but the defective chafe chain weld which failed in this casualty would probably not have been detected during normal inspections. Also, the facility has submitted a detailed inspection schedule to Commanding Officer, MSO Honolulu for approval. Considering the actions taken by HIRI and the excellent safety record of the HIRI SPM and the Louisiana Offshore Oil Platform (LOOP) SPM in the Gulf of Mexico, there is no need for regulatory involvement by the Coast Guard at this time.

Recommendation 13: The U.S. Coast Guard should request that the National Oceanographic and Atmospheric Administration (NOAA) prepare a larger scale chart to replace the current Chart No. 19357 for the waters in the vicinity of Barber's Point.

Action: I concur with the intent of this recommendation. Each type of nautical chart has a particular intended use. Coastal charts, such as chart 19357, are intended for coastwise navigation, not for precision approaches to areas such as the SPM. Harbor charts, such as chart 19362, are more appropriate for precision navigation and anchoring situations.

While chart 19357 serves its intended purpose for use in coastal navigation, it will better serve the mariner's needs if the coverage is expanded to meet the spirit of this recommendation. Therefore, I have requested that NOAA rescheme chart 19362 by shifting the western border from 158-07" W to 150-10" W to provide additional charted area for navigating in the vicinity of the offshore facility.

Recommendation 14: A copy of the final EXXON HOUSTON Marine Casualty Report should be forwarded to OCIMF, NOAA, SOFEC and the ABS.

Action: I concur with this recommendation. Copies of the report will be forwarded as recommended.

ADDITIONAL REMARKS

As noted in finding of fact 3, the mooring master submitted a false license to this Board and made false statements concerning the falsified license. On 20 June 1991, he was convicted of these offenses in U.S. District Court and received a $2,000 fine.

A charge of negligence against the master of the EXXON HOUSTON was dismissed by an administrative law judge during suspension and revocation proceedings against the master's license.

[redacted]

J. W. KIME
Admiral, U. S. Coast Guard
COMMANDANT

U.S. Department of Transportation
United States Coast Guard

Chairman, Marine Board
EXXON HOUSTON

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16732/EXXON HOUSTON
18 November 1989

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

Subj: SS EXXON HOUSTON, O.N. 297151; BREAKAWAY AND SUBSEQUENT GROUNDING ON 2 MARCH 1989 OFF BARBER'S POINT, HAWAII, WITH MEDIUM OIL SPILL, POTENTIAL MAJOR OIL SPILL, AND NO LOSS OF LIFE OR PERSONNEL INJURY

FINDINGS OF FACT

1. SUMMARY

ON 2 MARCH 1989, AT 1715 (all times are local Hawaiian Standard Times, HST, GMT +10W), the United States flag tankship EXXON HOUSTON broke away from the Hawaiian Independent Refineries, Inc. (HIRI) Single Point Mooring (SPM). The vessel subsequently grounded approximately .5 miles off Barber's Point, Oahu, Hawaii at 2006. As a consequence of the vessel separating from the SPM, approximately 400 barrels of Alaskan crude oil were released from a ruptured cargo transfer hose. In addition, the subsequent grounding of the vessel caused hull damage to No. 3 port and No. 5 starboard cargo tanks and to the port bunker tank and engineroom double bottom, resulting in approximately 200 barrels of No. 6 bunker oil entering the Hawaiian waters, navigable waters of the United States. At the time this incident occurred, the EXXON HOUSTON was conducting normal cargo oil transfer and bunkering activities at the HIRI terminal. There were no deaths or personnel injuries directly attributable to the vessel parting from the SPM or to the grounding. The damage sustained by the EXXON HOUSTON was significant enough to consider the vessel a constructive total loss. Following a final damage survey, the vessel was sold for scrap salvage value to Eastern Overseas, Inc. and towed to Hong Kong for dismantling.

2.A. VESSEL DESCRIPTION

The EXXON HOUSTON is of welded steel construction and is configured with an after deck house containing the navigating bridge, radio room, and crew quarters. The vessel propulsion is controlled from the bridge through an engine order telegraph to the vessel's engineroom. The ship is divided longitudinally into six independent tank sections. Each of these six sections consists of a center tank and separate port and starboard wing tanks. The cargo oil tanks (COTs) are numbered 1 through 5 from forward to aft. In addition, the vessel has a number of dedicated saltwater ballast tanks (SWBs) forward and aft and tanks at mid-ships which serve as both COTs and SWBs. The EXXON HOUSTON was last drydocked and examined by USCG marine inspectors at Hyundai Ship Repair Facility (MIPO), Ulsan, Korea, on 22 June 1988, and deemed fit for the service and route specified on the U.S. Coast Guard Certificate of Inspection (COI).

The vessel is propelled by a single Combustion Engineering steam boiler rated at 750 psi, generating approximately 19,000 ahead horsepower and 14,250 astern horsepower. Power is transferred through a General Electric steam reduction gear turbine to a single fixed 4 bladed bronze propeller capable of 103 rpm ahead (96 rpm continuous). The steering is accomplished through an electro-hydraulic powered single rudder. The EXXON HOUSTON is equipped with port and starboard stockless anchors at the bow, each with 1080 feet of chain, and a stern anchor with 720 feet of chain.

2.B. VESSEL DATA

NAME:	EXXON HOUSTON
OFFICIAL NUMBER:	297151
OWNER:	EXXON SHIPPING COMPANY 800 BELL STREET P.O. BOX 1512 HOUSTON, TEXAS 77251-1512
OPERATOR:	EXXON SHIPPING COMPANY 3400 E SECOND STREET BENICIA, CALIFORNIA 94510
SERVICE	Tank Ship

CARGO AUTHORITY UNDER CURRENT USCG COI:	Crude Oil; & other flamable and combustible liquids in bulk, grades "B" and lower, and grade "E" in deep tanks, excluding noxious substances

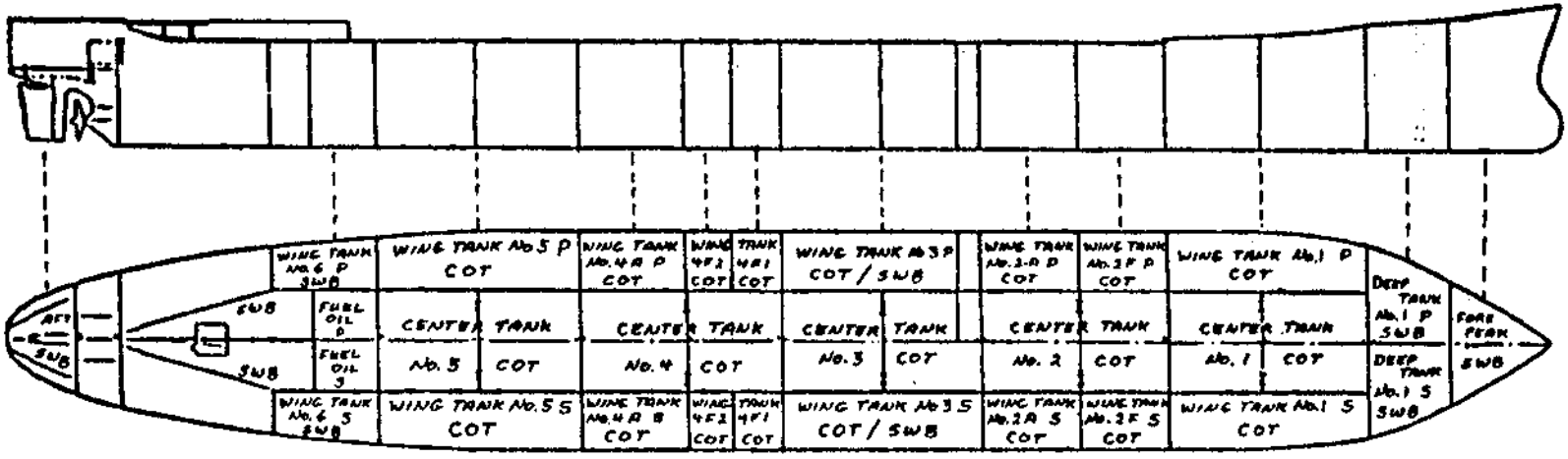
NUMBER/ARRANGEMENT CARGO TANKS

CARGO OIL TANKS (COT)	15
SALTWATER BALLAST TANKS (SWB)	12
COT/SWB	2

NUMBER TRANSVERSE BLKHDS	8
GROSS TONS	31,697
NET TONS	24,605
DWT	72,056
LENGTH	766.90 Feet
BREADTH	116.20 Feet
DEPTH	55.30 Feet
HULL MATERIAL	STEEL
PROPULSION	STEAM TURBINE, REDUCTION GEAR
NUMBER OF PROPELLERS	1
NUMBER OF RUDDERS	1
BOW THRUSTER	1 (Removed prior to 1986)

ANCHORS	LOCATION	WEIGHT (LBS)	CHAIN LENGTH (FT)
STOCKLESS	BOW	25,475	1080
STOCKLESS	BOW	25,479	1080
STOCKLESS	STERN	25,480	720

HORSEPOWER (AHEAD)	19,000 HP
(ASTERN)	14,250 HP



TANK ARRANGEMENT (EXXON HOUSTON)

DATE BUILT	11DEC64, NEWPORT NEWS, VIRGINIA
HOMEPORT	PHILADELPHIA, PA

INSPECTION/CERTIFICATE DATA

USCG CERTIFICATE OF INSPECTION:	19NOV87	Marine Safety Office, Seattle, WA
SOLAS SAFETY CONSTRUCTION CERT:	30NOV88	American Bureau of Shipping, ABS
SOLAS SAFETY EQUIPMENT CERT:	19NOV87	Marine Safety Office, Seattle, WA
LAST RE-INSPECTION	14DEC88	Marine Safety Office, San Francisco, CA
LAST DRYDOCK EXAMINATION	22JUN88	Marine Safety Office, Honolulu, HI
LAST USCG BOARDING: CARGO MONITOR	13FEB89	Marine Safety Office, Los Angeles, CA

NAVIGATION AND COMMUNICATIONS EQUIPMENT

EQUIPMENT	MODEL	MANUFACTURER
Radar	340	SPERRY
Radar	1640-5	RAYTHEON
Anti-Collision Radar	CASII	SPERRY
Gyro Compass	MK37A	SPERRY
Gyro Repeater	MX11125	MAGNAVOX
Gyro Repeaters	MK37	SPERRY
Magnetic Compass	2060	PLATH
LORAN Receiver	750MK7	RAYTHEON
Course Recorder		RAYTHEON
Fathometer	DE724	RAYTHEON
Fathometer	R8220	RAYTHEON
Radio Direction Finder	4004A	MACRAY RADIO
EPIRB	ACRRLB-14	ACR ELECTRONICS

All of the above equipment was reported to be in satisfactory operating condition at the time of the incident. The vessel had no outstanding U.S. Coast Guard requirements.

