PB92-916401
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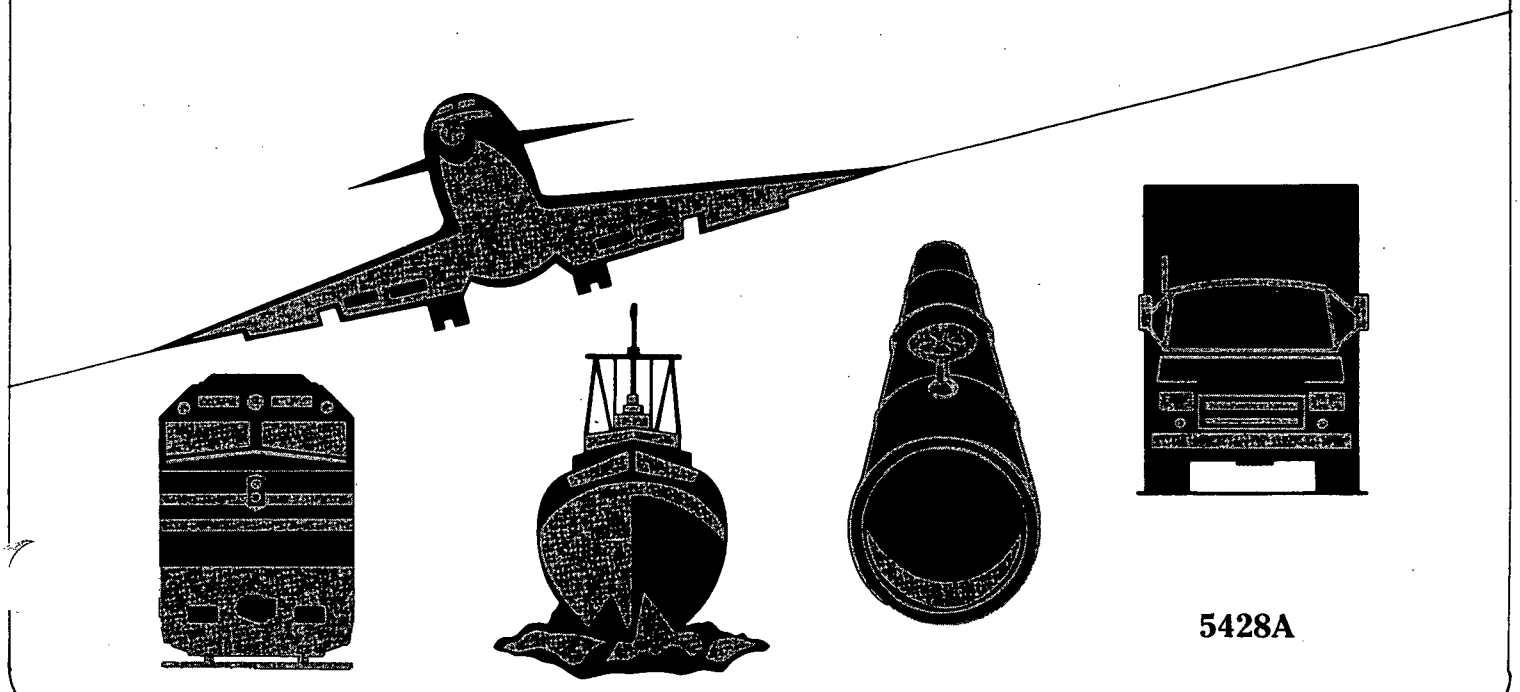
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

GROUNDING OF THE U.S. TANK SHIP STAR CONNECTICUT PACIFIC OCEAN, NEAR BARBERS POINT, HAWAII NOVEMBER 6, 1990



5428A

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ADOPTED: JANUARY 7, 1992

NOTATION 5428A

Abstract: This report explains the grounding of the U.S. tank ship STAR CONNECTICUT, in the Pacific Ocean, near Barbers Point, Hawaii, on November 6, 1990. The safety issues discussed are: Federal pilotage requirements at offshore oil transfer facilities; adequacy of vessel operating procedures for departing from the spm buoy at Barbers Point, Hawaii; need for regulations governing the operation of offshore oil transfer facilities within the United States' territorial sea similar to those which regulate the operation of deepwater ports (33 CFR 148-150); and bridge resource management training for deck watch officers of U.S.-flag vessels of more than 1,600 gross tons.

The National Transportation Safety Board made safety recommendations addressing these isssues to the U.S. Coast Guard, the Hawaiian Independent Refineries, Inc., and the Texaxo Marine Services, Inc. The Safety Board also reiterated one safety recommendation to the Coast Guard.

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EXECUTIVE SUMMARY

On November 6, 1990, the 723-foot-long U.S. tank ship STAR CONNECTICUT completed cargo loading operations and began unmooring operations from the Hawaiian Independent Refinery, Inc's (HIRI) single point mooring (spm) buoy off Barbers Point, Hawaii. The mooring master, who was in charge of maneuvering the vessel during the unmooring operations, was stationed on the ship's bow. The ship's master and the junior third mate were on watch in the pilothouse. An able bodied seaman (AB) was at the helm. A mooring master-in-training was also in the pilothouse in an observer status.

After the ship released the mooring chain and became free of the spm buoy, the mooring master passed the conn to the navigation bridge where the ship's master assumed control. The master maneuvered the vessel to pass inshore of the spm buoy. He then slowed the vessel and stopped the engine to allow a launch to come alongside. After several unsuccessful attempts, the launch operator maneuvered the launch alongside the tanker and the cargo gauger, the ship's agent, and the mooring master-in-training disembarked. Once the launch cleared the STAR CONNECTICUT, a service vessel came alongside the tanker and the mooring master disembarked. As soon as the service vessel cleared the tanker's side, the master began to turn the STAR CONNECTICUT to the south to head for deep water. Moments later the vessel's stern grounded on a reef.

Although no loss of life or personal injury resulted from this accident, the STAR CONNECTICUT suffered approximately $4 million in damages. The grounding also posed a risk of a major oil spill which could have caused great environmental harm to the Hawaiian Islands. After the STAR CONNECTICUT was refloated and damage was assessed, the vessel was declared a constructive total loss.

This accident report addresses the following safety issues:

- Federal pilotage requirements at offshore oil transfer facilities;
- adequacy of vessel operating procedures for departing from the spm buoy at Barbers Point, Hawaii;
- need for regulations governing the operation of offshore oil transfer facilities within the United States' territorial sea similar to those that regulate the operation of deepwater ports (33 CFR 148-150); and
- bridge resource management training for deck watch officers of U.S.-flag vessels of more than 1,600 gross tons.

The National Transportation Safety Board determines that the probable cause of the grounding of the U.S. tank ship STAR CONNECTICUT was the failure by the STAR CONNECTICUT's master and the Hawaiian Independent Refinery's mooring master to plan and coordinate the vessel's departure from the single point mooring buoy which resulted in the master's inability to focus on and prioritize the critical tasks associated with departing the buoy while maneuvering close to a shoal area known to have unpredictable ocean currents.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

GROUNDING OF THE U.S. TANK SHIP STAR CONNECTICUT PACIFIC OCEAN, NEAR BARBERS POINT, HAWAII NOVEMBER 6, 1990

INVESTIGATION

The Accident

On the morning of November 3, 1990, the 723-foot-long U.S. tank ship STAR CONNECTICUT moored at the Hawaiian Independent Refinery, Inc. (HIRI) single point mooring (spm) buoy to discharge a cargo of crude black oil, to load a cargo of naphtha and gas oil, and to take on fuel. The spm buoy was a floating buoy anchored about 1.5 nautical miles (nmi) offshore of Barbers Point, Hawaii. (See figure 1.) A vessel moored to this buoy by attaching a single cable from its bow, hence the name. By being connected in this manner, a moored vessel was free to swing around the buoy in any direction, depending upon the prevailing wind and current. (See figure 2.) Tank ships and barges tied up to the spm buoy to load and discharge petroleum products via a submerged pipeline system which connected the buoy to the refinery ashore.

A mooring master-in-training under the supervision of a senior mooring master executed the mooring operation without incident. Once the vessel was moored, the senior mooring master and the mooring master-in-training remained on the vessel and alternated as HIRI's person-in-charge[1] of oil transfer operations during the cargo transfer.

At approximately 0800[2] on November 6, 1990, another fully qualified senior mooring master relieved the senior mooring master on board the STAR CONNECTICUT. According to the deck log, all product transfer operations were completed at 1510. Having completed the transfer operations, the ship's crew, under the direction of the chief mate, began to disconnect the cargo hoses in preparation for departure from the spm buoy.

Two service vessels attended the STAR CONNECTICUT, the stern assist vessel NA'INA and the workboat NENE. When the STAR CONNECTICUT moored at the spm buoy, the NA'INA was tethered to the tanker by a stern line and was used to pull on the vessel as necessary to prevent the tanker from making contact with the buoy. The NENE was on scene to handle the floating cargo hoses after they were disconnected from the tanker and to pull the hoses away from the ship so that they did not interfere with the unmooring.

1The oil pollution prevention regulations for marine oil transfer facilities (33 CFR 154) require that a properly qualified representative of the facility be designated as the person-in-charge of oil transfer operations and that this person must be present during all such operations.

2All times in this report are Hawaii-Aleutian standard time, based on the 24-hour clock.

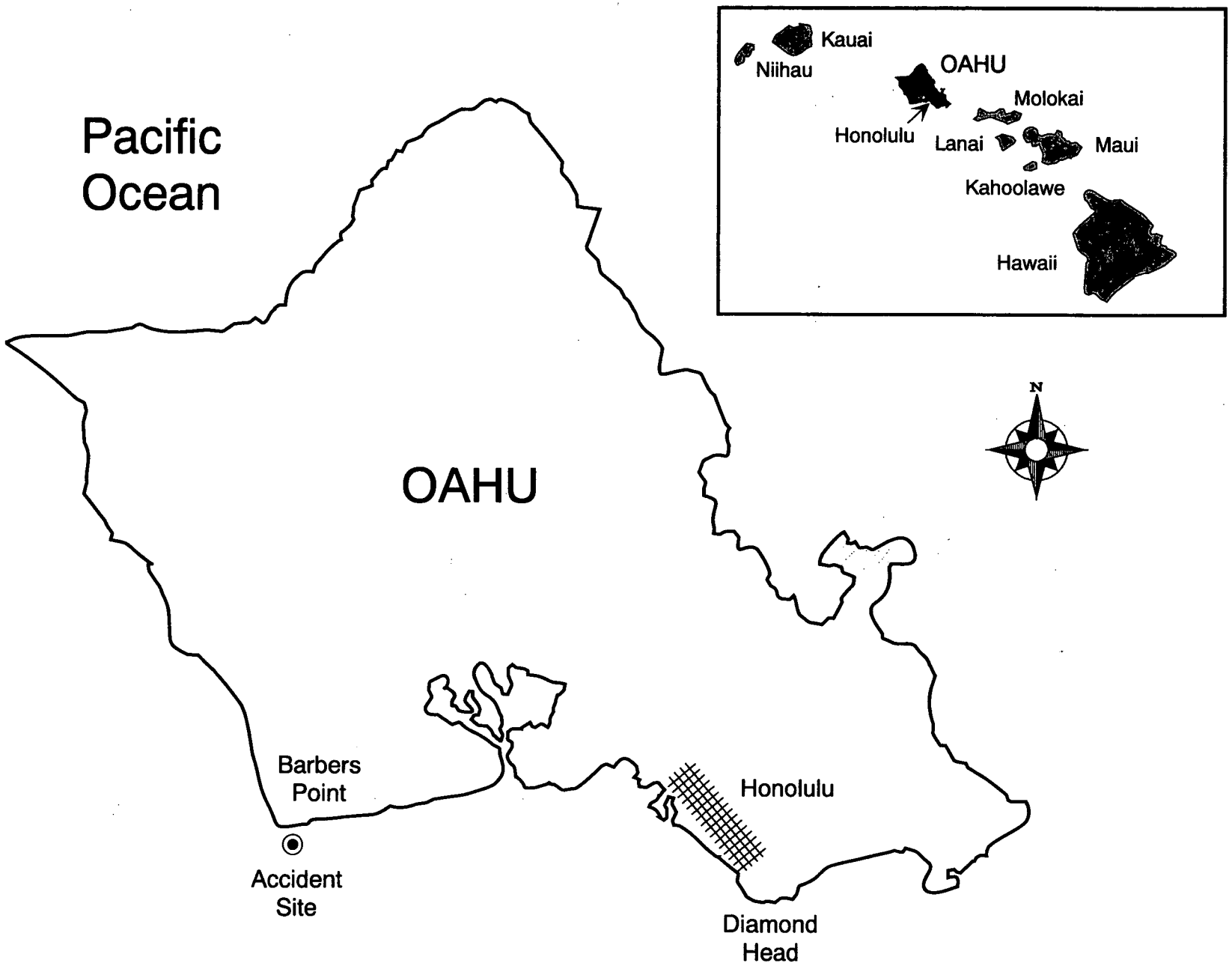

Figure 1.--The island of Oahu.

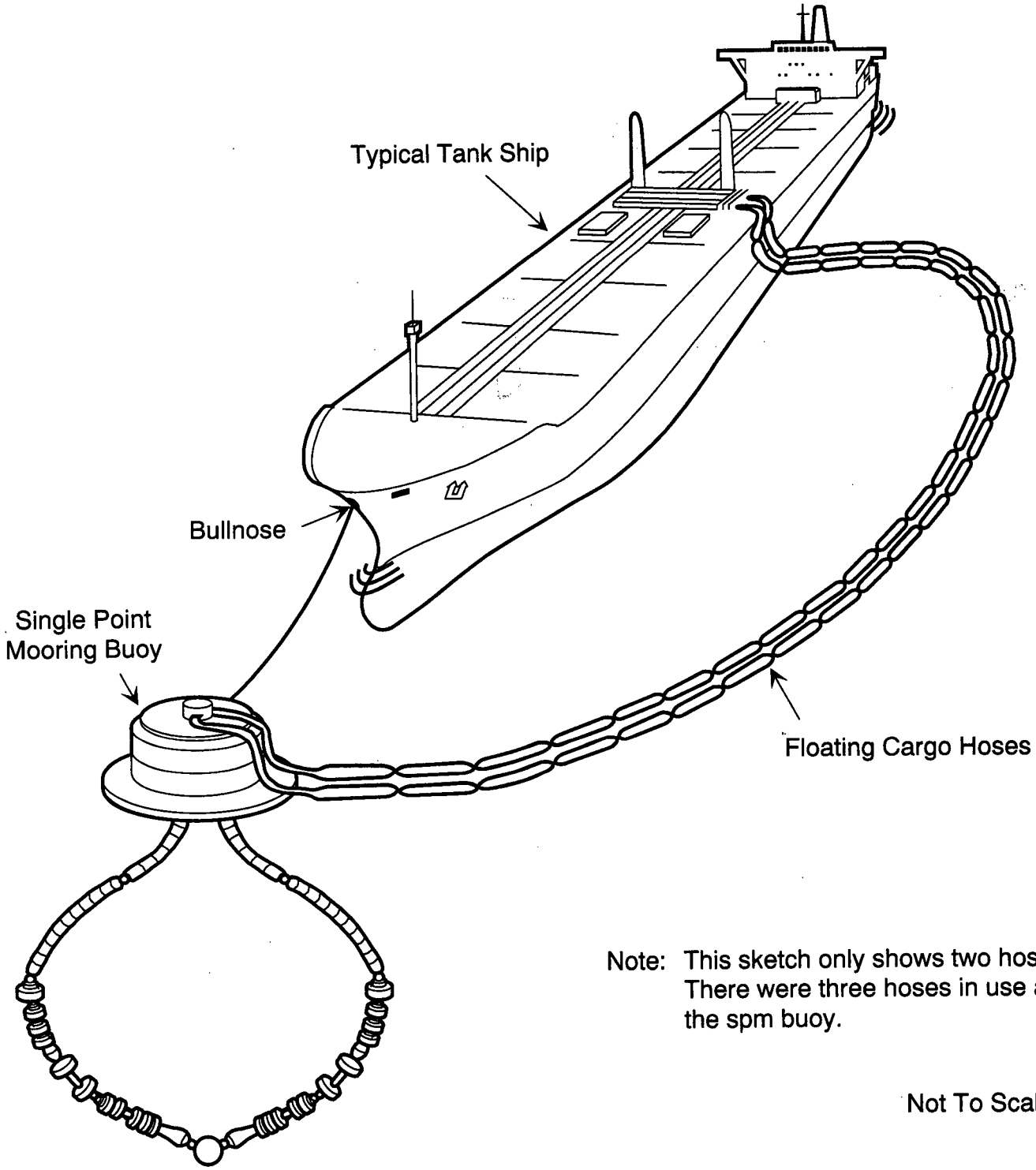

Figure 2.--Sketch of a typical ship moored at the Hawaiian Independent Refinery, Inc., Single Point Mooring Buoy.