MANNING REQUIREMENTS

MINIMUM CREW	18
MASTER	1
CHIEF MATE	1
SECOND MATE	1
THIRD MATE	1
RADIO OFFICER	1
ABLE SEAMEN	3
MAINTENANCE DEPT	3
CHIEF ENGINEER	1
FIRST ASST ENG	1
SECOND ASST ENG	1
THIRD ASST ENG	1
OILERS	3

The EXXON HOUSTON was under the navigational and operational authority of [redacted] of [redacted] prior to and during the transit from Valdez, Alaska, and through the grounding incident off Barber's Point, Hawaii. Captain [redacted] is [redacted] years old and is employed by the EXXON Shipping Company. He is a 1977 graduate of the United States Merchant Marine Academy at Kings Point, New York, and presently holds a U.S. Coast Guard Unlimited Master's License.

All the evidence presented to the marine board indicates strict adherence to a stringent EXXON policy of no drugs or alcohol onboard the EXXON HOUSTON. Personnel aboard the EXXON HOUSTON were not tested for alcohol or drug use after the incident. This testing was not required nor deemed necessary.

2.C. ADDITIONAL VESSEL INFORMATION

A work boat named NENE was assigned to assist the EXXON HOUSTON during all stages of the mooring and cargo oil off-loading operation at the HIRI SPM. The NENE also became involved in the handling, controlling and final removal of a parted cargo hose attached to the cargo oil manifold aboard the EXXON HOUSTON.

VESSEL NAME NENE

OFFICIAL NUMBER 670788

VESSEL TYPE Work Boat used for line and cargo hose handling operations at HIRI SPM

VESSEL OWNER Uaukewai Diving, Salvage and Fishing Company
1021 Koloa Street
Honolulu, Hawaii 96816

PROPULSION Twin propeller; Two General Motors 12V71N, 4-cycle, diesel engines rated at 400 SHP continuously at 2100 RPM.

SIZE

Length, over fender	64' 3"
Beam, molded	21' 0"
Depth, molded	8' 0"
Draft, design waterline	6" 6"
Registered Gross Tonnage	75.30 tons
Registered Net Tonnage	51.00 tons

AGE

Designed and built in 1984 by:

MARCO SEATTLE
2300 West Commodore Way
Seattle, Washington 98199

INSPECTION/CERTIFICATION DATA The NENE is not inspected by the U.S. Coast Guard and required no U.S. Coast Guard Certificate of Inspection.

NAVIGATION AND COMMUNCIATIONS EQUIPMENT

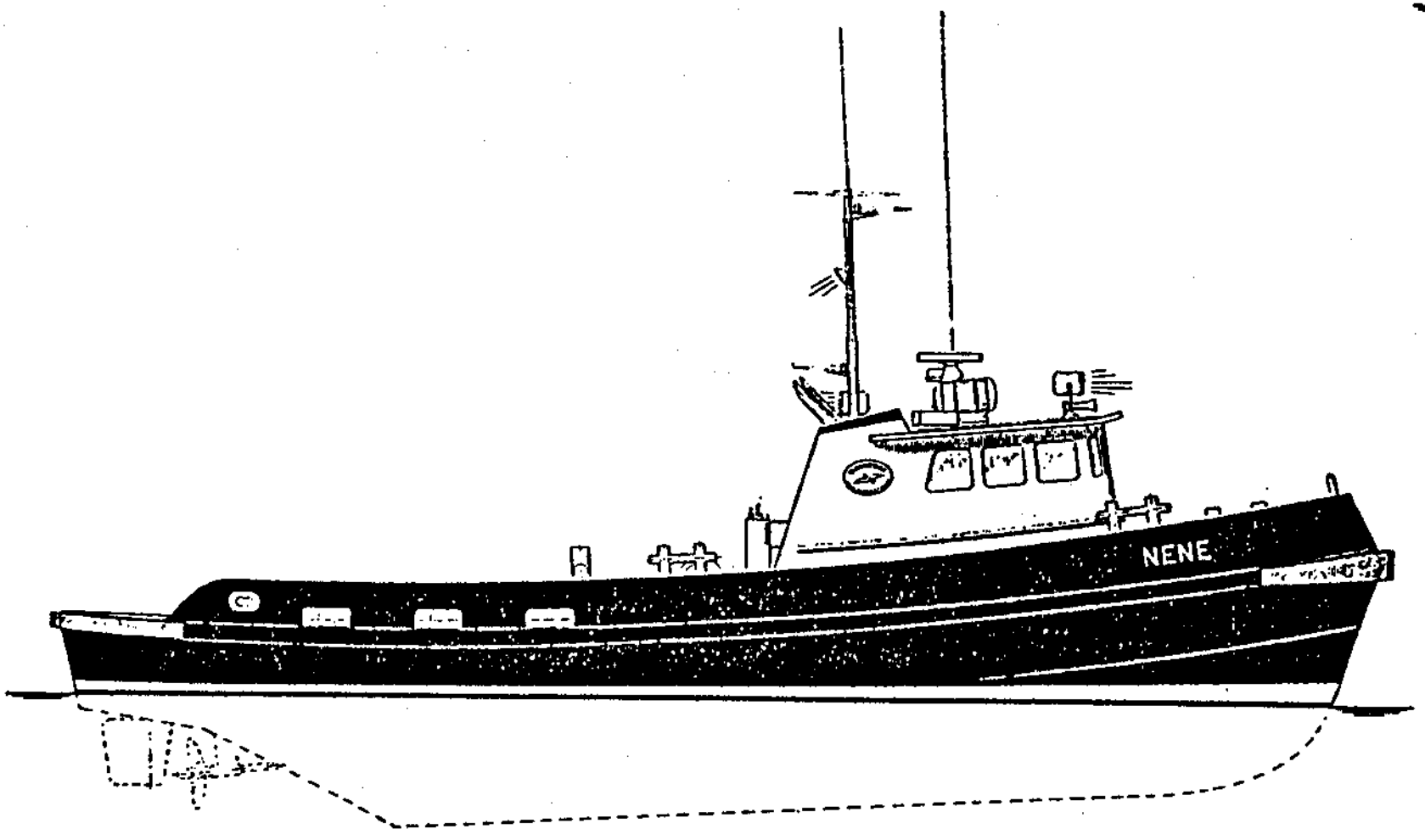
EQUIPMENT	MODEL	MANUFACTURER
RADIO-TELEPHONE	RAY #55	RAYTHEON
RADIO-TELEPHONE	N850/N860	NORTHERN RADIO
DEPTH FINDER	DR-1200D	ROSS
LOUDER HAILER	400	RAYTHEON
RADAR	3400	RAYTHEON
SATELLITE NAVIGATOR	FSN-80	FURUNO

All of the above equipment was reported to be in satisfactory operating condition at the time of the casualty.

CHARACTERISTICS

LENGTH OVERALL
BEAM, MOLDED
DEPTH, MOLDED
DRAFT, MEAN LIGHT

TANK CAPACITIES
FUEL OIL
FRESH WATER
LUBE OIL
HYDR. OIL



64' TWIN SCREW WORKBOAT

MANNING REQUIREMENTS

The operation of the NENE engaged in commercial operations as described required no U.S. Coast Guard licensed personnel.

> The work boat NENE was operated by [redacted] employed as captain and diver by Marine Logistics. Mr. [redacted] holds a 100 ton vessel Coast Guard ocean operators license endorsed for operating in the waters 25 miles offshore Oahu, Hawaii. In addition to the captain, the NENE had a crew of two deckhands, [redacted] and [redacted] who handled lines and the floating cargo hoses. The crew of the NENE was also responsible for inspecting the SPM prior to transfer and periodically during the transfer operations. They also perform diving operations, as required.

All evidence presented to the marine board indicates no drug or alcohol use on board the NENE. Drug and alcohol testing was not required nor deemed necessary following the grounding of the EXXON HOUSTON.

3. DUTIES OF THE MOORING MASTER

All Mooring Masters employed by the HIRI facility are selected for their previous experience applicable to the operation of the SPM. In addition, a license as Master of steam and motor vessels of any gross tons, oceans, issued by the U.S. Coast Guard, is considered a prerequisite for employment. Individuals are initially designated Assistant Mooring Master until they complete a training program and are designated as Mooring Master by the Senior Mooring Master.

The Mooring Master advises the ship's Master on approaches to the berth, mooring, unmooring, and all operations within the mooring area. The Mooring Master inspects the ship's gear for its adequacy and initiates the safety inspection procedure. This safety inspection on the EXXON HOUSTON was conducted by [redacted] prior to the arrival of relief Mooring Master, [redacted] The tanker's crew is to perform all operations concerning raising, connecting, disconnecting, and lowering of the hoses, and furnish the appropriate manifold reducers. If, in the opinion of the Mooring Master, conditions so dictate, shore personnel may be used to ensure safe hose handling operations. In this instance, there were no additional shore based terminal personnel used in connecting or disconnecting the cargo hose.

Maneuvering of ships during approach to and within limits of the berth shall be done in accordance with the advice of the Mooring Master, subject to the understanding that in all cases and circumstances, the Master of the vessel being maneuvered shall remain solely responsible on behalf of his vessel's owners, for the safety and proper maneuvering of the vessel. The ship's Master or a qualified deck Officer must be on the bridge at all times while the vessel is maneuvering. While the EXXON HOUSTON was secured to the SPM with astern propulsion to maintain position, there were no officers or crewmen stationed on the bridge.

A Freedom of Information Act request was received by the U.S. Coast Guard Marine Inspection Office, New York concerning information contained in Mr. [redacted] license file. When no license or file could be found, the U.S. Coast Guard Officer-In-Charge of Marine Inspection, Honolulu was notified. The Marine Inspection Office, Honolulu, initiated an investigation concerning Mr. [redacted] presentation of a false license and making a false statement about having a Coast Guard license to this Marine Board. In a letter dated 2 July 1990, to the Marine Safety Office, Honolulu, Mr. [redacted] admitted to submitting a false license document and making a false statement about his license status. On 19 July 1990, the Marine Inspection Office submitted its investigation to Commander, Fourteenth Coast Guard District for forwarding to the U.S. Attorney's Office for appropriate action concerning liability on the part of Mr. [redacted]

4A. SINGLE POINT MOORING (SPM)

In general, HIRI will accept tankers having the following maximum particulars; however, in no case can acceptance be considered automatic on nomination, as operating conditions can always preclude receiving the vessels:

L.O.A.	945 Feet
Breadth	150 Feet
Summer DWT	150,000 Tons
Bow to Center Manifold	470 Feet

Depth of water at the berth is in excess of 90 feet, so no draft limitation is necessary.

The following environmental conditions are considered safe operating parameters for the SPM:

A. Operating Conditions -- Vessel Moored at SPM*

Maximum wave height	15 feet
Significant wave height **	10 feet
Wind velocity	45 knots
Surface current	3 knots

B. Survival Condition for SPM -- No Vessel Moored

Maximum wave height	57 feet
Significant wave height **	38 feet
Wind velocity (1 minute gusts)	90 knots
Surface current	3 knots

* The HIRI Mooring Master, [redacted] erroneously advised Captain [redacted] that the buoy and the chain were set up for a 150,000 ton vessel in 50 knot winds with 20 foot seas.