By 1635, all three cargo hoses were off the vessel and floating in the sea. The NENE pulled the hoses to the south, away from the port side of the ship, while the ship's crew secured the deck for sea and awaited the arrival of a tug to commence unmooring operations.

At 1757, the junior third mate completed routine tests of the ship's navigation, communication, and control equipment. He found all equipment to be in good operating condition. Between 1849 and 1853, he tested the main engine satisfactorily in the astern direction. About 1856, the tug NIAU arrived alongside the STAR CONNECTICUT and within a few minutes, was made fast by one mooring line to the tanker's port bow. (See figure 3.)

The senior mooring master stated that about this time he noticed a sheen on the water which he thought might have been caused by an oil leak at the spm buoy. The senior mooring master stated that he did not consider the sighting of the oil significant and that he continued to conduct the ship's departure from the spm buoy in a routine manner. However, the STAR CONNECTICUT master testified that when the mooring master noticed the sheen, there was a lot of "rushing around" on the deck. The senior mooring master stated that he asked the NENE operator to halt tending the refinery's floating cargo hoses and maneuver his vessel close to the buoy and check for the presence of oil in the water. After searching the area around the spm buoy, the NENE operator radioed that he saw no oil in the water. Despite the NENE operator's findings, the senior mooring master reported a suspected spill to the local Coast Guard authorities and arranged to meet Coast Guard officers ashore and return with them to inspect the spm buoy for leaks.

Shortly after the junior third mate completed tests of the main engine,the senior mooring master informed the STAR CONNECTICUT master that the Coast Guard Captain of the Port (COTP)[3] had ordered the ship not to leave the mooring because of the suspected oil leak from the spm buoy. In addition, the COTP had ordered all oil transfer operations at the spm buoy suspended until the Coast Guard could inspect the buoy. After a while, following further communications with COTP personnel, the senior mooring master informed the master that the Coast Guard had granted the ship permission to leave the buoy. When asked if the mooring masters showed any anxiety about getting off the vessel earlier because of the suspected oil leak than they would have demonstrated during the course of a regular unmooring operation, the STAR CONNECTICUT master testified,

> Not in those words, but there was a sense of urgency about the situation, that they need to get on with their business. . . . Well, I think that pretty near every time you leave the buoy, there is a sense of urgency of everyone getting off and that [the suspected oil leak at the buoy] only amplified it.

Having been granted permission to leave the buoy, the master ordered the STAR CONNECTICUT's chief mate to the stern in order to supervise letting go the stern assist vessel, NA'INA. At 1908, the stern line was cast off and the NA'INA began retrieving the line while moving clear of the tanker. The chief mate then proceeded

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3The officer of the Coast Guard, under the command of a District Commander, so designated by the Commandant for the purpose of giving immediate direction to Coast Guard law enforcement activities within his assigned area.

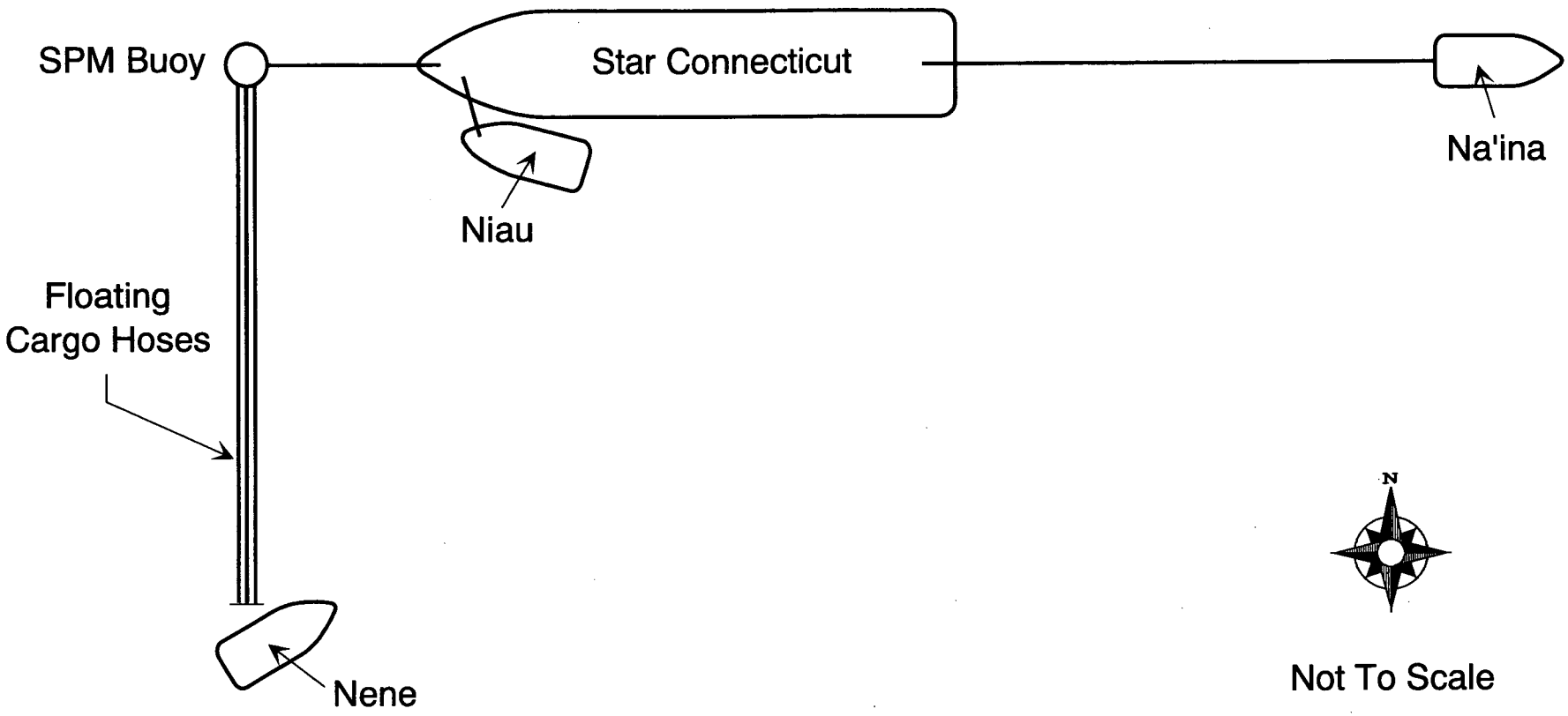

Figure 3.--Arrangement of vessels prior to umooring.

to the ship's bow, where the senior mooring master was waiting to unmoor the vessel from the buoy.

The master, the junior third mate, and a helmsman were on duty on the navigation bridge. The junior third mate was responsible for monitoring the performance of the helmsman, operating the engine order telegraph, and recording the times of engine orders and significant events in the deck bell book. The master's standing orders also required the junior third mate to obtain and plot a navigation fix every 15 to 20 minutes. The mooring master-in-training was also on the bridge, maintaining communication with the senior mooring master who was on the bow. The master stated that he had been told that the mooring master-in-training was on the navigation bridge solely to observe the unmooring operation and that he did not expect the mooring master-in-training to assist him in any way with the unmooring.

The master testified that just prior to unmooring, the STAR CONNECTICUT was on a westerly heading. He further stated that he had moored and unmoored the STAR CONNECTICUT at the HIRI spm buoy eight times as master but had never unmoored while on a westerly heading.

The master described the weather as "ideal." He testified that the wind was northeasterly about 5 knots and that the sea was almost calm, with a "small" swell from the southeast.

From the bow, the senior mooring master radioed the STAR CONNECTICUT master, "Captain, I request permission to unmoor the vessel and maneuver away from the buoy." At 1912, the master granted permission and passed the conn[4] to the senior mooring master who then ordered the mooring chain released and began to issue engine orders via VHF radio to back the ship away from the spm buoy. The course recorder printout showed that the ship's heading[5] was 290° at this time. According to the deck bell book, the senior mooring master issued his first engine order, slow astern, at 1912.6.

The STAR CONNECTICUT master testified that at some time during the unmooring operation, he overheard a radio transmission from the mooring master reporting that the current was slack or setting slightly toward Diamond Head [in an easterly direction].

According to the master, the senior mooring master radioed engine orders to him and he relayed them to the junior third mate who was operating the engine order telegraph. However, the junior third mate testified that he thought the mooring master-in-training had the conn. He stated that the senior mooring master and the mooring master-in-training were in radio communications with each other and that the mooring master-in-training, who was stationed in the pilothouse, gave the engine orders, which he [the junior third mate] repeated and executed.

4A marine term for the responsibility to control or direct the movement of a ship through the use of rudder and engine orders.

5Unless otherwise noted, all headings in this report are given per gyrocompass as read from the vessel's course recorder print out.

The senior mooring master ordered half astern at 1912.7, slow astern at 1913.2, and full astern at 1913.3. The mooring chain paid out through the bullnose[6] as the ship backed away from the spm buoy. The master stated that at 1914 the ship's bow was starting to swing "rapidly" to starboard.

According to the senior mooring master, "There was no movement of the bow that I would consider significant" as a result of the full astern order. He stated that the spm buoy had been off the starboard side of the bow of the STAR CONNECTICUT at the beginning of the unmooring operation and that, while the ship backed, he noticed that the buoy was off the port bow of the ship. He stated that he thought that the relative movement between the buoy and the bow resulted from the current acting on the ship, rather than a heading change.

At 1917, with the ship heading 292°, the pickup line[7] passed through the bullnose and the ship was completely free of any attachment to the spm buoy. The senior mooring master stated that about 1918 he ordered the engine stopped and passed the conn to the ship's master through the mooring master-in-training.

According to the master, he, and not the senior mooring master, ordered the ship's engine stopped. The master testified that the ship was swinging "rapidly" to starboard when the mooring master passed the conn to the pilothouse. He stated:

> Since the vessel is swinging rapidly to starboard, I issue the order to stop at 1918.2. And then I go hard left and half ahead at 1918.3, trying to check the swing, as I want to bring the vessel around to the south around the buoy.

When asked if anything hindered him from backing the STAR CONNECTICUT farther than he did, the master said, "Well, there was the Chevron mooring buoys. Their operation was astern of me." The master further stated that he didn't continue backing because he wasn't sure where he would "end up." He said that if he had backed continually in a circle, the ship would have backed into the floating cargo hoses. He testified that he felt that he had no choice but to go inshore of the buoy, saying:

> Well, I couldn't go seaward of the buoy, because the hoses were in my way. So I was only left with the option of going between the buoy and the shore.

However, the master further testified that he had no concern about passing inshore of the spm buoy. He said that he thought he had enough room to execute the maneuver safely based upon his understanding of the current at the time. (Figure 6 shows the approximate reconstructed trackline of the STAR CONNECTICUT as it passed inshore of the buoy.) The master said that he understood the current to be slack or flowing slightly toward Diamond Head (i.e., easterly) and that if this

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6An opening in a ship's stem (bow) through which a mooring line or tow line may be passed.

7The pickup line was a length of synthetic rope secured to the mooring chain. The pickup line floated in the water and was "picked up" by a launch and taken to a ship intending to moor at the spm buoy. The pickup line is led through a fairlead in the ship's bow and is then heaved in by the ship until the mooring chain is heaved on board and secured to the vessel. Upon unmooring from the spm buoy, the pickup line is the last part of the mooring assembly to leave the vessel.

information had been accurate, the vessel would not have been set toward the shoal inshore of the buoy.

Immediately after he had assumed the conn, the master turned to the mooring master-in-training and said, "Well, I guess you can go," whereupon, the mooring master-in-training left the pilothouse.

The master then received a request from the senior mooring master to release the tug which was still secured to the ship's port bow. The master granted the request, and the tug was released at 1919. According to the master, the bow was still swinging to starboard when the tug was released.

Moments after the tug cleared the ship, the bow lookout radioed the presence of white lights off the STAR CONNECTICUT's port bow. The master sighted two lights visually and acknowledged the lookout's report. He then attempted to locate the source of the lights by checking the ship's radar but no targets showed up on the radar screen. He stated that he thought that the lights seemed close enough to the buoy to preclude his immediately turning the ship to the south after he passed the buoy and proceeding directly offshore.

At 1922, the master ordered the engine slow ahead. The rudder was still hard left but the bow continued to swing to starboard. The master said that as he maneuvered the ship past the spm buoy, he became concerned about the pickup line in the water because he thought that the line might become fouled in the ship's propeller. He radioed the NIAU operator and asked the tug operator to locate the line in the water with the tug's spotlight. The NIAU operator testified that he could not recall being asked to illuminate the pickup line. However, the mooring master-in-training testified that he overheard a radio transmission from the NIAU operator in response which stated, "You [the STAR CONNECTICUT] are well clear [of the line]."

The master stated that this was not the first time that he had departed from the spm at night. He said that on past occasions, attending work boats would use their spotlights to look for the pickup line, but that they would not continuously illuminate the line. He said that he had not had to ask previous mooring masters to "keep an eye on" the pickup line, that they "knew what was important and took care of it." He stated that he did not feel it was necessary to make the request this time.

At 1925, the STAR CONNECTICUT master ordered the engine dead slow ahead; at 1925.9, he ordered stop. He said that he estimated that the tanker was about 600 feet off the spm buoy at this time and that he was attempting to allow the ship to drift past where he thought the pickup line was located.