** Significant wave height is defined as the average of the highest one-third of the waves.

While subsurface currents may also affect the movement of vessels in the vicinity of the SPM, the speed, direction and location of these currents are extremely unpredictable and localized.

The SPM is designed to accommodate safely vessels with the following maximum dimensions:

Crude and Black Products Tanker

Maximum Displacement	150,000 DWT
OAL (length)	945 feet
Beam	150 feet
Maximum Draft	57 feet

4.B. DOCUMENTATION

The Master of each tanker will be given a copy of the General Instructions, Discharging/Loading Orders and the Indemnification Letter which he will be asked to sign. This document was signed by the EXXON HOUSTON Master, [redacted] on 1 March 1989 upon his arrival at HIRI SPM in acknowledgement of receipt, understanding, and agreement with specific instructions and guidlelines. Captain [redacted] in signing, acknowledged that "it is expressly understood and agreed that at all times and under all circumstances, the Master of the vessel (EXXON HOUSTON) and her owners are responsible for maneuvering, mooring and unmooring of the vessel, connecting and disconnecting cargo hoses, discharging and loading cargo, ballasting, pollution prevention and adherence to Coast Guard Regulations and these instructions."

The Mooring Master, operator and crew of the mooring launch and said launches furnished by the Terminal, are supplied on the condition that in the performance of such services as they may render to the vessel, they are the servants of the owners of the vessel in every respect, and shall be indemnified and held harmless from all liability, loss or claim arising in the course of rendering such services.

4.C. BALLAST REQUIREMENTS

A tanker must have sufficient ballast for safe handling, having due regard to existing weather and sea conditions. Through a careful watch of the weather and sea conditions, frequent exchange of information between ship and Terminal, and by a knowledge of the behavior of his own ship, a ship's Master may come to the Terminal with a minimum of ballast and thus lessen any possibility of infringement of sea pollution regulations.

For the safety of the vessel and at the Master's discretion based upon the weather, sea and wind conditions, etc., the discharge of cargo should be arranged so that when approximately sixty-five percent (65%) of the total cargo has been discharged, there will be sufficient empty and dry tanks to accommodate salt water ballast as required to produce a mean draft of approximately 25 feet and, in a suitable trim condition, not to exceed 6 feet by the stern upon the completion of discharging operations.

At the time of separation from the SPM, the draft of the EXXON HOUSTON was reported by the Mooring Master as being 12 feet forward and about 32 feet aft.

4.D. EMERGENCY UNMOORING

A sufficient number of officers and crew members must be on board at all times to disconnect the hoses, unmoor, and vacate the berth, should such action become necessary, or be deemed advisable. The main engine must be kept ready for use at all times.

No detailed contingency plans were available to provide guidance for responding to approaching heavy weather or a breakaway of a vessel from the SPM.

4.E. COMMUNICATIONS

During loading/discharging operations, the Mooring Master is required to have two portable VHF radios for communications between the tanker and the HIRI pumphouse control station. These VHF radios were also used to communicate with the work boat, NENE.

Pacific Resources Terminals, Inc. and Hawaiian Independent Refinery, Inc. have been licensed to use the following simplex VHF frequencies:

Channel 6	-	Emergency	156.30 MHz
Channel 9	-	Ship to Shore (Primary)	156.45 MHz
Channel 16	-	Call/Emergency	156.80 MHz
Channel 19A	-	Ship to Shore (Secondary)	156.95

The vessel NENE was equipped with two VHF radios, one monitoring Ch 16 and the other Ch 9. In addition, the NENE had a cellular telephone on board to contact shore personnel and the Mooring Master.

4.F. DESCRIPTION OF THE HIRI SINGLE POINT MOORING BUOY (SPM) INSTALLATION

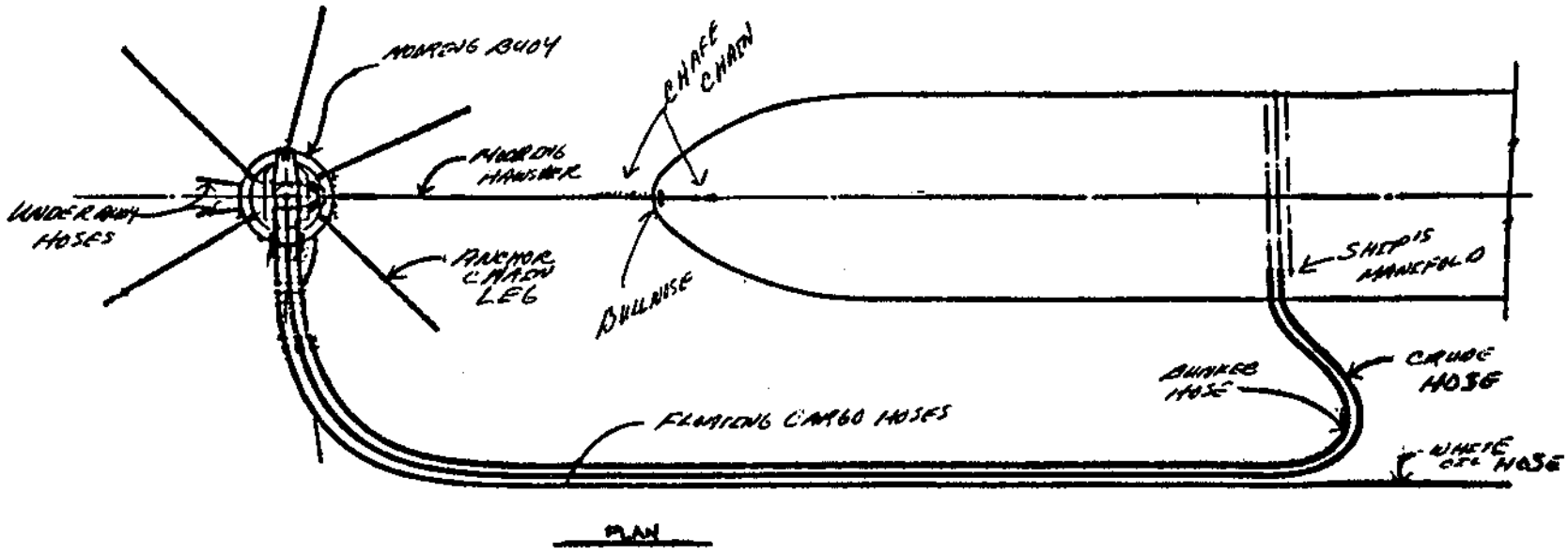
HIRI's sea berth consists of a CALM (Catenary Anchor Leg Mooring). This single point mooring buoy is located at 21 degrees 16.4 minutes North, 158 degrees 5.5 minutes West, bearing approximately 2 miles, 146 degrees true from Barbers Point Light, island of Oahu. Its relative distance to the shoreline is approximately one and one half miles and the water depth at that point is approximately 90 feet. This particular SPM was designed and manufactured by SOFEC, INC, Houston, Texas. It was installed and became operational in February of 1987. The HIRI SPM consists of a 350 ton buoy which is anchored to the sea floor by six chains in the form of a catenary. Three cargo hoses run from the sea floor to the buoy and submerged pipelines transit from the ocean floor beneath the buoy to the refinery. These pipelines consist of a 30 inch crude oil line, a 20 inch clean product line and a 16 inch ship bunkering line. The buoy which is 38 feet in diameter with a 14 foot molded depth consists of three concentric chambers and a rotating element with a bearing located on the top the buoy. The rotating element has two projections. Three 840 foot floating cargo hoses are attached to the oil manifold projection, and the other is for attachment of the mooring gear. A vessel utilizing the SPM is moored by a double braided nylon hawser, 160 feet in length and 18 inches in circumference.. The vessel end of the hawser has a 40.5 foot chafe chain attached to it. This chafe chain consists of 76mm links running for 28 feet from its attachment to the hawser and then is attached to a 54mm link chain, 12.5 ft long.

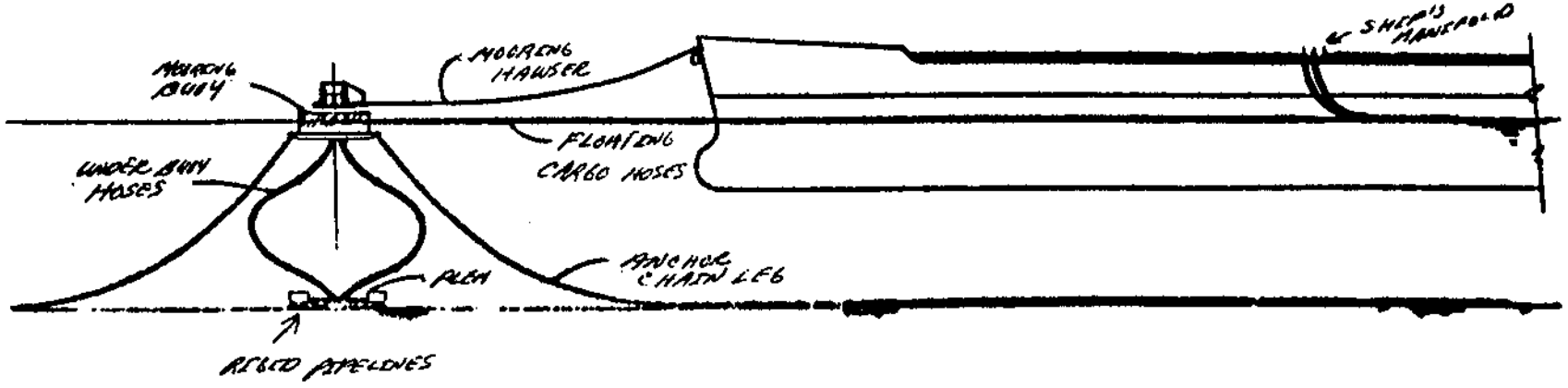
On the day of the incident, the Exxon Houston was moored with the 54mm chain passing through the ship's bullnose (stem fairlead) and was in turn attached to a 10 inch hawser (referred to as a snotter line). The snotter line was then placed around twin mooring bitts on the vessel's starboard foc'sle area.

The 76mm chafe chain is designed to handle vessels up to 150,000 deadweight tons and the 54mm chain is designed for vessels of 100,000 deadweight tons or less. HIRI may connect the snotter directly to the 76mm chain when handling larger vessels or to the end of the 54 mm chain for vessels such as the Exxon Houston.