About 1927, the motor launch KEOKI arrived off the STAR CONNECTICUT's starboard side and attempted to land alongside to disembark the mooring masters, the cargo gauger, and the ship's agent before the tanker headed for sea. According to the master, the STAR CONNECTICUT was still about 600 feet north of the spm buoy and the ship's stern was just passing the buoy at this time. The master stated that if there had been a "Diamond Head current" [i.e. if the current had been flowing easterly toward Diamond Head] as he had overheard, he would have been holding the ship in a stationary position at this time.

According to the master, sometime between 1930 and 1932.5, the senior mooring master radioed him to turn the ship to port to create a lee for the KEOKI.

About 1932, the master, assuming that the STAR CONNECTICUT had drifted clear of the pickup line, ordered the engine slow ahead. He stated that no one from his tanker or the support vessels had as yet reported seeing the pickup line in the water.

Moments later, the master ordered the engine half ahead. He said that the ship's bow was swinging to port to head the ship away from the shore and to make a lee for the KEOKI along his starboard side.

At 1933, the STAR CONNECTICUT master ordered the engine stopped so that the motor launch KEOKI could get alongside the ship and disembark the waiting personnel. The ship's heading was 330° at this time.

The mooring master-in-training, cargo gauger, and the ship's agent disembarked on the KEOKI. As soon as the KEOKI cleared the side of the tanker, the NENE came alongside and removed the senior mooring master.

While the KEOKI was attempting to land alongside the tanker, the NA'INA operator became concerned that the STAR CONNECTICUT may have moved too far inshore of the spm buoy. The NA'INA operator maneuvered his vessel to within 75 feet of the tank ship's stern and took a fathometer reading. He then radioed the STAR CONNECTICUT and reported that he only had "38 feet [of water] under my boat." The STAR CONNECTICUT master acknowledged this transmission. The master recalled that he also received another radio transmission from an unidentified source which stated something to the effect, "It gets kind of shallow up there." However, the master did not recall if he received this transmission before or after the NA'INA operator radioed him with his depth reading.

The master stated that the NA'INA operator's transmission caused him some concern. He said that if the operator's warning was correct, the current must have set his ship toward the shoal. He ordered the junior third mate to take a navigation fix on the spm buoy and to plot the ship's position on the navigation chart.

The junior third mate obtained the radar range and bearing to the spm buoy and plotted the ship's position on the navigation chart. He labeled the position with a time notation of 1940. When he plotted the position, he noted that the ship was in 38 to 40 feet of water and reported this to the master. The master acknowledged the report. The vessel's deepest draft was 36.4 feet.

The 1940 fix taken by the junior third mate marked the first time a navigation fix had been plotted after the vessel departed the spm buoy. The master stated that he himself had been too busy to take or plot a fix.

At 1940.3, the master ordered the engine half ahead and ordered hard left rudder. About this time the master went into the chartroom and looked at the 1940 fix plotted by the third mate. He stated that he realized that the ship was "in trouble" as soon as he saw the plotted position and that he had to get the ship "out of there." He said that as soon as he saw his charted position, he realized:

> I didn't have a Diamond Head current and I didn't have a slack current. I had a current that was either setting me west and north or just north, and I better do something. I think it was at that time that I came out of the chart room and ordered the engine [full] ahead and with a hard left rudder.

According to the deck bell book, the master ordered the engine full ahead at 1941.5. At the same time, he announced over the VHF radio that the vessel was turning south and warned attending vessels to keep clear.

At 1943.4, the master ordered the engine half ahead. However, moments later, about 1944, the master testified that he felt the vessel shake as it made initial contact with the bottom. The vessel was heading about 290° at this time. The master ordered the engine full ahead [according to the deck bell book this order was issued at 1946]. The junior third mate took a second navigation fix and plotted it on the navigation chart as a 1945 fix. The master said that after he had ordered the engine full ahead, he felt the ship shake again and that he immediately ordered the engine to full astern. The deck bell book shows that the full astern order was issued moments after the 1946 full ahead order.

The third mate stated that when he left the chart room after plotting the 1945 navigation fix, he felt "a little vibration" and that the ship went aground shortly thereafter.

The engineroom bell book showed that at 1944, the engineroom watch logged: "felt bump." At 1945, the chief engineer sent the third assistant engineer to the ship's stern to assess the situation. The engineroom rough log showed that the third assistant engineer noted excessive propeller wash and that the ship did not appear to be moving in reference to the lights on the shore.

After the vessel grounded, the master continued to maneuver the engine in an effort to free the vessel from its strand. The bridge bell book and, the engineroom bell book show the following sequence of engine orders:

Time	Order
1949	Stop
1949.5	Full Astern
1953.7	Half Ahead
1953.8	Full Ahead
1957	Stop
1959.2	Full Astern
2005.9	Stop

The master stated that when he issued the stop order at 1957, the vessel was no longer moving over the ground. Both the master and the junior third mate testified that no equipment failure contributed to the grounding of the STAR CONNECTICUT. Both officers also testified that the helmsman executed all helm orders correctly and in a timely manner.

The master said that when he issued the stop order at 2005.9, the vessel was "hard on the reef." He did not notify anyone right away that the vessel was aground. He stated that he had to take soundings and assess the vessel's condition and that he wanted to do everything necessary to keep the ship from sinking before

he contacted anyone ashore to report the grounding. He said that he knew that once he got on the telephone or the radio to report that the vessel was aground, that he wouldn't be able "to get away" [from the telephone/radio]. At 2028, after completing an initial assessment of the vessel's condition, the master notified the Coast Guard that the STAR CONNECTICUT was aground off Barbers Point.

Service Vessels

NENE.--The motor vessel NENE, a 56-foot-long, 800-horsepower, diesel-driven workboat, was the hose handling vessel. The NENE operator testified that on the date of this accident, he received all of his orders from the mooring masters and that he did not receive any direct orders from any of the ship's officers on the STAR CONNECTICUT. He stated that he routinely received his orders only from the mooring masters. However, he also testified that if he had received an order from the STAR CONNECTICUT master, he would have executed it.

On the day of the accident, the NENE had been standing by at the nearby Chevron offshore mooring until the STAR CONNECTICUT began unmooring operations. At 1530, the NENE operator moved his vessel to the STAR CONNECTICUT's port side in order to control the floating cargo hoses after the tank ship's crew disconnected the hoses from the ship's manifold and lowered them into the sea. Once the three cargo hoses were floating in the water, the NENE operator pulled them to the south, clear of the ship. He then released the hoses and moved to the STAR CONNECTICUT's starboard side in order to retrieve the floating oil boom that had been rigged as a pollution containment precaution. Once he had retrieved the boom, the NENE operator returned to the port side of the tank ship and reestablished control of the floating cargo hoses. The NENE operator stated that the hose handling vessel normally pulls the floating hoses "as far away from the ship as possible" so that when the pickup line is released, it does not fall on top of the hoses. He testified that he held the hoses at approximately a right angle to the fore and aft line of the STAR CONNECTICUT while the tank ship was unmooring and that he did not receive any order from the mooring masters or the master of the STAR CONNECTICUT to move the hoses farther.

The NENE operator kept his radio tuned to VHF-FM channel 9, the working frequency for the service vessels. He stated that he did not hear any transmissions from the ship requesting that he illuminate the pickup line. He also stated that he did not hear any radio transmission from anyone stating that they were illuminating the pickup line. The operator stated that in his experience, service vessels usually tended the pickup line during mooring operations, but only tended the line during unmooring operations if the mooring master so requested. He said that he did not receive such a request from the STAR CONNECTICUT on the date of this accident.

About 1930, the NENE operator received a radio call from the senior mooring master aboard the STAR CONNECTICUT requesting that the NENE come alongside the tanker to disembark him. The operator testified that at this time he noticed that the STAR CONNECTICUT was located farther inshore of the spm buoy than he had ever seen a tank ship of this size. He stated that he could not say exactly how far inshore the ship was, but added that he did not consider the ship's location to be cause for concern at the time.

The NENE operator testified that when the NENE arrived off the STAR CONNECTICUT's starboard side to disembark the senior mooring master, the launch KEOKI was already alongside the tanker.

After the KEOKI departed, the NENE operator maneuvered his vessel alongside and disembarked the senior mooring master. The operator said that he was not alongside of the tanker very long because he was only picking up one man and one bag. Once the mooring master was aboard, the NENE operator radioed the master of the STAR CONNECTICUT that the NENE was leaving the side of the tank ship. The STAR CONNECTICUT master acknowledged the transmission.

NA'INA.--The NA'INA was a 79-foot-long, 1600-horsepower, diesel-driven vessel which was used for salvage, diving, and towing service. While the STAR CONNECTICUT was moored to the HIRI spm buoy, the NA'INA served as the stern assist vessel, pulling, as needed, on a stern line from the STAR CONNECTICUT to keep the tanker from colliding with the buoy.

The NA'INA operator testified that at 1530, the crew of the STAR CONNECTICUT began disconnecting the cargo hose to prepare for unmooring from the spm buoy. Between 1530 and 1900, the NA'INA remained in a standby mode, tethered to the tanker by the stern line. At 1908, the STAR CONNECTICUT released the stern line into the water and the operator maneuvered the NA'INA toward the Chevron offshore mooring while his crew retrieved the line from the water. He said that by 1919, the line was completely aboard his vessel. The operator then radioed the STAR CONNECTICUT master that the NA'INA was clear of the tanker and the stern line was out of the water. The master of the STAR CONNECTICUT acknowledged the transmission.

Once he had the stern line aboard, the NA'INA operator headed his vessel for Honolulu. However, he noticed that the STAR CONNECTICUT appeared to him to be located farther inshore of the spm buoy than it should have been. The operator maneuvered the NA'INA within 75 feet of the STAR CONNECTICUT's stern and took a depth reading with the service vessel's fathometer. The operator then radioed the STAR CONNECTICUT's master via VHF-FM channel 9 and reported that the NA'INA had only 38 feet of water beneath it. Once the master acknowledged his transmission, the NA'INA operator proceeded to Honolulu, arriving at Pier 14 at 2130. The NA'INA operator stated that 38 feet of water under the bottom of his vessel meant that the water depth was 48 feet.

The NA'INA operator had worked on service vessels at the HIRI spm buoy since the buoy was originally installed in 1987. He estimated that in that time, he had observed 200-300 ships moor or unmoor from the spm buoy. He stated that he had observed numerous ships unmoor from the spm buoy on a westerly heading and pass inshore and offshore of the buoy. He added that if a vessel passes inshore of the buoy, it must stay close to the buoy to avoid the shoals.

NIAU.--The NIAU was a 65-foot-long, 1100-horsepower, diesel-driven tug. According to the NIAU operator, the tug usually worked in inter-island barge towing, and had performed limited work assisting with ship mooring and unmooring.

The NIAU operator testified that the tug arrived at the STAR CONNECTICUT at about 1845 on November 6, 1990, and that he put a single line out to the ship's port bow. After the line was secured to the ship, the operator maintained the tug's bow on approximately the same heading as the ship's bow.

The NIAU operator testified that on the two previous occasions when he had assisted ships the size of the STAR CONNECTICUT unmoor from the spm buoy, he had secured the NIAU as he secured the tug to the STAR CONNECTICUT. He stated that in previous instances when he had used the tug's engine to assist in turning ships' bows, he had used the engine only in the ahead direction. He said that he believed that the NIAU did not have sufficient horsepower to use the engine effectively in the astern direction.

On the order from the STAR CONNECTICUT mooring master, the NIAU operator used the tug's engine astern to hold the STAR CONNECTICUT away from the spm buoy until the NA'INA's stern line was released, the assist vessel cleared the area, and the tanker could use its own propulsion system to back. The tug operator said that once the NA'INA was clear of the tanker's stern, he released his own line to the ship's port bow and stood by, awaiting further orders.

The tug operator stated that the ship released its mooring line to the spm buoy and backed away slowly to port until it was approximately parallel to the beach. He said the ship then started to maneuver ahead, passing inshore of the spm buoy. The tug operator stated that he kept the NIAU on the STAR CONNECTICUT's port side, between the ship and the buoy, while the tanker maneuvered at a "slow bell" to transfer personnel to a launch off its starboard side.

The NIAU operator testified that while the STAR CONNECTICUT was engaged in transferring personnel, he overheard the NA'INA operator's radio transmission to the master of the STAR CONNECTICUT reporting that the water depth was 38 feet at the ship's stern. He said that the master of the STAR CONNECTICUT acknowledged the transmission from the NA'INA operator and then contacted the officer on deck to expedite the offloading of personnel from the tanker. The tug operator said that the STAR CONNECTICUT master radioed vessels alongside that he was going to turn the ship to port and began his maneuver all within 2-4 minutes. According to the tug operator, the vessels alongside the tanker completed personnel transfer procedures and departed as the tanker began its turn to port. The NIAU operator said that he continued to follow the STAR CONNECTICUT for about 5 minutes, after which time he radioed the tanker master to request that the NIAU be released. The master released the tug and the NIAU departed the area bound for Honolulu.

Injuries to Persons

No deaths or personal injuries resulted from this accident.

Damage to Vessels

Damage to the STAR CONNECTICUT extended from the forward bulkhead of the pumproom (Frame 60) aft to about Frame 10 in the after peak tank, a distance of about 75 feet. The pumproom, located immediately forward of the engineroom, and the four double-bottom tanks, located below the engineroom, sustained the greatest damage. The grounding forced the bottom hull plating in these tanks upward and bent and twisted associated internal structural framing.

The pumproom, No.1 port double-bottom tank, No.1 starboard double-bottom tank, and the after peak tank all sustained fractures through which sea water flooded into the vessel. The grounding caused the bulkheads between compartments to separate from the bottom plating. This allowed water to flood the pumproom and all four of the double-bottom tanks under the engineroom.

Although the double-bottom tanks were flooded completely, the engineroom was not affected because the inner bottom (tank top) remained intact. None of the 18 cargo tanks were breached and no cargo was lost. Damage to the STAR CONNECTICUT was estimated at $4 million and the vessel was declared a constructive total loss.

Crew and Mooring Master Information

STAR CONNECTICUT.--The certificate of inspection issued to the STAR CONNECTICUT by the U.S. Coast Guard required that the vessel meet the following manning scale:

Licensed Officers	Unlicensed Seamen
1 Master	6 Able Bodied Seamen
1 Chief Mate	3 Oilers
1 Second	
1 Third Mate	
1 Chief Engineer	
1 First Assistant Engineer	
1 Second Assistant Engineer	
1 Third Assistant Engineer	
1 Radio Officer	

The certificate of inspection also authorized the STAR CONNECTICUT to carry 20 other persons in the crew and 2 persons in addition to the crew, for a total of 40 persons allowed.