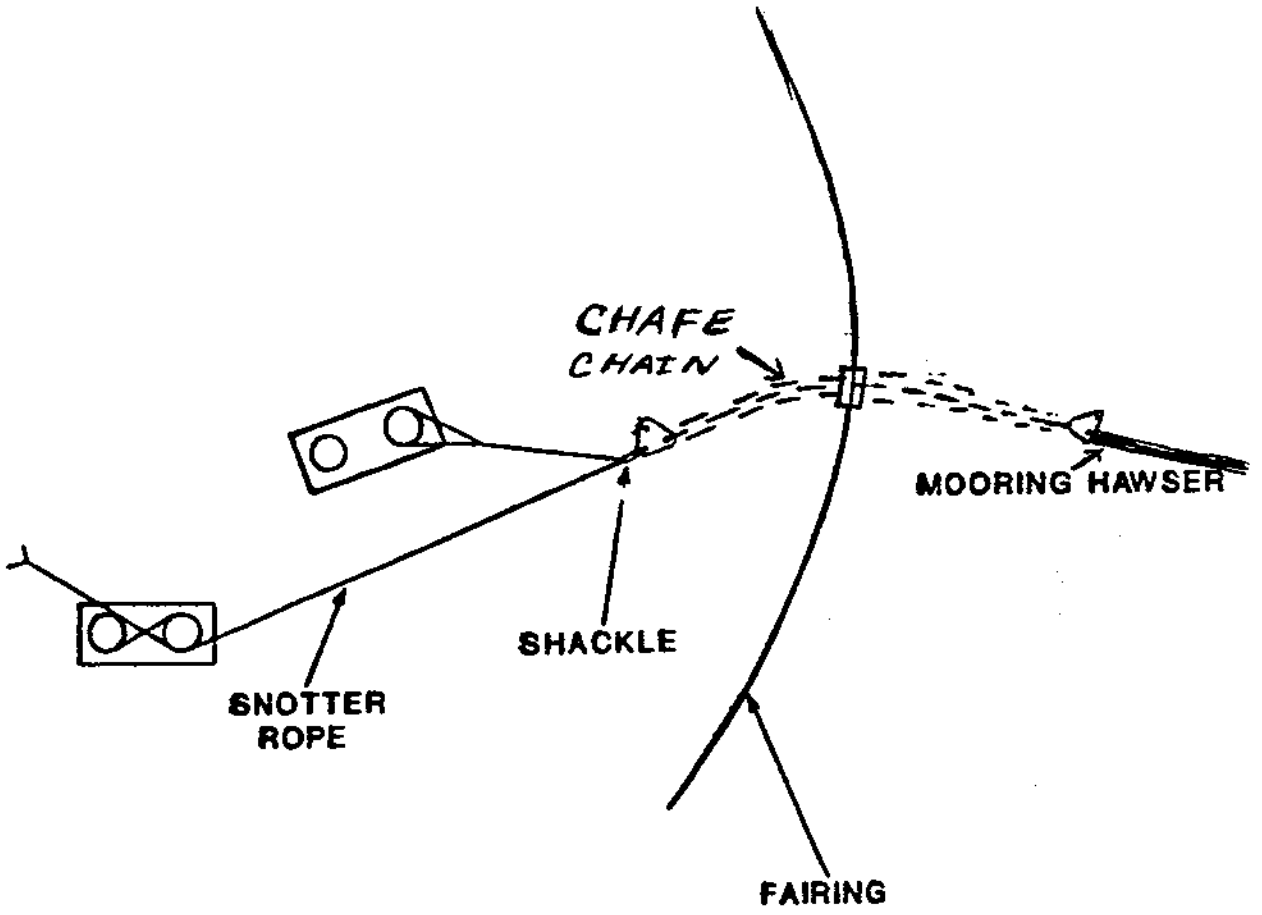
4.G. DESCRIPTION OF CARGO TRANSFER HOSES

The floating cargo hoses are attached between one of the projections on the buoy and the ship's manifold. Each hose section is 40 feet long with the entire string being 840 feet.





SPM Connection



VESSEL WITHOUT BOW CHAIN STOPPERS OR SMIT TYPE BRACKETS

The diameter of the hoses are as follows: Two black oil floating hoses are 16" in diameter, reduced to 12" over the rail; the dedicated bunker hose is 12" in diameter end to end. These cargo hoses are rated for a 225 psi working pressure and capable of a 34,000 barrels per hour discharge rate. They are constructed of heavy metal reinforced rubber with heavy flange type bolted connections. The connection to the buoy and to the ship's manifold is accomplished using a manual bolted connection. Two 16 inch cargo hoses were attached to the Exxon Houston at the time of breakaway.

Normal hookup procedure for the hose would call for an assist boat to bring the bitter end of the transfer hose to the ship's side beneath the manifold area. The bitter end would then be lifted to the manifold utilizing the ship's crane. After alignment of the cargo hose with the manifold by the use of slings and guide lines, 12 steel bolts are inserted through the flange holes and secured with nuts. Sufficient slack is maintained in the cargo hose loop to avoid unnecessary strain on the ship to hose connection.

When the SPM was initially installed in February of 1987, the system included camlock type quick connect/disconnect fittings to facilitate connections of the hose to ship's manifold. Shortly after the SPM installation, HIRI determined that these fittings were difficult to properly align and considered them to be a personnel hazard. As a substitute, they were replaced with manual bolted flange connections. Each bolted flange connection of the hose to the vessel would take approximately one half hour to rig or unrig in good weather conditions. No emergency disconnect system or procedures were in existence at the time of breakaway

4.H. SPM INSPECTION AND MAINTENANCE PROGRAM

Basic maintenance requirements are stated in "Hawaiian Independent Refinery Operations Manual" which was prepared by SOFEC, INC. at the time of the SPM delivery. A monthly inspection checklist was prepared by the Chief Mooring Master, Mr. [redacted] based on information contained in this manual, the Oil Companies International Marine Forum (OCIMF) "Standards for Equipment Employed in the Mooring Of Ships at Single Point Moorings" and other sources. The actual inspection of the buoy and all associated equipment was performed by Uaukewai Diving and Salvage Company which holds the maintenance contract for the SPM. This checklist is general in nature stating categories of equipment such as mooring assemblies. It does not list specific items of equipment such as chafe chains nor does it state

specific inspection procedures or maintenance to be performed nor any standard against which the equipment is to be evaluated. The most recent report that could be produced at the time of the hearing was 21 December 1988.

Neither Mr. [redacted] nor Mr. [redacted], employed by Uaukewai Diving and Salvage Co., could state what guidelines should be used to determine the suitability of the chafe chain upon examination. A visual examination was recorded on a monthly basis with the chafe chain given a more cursory visual examination at each mooring evolution and recorded on a form entitled "HIRI Marine Terminal SPM Status Report". Reference was made in testimony that calipers were used on the chain about two to three times a year to measure thickness, but that readings were not recorded. No length measurements were performed on the chafe chain to determine elongation since the chain was placed in service April of 1987. Neither Mr. [redacted] or Mr. [redacted] were aware of the OCIMF guidelines that recommend that a chafe chain be replaced when any chain link diameter is reduced, due to wear, to 90 % of its original diameter. HIRI was working on the supposition that the chain had a two-year life span prior to replacement. HIRI did have a program in effect to replace the mooring hawser every 7.5 to 8 months and snotter replacement after it had been used on 10 to 12 ship evolutions.

5. CASUALTY ASSESSMENT

The EXXON HOUSTCN arrived at the HIRI SPM on 01 March 1989 on voyage number 04 with approximately 480,000 barrels of Alaskan north slope crude and a little more than 4000 barrels of bunker oil after a 8 day transit from Valdez, Alaska. The vessel was secured to the mooring at 0642 on 1 March 1989 with the main steam propulsion plant on line. The cargo transfer began at approximately 1034 on 1 March 1989. The weather conditions at the time of mooring at the SPM were: winds out of the northeast at 11 to 16 kts, with partly cloudy skies and smooth to moderate sea state and ambient temperature of 68 degrees f. and barometric pressure of 1008 millibars (29.76" mercury).

Two work boats were used to run lines between the EXXON HOUSTON and the SPM buoy mooring system and assisted with handling and connecting the transfer hoses. On the morning of 1 March 1989, the NENE and another work boat, NAHIKU, provided assistance to the EXXON HOUSTON. After the tanker was secured to the SPM at 0642, the NAHIKU departed, leaving the 65-foot work boat, NENE, to standby during the cargo transfer and bunkering operations. Tugs may be used to assist maneuvering at the Mooring

Master's discretion. In this instance no tugboats were requested. HIRI policy required the NENE to remain with the ship throughout the period the tanker is in the berth and until it is safely unmoored from the SPM.

As part of the established HIRI procedures to secure a vessel to the SPM, the assigned Mooring Master is required to complete a detailed checklist to satisfy himself that the vessel is moored safely. After the EXXON HOUSTON was secured at the HIRI SPM, Mooring Master, Mr. [redacted], completed the required inspection which included specific attention to the mooring equipment. He then signed the Ship/Shore Safety Checklist. Mr. [redacted] was relieved by a second Mooring Master, Mr. [redacted], at about 1430 on March 1st. During the transfer of duties, Mr. [redacted] and Mr. [redacted] discussed the condition of the equipment and confirmed that there were no unusual circumstances concerning this mooring or cargo transfer operation. Mr. [redacted] departed the EXXON HOUSTON at approximately 1500 that afternoon.

During the cargo oil transfer operations, the EXXON HOUSTON maintained 8 to 12 rpms astern with no rudder to keep the mooring line taut and to keep the vessel off the buoy. The normal transfer time at the SPM is from 36 to 40 hours, depending on any shore induced delays, bunkering of the vessel, or crude oil washing of cargo tanks. Maximum discharge rates from crude tankers at 150 psi rail pressure is approximately 45,000 Barrels per hour. After filling HIRI shoreside crude oil storage tanks at 0140, 2 March, the vessel transfer operations were shutdown and preparations for fuel oil bunkering commenced. Vessel bunkering operations started at 0222 on the morning of 2 March and were concluded at about 0430 that morning.

During the afternoon hours of 2 March 1989, the EXXON HOUSTON was caught in a trough with the wind out of the southeast and swells coming from the southwest. Varying the astern rpms had no effect on getting the vessel out of the trough or reducing an approximate 5 degree roll. The Master and the HIRI Mooring Master, Mr. [redacted], decided to ballast the ship down to reduce the rolling induced by the vessel's position in the trough. This ballasting was never started because ship's personnel were committed to crude oil washing and stripping of a starboard cargo tank in preparation for later weld repairs of a small deck crack. This small deck crack was discovered during on-going transfer operations.

At 1715, the mooring chain parted at a point where it passed through the bullnose of the EXXON HOUSTON. The vessel separated from the SPM during heavy sea and weather conditions with the ship's head lying toward the shore. At the actual instant of

separation from the SPM, the propeller was turning 10 rpms astern. The chain and snotter line recoiled back and was found lying on the deck. No crew members actually witnessed the chain parting.

Just prior to the breakaway at approximately 1645, Mr. [redacted] conducted a visual examination of the mooring chain, looking for signs of wear, bright marks, scratches, etc. There were no signs of chain elongation or indications of wear noted. The mooring chain was observed coming out of the bullnose at about 90 degrees to the axis of the ship and appeared to be brought under considerable tension as the vessel rolled away from the SPM.

At the time of the breakaway (1715) from the SPM, the Master of the EXXON HOUSTON, Captain [redacted] was having his evening meal in the officer's mess. He was immediately notified by an unidentified crew member that the mooring line had parted. Captain [redacted] went directly to the bridge to determine the vessel's attitude with respect to the SPM and to assess the condition and position of the cargo transfer hoses. Within a minute after the separation, steering was shifted to bridge control from the engineroom.

The weather conditions at the time of separation were sea swells out of southeast at 8-12 feet and winds out of the south-southeast at 25-30 knots.

The Second Mate, [redacted], HIRI Mooring Master, [redacted] and Seamen, [redacted] arrived on the bridge within minutes to assist. Captain [redacted] first action was to try to keep the vessel heading in close to the SPM to keep from parting the HIRI floating hoses. This attempt was thwarted by the close working area, heavy weather and sea conditions. The maneuverability of the vessel was also hampered by the two cargo hoses, one of which was running beneath the bow of the ship. A position fix was established off Barber's Point light with a range off the beach of approximately 1.25 miles.

Upon becoming aware of the separation, [redacted] immediately called the work boat, NENE, and directed it to leave the Chevron Mooring Buoy located approximately one mile east, northeast of the HIRI SPM and provide assistance to the EXXON HOUSTON. He also called the HIRI shoreside pump house located in Campbell Industrial Park, Oahu, about two miles from the offshore tanker mooring. He told them to take a suction on the 30 inch crude oil line (attached to the 16-inch cargo line) to prevent oil from flowing into the water in the event of a hose rupture.

At 1725, one cargo hose parted near the port cargo oil midship manifold, approximately 20 feet below the surface of the water on the port side. A few minutes later (1728) the second cargo hose, trailing underneath the vessel from the port side to the starboard side separated at the SPM. A section of the SPM valve assembly was torn off, leaving the entire 840-foot length of the 16 inch diameter floating cargo hose attached to and running underneath the EXXON HOUSTON. At the time of hose failure, there was little cargo pumping in progress and approximately 90,000 barrels of crude oil remained aboard the vessel.

Captain [redacted] controlled the initial set of the vessel to shore through forward and astern engine commands and rudder shifts. His intent was to stabilize the ship's movement and attempt to increase maneuverability by removing the hose from underneath vessel. Just after the EXXON HOUSTON broke away from SPM, the Master had Mr. [redacted], Third Mate, at the vessel's foc'sle head making ready the starboard anchor. Upon hearing of preparation to drop the starboard anchor over his radio, the Mooring Master strongly advised against using an anchor while vessel was over submerged pipe lines of the HIRI Terminal and the Chevron Terminal. Captain [redacted] agreed and this attempt to anchor the vessel was aborted.

The NENE arrived on scene within fifteen minutes of breakaway and immediately put a line around the errant hose at a point approximately three quarters its length toward the submerged trailing end. The NENE's first attempt at attaching a 1{-inch nylon line to the hose failed when this line parted. At approximately 1735, a 2-inch poly line was then attached, and the NENE was successful in bringing the hose across from the starboard side to the port side of the EXXON HOUSTON. While no longer under the tankship, the hose continued to trail down the port side into the area of the propeller. The NENE finally gained control of the hose and maneuvered to prevent it from entering the area of the EXXON HOUSTON's stern. In order to proceed safely ahead, the EXXON HOUSTON had to go "dead slow" to permit the smaller and less powerful NENE, to keep the cumbersome cargo hose clear of the larger vessel's propeller. An increasingly turbulent sea state also inhibited the maneuverability and speed of these two vessels tethered by the cargo hose.

The EXXON HOUSTON continued to drift in a northeasterly direction toward the Chevron berth. The Mooring Master recommended that the Master drop an anchor as the vessel came into position about 300-400 yards due west of the Chevron berth. The Mooring Master's intent was to have Captain [redacted] secure the vessel temporarily at this deep water location clear of

underwater obstructions in order to get the hoses totally under control or removed from the vessel.

Immediately upon clearing the underwater pipelines, the starboard anchor was dropped on a short scope of 90 feet at 1740. This attempt at using the starboard anchor to stabilize the position of the vessel was not successful. The anchor did not immediately grab the bottom and the vessel continued to drift. With the anchor dragging the EXXON HOUSTON was in danger of drifting into HIRI and Chevron buoys.

At 1747 it became apparent that the vessel was not holding its position and the stern was indeed swinging towards the beach. The anchor was raised and astern propulsion was used to back the ship away from the beach. The raising of the starboard anchor was initially hampered when it became entangled with the trailing cargo hose drifting over from the port side. The anchor was quickly relowered to free the hose and then raised into position out of the water.

The EXXON HOUSTON's bow was pointing toward the shoreline and the vessel was drifting in a westerly direction against the wind. At this point, the Mooring Master recommended that the Master maneuver the EXXON HOUSTON to one of the designated vessel anchorages off Barber's Point. Captain [redacted] acknowledged that he preferred to get rid of the cargo hose first and would continue to provide a port lee to minimize the sea turbulence for the NENE to assist in this removal. Captain [redacted] continued "back and fill" maneuvers to provide a lee and to maintain a relative position in safe deep waters outside an established reference grounding line.

Captain [redacted] established a .5 mile grounding line by making a visual reference to his charts. This grounding line was marked on the bridge radar screens and provided an approximate boundary beyond which adequate water depths existed. By monitoring the westerly advance of the EXXON HOUSTON through a radar plot and by keeping the relative position of the vessel to the seaward side of this line, Captain [redacted] felt his vessel would be in safe waters. As indicated on the navigational charts of this area, the shoreline beyond Barber's Point turns abruptly toward the north and the water depths increase dramatically as you proceed westward.

At 1752, the U.S Coast Guard Joint Rescue Coordination Center (JRCC), Honolulu, Hawaii, established communications with the EXXON HOUSTON via MARISAT (Marine Satellite communications network). Captain [redacted] advised that the engine was on-line, the vessel was backing away from the SPM, and that Coast Guard

assistance was not required. The ship's radio officer advised the Coast Guard that he was not aware of any oil being spilled into the water. Captain [redacted] passed that he would contact Coast Guard Group Honolulu via Ch 16 VHF-FM if the situation changed. Honolulu JRCC initiated contact with the EXXON HOUSTON was precipitated by a telephone report from HIRI's shoreside terminal to Marine Safety Office Honolulu indicating that the Mooring Master had reported that the vessel had separated from the SPM.

Until his vessel had actually gone aground, Captain [redacted] did not consider that the EXXON HOUSTON was in danger, and was confident that he was always in control of the vessel and therefore, did not require any outside assistance.

With the hoses still connected to the vessel, the Mooring Master felt that somewhere between 1800 and 1815 the vessel had been worked out to safe water. Vessel logs indicate that at 1810 EXXON HOUSTON was clear of sea berth area, buoy and hoses, backing to open water. She was essentially right on the line of the ship making a normal approach to the buoy with a current flowing to the west. Once the cargo hose had been brought around on the port side, the vessel regained maneuverability within speed limitations imposed by the trailing hose and capabilities of attending work boat, NENE. Though somewhat restricted, the EXXON HOUSTON had her rudder and her screw available and could be steamed forward or astern in whatever direction the Master wanted to go.

The operator of the NENE, [redacted], radioed the Mooring Master and recommended that the trailing end of the floating cargo hose be winched aboard the EXXON HOUSTON. This would eliminate the possibility of the hose running aft under the vessel's stern, causing damage to the rudder or propeller. The Mooring Master did not accept this recommendation and said that Captain [redacted] anted the hose unbolted and removed from his vessel.

At approximately 1830, Captain [redacted] and [redacted] determined visually that the trailing end of the cargo hose was apparently under limited control of the NENE, and the EXXON HOUSTON was in safe water about 400-500 yards due west of the HIRI SPM. [redacted] departed the bridge to assist with the removal of the cargo hose at this time.

With the Mooring Master supervising and the Chief Mate in charge, the cargo hose was unbolted from the cargo manifold, disconnected, capped, and raised with the ship's 5-ton crane to be lowered over the port rail. This one and a half hour evolution was completed at approximately 1930 and the hose was prepared to be lowered into the sea with a slip line. The NENE, which had a

line on the hose, inadvertently pulled the hose taut, and the crane topppled onto the main deck. The hose was pulled free and completely removed and clear of the vessel at approximately 1935.

After the EXXON HOUSTON was released from the trailing cargo hose, [redacted] and the deck crew turned their efforts toward securing the toppled crane. The loose crane posed a personnel hazard as it swung freely about the deck. at approximately 1945 the crane had been lashed down and the Mooring Master stowed his equipment and prepared to return to the bridge.

During this entire hose removal procedure, there were radio communications between the EXXON HOUSTON bridge and the NENE cautioning the NENE to keep the hose away from the ship' stern. During the 2 hours and 51 minutes after the EXXON HOUSTON separated from the SPM until it was aground at 2006, radio communications with the NENE were unreliable. Frequently, the EXXON HOUSTON had difficulty raising the NENE on either Ch 16 or the working Ch 9, and had to resort to whistle blasts to get her attention. The operator of the NENE, Mr [redacted] was often too busy handling his vessel and the hose to answer EXXON HOUSTON radio communications. He was not aware of any whistle blasts or other signals from the EXXON HOUSTON directing the NENE's movements.

As a result of the 5-ton crane toppling, the crane operator, [redacted] was injured. After Mr. [redacted] was removed from the crane and taken to his quarters, Captain [redacted] sent his Second Mate, [redacted] to assist shortly after 1948. Mr. [redacted] was trained in first responder medical treatment and the Master felt that Mr. [redacted] required immediate medical evaluation and possible treatment. Also, Captain [redacted] felt that Mr. [redacted] absence from the bridge would be of minimal consequence to the safety of the vessel. His departure from the bridge left the Master alone with Mr. [redacted] at the helm. After a brief physical examination, Mr. [redacted] prognosis was that although there didn't appear to be any significant physical injuries, Mr. [redacted] was possibly going into shock and required preventive treatment and oxygen. Mr. [redacted] remained with Mr. [redacted] to administer aid and was absent from the bridge when the EXXON HOUSTON grounded.

The Third Mate, [redacted], was summoned to the bridge by Captain [redacted] arriving there at about 2002. Captain [redacted] immediately requested that Mr. [redacted] establish and plot a fix of the vessel's position. He attained a bearing of 081 degrees off Barber's Point light with a range of .65 miles and established a 2004 plot on Chart No. 19357 at 21 degrees 17.87 minutes N, 158 degrees 0.7 minutes W. Mr. [redacted] immediately

recognized from the vessel's plotted position that it was in close proximity to a reef in shallow waters. He immediately advised the Master. Approximately a minute later Captain [redacted] gave the command half ahead and directed the helmsman to come right. The Master ran over and looked at the fix and a few seconds later at 2005.5 ordered a full ahead with hard right rudder and course heading of 165 degrees. At 2006 the EXXON HOUSTON touched bottom and grounded.