On the date of this accident, the STAR CONNECTICUT was properly manned in accordance with its assigned manning scale. A total of 32 persons were on board the vessel, 30 of whom were operating crew, and 2 of whom were representing potential buyers and riding the ship as observers. Although the vessel manning did not exceed the total number permitted by the Certificate of Inspection, the number of licensed officers on board the vessel exceeded minimum requirements. The vessel carried an additional third mate (referred to in this report as the junior third mate) in order to provide a manned bridge watch while the vessel was moored to the spm buoy, as required by local Coast Guard authorities. According to the master's testimony, the STAR CONNECTICUT had carried an additional third mate since February 1990.

The Master.--The master began sailing in an unlicensed capacity in the early 1960s. He advanced through the ranks of Ordinary Seaman (OS) to Able Bodied Seaman (AB), and obtained his original third mate's license in February 1967. He had sailed regularly as a licensed deck officer for Texaco Marine ever since that time.

In July 1968, the master obtained his second mate's license and began sailing as a second mate in August 1968. He was licensed and began sailing as a chief mate in April 1970. Although he obtained his original master's license in December 1972, he continued to sail mainly as a chief mate until October 1978. From October 1978 through December 1979, he trained and acted as a mooring master in Texas. In January 1980, he returned to the Texaco fleet, sailing briefly as master of the TEXACO NEW YORK and the TEXACO WISCONSIN, and then as chief mate on various Texaco tankers. In November 1984, he began sailing as master of the STAR

CONNECTICUT. He stated that he had moored and unmoored the STAR CONNECTICUT from the HIRI spm eight times while serving as the vessel's master.

The master testified that on the evening before the accident, he had received a full night's sleep and was well rested. The day of the accident, he went ashore for several hours to take care of ship's business and some personal matters. While ashore, he took time for some recreational activities, including walking and swimming. When he arrived back at the STAR CONNECTICUT late in the afternoon, he ate supper and conducted ship's business with the ship's agent before preparing for the tanker's departure.

The master characterized his health condition as "good" and said that he was not taking any drugs or medications on the date of the accident. He said that he had never lost work on account of illness and that he had not been hospitalized in the past year. About 9 hours after the accident, he submitted to a breath analysis and a urine test for drugs and alcohol in the presence of U.S. Coast Guard officers. The master stated that he could not report for toxicological testing sooner because he was overseeing activities related to getting the ship off the reef. The results of his tests were negative.

The STAR CONNECTICUT's chief mate, who had sailed with the STAR CONNECTICUT master for five years and who also was a licensed master, described the master as "a good ship handler" who was somewhat conservative in his decisionmaking and who did not leave things to chance. He said that the master tended to maintain as much direct control over operations as possible. According to the chief mate, the master remained calm and showed no signs of panic throughout the grounding crisis.

The junior third mate, who was on watch with the master at the time of the accident, characterized the master as a very professional man who ran a bridge watch in a business-like manner. He further stated that the master was very organized, and liked things done "his way." The junior third mate said that although the master himself was not a nervous individual, he did not engender a relaxed atmosphere when he conducted a bridge watch.

The Junior Third Mate.--The junior third mate graduated from the Massachusetts Maritime Academy in 1986 and began his professional maritime career on board small passenger vessels that operated sightseeing cruises, dinner cruises, and private charters in Boston Harbor. From August 1986 to October 1986, he sailed in an unlicensed capacity on board the KENAI, a 60,000-gross-ton U.S. tank ship. From January 1987 to June 1988, he sailed as an AB on board a converted offshore supply vessel; from June 1988 until September 1990, he sailed on board converted offshore supply vessels as second mate and chief mate. He reported on board the STAR CONNECTICUT as temporary third mate on October 3, 1990. His STAR CONNECTICUT assignment marked the first time that he had sailed as an officer on a large ship (over 1,000 gross tons). The junior third mate had been on board the STAR CONNECTICUT when the tanker visited the HIRI spm buoy on one previous occasion.

While the STAR CONNECTICUT was moored to the HIRI spm, the junior third mate stood bridge watches on a rotating 6-hour-basis with the senior third mate. The junior third mate's bridge watches were from 0600 to 1200 and from 1800 to 2400. He testified that it was his practice to sleep between midnight and 0600 and to take a nap in the afternoon. He said that even though he had missed his regular

nap the day before the accident because of a trip ashore, he had felt "pretty good" physically on the night of the accident. He said that he was "a little tired," but that he was rested enough to stand an alert navigation watch.

The junior third mate stated that he had not been hospitalized or suffered from any serious illness in the past year. He did not wear or need corrective lenses and had no hearing problems. The junior third mate further stated that he had never consumed alcohol while on board the STAR CONNECTICUT and that he had not consumed alcohol while ashore the day before the accident. After the accident, the junior third mate submitted to a breath test and urine test for drugs and alcohol in the presence of U.S. Coast Guard officers. The results of these tests were negative.

The STAR CONNECTICUT's chief mate testified that he had had the opportunity to observe the junior third mate standing navigation watches. His assessment of this officer was that the junior third mate ". . . is a young third mate. He makes all of the same mistakes we have all made coming through." He said that the junior third mate paid "pretty close attention" to what was "going on" and that he knew the equipment on the navigation bridge "fairly well." He further described the junior third mate as a competent third mate who because of a lack of experience may have been somewhat unsure of himself.

The master of the STAR CONNECTICUT described the junior third mate as "just starting out in the business" and said that the junior third mate had made no errors or omissions which contributed to the accident.

Mooring Masters.-- The State of Hawaii enforces compulsory pilotage for all foreign vessels and for all U.S. vessels under registry entering or departing Hawaiian ports. A U.S. vessel in coastwise trade entering and departing from Hawaiian ports may have a State or a Federal pilot on board. At the time of the accident, the area of and approaches to the offshore berths at the HIRI spm buoy and the nearby Chevron mooring were not designated pilotage waters. Therefore, vessels arriving and departing from these facilities were not required to have either a State or a Federal pilot on board.

Recognizing that mooring and unmooring large tank ships safely and efficiently at the spm buoy required a certain expertise, HIRI required that any tank ship that called at the offshore facility be assigned a specially trained mooring master. The four mooring masters authorized to moor and unmoor ships from the HIRI spm buoy at the time of this accident included a private contractor and three employees of an HIRI affiliate, Pacific Resources Terminals, Inc., (PRT). HIRI had required each of the four to complete an internal training program to become "qualified" as a mooring master. All four had to meet qualifications established by HIRI and follow procedures set forth in the HIRI operations manual.

The HIRI operations manual stipulated that the mooring master was to function as an advisor to the ship's master in matters of "navigation, ship handling, hazards, operating conditions, mooring, unmooring, connection and disconnection of cargo hoses, and discharge or loading of cargo." In addition, a ship's master calling at the offshore facility was required to sign a statement that indemnified and released HIRI, its affiliates, and the mooring masters from all liability for "any loss, claims or damages arising out of the rendering of services" to the ship, whether or not arising out of the fault of the mooring master. A copy of the statement of indemnification signed by the STAR CONNECTICUT's master is contained in appendix C.

The mooring master usually boards a tank ship about a mile south of the buoy. He then conducts a bridge briefing with the ship's master during which the mooring master explains the mooring operation, the use of the service vessels, and Coast Guard requirements that the vessel must adhere to while moored at the buoy. The mooring master also obtains information regarding the vessel's maneuvering characteristics and operational limitations. The mooring master then assumes the conn and maneuvers the ship until it is safely moored to the buoy.

After the ship is moored at the spm buoy, the mooring master remains on board the vessel and participates in cargo transfer operations until they are completed. He serves as HIRI's "person-in-charge" for oil transfer operations at the terminal. The mooring master is also responsible for inspecting the vessel's cargo handling equipment for adequacy and compatibility with the terminal hoses and is expected to inspect the mooring assembly periodically.

HIRI did not require that a "bridge briefing" be conducted when a ship is to unmoor from the spm buoy. The mooring master assumes the conn and maneuvers the vessel away from the buoy. HIRI's manual and training procedures did not stipulate a location or recommended distance from the buoy where the mooring master is required to return the conn to the ship's navigating officer. The senior mooring master testified that the location where the mooring master transfers the conn to the ship's navigating watch varies greatly; the decision is left to the discretion of the mooring master based upon his evaluation of the situation. The STAR CONNECTICUT's master also testified that the location for the transference of the conn varied, but also expressed his opinion that where the mooring master disembarks the vessel should be defined. He stated:

> Normally it [the location at which the conn was transferred] was about the position where we were [on the date of the accident] or in some cases, they [the mooring masters] had gotten the vessel all of the way past the [spm] buoy.
>
> I think a definite procedure for leaving the mooring should be instigated. And at what point, you know, how far away the mooring master should get the vessel [before he transfers the conn and disembarks.]

The STAR CONNECTICUT's chief mate, who had sailed on board the tank ship for 9 years, stated that he had called at the spm buoy 15 to 20 times. He further stated that other mooring masters who had worked at the spm buoy longer than the senior mooring master involved in this case "always waited until the ship was headed south before coming down from the [navigating] bridge."

The senior mooring master who unmoored the STAR CONNECTICUT from the spm buoy on the date of this accident testified that even when the mooring master has the conn, the master of the vessel retains control of the vessel. He stated, "I have the conn and I give an engine order or a rudder order, and it is subject to his [the vessel's master] approval."

The Senior Mooring Master.--The senior mooring master who was on duty on board the STAR CONNECTICUT was a 1975 graduate of the United States Merchant Marine Academy. According to his testimony, he had been employed on seagoing tank ships of up to 36,000 gross tons by Gulf Oil Company (Gulf) from 1975 to 1982.

He obtained his original second mate's license in 1977, his chief mate's license in 1979, and his unlimited master's license in 1981. He had sailed as third mate, second mate, and chief mate on board tankers. Even though he obtained his master's license in 1981 while employed with Gulf, he did not sail as a tanker master before he left the company. In 1982, he went to work for the Ocean Drilling and Exploration Company (ODECO) as the master of a 29,000-ton semi-submersible mobile offshore drilling unit (MODU) in the North Sea. In 1985, he came ashore and worked as marine superintendent for ODECO. In 1987, he left ODECO and went to work for Global Marine Drilling Company as the master of a semi-submersible MODU. In July 1990, he joined Pacific Resources to become a mooring master for the HIRI spm facility.

The senior mooring master had completed HIRI's training program and been "fully qualified" as a mooring master by HIRI in late October 1990, about 2 weeks before the accident. In order to become "qualified," he was required to perform a specified number of mooring and unmooring operations at the spm buoy under the supervision of a senior mooring master and demonstrate that he could perform these operations competently.

The senior mooring master testified that, including his training period, he had moored vessels at the HIRI spm buoy approximately 20 times and that he had worked as a mooring master on board the STAR CONNECTICUT four times. However, he had never worked with this particular vessel master before. He described the STAR CONNECTICUT master as "communicative" and "responsive."

The senior mooring master stated that at the time of this accident, he had not yet conned a ship to moor at the spm buoy as a "qualified mooring master" and the STAR CONNECTICUT was the first ship that he had conned unmooring from the spm buoy since becoming "qualified." He testified that although ships may depart from the buoy on any heading, he had never witnessed a ship depart from the buoy on a westerly heading. The senior mooring master stated that the current near the spm buoy predominantly flows toward the west so that ships moored at the buoy are usually on an easterly heading when they depart.

According to the senior mooring master, a valid Coast Guard master's license was a condition of employment as a mooring master with HIRI. However, at the time of this accident, he was not serving under the authority of his license when he assumed the conn because he was neither a member of the ship's crew nor a pilot.

The senior mooring master testified that he considered the mooring operation more critical and complex than the unmooring process. He compared mooring a ship to the spm buoy with trying to park an automobile an inch from an egg. He said unmooring was far more simple. He likened unmooring to backing a car away from an egg, " . . . you can just back away" ". . . you can just put it in reverse and it doesn't much matter what else you do."

Vessel Information

The STAR CONNECTICUT was a steel-hull tank ship of modern design owned by Leased Tankers, Inc., of Dover, Delaware, and operated by Texaco Marine Services, Inc., of Port Arthur, Texas. The vessel was built in 1953 by the Newport News Shipbuilding and Drydock Company, Newport News, Virginia. In December 1971, a new 538-foot-long cargo and bow section was fabricated by the shipbuilding division of Bethlehem Steel Company, Sparrows Point, Maryland, and was joined to

the vessel's stern section by the Bethlehem Steel Company Key Highway Yard, Baltimore, Maryland. The principal characteristics the STAR CONNECTICUT were:

Length Overall	723.0 feet
Breadth	90.0 feet
Depth	48.8 feet
Draft (Max.)	37.4 feet
Gross Tons	23,459
Net Tons	18,256
Deadweight Tons	42,046
Displacement Tons	51,442

The STAR CONNECTICUT was fitted with 18 cargo tanks, arranged three across (1 port, 1 center, 1 starboard) by six longitudinally. The cargo tanks had no double bottom space underneath them. The vessel was certificated to carry flammable and combustible liquids of Grade B and lower, and crude oil. At the time of the accident, the STAR CONNECTICUT was loaded to about 75 percent capacity with 65,000 barrels (bbls.) of light naphtha, 60,000 bbls. of high sulfur vacuum gas oil (HSVGO), and 120,000 bbls of light sulfur vacuum gas oil (LSVGO). The cargo was loaded into the cargo tanks as follows:

CARGO	CARGO TANK NO.
Light Naphtha	4 port, 4 center, 4 starboard
HSVGO	1 port, 1 center, 1 starboard 5 port, 5 center, 5 starboard 6 port, 6 starboard
LSVGO	2 port, 2 center, 2 starboard

The STAR CONNECTICUT's pumproom and engineroom were located aft of the cargo tanks and the engineroom was protected by double bottom tanks. The vessel's single deckhouse, which contained the accommodation spaces and the pilothouse, was located aft, over the engineroom. The vessel's fuel tanks, located aft of the pumproom, contained 8,300 bbls. of No. 6 fuel oil.

The pilothouse contained modern navigation communications and vessel control equipment, including VHF radio (2), radar (2), collision avoidance radar, Doppler speed log, Sperry gyrocompass and repeaters, satellite navigation, loran C, radio direction finder, engine order telegraph, RPM indicators, rate of turn indicator, and rudder angle indicators. The master and third mate both testified that all of this equipment was in good operating condition at the time of the accident.

The STAR CONNECTICUT was fitted with two independent steering systems, one electric and one telemotor system. At the time of the accident, the electric steering system was in use in the hand electric mode. The master, junior third mate, and helmsman all testified that the steering system was in good operating condition and no steering gear failure was involved in this accident.

The vessel was outfitted with a Raytheon Model DE-741 recording fathometer in the chartroom aft of the pilothouse. Although the fathometer was in operation

at the time of the accident, the device did not generate a readout in the pilothouse and was not suitable for shallow water service. Neither the master nor the junior third mate, who was the navigation watch officer at the time of the accident, referred to this depth sensing device prior to the accident. The master testified that the fathometer was of little use in shallow water. He also stated that he had never asked Texaco Marine to provide the STAR CONNECTICUT with a fathometer that could be used in shallow water.