From 1830 until the trailing hose was finally removed at approximately 1935, Captain [redacted] continued "back and fill" maneuvers to maintain a safe distance offshore. The Master felt that he could not get further offshore using ahead propulsion without the risk of running over the hose. He therefore resorted to astern power to maintain his relative position and continue down the coast in a westerly direction away from the island as the shoreline turned toward the north beyond Barber's Point. The Master was convinced that as long as he did not bring the EXXON HOUSTON closer than .5 mile to the shore, it would be in safe waters.

After the 1715 breakaway position, five position fixes were taken at 1740, 1747, 1803, 1820, and 1830 and recorded on Chart 19362. These navigational fixes provided sound evidence that Captain [redacted] was indeed bringing the vessel into deeper waters.

Shortly after the 1830 fix placed the vessel's position at 20 degrees 16.89 minutes North, 158 degrees 06.74 minutes West, on Navigation Chart No. 19362, Captain [redacted] transferred to Chart No. 19357. Any further movement of the vessel westward beyond the established 1830 position would place it off the left hand margin limits of Chart 19362. Chart 19357 provided less detail with fewer depth soundings, and Captain [redacted] felt it was difficult to establish a good grounding line off the smaller scale chart.

DESCRIPTION OF CHARTS

A. CHART 19362 - South Coast of Oahu
Ahua Point to Barber's Point
Mercator Projection
Soundings in Fathoms - Scale 1:20,000
Inch to Nautical Mile: 3.65

U.S. Department of Commerce
National Oceanic And Atmospheric Administration
National Ocean Survey

B. CHART 19357 - Island of Oahu
Mercator Projection
Soundings in Fathoms - Scale 1:80,000
Inch to Nautical Mile: 0.91

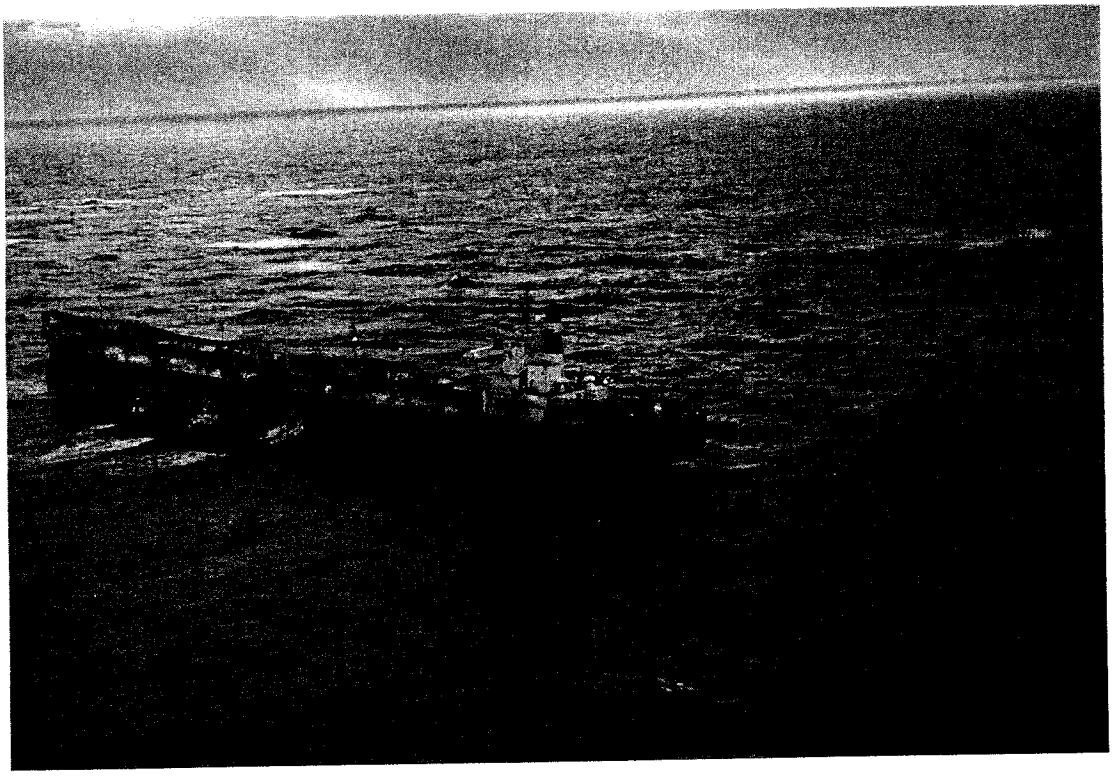
U.S. Department of Commerce
National Oceanic And Atmospheric Administration
National Ocean Survey

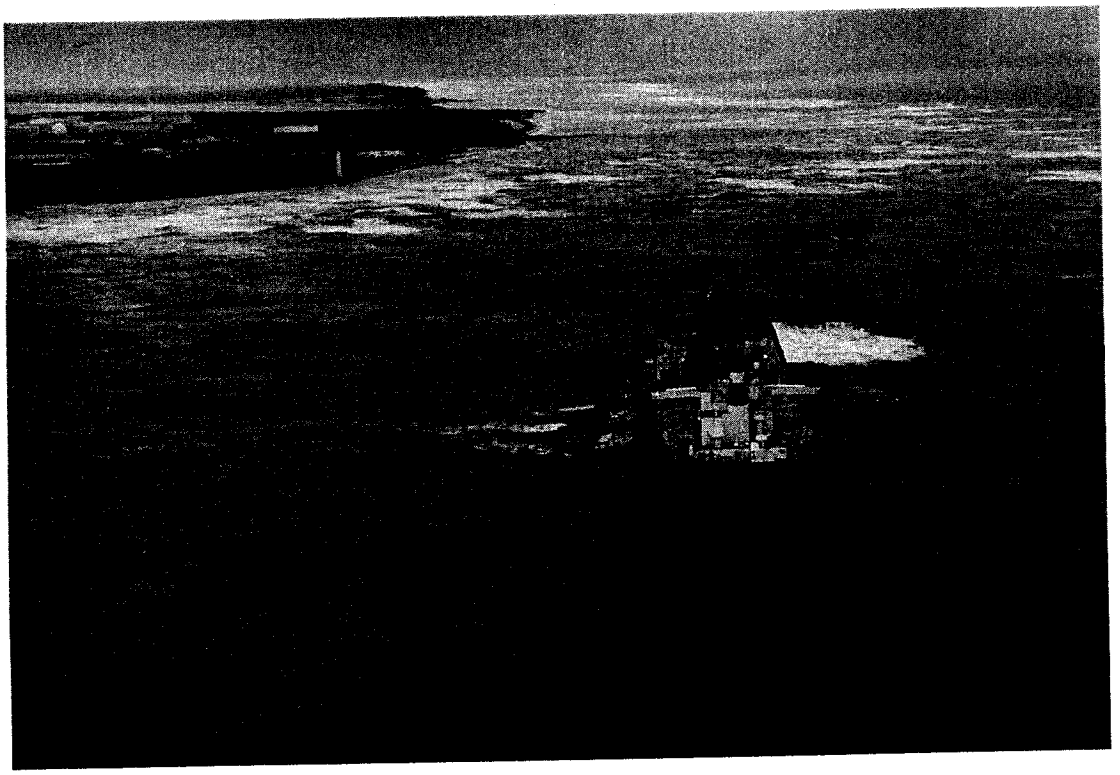
When the Master switched charts, his final 1830 fix plotted on Chart 19362 was not carried over and plotted on the new less detailed 19357 Chart.

Using the piloting technique of "Parallel Indexing" to rapidly determine relative position off the shore using a radar range, the Master continued his "back and fill" approach. Both Captain [redacted] and the Second Mate, using two separate radar sets and applying the same grounding line criteria, verified that the vessel was in safe waters. Captain [redacted] felt that considering all the activity on the bridge with regard to navigating the vessel, communications, and attending to the trailing cargo hose, that the "Parallel Indexing" procedure was more satisfactory than taking more accurate, but time-consuming fixes. Also, because the chart area was separated from the bridge wheelhouse and communications equipment, the ability to plot vessel positions on charts was deemed time consuming and imprudent. Therefore, no bearing fixes were taken or plotted between 1830 and 2004. The Master added that at the time, he didn't feel that he needed additional information since his margin (distance from grounding line) was safe enough and increasing.

Captain [redacted] was gravely concerned that the attached hose would drift underneath the vessel and possibly foul or damage the propeller and the rudder. Opinions differed concerning the actual potential for the hose getting enmeshed with the propeller or rudder and causing damage severe enough to impede or totally disable the EXXON HOUSTON. The Master felt the trailing hose posed a real threat and he maneuvered the vessel accordingly. Captain [redacted] continued to maneuver his ship in an attempt to provide a lee for safe removal of transfer hose section.

Once the cargo hose was pulled free with the assistance of the NENE at 1945, the Master attempted to go half ahead and swing the vessel's bow away from shore, while limiting vessel's advance. In this ahead mode (with no effect from the wind and seas) the vessel was calculated to assume a side transfer movement of approximately 1200-1500 feet. Captain [redacted] intent was to then power the EXXON HOUSTON away from shore as the vessel





EXXON HOUSTON - AGROUND BARBER'S POINT, 3 MARCH 1989

PHOTO BY - CCGD14(dpa)

came around Barber's Point. He felt that by continued backing into the wind, the vessel would just be holding its own without moving the ship further out to sea. The option of swinging the bow away from the shoreline and using ahead engines would provide an additional 40 rpm. At 1955, Captain [redacted] requested full ahead power to increase the rate of turn and he felt the vessel was turning in position to head out to sea.

As the EXXON HOUSTON came around Barber's Point, it drifted towards the north, closer along the coast then anticipated. The intensifying weather conditions had reached 12 foot seas with winds at 35 knots out of the south/southeast with a swell out of the southwest.

The EXXON HOUSTON ran aground at 2006 on 2 March 1989, at 21 degrees 17.8 minutes North, 158 degrees 07.3 minutes West, approximately .5 miles off Barber's Point, Oahu, Hawaii.

6. CHAIN FAILURE ANALYSIS

As stated, the chafe chain parted at 1715, 2 March 1989. The last time prior to the breakway that the chain was checked occurred between 1630 and 1645 on 2 March 1989. This inspection was performed by Mr. [redacted] and the chafe chain was tending at close to a 90 degree angle through the bullnose. As the vessel worked in a trough condition, the chain would fall away from the side of the bullnose and then snap back against the side. The chain was experiencing a combination of a bending movement, impact loading and tensile strain at the time of Mr. [redacted] inspection.

The chafe chain in use on 2 March 1989 was ordered by HIRI, based on specifications provided by SOFEC, INC. and purchased through Werth Engineering as agent for Bridon Fibres, LTD. The chain was manufactured by Griffen-Woodhouse, LTD. of Cradley Heath, West Midlands, England. The subject chain was tested by the American Bureau of Shipping (ABS) and is the subject of an ABS report dated September 23, 1986 (Report No. 86-LP19940). This chain is defined as a type C, OCIMF integral stud link chain manufactured of ANSI 8630 steel. It is a 54 mm chain, 12.5 ft long with 11 links of chain. One end has a Kenter Shackle attached to allow connection to a 76 mm section of chain. The other end has a triangle plate attached which allows connection of a pickup line and attachment of the snotter.