The STAR CONNECTICUT was propelled by a steam turbine that developed 13,650 shaft horsepower and drove a single, right-hand-turning propeller.[8] Maneuvering information[9] posted in the pilothouse showed the following rpm-to-speed ratios for the various engine orders under loaded and ballasted conditions:

Maneuvering Engine Order	RPM	Speed Loaded (Kts)	Speed Ballasted (kts)
Full Ahead	70	12.0	13.0
Half Ahead	55	9.4	10.4
Slow Ahead	40	6.8	7.8
Dead Slow Ahead	20	3.4	4.4
Dead Slow Astern	10	1.7	2.7
Slow Astern	20	3.4	4.4
Half Astern	30	5.1	6.1
Full Astern	40	6.8	7.8

In addition, the vessel maneuvering data showed an 8-minute backing time limit. Backing the STAR CONNECTICUT for more than 8 minutes could cause the astern element of the turbine to overheat and damage the engine. The vessel's chief engineer indicated that this limitation was a well known feature of all steam turbine ships and had never created a problem when maneuvering the STAR CONNECTICUT. Because of the limited time that the engine could be operated astern, the tank ship had to use a stern assist vessel while moored to the spm buoy to ensure that it did not drift into the spm buoy. The maneuvering information also showed the following turning distance information in deep water:

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[8]When viewed from a location astern of the ship, the propeller blades rotated to the right when turning in the ahead direction. When backing, the propeller blades rotated to the left, which caused the ship's stern to back to the left (to port).

[9]Maneuvering information assumes calm weather, calm seas, no current, water depth twice the vessel's draft or greater, and a clean hull.

Turn	Condition	RPM	Advance*[10]	Transfer*[11]	Final Diameter
Right	Loaded	80	.45	.42	.85
Left	Loaded	80	.45	.42	.85
Right	Ballast	80	.32	.30	.60
Left	Ballast	80	.32	.30	.60
Right	Loaded	60	.52	.51	1.00
Left	Loaded	60	.52	.51	1.00
Right	Ballast	60	.41	.40	.80
Left	Ballast	60	.41	.40	.80

* Measured in nautical miles

Waterway Information

In the Honolulu area, vessel traffic consists of approximately 10 percent general cargo by container ship and barge; 10 percent inter-island tug and barge; 15 percent roll-on/roll-off vehicle transport; 55 percent fishing and research vessels; 5 percent crude oil/refined products; and 5 percent miscellaneous shipping. Even though shipment of crude oil/refined products constitutes a small percentage of the vessel traffic, statistics on waterborne trade indicate that crude petroleum is the largest single commodity entering the state of Hawaii. Approximately 60 percent of the petroleum that Hawaii uses is shipped from Alaska. Laden crude oil carriers cannot enter Honolulu harbor, but rather discharge their cargoes at the two private offshore moorings operated by HIRI and Chevron, Inc., at Barbers Point. The combined refining capacity of the two refineries is approximately 120,000 barrels (5,040,000 gallons) per day.

The HIRI facility consists of an onshore element and an offshore element. The onshore element, located at Campbell Industrial Park, Barbers Point,[12] Oahu, Hawaii, includes a petroleum refinery and shoreside storage tanks. The refinery produces about 95,000 barrels (3,990,000 gallons) of refined petroleum products per day, mostly for local consumption in the Hawaiian Islands.

The offshore element of the marine oil transfer facility consists of a Catenary Anchor Leg Mooring (CALM) type spm system. Tank ships visiting the facility moor by means of a single cable from their bows to a large circular floating buoy which measures 38 feet in diameter by 14 feet in depth and weighs about 120 tons. The spm buoy is located about 1.5 nmi offshore of Barbers Point. Once moored, tank ships are free to swing 360° around the stationary buoy.

Underwater pipelines connect the onshore storage tanks with the underwater manifold of the offshore facility. Three petroleum submarine hose strings connect the underwater manifold to the CALM buoy. A tank ship moors at the spm buoy

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[10]The distance a turning vessel travels in the direction of the original course from the time that the rudder is put hard over until the course has been altered 90°

[11]The distance gained by a vessel to the right or left of the original track from the time the helm is put hard over until the ship has turned to a heading 90° from its original heading..

[12]Barbers Point is located 17 miles west of Diamond Head. It is the southwestern extremity of the Island of Oahu.

offloads/loads cargo by means of three 16-inch-diameter 840-foot-long floating hose strings that are connected to the buoy.

Tank ships that moor at the offshore facility routinely deliver shipments of Alaskan North Slope crude oil, Australian crude oil, and Indonesian Crude Oil in 550,000 to 650,000 bbl lots. Tank ships moored at the spm buoy also load refined products for export and sometimes take on fuel [but only if the ship is at the berth to load or discharge cargo].

Under most normal weather conditions, the offshore marine terminal operates 24 hours per day. The HIRI operations manual details various weather and sea conditions when cargo operations are to be suspended and when moored ships should be instructed to leave.

The offshore marine terminal was designed to accommodate one vessel at a time, no larger than 150,000 deadweight tons. Maximum dimensions for a vessel mooring at the buoy were:

Length Overall	945 feet
Breadth	150 feet
Draft (Summer)	57 feet

The Coast Guard has designated an area (about .2 square nmi) that surrounds the spm buoy as restricted anchorage. (See figure 4.) As stipulated at 33 CFR 110.236, no vessels may anchor, moor, or navigate in this area except:

i. Vessels using the anchorage and its related pipelines for loading or unloading;

ii. commercial tugs, lighters, barges, launches, or other vessels engaged in servicing the anchorage facilities or vessels using them; and

iii. public vessels of the United States.

National Oceanic and Atmospheric Administration (NOAA) chart 19362, which includes the spm buoy and the accident site, shows that within about 1,500 yards inshore of the spm buoy, water depths shoal to less than 6 fathoms (36 feet). Between February 1987, when the spm buoy was installed, and the date of this accident, approximately 450 barges and 370 ships moored at the HIRI offshore facility. During this time, Coast Guard records show two previous ship accidents reported. (See appendix D.)

Aids to Navigation.--At 1000 on the day after the accident, the U.S. Coast Guard cutter MALLOW checked all Federal aids to navigation in the Barbers Point area and found them to be on station and operating properly. The Coast Guard reported that one privately maintained aid to navigation, Chevron Lighted Buoy "A," was extinguished, but that all other private navigational aids in the area appeared to be operating properly.

Meteorological Information

At the time of the accident, visibility was about 15 miles, air temperature was about 75° F, and the wind was from the northeast at 2 knots.

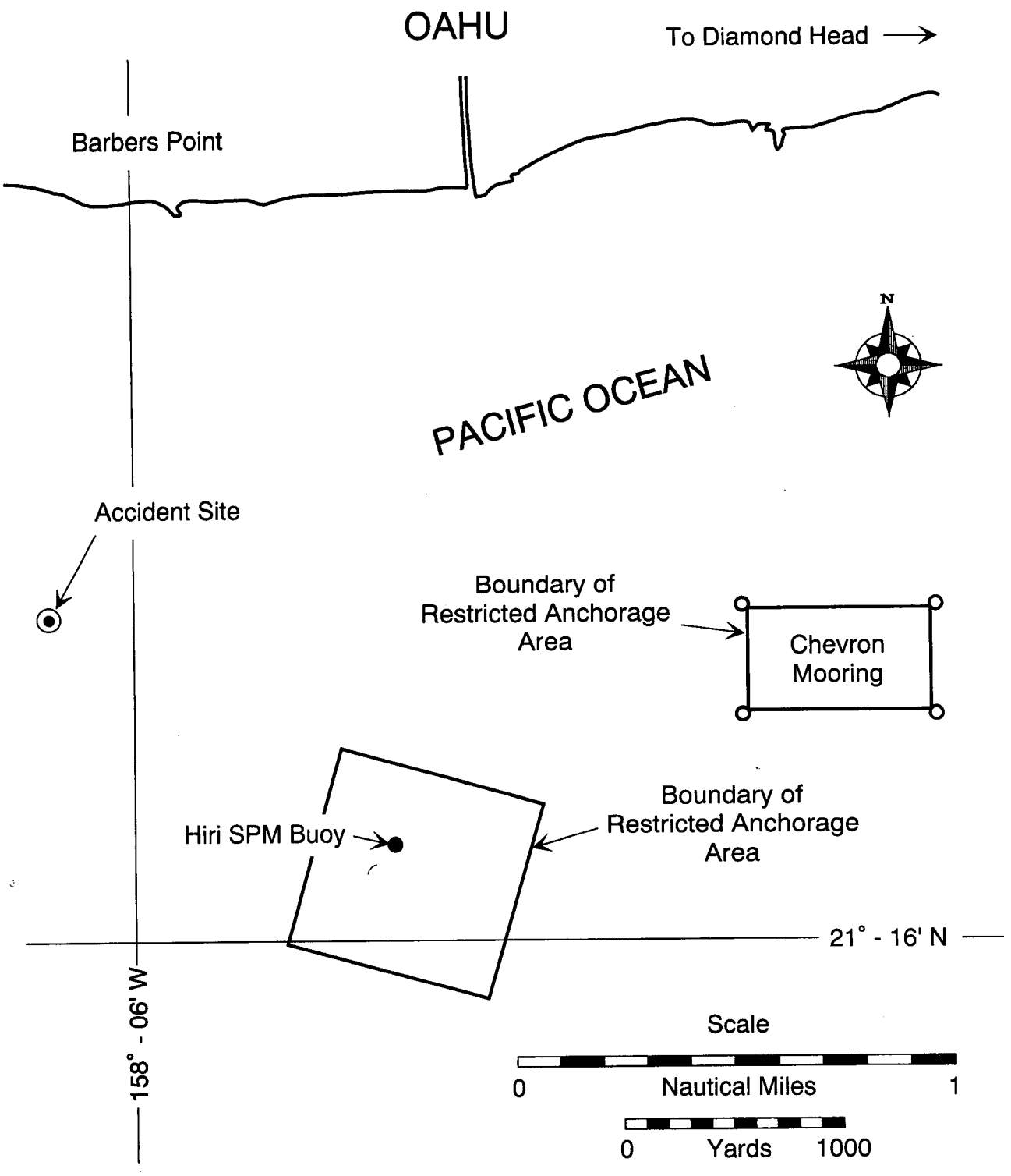

Figure 4.--Chart of area showing accident site.

The *United States Coast Pilot* provides the following description of ocean currents near the scene of this accident:

> There is a general W [westerly] current along the coast between Honolulu and Barbers Point. Velocities up to 0.8 knot, setting W, have been measured off the point, and greater velocities have been reported.

According to the STAR CONNECTICUT master and the mooring masters who were on board the vessel on the date of this accident, ocean currents in the HIRI spm buoy area were entirely unpredictable. They stated that the current changes direction and speed independently of tidal current changes and surface currents may differ in direction and velocity from subsurface currents.

After the STAR CONNECTICUT grounded, the chief mate took depth soundings around the periphery of the vessel's stern with a graduated metal gauging tape weighted at the end by two small steel shackles. He estimated that the shackles together weighed about 1/2 pound. He testified that when he took the soundings, the current was running so fast that the tape would not hang plumb, but held at an angle of 25- to -30°. He estimated that the current was westerly at 2- to -4 knots at that time.

Tests and Research

Course Recorder.--At the time of the accident, the STAR CONNECTICUT's course recorder was operating, i.e., recording the ship's heading with respect to local time onto a moving roll of graph paper. After the accident, investigators removed the graph paper roll from the course recorder and sent it to the Safety Board's laboratory in Washington, D. C., where the staff photographed the pertinent section and returned the original document to the vessel operator. The Safety Board's laboratory used the photographic reproduction to graph the vessel's heading with respect to time as shown in figure 5.

Laboratory staff next used an optical readout station to digitize the course recorder data from the time of the unmooring until the time of the grounding. Laboratory staff input the digitized course data, heading and time information, and assumed ship speed into the computer to determine distance traveled.[13] Figure 6 shows the resultant trackline that the computer plotted, overlayed onto a chart of the accident area.

Other Information

Pollution Risk.--The COTP, Honolulu also served as Officer-In-Charge of Marine Inspection (OCMI), Honolulu. Together, the COTP office and the Marine Inspection Office (MIO) constitute the Honolulu Marine Safety Office (MSO). Therefore, in this report, the terms MIO Honolulu, MSO Honolulu, and COTP Honolulu all refer to the same office and the commander of each is one and the same individual. The Commanding Officer (CO), MSO Honolulu reports to the 14th Coast Guard District Chief of Marine Safety. The Commanding Officer, MSO, Honolulu is the

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[13]Staff assigned no value for ocean current in the Board's trackline reconstruction.

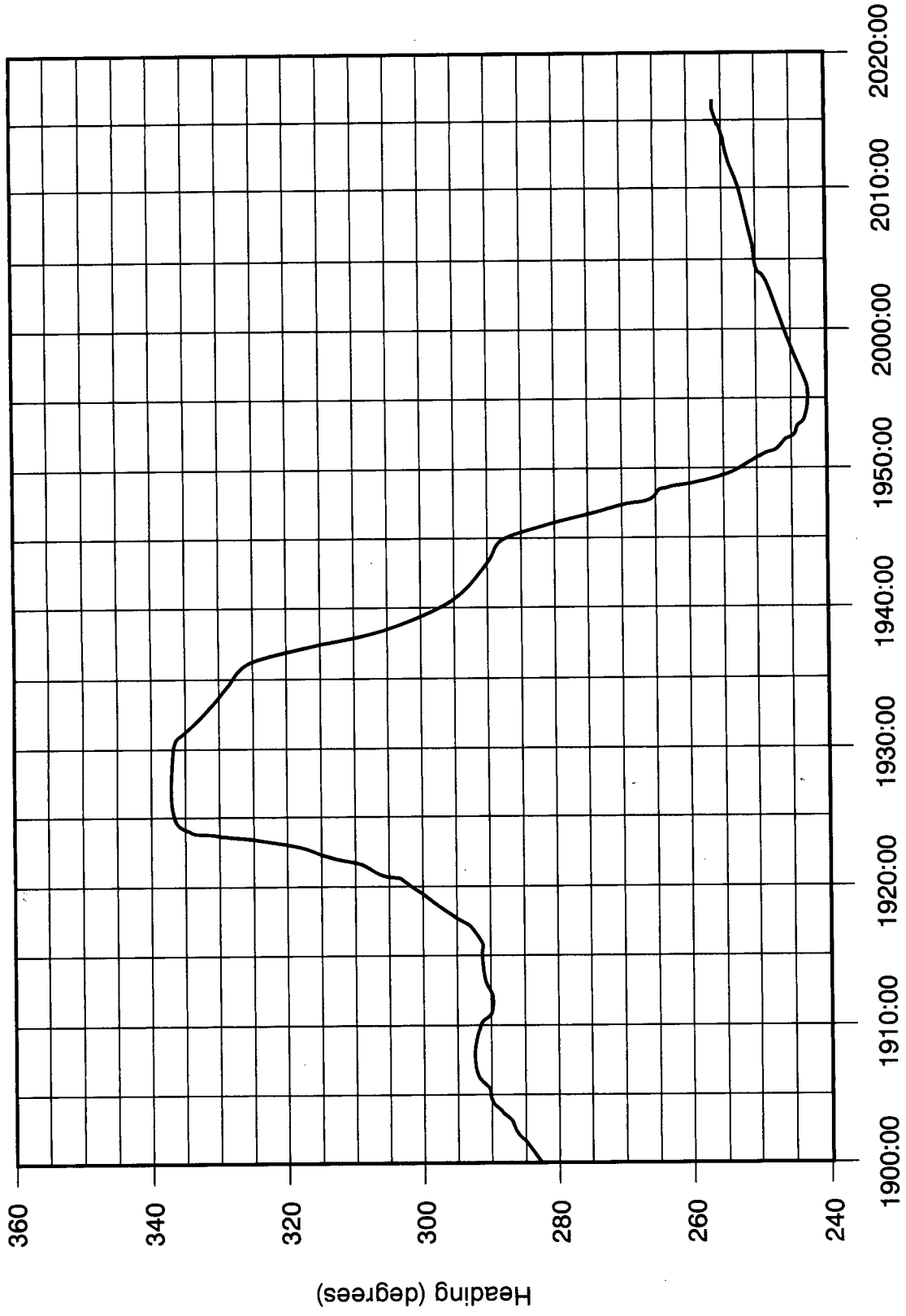

Figure 5.--Course recorder data.

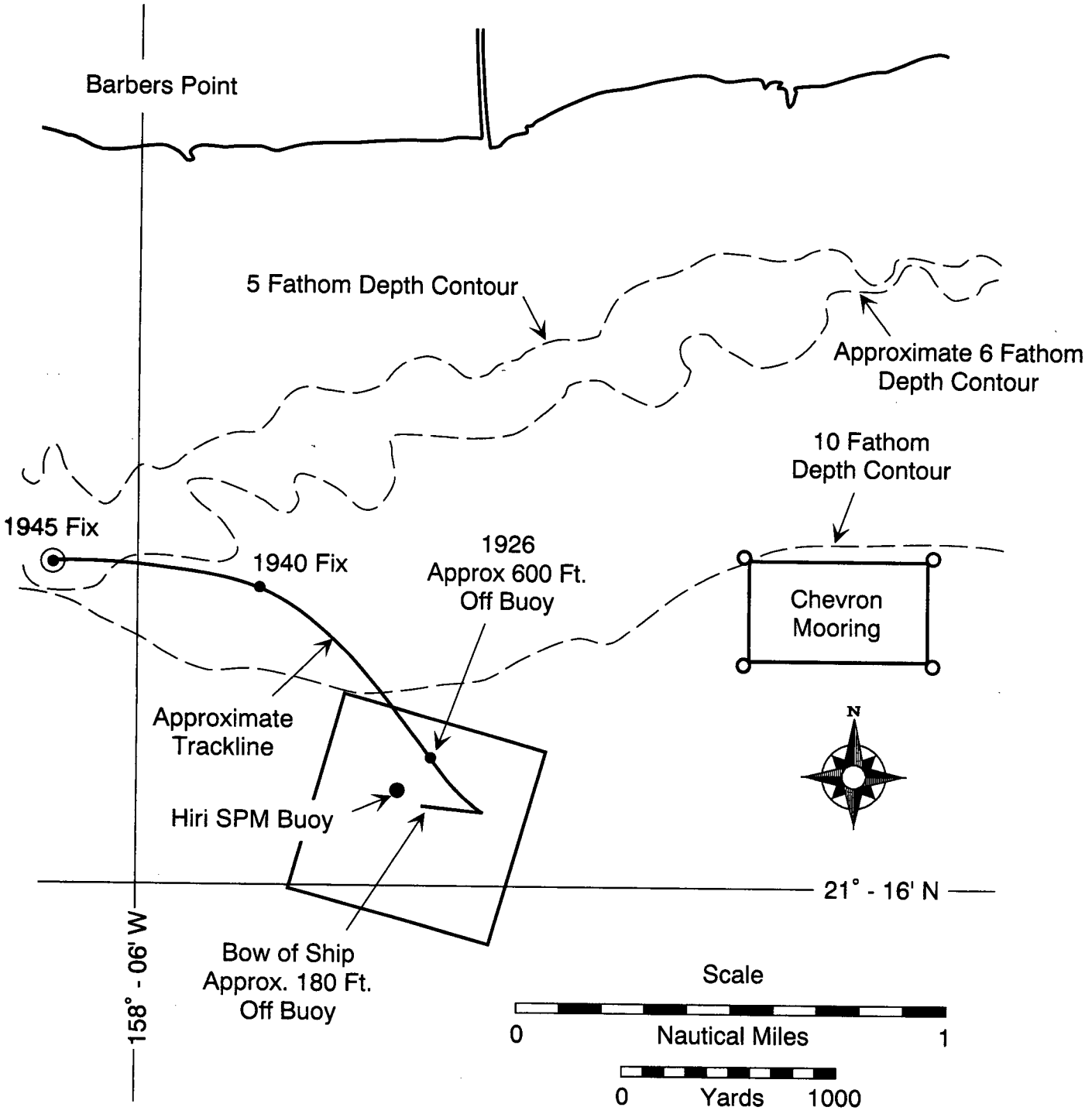

Figure 6.--Chart of area showing approximate trackline of STAR CONNECTICUT departing the HIRI SPM buoy.

predesignated Federal On-Scene Coordinator (FOSC) for marine oil spills for the area including the State of Hawaii, the Territory of American Samoa, and various miscellaneous Pacific islands and atolls.

Personnel from the Marine Environmental Protection/Port Safety Section of MSO Honolulu usually were responsible for spills of a routine nature. In the event of a large or unusually significant spill, the FOSC could obtain additional assistance from other 14th Coast Guard District units and from Coast Guard Reserve personnel.

When it grounded, the STAR CONNECTICUT had No. 6 fuel oil, light naphtha, and vacuum gas oil on board. No. 6 fuel oil, also known as bunker C oil and residual fuel oil, is a highly viscous, strongly acrid black liquid. No. 6 oil usually floats on water, but in some instances its specific gravity is greater than water. In high concentrations, No. 6 oil is dangerous to aquatic life and will foul shorelines. In the event of a spill, containment booms, skimmers, and absorbents are the recognized methods of control and removal from the water.

Light naphtha is a colorless liquid with a mild kerosene odor. It boils at 80-300° F and freezes at approximately, 160° F. Its vapor pressure is 11.0 psi at 100° F and its specific gravity varies between 0.669 and 0.702. Its vapor density is 3.5 (air = 1.0). Thus, in the liquid state, this product is lighter than water and in the vapor state, it is heavier than air. If spilled into the water, this product would evaporate into the atmosphere.

Vacuum gas oil (VGO, HSVGO, and LSVGO) is a complex mixture of hydrocarbons produced by the vacuum distillation of the residue from atmospheric distillation of crude oil. A dark colored, waxy substance, vacuum gas oil is generally solid at room temperature. It is not soluble in water and its specific gravity is 0.865 to 0.940 at 60° F. If spilled into water, the oil would solidify into a paraffin-like mass. According to an HIRI spokesman, if the spilled product were to reach a shore, clean-up would be a rather straightforward operation requiring conventional earthmoving equipment.

Pollution Response.--At 2028 on November 6, 1990, Coast Guard Group Honolulu (Group Honolulu) received a radio call from the STAR CONNECTICUT master reporting that the ship was aground about 1 nmi off Barbers Point and taking on water in the aft pumproom. Group Honolulu notified other Coast Guard commands immediately, and within minutes directed the U.S. Coast Guard Cutter WASHINGTON to get underway to the scene. Group Honolulu also placed several other cutters, including MALLOW, SASSAFRAS, STORIS, and FIREBUSH on alert to assist as necessary. The Coast Guard 14th District Office (CGD14) contacted U.S. Navy Pacific Fleet Headquarters to request U.S. Navy salvage resources. The USS CONSERVER, the USS SAFEGUARD, and a U.S. Navy salvage team responded to the incident. CGD14 also contacted local commercial marine salvage and tug companies for assistance.

At 2110, the first Coast Guard aircraft was airborne en route to the scene from Coast Guard Air Station Honolulu. By 2139, a Coast Guard team had boarded the STAR CONNECTICUT; at 2145, the team reported that flooding was under control and no pollution had been detected. At 2224, the Coast Guard activated the Regional Response Team.

At 2305, CGD14 requested the Commander Pacific Area to activate the Coast Guard Pacific Strike Team. By this time, the Coast Guard had officially Federalized the response to the spill under authority of the Oil Pollution Act of 1990. According to the Assistant Chief, Port Operations Department at MSO Honolulu, the Coast Guard Federalized the response effort and thus assumed responsibility for organizing and deploying necessary resources because of the great potential for a serious oil spill and because the Coast Guard believed that Texaco was not in a position to take immediate action to marshal the necessary pollution response forces. He stated that the Coast Guard believed that the ship's master was preoccupied with freeing his vessel from its strand, and was therefore unable to get a quick overview of the pollution control effort needed in order to take timely measures. About the same time, the CGC WASHINGTON arrived on scene and assumed the role of On Scene Commander (OSC).

At 0035, on November 7, 1990, the Pacific Strike Team was en route to C.G. Air Station Sacramento, California, for C-130 transport to Honolulu. They arrived on scene shortly after 1400.

At 0700, Group Honolulu reported that the STAR CONNECTICUT was free from its strand and underway on its own power en route to an anchorage. At the time that the ship was refloated, two U.S. Navy salvage vessels, the Clean Islands Council [14] vessel CLEAN ISLANDS, an oil skimmer, four commercial tugs, and one oil recovery barge, and various Coast Guard vessels were on scene. CGC MALLOW reported a small (100-yd X 200-yd) product/ballast oil slick in the area of the tanker. The MALLOW and the Clean Islands Council vessel cleaned up the slick using absorbent material. At 0816, clean-up activity was completed.

Coast Guard Response To Previous Accidents.--As a result of the massive EXXON VALDEZ oil spill in Prince William Sound, Alaska, in March 1989 and previous accidents at the HIRI spm buoy, the U.S. Coast Guard required that the HIRI initiate several precautionary measures to enhance marine environmental protection at their offshore marine terminal. These measures, which had been incorporated in the HIRI operations manual at the time of this accident, included:

1. Establishment of weather operating criteria to describe conditions under which cargo transfer operations shall be shutdown, when cargo hoses shall be disconnected, and when a vessel shall be required to depart from the mooring.

2. Establishment of a tug assistance requirement for all laden or partially laden tank ships mooring and unmooring from the spm.

3. Establishment of a requirement for a manned bridge watch at all times while a vessel is moored to the spm.

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[14]The Clean Islands Council, originally organized in 1972, is a nonprofit oil spill clean up cooperative which was created to help protect the local Hawaiian marine environment. Both Hawaiian Independent Refinery, Inc., and Chevron, U.S.A. are members.

4. Establishment of a requirement for a qualified member of the ship's crew to stand bow lookout watch at all times while the vessel is moored to the spm.

5. Establishment of a requirement to maintain the ship's engines on immediate standby, and if the engines are unavailable, to have a tug (stern assist vessel) made up to the ship.

6. Implementation of detailed emergency action procedures for persons-in-charge to include termination of transfer operations when any spill occurs and resumption of transfer operations only upon COTP approval.

Regulation of Offshore Oil Transfer Facilities.--U.S. offshore oil transfer facilities located beyond the territorial sea[15] of the United States operate under the regulations contained at 33 CFR 148-150. Currently, these regulations apply only to the Louisiana Offshore Oil Port (LOOP), a deepwater port facility located off the coast of the United States in the Gulf of Mexico. These regulations not only set professional standards for mooring masters and other persons involved in the operation of tank ships at offshore oil transfer facilities, but also specify when mooring masters are required to be on board. Moreover, the regulations contain operational requirements for cargo transfer operations, for periodic tests and inspections of oil transfer systems, and for oil discharge containment. Additionally, they specify the traffic control, radar surveillance, and ship routing measures required of vessels operating within the deepwater port area. These regulations did not apply to the HIRI offshore oil transfer facility at Barbers Point because this facility was located within the territorial sea of the United States.

The Coast Guard regulated both the HIRI and the Chevron offshore facilities for compliance with Federal oil pollution prevention standards contained at 33 CFR 154, the same regulations that govern marine shoreside transfer facilities. These regulations do not contain any operational requirements related to the mooring and unmooring of vessels at offshore facilities. At the time of this accident, these regulations applied to 12 offshore oil transfer facilities, including the HIRI and the Chevron facility, within the territorial sea of the U. S. The other 10 facilities were all located off the California coast within the 11th Coast Guard District.

Coast Guard Response to This Accident.--As a result of the grounding of the STAR CONNECTICUT on November 6, 1990, the Honolulu COTP took the following action:

1. After holding discussions with industry representatives in December 1990, the COTP issued an order designating as Federal pilotage waters the area containing and surrounding the HIRI and the Chevron offshore mooring facilities (the area extended roughly from the shoreline out to 3 miles and from Barbers Point eastward to Ewa Beach). The order, which went into effect on May 1, 1991, required that all mooring masters

[15]With respect to the United States, "territorial sea" means the waters within the belt, 3 nautical miles wide, that is adjacent to its coast and seaward of an artificially established baseline.

conning U.S. vessels engaged in coastwise trade within this area obtain a Federal pilot's endorsement on their licenses.

2. In a letter dated December 17, 1990, to the Commandant of the U.S. Coast Guard, the COTP for Honolulu recommended that detailed regulations, analogous to the deepwater port regulations contained in 33 CFR 148-150, be promulgated to address safety and environmental protection for offshore oil transfer facilities located inside the territorial sea. To date [January 1992], Coast Guard Headquarters has not acted upon the recommendation.

3, In June 1991, the local Coast Guard authorities initiated a rulemaking project to require pilotage for U.S. vessels engaged in foreign commerce and for foreign vessels while such vessels are operating within the designated pilotage area and/or mooring or unmooring from the offshore oil transfer facilities.

4. On August 12, 1991, the Honolulu COTP directed that a tug of at least 4000 horsepower be made up to each tank ship at all times while such tank ship is moored at the HIRI spm buoy.

5. On August 16, 1991, the Honolulu COTP requested that the Commander of the 14th Coast Guard District redefine the description of the restricted area surrounding the HIRI spm buoy to increase its size by about 50 percent.

In addition to the above listed actions, the Commander of the 11th Coast Guard District,[16] whose jurisdiction included 10 other offshore oil transfer facilities located in the territorial sea, instituted a rulemaking project to bring these facilities under regulations more suitable to their offshore operations. This project is still in a draft stage and the notice of proposed rulemaking is not expected to be published until early 1992.

Actions Taken By HIRI.--As a result of this accident, HIRI has ensured that all of its mooring masters have obtained the necessary federal pilot endorsement on their Coast Guard licenses. In addition, HIRI has ordered an ocean current monitoring device be installed on the spm buoy.