The chain parted at link No. 10 near the stud and that portion sprung back and remained on the vessel's foc'sle. Link (No. 11) and the Kenter Shackle remained attached to the 76 mm portion to the chafe chain and fell into the water. Visual

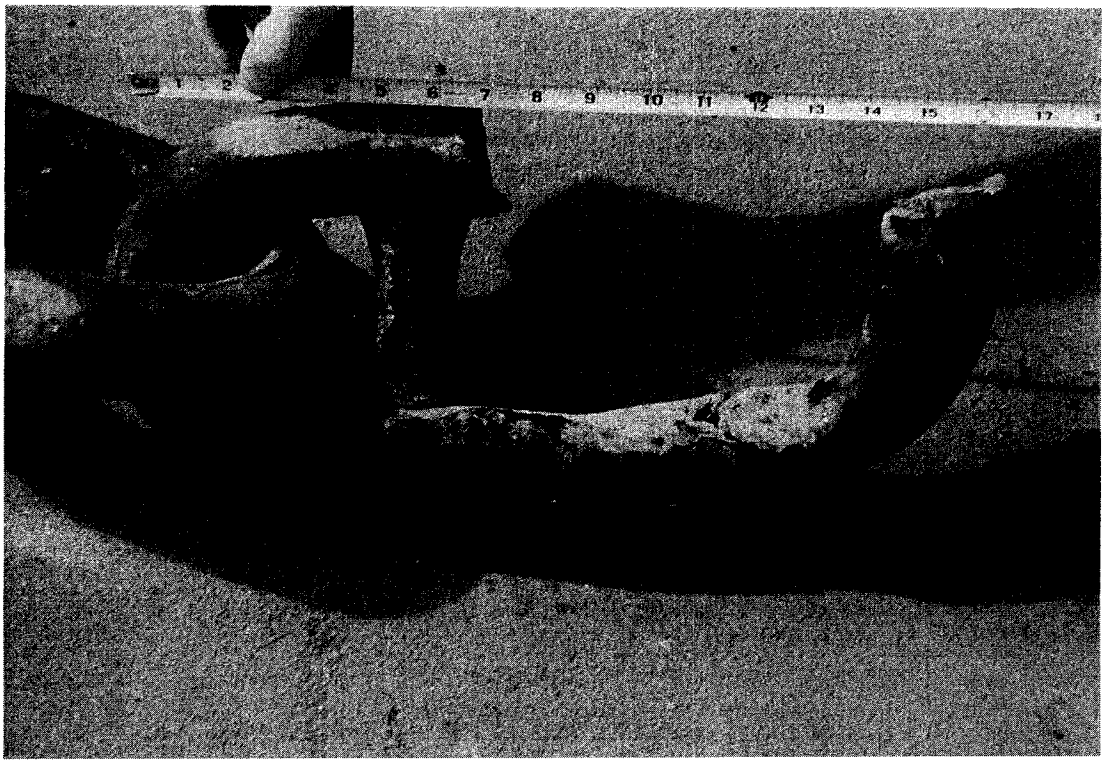
examination of the chain links revealed wear patterns at the end some of the links which indicated that the chain had experienced a considerable load during service resulting in a mushrooming effect. The bullnose of the Exxon Houston also showed evidence of wear, such as would be produced by a chain link rubbing against the surface.

Both sections of the chain were retained for testing. Link 1 thru 10 remained onboard the Houston and the remainder was stored at the HIRI shoreside refinery. The Kenter Shackle was cut by HIRI personnel to separate it from the 76 mm chain and together with the 10 links and triangle plate sent to Anamet Laboratories, Hayward, California where they were received on 10 April 1989. Testing of this chain was conducted 4-6 May 1989 and the test results published in Anamet Laboratory Report No. 489.089 on 15 August 1989. This report detailed the testing protocol and test results, but did not address an analysis of these results. The U. S. Coast Guard commissioned Anamet to study these test results and to give their best professional opinion as to why the chain failed. This analysis is contained in Anamet Lab Report No. 889.102 dated 30 August 1989. The two principle parties in this incident also commissioned independent interpretation of the test results. HIRI commissioned Material Testing Laboratories of Honolulu, Hawaii and Exxon Shipping Co. utilized Failure Analysis Associates of Los Angeles, California.

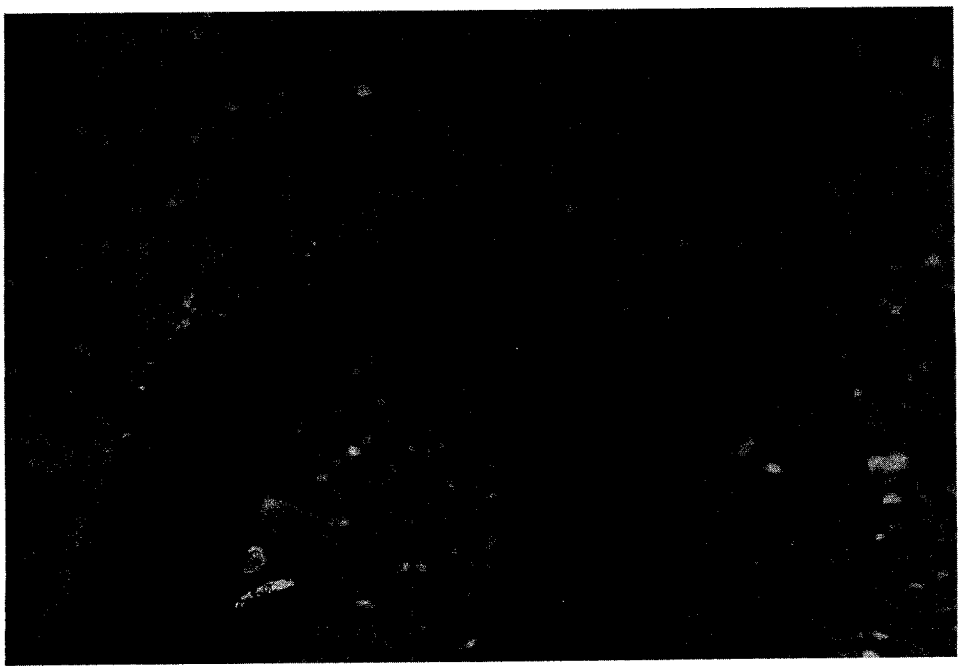
Each laboratory used the test results contained in Anamet Laboratory Report No. 489.089 to formulate their analysis. Representatives of each party in interest, each laboratory and the U. S. Coast Guard attended the testing conducted in May 1989 and agreed to the protocol of testing.

Review of the three reports exhibited some difference of opinion as to what various test results proved. Anamet Laboratories concluded and the other two reports agreed in somewhat different terminology the following:

"It is concluded that the failure of link No. 10 in the mooring chain was due to the defects in the weld and to the poor properties exhibited by the base metal immediately adjacent to the weld. The poor properties of the base metal are attributed to the forging design which caused the material to be loaded, effectively, in the transverse direction. The transverse properties, ductility and strength of steels such as used here are undoubtedly lower than the longitudinal properties measured in the tensile test. The defects left in the weld are caused by inadequate ejection of molten metal during the welding process and suggest that a redesign of the weld cycle is warranted."



LINK NO. 10 OF FAILED CHAFE CHAIN. THIS LINK REMAINED ON BOARD EXXON HUSTON AFTER SEPARATION. PHOTO TAKEN BY LT [redacted] ON 5 MARCH 1989. EXHIBIT NO. 41



LINK NO. 11 OF FAILED CHAFE CHAIN. THIS LINK REMAINED ATTACHED TO THE SECTION OF MOORING SYSTEM LEADING TO THE BUOY. PHOTO TAKEN BY PO [redacted] CCGD14(dpa) ON 8 MARCH 1989. EXHIBIT NO. 39

Proof testing of chain at the time of manufacture to meet American Bureau of Shipping specifications are basically a tensile test with longitudinal pull being applied. This test may not be sufficient to predict subsequent performance in the field were transverse forces may be applied. The visually noted mushrooming or cupping at the mating surfaces of the chain links is an indication of reduced service life, but in this particular case did not effect the tensile strength of the chain. All of the analysis reports pointed to the fact that the failure of link 10 was virtually instantaneous due to the brittle nature of the weld. Due to manufacturing defects and method of fabrication found in this chafe chain, it can be assumed that the strength characteristics were both "unpredictable" and" impossible to detect the progression of the failure". Normal anchor chain in most applications is only subject to longitudinal tension whereas chafe chain used in offshore mooring applications has the additional stress applied by bending and twisting.

A study conducted by the OCIMF concluded that chain, when subject to transverse loading, has reduced strength characteristics. The chafe chain on the Exxon Houston just prior to breakaway was leading at approximately 90 degrees from the bow to the buoy and was also slapping the side of the bullnose. The combination of stresses on the chain could lead to failure below load rating.

7. FACILITY VISITS

Visits to other similar offshore mooring installations were considered necessary in order to broaden the Marine Board's knowledge of offshore moorings. A representative of this Marine Board visited LOOP, Inc., New Orleans, La. on 29 September 1989 and Refineria Dominicana de Petroleo, Santa Domingo, R.D. on 14/15 October 1989. These facilities were chosen upon recommendation of SOFEC, INC. due to similarity to HIRI operations and common manufacture. Furthermore, extensive telephone conversations were conducted with other offshore facilities.

Several points of interest developed during the course of these visits and phone conversations.

a. Chafe chains are brought ashore for a monthly inspection where they are measured and visually inspected. This inspection is recorded and at one facility the normal service life of chafe chains prior to replacement is 6-8 months.

b. One facility had experience with hoses being drawn into ship's propellers. No damage to the vessel's steering or propeller blades was noted.

c. Several facilities agreed that upon breakaway, prevention of grounding or collision was the first priority. Anchoring, regardless of pipeline location was the desired action if a vessel could not proceed to sea due to maneuverability problems.

d. Two facilities used 2 separate mooring hawsers for each vessel. Each mooring hawser utilized the 76 mm chafe chain regardless of tanker size.

e. One facility utilized brass bolts for the flange connection to the manifold with a procedure to break the bolts and trip retaining lines holding the cargo hose from a safe distance. This procedure has been pretested with satisfactory results and could be utilized for emergency cargo hose disconnect.

f. One facility successfully utilizes automatic hose disconnects. This connection is placed between two lengths of cargo hose and operates on spring tension arrangement that separates the hoses from each other at a preset load and automatically closes valves on each hose end to prevent spillage.

g. One facility Operations Manual calls for the use of strain measuring devices on the mooring arrangement and audio/visual alarms when the system is approaching a preset safe working load. Another facility had a hawser load monitoring system installed with strain gauges mounted on the mooring coupler to the buoy.

h. One facility requires a 24 hour facility provided deck watch to assist the mooring master while the vessel is moored at the offshore port.

It should be noted that one facility was approximately 5 miles offshore and that another was 20 miles offshore.

8. STRUCTURAL DAMAGE TO EXXON HOUSTON

Upon grounding of the vessel, the only immediately detectable damage was in the way of the Port Bunker Tank which was leaking bunker oil to the sea and in the engine room double bottoms in the vicinity of the main condenser sea chest. The surveys conducted after freeing the vessel revealed extensive damage in the No. 3 Port Cargo Tank and No. 5 Starboard Cargo Tank. In

addition, several indented areas in scattered areas of the bottom plate with related framing damage was discovered. Based on the age and condition of the vessel, the Exxon Houston was determined to be a constructive total loss.

9. OIL SPILL AS A RESULT OF THIS MARINE CASUALTY

When the cargo hoses parted, approximately 400 barrels of Alaskan crude oil entered the water off Barber's Point, Hawaii. Upon grounding of the vessel, the Port Bunker Tank was punctured and approximately 200 barrels of No. 6 Bunker oil entered the water. The bulk of the crude oil was taken offshore by prevailing currents and dissipated. The bunker oil impacted the beaches in the area of Barber's Point and was cleaned up by crews hired by Exxon Corporation. The U.S Coast Guard Captain of the Port, Honolulu, Hawaii, was the federally designated On Scene Coordinator and directed the response and investigation of these spills.

CONCLUSIONS

1. HIRI did not inspect the chafe chain in accordance with standards established by OCIMF. Inspections were basically visual in nature with an occasional use of calipers to measure wear on the chain links. Records did not confirm specific inspection of the chafe chain and were not up-to-date.

2. HIRI had no specific written contingency plans or directives on actions to be taken in response to the approach of heavy weather or other emergency conditions.

3. HIRI had no written emergency procedures for a vessel breaking away from the SPM. The company did not consider all available equipment and procedures which would assist in a breakaway situation. Such items could include various types of manifold to hose quick connect/disconnect systems, emergency hose coupling breakaway systems, and other emergency ship-to-mooring breakaway systems.

4. HIRI removed camlock type quick connect/disconnect fittings on the manifold to hose connections shortly after the SPM installation and did not replace these fittings with devices or procedures offering equivalent levels of safety. Providing an additional bolt type spool piece connected to the cargo hose by a quick release type fitting may have eliminated alignment problems at the ship's manifold, while ensuring emergency quick release capability.

5. The EXXON HOUSTON was moored on a 54mm chafe chain which was designed to hold up to a 100,000 DWT tankship.

6. The trim condition of the EXXON HOUSTON at the time of breakaway exceeded that recommended by HIRI guidance. This lack of ballast and improper trim aggrevated the rolling moment of the vessel and contributed to a higher level of stress on the mooring system.

7. The EXXON HOUSTON, just prior to breakaway, was held in a trough due to existing weather conditions. This caused the chafe chain to ride at approximately a 90 degree angle from the bow of the vessel to the mooring buoy. This sharp angle induced significant transverse stress forces on the chain at the ship's bullnose.

8. Weather and sea conditions existing on 2 March 1989 were approaching the environmental design limitations of the SPM buoy.

9. The Mooring Master inadvertently misinformed the Master of the EXXON HOUSTON as to the maximum sea and weather conditions vessels moored to the SPM could safely encounter. This inaccurate information could have led to a false assessment of the safety of the moored vessel.

10. It could not be determined if the tensile strength of the chafe chain had been exceeded at the time of the breakaway. All available means to assess the effects of weather on related SPM equipment were not employed. The use of mooring tension monitors may have assisted in determining inordinate stresses on the mooring equipment.

11. The actual breakaway from the SPM was caused by the separation of Link No. 10 in the 54mm portion of the chafe chain.

12. Analysis of the failed chafe chain indicated that weld defects and possible improper manufacturing procedures and design contributed to the chain separation.

13. The chafe chain as tested met the specifications of the American Bureau of Shipping, ABS, for mooring chain. This ABS standard used for conventional mooring chains may not be adequate to account for the various dynamic forces encountered by chafe chains used for SPM mooring applications.

14. Two 16-inch cargo hoses separated shortly after the breakaway. This resulted in approximately 400 barrels of Alaskan North Slope crude oil being discharged into the navigable waters of the United States.

15. The Master's concern for both the possibility of the trailing cargo hose damaging his vessel and it's removal limited the options he was willing to exercise to maneuver his vessel to safety.

16. Shortly after breakaway, the Master declined assistance and did not subsequently request assistance because he was confident that he had the situation fully under control.

17. The Master did not report to the U.S. Coast Guard JRCC that the maneuverability of the EXXON HOUSTON was encumbered by the trailing 840 foot cargo hose.

18. The U.S. Coast Guard did not initiate any on-scene response action to confirm whether the EXXON HOUSTON was in danger or that pollution occurred upon being notified of the vessel breaking off the SPM.

19. The captain of the NENE's suggestion to bring the trailing end of the cargo hose onto the deck of the EXXON HOUSTON could have provided the EXXON HOUSTON with greater maneuverability.

20. The Master of the EXXON HOUSTON chose not to anchor his vessel nor continue to maneuver to deeper and less confined waters because of his primary intent to remove the cargo hose from his vessel.

21. Under the existing sea state and vessel trim and freeboard conditions, the plotted positions between 1715 and 1830 indicate that the vessel had sufficient backing power and maneuverability to proceed to deeper water, even with the cargo hose attached.

22. The Master's decision to provide a lee for the removal of the cargo hose kept his vessel oriented broad to the wind, in a position relatively close to the shoreline.

23. The Master failed to establish a safe grounding line for his vessel and did not transfer his last plotted 1830 position when he changed to a less detailed chart as his vessel worked in a westerly direction past Barber's Point.

24. The increased sail area caused by the vessel's improper ballast condition existing at breakaway restricted the Master's ability to maneuver with prevailing winds.

25. Communications difficulties between the EXXON HOUSTON and the NENE created coordination problems which resulted in excessive strain on the cargo hose, causing the crane to topple. The crane operator, [redacted] although badly shaken, was not incapacitated in excess of seventy-two hours.

26. The communications procedures and lines of authority between the Master, the Mooring Master and the captain of the NENE were not properly followed. This created problems with communications between the EXXON HOUSTON and the NENE during the hose disconnect process.

27. Once the Master committed himself to the use of the smaller and lesser horsepowered NENE to secure the trailing cargo hose, the EXXON HOUSTON's maneuverability was further restricted.

28. The Master transferred to Navigational Chart No. 19357, which, while showing the reef upon which the EXXON HOUSTON grounded, had reduced detail compared to the previously plotted Chart No. 19362.

29. The location of the SPM subjects it to heavy weather and sea conditions and variable and shifting surface and subsurface currents. The close proximity of the SPM to the shore and shallow waters contributed to the vessel grounding. The SPM is relatively remote from available tug assistance.

30. Upon grounding, the EXXON HOUSTON punctured its port bunker tank and discharged approximately 200 barrels of No. 6 bunker oil into the navigable waters of the United States.

31. Available manning (crew complement) aboard the EXXON HOUSTON was in accordance with U.S. Coat Guard regulations as stated on the current Certificate of Inspection. This manning level was considered adequate to operate the vessel. The work boat, NENE, was considered adequately manned during the period of this incident.

32. All equipment on board the EXXON HOUSTON and the NENE was adequate and in good operating condition.

33. The breakaway from the SPM, which left the entire 840 foot cargo hose attached to the EXXON HOUSTON, contributed to the vessel's subsequent grounding.

34. The Master's concern for maneuvering the EXXON HOUSTON to facilitate removal of cargo hose contributed to the vessel's grounding.

35. The cause of the grounding of the EXXON HOUSTON on 2 March 1989 was the Master's maneuvering of the vessel without accurate and recorded fixes to determine his position. Five fixes using radar ranges and visual bearings were taken during the initial 1 hour and 15 minutes after breakaway to establish an accurate vessel position. Only one additional navigational fix was plotted during the 1 hour and 36 minute period (from 1830 until the vessel grounded at 2006) and that fix was taken at 2004 just prior to grounding.

36. The failure of the Master of the EXXON HOUSTON, [redacted] to adequately fix the position, is considered negligent action. His failure to transfer his 1830 position onto the new chart and to establish a valid grounding line constitute misconduct. This matter has been referred to the Commander, Fourteenth Coast Guard District for appropriate action.

37. There is no evidence that Mr. [redacted] testimony was false other than he fact that he did not have a U.S. Coast Guard license and the copy of the license presented to this board was a photo copy of a license altered to appear as one issued to him.

RECOMMENDATIONS

1. Offshore mooring facilities, particularly HIRI, should conduct research into the availability of a mooring chafe chain that is more suitable for its intended use.

2. HIRI should conduct periodic inspections of the chafe chain to existing standards and maintain accurate detailed records of inspection results.

3. OCIMF, or another recognized organization, should conduct research into establishing more specific maintenance and inspection procedures for SPM chafe chains which may include appropriate nondestructive testing and other measurement techniques. Standards should be developed to account for the unique stresses and demands placed on SPM chafe chains.

4. HIRI should publish adequate contingency plans to cover appropriate response actions to be taken in the event of approaching heavy weather at the SPM, other casualties (i.e., fire, collision, etc.) requiring an emergency breakaway from the SPM or other assistance.

5. HIRI should provide a means of rapid cargo hose removal and mooring line release to ensure emergency separation of a tankship from the SPM and cargo hoses.

6. Written guidance should be provided to each tanker Master at the HIRI SPM regarding weather, sea state, and SPM equipment operating limitations.

7. HIRI should consider the installation of mooring system tension monitors.

8. HIRI should institute emergency response procedures which require that tug assistance will be requested by the vessel Master immediately upon a breakaway from the SPM.

9. The U.S. Coast Guard should review response policies and procedures regarding on-scene verification of vessel breakaways from offshore oil transfer terminals.

10. HIRI should adopt specific procedures to clarify communications and review communications equipment capabilities between tankers moored at SPM and attending work boats.

11. HIRI's personnel responsible for the determination of fitness of future employees should obtain the proper documentation to substantiate hiring requirements and initiate a program to insure employees keep appropriate mariner's licenses current.

12. The U.S. Coast Guard should initiate a study to determine the need for promulgating a regulatory package addressing the design, construction, installation, operation, maintenance, and inspection of Single Point Mooring systems.

13. The U.S. Coast Guard should request that the National Oceanography and Atmospheric Administration, NOAA, prepare a larger scale chart to replace the current Chart NO. 19357 for the waters in the vicinity of Barber's Point.

14. A copy of the final EXXON HOUSTON Marine Casualty Report should be forwarded to OCIMF, NOAA, SOFEC, and the American Bureau of Shipping, ABS.

15. No further actions be taken and this investigation be closed.

[redacted]

W. O. ESCHENBURG, Captain, U. S. Coast Guard
Chairman

[redacted]

G. W. ABRAMS, Commander, U. S. Coast Guard
Member

[redacted]

E. H. OLSSON, Lieutenant Commander, U. S. Coast Guard
Member and Recorder