ANALYSIS

General

The grounding of the STAR CONNECTICUT did not result from adverse weather or sea conditions. The weather was clear and the seas were calm. Equipment failure did not cause or contribute to the accident. All of the ship's maneuvering, navigation, and communication equipment had been tested and found to be in good working order prior to the ship's getting underway and did not malfunction after the ship departed from the spm buoy. The master was a very experienced

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[16]The Eleventh Coast Guard District is composed of the States of California, Nevada, Utah, and Arizona.

mariner with a reputation for being a good shiphandler. He had been the master of the STAR CONNECTICUT for six years, and was thoroughly familiar with its handling characteristics. Moreover, he had unmoored from the HIRI spm buoy eight times and was familiar with the area. Neither the master nor the junior third mate was impaired by fatigue or by drug or alcohol. Both officers were adequately rested and tested negatively for drugs and alcohol. Investigation revealed no obvious cause for this accident. The Safety Board believes that the ship grounded because of a series of human errors by the ship's master who was directing the navigation of the vessel at the time. The following discussion addresses these errors.

The Accident

The course recorder data showed that at 1912, when the master passed the conn to the senior mooring master to commence the unmooring, the ship was heading 290°. On this heading, the ship's stern was to the sea and nothing was directly astern of the tanker. The master had released the stern assist vessel NA'INA at 1908 and it was clear of the tanker.

Beginning at 1912.6, the senior mooring master issued a series of astern engine orders to back the ship clear of the spm buoy. The STAR CONNECTICUT had a single right-hand-turning propeller. When the engine was operated astern, the ship would back to port, which would cause the bow to swing to starboard. The data from the course recorder showed that about 1916, the ship's head started swinging rapidly to starboard. At 1918, when the senior mooring master transferred the conn to the master, the master attempted to check the swing by ordering hard left rudder and half ahead with the engine. At 1922, the master ordered the engine to slow ahead, but kept the rudder hard left. Despite the execution of these orders, the ship continued to swing to the right until it reached a heading of 337° at 1925. Even with the application of hard left rudder for 9 minutes, the ship swung through a 45° arc to the right. Thus, the ship was under a substantial turning moment after the master assumed the conn.

The master testified that while he was maneuvering the STAR CONNECTICUT to pass the spm buoy at 1922, he was concerned about the possibility of getting the pickup line caught in the propeller. He therefore ordered the engine to dead slow ahead at 1925.2 and to stop at 1925.9 so that he would avoid the line. At 1927, the KEOKI arrived off the starboard side of the tanker to receive personnel disembarking from the STAR CONNECTICUT. The master kept the engine at stop until 1932 when he ordered slow ahead. At 1932.6, he ordered half ahead; at 1933.8, he ordered the engine stopped. At 1940.3, after seeing the third mate's 1940 navigation fix plotted on the chart and realizing that the ship was in danger, the master ordered hard left rudder and half ahead on the engine. During the total 18.3 minutes that he maneuvered the STAR CONNECTICUT inshore of the spm buoy, the master kept the engines stopped for 12.6 minutes (68.8 percent of the time). During this time, the ship made minimal headway and drifted under the influence of the ocean current, which set the ship toward the shoal.

The 1940 navigation fix showed that the STAR CONNECTICUT was about 1,200 yards and on a bearing 329° true from the charted position of the spm buoy. The charted depth in this area was 7 fathoms (42 feet). Course recorder data showed that at this time the ship was on a heading of 297° and swinging to the left. The navigation chart showed that the charted water depths about 200 yards ahead of the vessel were less than 6 fathoms (36 feet). Despite the application of rudder,

the ship's forward momentum, combined with the effects of the current, carried the vessel over the shoal, and the STAR CONNECTICUT grounded at 1944.

The first and foremost responsibility of the STAR CONNECTICUT's master was the safety of his ship. Regardless of whether he or the senior mooring master had the conn, the master retained the ultimate responsibility for the ship's safe departure from the spm buoy and navigation out to sea. While the senior mooring master had the conn, the master assumed an oversight position. When the mooring master passed the conn to the master after the unmooring, the master's role immediately changed to one of active participation. He assumed navigational control of the vessel and believed he was forced by circumstances to navigate his vessel inshore of the spm buoy.

The Safety Board believes that the timing and circumstances for transferring the conn should have been a matter that was worked out between the senior mooring master and the ship's master ahead of time. The proper transfer of the conn should have been the subject of discussion between the mooring master and the master before the unmooring operations were begun.

The Safety Board has found that the problem of poor communication and planning prior to executing a potentially jeopardous maneuver continues to be a direct and/or contributory cause of major marine accidents. As early as 1974, as a result of its investigation of the AFRICAN NEPTUNE[17] accident where a U.S. freighter rammed the Sidney Lanier Bridge at Brunswick, Georgia, the Safety Board recommended that the U.S. Coast Guard:

> M-74-15
>
> Require that every master of an ocean-going vessel inform himself of the pilot's plan to maneuver his ship in or out of a harbor and that the master determine, with the pilot's assistance, the critical aspects of the maneuver, including the pilot's plan for emergencies.

Most recently, as a result of its investigation of the collision between the Greek tank ship SHINOUSSA[18]

> M-91-28
>
> Amend 33 CFR 164.11(k) to require that masters and pilots discuss and agree beforehand to the essential features and relevant checkpoints of maneuvers they expect to undertake.

In the case of the STAR CONNECTICUT's grounding, the master of that tank ship complained that there were no formalized procedures for unmooring from the HIRI spm buoy similar to those for mooring to the buoy. The Safety Board agrees that a

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[17]For more detailed information, read "SS AFRICAN NEPTUNE: Collision with the Sidney Lanier Bridge at Brunswick, Georgia, on November 7, 1972, with Loss of Life (NTSB/MAR-74/04).

[18]For more detailed information, read "Collision Between the Greek Tankship SHINOUSSA and the U.S. Towboat CHANDY N and tow Near Red Fish Island, Galveston Bay, Texas, July 28, 1990" (NTSB/MAR-91/03).

predeparture conference between a master and a mooring master is a necessary procedure. The Safety Board believes that as the master of the STAR CONNECTICUT, he should have insisted before the unmooring operation commenced that the mooring master discuss with him what procedures would be followed for departing from the spm buoy, the manner and timing of the transfer of the conn, the intended direction from which the ship would leave the buoy, and the timing and location for the transfer of personnel to the launch.

Moreover, the master should have included the navigation watch officer in these discussions so that watch officer would know what to expect, and could be more effective in carrying out his duties. As it happened, the watch officer did not even know that the mooring master on the bow had the conn during the unmooring. Had the master insisted upon such discussions before unmooring from the spm buoy on the date of this accident, he would have known ahead of time when the mooring master would transfer the conn, and he would not have been placed into a situation where he would be forced to extemporize the navigation of his vessel.

Between 1974 and 1991, the Safety Board has repeatedly made recommendations to the U.S. Coast Guard and several pilots associations regarding the need for discussions between masters and pilots and/or plans prior to maneuvers in no fewer than eight major accident reports. (See appendix E.) Poor planning/communication is obviously a recurring problem that continues to result in major marine accidents. The Safety Board therefore believes that the Coast Guard should require that masters of all tank ships arriving and departing from offshore oil transfer facilities conduct prearrival and predeparture conferences with the mooring masters to plan intended maneuvers.

As the navigation watch officer, the junior third mate performed the traditional watch duties when a master or a pilot has the conn, which include monitoring the helmsman, executing the engine orders, and keeping the deck bell book. He was also responsible for periodically fixing the vessel's position. The master's standing orders required that the mate obtain and plot a navigation fix every 15 to 20 minutes. However, the rapidity of the engine orders issued by the mooring master or the ship's master from the time the unmooring operation began required that the third mate remain at the engine order telegraph until about 1930. His first opportunity to take a navigation fix was at 1940. The Safety Board believes that the junior third mate could not have reasonably taken a fix much earlier without some prioritization of tasks by the master which would have provided the opportunity for the junior third mate to do so.

Although the senior mooring master testified that he did not consider the sighting of the oil as significant and that the ship's departure from the spm buoy and the disembarkation of personnel were routine, the STAR CONNECTICUT master testified that the mooring master appeared anxious to complete the unmooring of the STAR CONNECTICUT and to get off the ship so that he could meet with the Coast Guard inspectors and examine the spm buoy. The STAR CONNECTICUT master, in attempting to accommodate what he perceived to be the mooring master's urgency to disembark, placed his ship in jeopardy. The Safety Board believes that he should not have allowed the disembarkations to take place until after he had completed maneuvering the ship into safe water.

When the STAR CONNECTICUT master chose to maneuver the tank ship toward shoal water rather than deep water, he set up the chain of events which led to the

vessel's grounding. The STAR CONNECTICUT's deepest draft was 36.4 feet. Within about 1,500 yards inshore of the spm the water depth shoaled to less than 36 feet. Despite his knowledge that ocean currents were unpredictable, the master maneuvered the vessel into a constricted area inshore of the buoy. Given the master's experience, the Safety Board believes that he should have recognized that he was placing his vessel at increased risk of grounding even if navigation fixes were plotted frequently. If the vessel suffered a propulsion or steering failure, or some other serious breakdown while maneuvering inshore of the buoy, the master would have little time and space within which he could react in order to prevent grounding. Moreover, his course inshore of the spm buoy took the tank ship over submerged pipelines which might interfere with the ability of the ship to drop its anchors in an emergency. In the Safety Board's opinion, the master's decision to pass inshore of the spm buoy was a poor one, exacerbated by his decision to disembark personnel before he had completed the intended maneuver and placed his vessel in safe water.

Monitoring Depths

U.S. Coast Guard regulations (33 CFR 164.35(h)) require that a vessel have on board an "echo depth sounding device" and a device to continuously record depth readings. However, the regulations do not define the range for which the required devices must be able to sense and record depths. The recording fathometer that was on board the STAR CONNECTICUT at the time of the accident fulfilled the requirements of the regulations, however, it was not suitable for use in shallow water areas and was not being used by the navigation watch standers to monitor the water depth under the vessel as it proceeded inshore of the buoy.

Although the lack of a suitable depth monitoring device with readout capability on the navigation bridge was not causal to the grounding of the STAR CONNECTICUT, the Safety Board believes that if the vessel had been outfitted with such a device, the master and the junior third mate would have had an additional cue that the tank ship was approaching dangerously close to a shoal. Such a device may have spurred them to have taken earlier action to avoid the grounding.

In the Safety Board's opinion, the safety of tank ship navigation would be enhanced if vessels were required to carry a depth sounding device suitable for shallow water which has readout capability on the navigation bridge. Catastrophic environmental harm and expensive clean-up operations can result from a tank ship grounding. The 1989 costs to clean up spilled oil from the grounding of the EXXON VALDEZ were estimated at $1.85 billion. As long as oil and oil products are carried by ships, the potential for a recurrence of this type of disaster exists. However, in the Safety Board's view, providing navigating watch standers on tank ships with additional cues to warn them of impending shoal areas may lessen the likelihood that such an accident will occur.

The Master's Options

The senior mooring master passed the conn to the ship's master at 1918. The master testified that when he assumed the conn, maneuvering the STAR CONNECTICUT inshore of the buoy was his only option. He stated that the floating cargo hoses on the ship's port side and the two small vessels to the southwest and west of the spm buoy precluded his turning immediately to the left when he departed the spm buoy. However, the Safety Board believes that the master could have taken several alternative actions.

When the master ordered the engine stopped at 1918.2, the STAR CONNECTICUT had backed for a total of 5.6 minutes, 2.4 minutes less than the vessel's 8-minute backing limit. If he had reached the backing limitation, the master could have either stopped the engine, or ordered dead slow ahead with right rudder for a short time in order to keep the ship turning and give the astern element of the engine a chance to cool. He could then have restarted the backing maneuver for another 8 minutes and continued backing the vessel to a course away from the spm buoy toward deep water.

When asked if anything hindered him from backing the STAR CONNECTICUT further than he did, the master stated, " Well, there was the Chevron mooring buoys. Their operation was astern of me." However, the charted position of the closest Chevron mooring buoy was about .9 nmi away from the charted position of the HIRI spm buoy. Considering the STAR CONNECTICUT's heading when it departed from the spm buoy, the nearest Chevron mooring buoy would not have been directly astern of the ship, but would have been located off the tanker's starboard quarter. Also, with the tanker's bow swinging to starboard as it backed, its stern was swinging away from the Chevron mooring. The Safety Board believes that the Chevron mooring buoys did not hinder the master of the STAR CONNECTICUT from backing farther than he did, and that if he had done so, he probably could have turned the vessel onto a heading that would have taken the ship safely to sea without having to pass inshore of the HIRI spm buoy.

The master further testified that he did not continue backing because he was not sure where he would "end up." He said that if he had backed continually in a circle, the ship would have backed into the floating cargo hoses. The Safety Board does not accept the master's stated concern that the ship would have backed into the floating cargo hoses if he had continued backing. The NENE was tending the hoses and could have pulled the hoses clear of the ship if that became necessary, and the ship had an assisting tug available, which could have been used to facilitate the turn.

Local U.S. Coast Guard requirements mandate that tug assistance be available for all tank ships unmooring from the HIRI spm buoy. The tug NIAU was on scene and made up to the STAR CONNECTICUT's port bow during the unmooring operation. However, the STAR CONNECTICUT master did not use the NIAU to help turn the ship during or after the unmooring. He stated that the tug was too small to have been effective. The NIAU had 1100 horsepower, and the master testified that he considered 3000 horsepower to be the minimum horsepower that a tug should have in order to be effective in maneuvering the STAR CONNECTICUT. However, he also stated that he could have refused the NIAU and requested a larger tug if he had wanted to, but he did not do so. The Safety Board agrees that a tug with more horsepower would have been of greater use to the STAR CONNECTICUT than the NIAU. However, because the wind and seas were calm, the NIAU did not have to overcome any significant environmental forces and probably could have been used effectively to help turn the vessel. The Safety Board believes that had the master used the NIAU to help turn the STAR CONNECTICUT, he could have immediately maneuvered the tanker offshore toward deep water when he departed from the spm buoy.

In sum, the Safety Board believes that the master had several options for alternative action. He could have used the tug NIAU in conjunction with the ship's engine and rudder to turn the ship to the left; he could have requested that the

NENE operator move the floating cargo hoses out of the way; he could have continued to back the STAR CONNECTICUT to increase the distance between the ship and the small vessels and hoses before turning left; or he could have continued to back until the ship swung around to an offshore heading.

Human Performance Aspects of Conning Tasks and Workload

Because the master of the STAR CONNECTICUT had an established reputation as a careful, disciplined, and competent shiphandler, the Safety Board believes that his uncharacteristic lack of attention to the ship's position after the unmooring resulted from his attempt to handle too many tasks concurrently. Prior to the accident, the master's workload included monitoring the disembarkations, maneuvering the STAR CONNECTICUT in small boat traffic, and conducting communications with assisting service vessels, all during a nighttime departure.

When he assumed the conn, the master may not have considered that maneuvering the ship to a outbound heading could prove difficult. However, his decision to take an inshore departure route for which he had not planned demanded greater attentiveness to navigating the passage. His workload situation was exacerbated when he had to juggle several major activities simultaneously, activities that one might reasonably have expected to occur one after the other. The master indicated in his testimony that he initially expected to disembark the personnel who were going ashore and then proceed past the small boats west of the spm for the turn to safe water.

Although the master of the STAR CONNECTICUT did not state in testimony that his workload affected his performance before the grounding, by taking on all navigation and maneuvering decisions himself, he compromised his ability to maintain situational awareness or an overview of all conning tasks. As is often the case in high workload situations, he increasingly focused on details to the detriment of the overall situation. For example, when the KEOKI did not come alongside as expeditiously as he anticipated, the master became preoccupied in the disembarkations to the exclusion of more important tasks, including frequently fixing the ship's position.

Before the grounding, communication between the master and the third mate concerning the departure was very limited. The master had not informed the third mate about any of the unmooring plans. In effect, the third mate was involved in the departure only to the extent that he was available to follow orders. He was executing the master's engine orders, monitoring the helmsman, and making log entries. Even after obtaining the 1940 fix of the ship's position, the third mate merely reported that the water depth was 38 to 40 feet, rather than alerting the master as to the urgency to maneuver away from the reef. A more prudent decision would have been to call an experienced deck officer to the bridge to assist with navigation tasks as soon as the master became aware of the disembarkation intentions of the mooring masters.

Management of Navigation Bridge Resources and Team Coordination

The management of modern transportation systems has evolved over many years from the simpler hierarchical form of team management in which one or a few persons provide expertise and direction and the remainder of the team carry out orders, to one in which a team of highly trained people with varying degrees of experience manipulate and monitor complex operating systems. In the course of the

Safety Board's accident investigations, we have frequently identified operational breakdowns, coordination lapses, lack of communication, and poor task allocation which clearly reflect failures in the organization and use of available resources.

Research in system management has demonstrated that crewmembers needed to change the way that they approached their jobs; they needed to see themselves as team members with a goal for improved communication. This new approach in management of transportation systems was first applied in aviation transportation. Called Cockpit Resource Management (CRM), the managerial approach is defined as the effective utilization of all available resources (people, equipment and procedures) to achieve a safe and efficient operation.[19]

In marine transportation, several marine training facilities have developed various forms of resource management training using computer-aided bridge/ship simulators. The principles presented in such courses have been adopted under such titles as bridge resource management, bridge team training, vessel resources management, and others. Generically, this training is termed bridge resource management. The Safety Board notes that few of these marine training courses have been designed by professionals skilled in the principles of resource management. While these facilities feature lectures on effective communication, crew coordination, and resolution of conflict between crewmembers, most still emphasize individual rather than group skills to resolve problems.

The Safety Board has recently identified the importance of this management training in the grounding of the tank ship WORLD PRODIGY off the coast of Rhode Island. In this report, the Safety Board stated:

> Neither the U.S. Coast Guard license regulations nor the provisions contained in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW) require bridge resource management training for applicants seeking to obtain an original, an upgraded, or a renewed deck license. The Safety Board believes that the maritime industry has not yet embraced these concepts nor endorsed their application to the operation of merchant ships, although it has begun to explore the relationship between vessel crew interaction and accident causation.
>
> The Safety Board believes that providing bridge resource management training, which embodies the cockpit resource management concept, to licensed deck officers can prevent the type of crew interaction difficulties evident in the [WORLD PRODIGY] accident without eroding command authority or accountability.

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[19]Safety Board Member John K. Lauber originally expounded this concept in his definition of cockpit resource management given during the keynote address, "Cockpit Resource Management: Background and Overview," at the NASA/MAC Workshop on Cockpit Resource Management Training, May 6, 1986. See *Cockpit Resource Management Training*, NASA Conference Publication 2455, May 1987, p. 9.

On February 21, 1991, as a result of the WORLD PRODIGY investigation, the Safety Board issued the following recommendation to the Coast Guard:

M-91-6

Require bridge resource management training for all deck watch officers of U.S.-flag vessels of more than 1,600 gross tons.

The Safety Board is still awaiting the Coast Guard's response to this recommendation. The Safety Board believes that the circumstances of this accident reinforce the importance of bridge resource management training for deck watch officers, and therefore, reiterates M-91-6.

Texaco Marine Services, Inc. (Texaco), the operator of the STAR CONNECTICUT, has been training its deck watch officers in bridge resource management since 1977. The Safety Board acknowledges Texaco's efforts and continued commitment to this type of training for deck officers. The Texaco "bridge resources management" course has evolved to a 5-day seminar in which officers receive a series of lectures emphasizing several team coordination principles, and plan and perform several different conning tasks on the bridge/shiphandling simulator at MSI/CAORF.[20] The training staff endeavors to introduce bridge resource management into the technical shiphandling tasks on the bridge simulator but the principles of these team coordination concepts are not specifically integrated into the shiphandling exercises or subsequent evaluations.

Although the master of the STAR CONNECTICUT attended Texaco's bridge resource management course in 1990, he did not implement the basic resource management function of workload distribution when he assumed the conn on the night of the grounding. The master's testimony after the accident did not indicate that he was intractable or otherwise resistant to bridge resource management principles. Rather, the Safety Board believes that the master's failure to make use of the junior third mate to take fixes emphasizes that Texaco needs to put increased focus on team coordination in its bridge resource management course, and to provide this training to deck officers at regular intervals in the future.

Authorities in both marine and aviation training agree that one course in navigation bridge or cockpit resources management is not likely to provide enough training to overcome habitual individual skills at times of demanding workloads or in emergencies. According to the Maritime Training and Research Center,[21] a mariner will revert to his individual skills to resolve challenges in a real life situation unless he has mastered team performance skills. In his publications, J.R. Hackman, an authority on cockpit resource management, states that when an officer's most "dominant actions" are individual skills rather than crew performance skills, long term training will be necessary before appropriate coordination can be expected

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[20]Computer Aided Operations Research Facility (CAORF) operated for the Maritime Administration by Marine Safety International, Inc.

[21]Located in Toledo, Ohio, the Maritime Training and Research Center is a computer-aided instructional and research facility that offers bridge resource management training.

under highly stressful situations.[22] Another authority, R.L. Helmich, cautions that the impact of this training will "decay" unless the trainees' [operational and supervisory] settings reinforce the instructional goals and practices.[23]

The Safety Board recognizes the need for deck officers to develop and maintain both team coordination skills and technical shiphandling proficiency. While Texaco should continue to emphasize shiphandling skills in future recurrent training to deck officers, the Safety Board believes that the company should ensure that the courses equally stress team coordination and management principles.

The Safety Board also believes that instructors of future courses should receive additional training in social interaction variables to include evaluation of team structures, individual personality issues, group and individual communication, and crew coordination problems. If Texaco continues to use bridge/shiphandling simulators in its training, the company should provide performance feedback by means of video and/or audio taped replays of their activities during exercises in conjunction with computer generated charts showing simulated vessel tracklines.

Texaco should also consider patterning future bridge resource management training after courses developed by major commercial air carriers and regularly monitoring developments in both aviation and marine resources management instructional technology. The Safety Board believes that Texaco should incorporate the concepts of bridge resource management along with technical principles of shiphandling in future courses. Future courses should be developed by assessing the needs of Texaco deck officers in such ways as direct observation of conning and bridge management performance, critiques of previous "bridge resources management" courses, and input from working deck officers for topics and instructional materials. Training that is designed and implemented according to actual observed job requirements is more likely to obtain acceptance among officers than generic courses.

Aids to Navigation

On the morning after the accident, the U.S. Coast Guard verified that the Federal aids to navigation in the area of the HIRI spm buoy were on station and in good operating condition. Although the light on a privately maintained navigational aid at the Chevron mooring was extinguished, its malfunction had no bearing on this accident because the navigation watch on the STAR CONNECTICUT was not navigating in reference to this aid.

Federal Pilotage Requirements

At the time of this accident, the area surrounding the HIRI spm buoy was not a designated State or Federal pilotage area. Although HIRI required the mooring masters to possess a valid Coast Guard-issued master's license as a condition of employment, the mooring masters were not serving under the authority of their

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[22]Hackman, J.R., "Group Level Issues in the Design and Training of Cockpit Crews," in Orlady, H.W. and H.C. Foushee, Eds. *Cockpit Resource Management Training*. NASA Conference Publication 2455, May 1987, p. 31.

[23]Helmreich, R.L., "Theory Underlying CRM Training: Psychological Issues in Flight Crew Performance and Crew Coordination," Ibid, p. 19.

licenses. Therefore, the Coast Guard had no authority over a mooring master's license in the event that his negligence caused an accident. After the STAR CONNECTICUT accident, the Coast Guard COTP in Honolulu issued an order that designated the area surrounding the HIRI and Chevron offshore moorings as a Federal pilotage area for U.S. vessels engaged in coastwise trade. This means that a vessel to which this order applies now is required to be under the navigational control of a duly licensed federal pilot whenever the vessel operates within the designated area. Moreover, prospective pilots are now required to meet professional standards established by the Coast Guard and to pass a professional examination administered by the Coast Guard before they can serve as a pilot on such a vessel.

Unfortunately, the order resulting from the STAR CONNECTICUT grounding did not apply to U.S. vessels in foreign trade or to foreign vessels. Title 46 U.S.C. 8503 provides that the Secretary of Transportation may require a Federally licensed pilot on self-propelled vessels when State law does not require a pilot and the vessel is engaged in foreign commerce and operating on the navigable waters of the United States. Additionally, the statute provides that Federal authority to require a pilot on such vessels is terminated when the State having jurisdiction establishes pilotage and notifies the Secretary of that fact.

As of January 1992, the State of Hawaii, which did not enforce State pilotage in the area of the offshore moorings, has not objected to the establishment of Federal pilotage in the area. To extend the pilotage requirement to all tank ships that operate to and from the Barbers Point offshore oil transfer facilities, in June 1991, local Coast Guard authorities requested that Coast Guard Headquarters initiate a regulatory project to require pilotage for U.S. tank ships in foreign trade and for foreign tank ships that call at the spm buoy or at the nearby Chevron mooring. In a similar action, the Eleventh Coast Guard District requested that Coast Guard Headquarters initiate a similar regulatory project for the 10 offshore moorings located off the California coast.

The Safety Board believes that compulsory pilotage will significantly increase the Coast Guard's oversight of tank ship operations at offshore oil transfer facilities and the safety of the navigation in these areas. As demonstrated by the grounding of the U.S. tank ship EXXON VALDEZ in Prince William Sound, Alaska, in 1989, an accident involving a modern tank ship can result in the loss of hundreds of thousands of barrels of oil and cause catastrophic pollution to the environment. The areas where these offshore oil transfer facilities are located are environmentally sensitive and action should be taken to decrease the likelihood of serious tank ship accidents. The Safety Board agrees that the areas surrounding the offshore oil transfer facilities in Hawaii and off the California coast should be designated as Federal pilotage areas so that tank ships mooring and unmooring from such facilities will be under the navigational control of properly licensed Federal pilots. Moreover, the Safety Board believes that the pilotage requirements should extend to all tank ships that call at these offshore facilities. The Safety Board urges the Coast Guard to expedite action to require Federal pilotage for the areas surrounding these offshore oil transfer facilities.

Offshore Oil Transfer Facilities

At the time of this accident, the HIRI and the Chevron offshore oil transfer facilities, as well as similar offshore facilities located off the Coast of California, were required to meet operational regulations designed for shoreside facilities. These

regulations do not contain standards for mooring masters or shipboard procedures involved with mooring and unmooring. These facilities present unique operational risks and the potential for serious pollution accidents.

The Coast Guard has regulatory authority over a similar type of operation, the Louisiana Offshore Oil Port (LOOP), located in the Gulf of Mexico. The regulations applicable to the LOOP, which are contained in 33 CFR 148-150 (Deepwater Ports), address the safety of dynamic shipboard operations as well as the more static facility operations. These rules govern such procedures as traffic control, communications, weather monitoring, and support vessel operations. In December 1990, as a result of the grounding of the STAR CONNECTICUT, the Honolulu COTP requested that Coast Guard Headquarters initiate a project to promulgate regulations for offshore oil transfer facilities located inside the territorial sea that would be analogous to deepwater ports regulations. The Safety Board agrees that a need for such regulations exists. The Safety Board believes that the safety of tank ship operations at offshore oil transfer facilities inside the territorial sea and the protection of the environment will be greatly enhanced by the promulgation of these regulations and urges the Coast Guard to expedite completion of the project.

Pollution Response

When the STAR CONNECTICUT grounded, none of its cargo tanks or fuel tanks were breached. The minor amount of oil spilled in this accident was probably residual oil from the bilges of the pumproom that had been breached. Despite the fact that no major spill resulted from this grounding, the accident posed the potential for a major spill in a very environmentally sensitive area.

The STAR CONNECTICUT carried three potential oil pollution products: light naphtha, gas oil, and No. 6 fuel oil. A release of the naphtha, which would have evaporated into the atmosphere, probably would have caused more damage to the atmosphere than to the water. However, until the naphtha vapor dispersed, it would have represented a very serious fire or explosive hazard that would have jeopardized persons and the remaining cargo on board the STAR CONNECTICUT.

The gas oil, which would have solidified into a wax-like mass if spilled into the water, probably would not have presented any great technical problems to clean up, and the Coast Guard assembled resources were probably adequate to do so. The major water pollution threat on board the STAR CONNECTICUT was its 8,300 barrels (388,600 gallons) of No. 6 fuel oil. If this oil had spilled, it would have caused serious environmental harm, especially if it had washed onto the shores of Oahu, or one of the other Hawaiian Islands. Recognizing this threat, the Coast Guard marshaled all available pollution containment and abatement resources, from both the public and the private sectors. In addition, the Coast Guard called in resources from the mainland, activated the Regional Response Team, and notified the National Response Team in a timely manner. Moreover, the Coast Guard federalized the response effort within 3 hours of being notified of the accident. This quick action ensured that all available response equipment and personnel were in place and ready for immediate use. The Safety Board believes that the Coast Guard's pollution response to this incident was appropriate for the circumstances of the case and was executed in a timely and proper manner.

CONCLUSIONS

Findings

1. The navigation watch standers on board the STAR CONNECTICUT were properly qualified and fit for duty. At the time of the accident, the vessel control, navigation, and communication equipment was in good operating condition, area navigational aids were adequate, and weather was not a factor in this accident.

2. The master's decision to pass inshore of the single point mooring buoy was a poor one, exacerbated by his decision to disembark the mooring masters and other personnel before he had completed the intended maneuver and placed his vessel in safe water.

3. Given the unpredictability of ocean currents and proximity of shoals in the area, the master should have determined and plotted the vessel's position at frequent intervals when he maneuvered inshore of the single point mooring buoy.

4. The master did not ensure that his vessel's position was fixed frequently because he became progressively preoccupied with the disembarkation of personnel. Such a tendency to give precedence to specific operation over the overall situation is symptomatic of an individual operating under a high workload situation.

5. The safety of tank ship operations at Hawaiian Independent Refinery, Inc., and similar facilities would be increased by the development and enforcement of Federal pilotage requirements at such facilities and of regulations analogous to the Deepwater Ports regulations (33 CFR 148.150).

6. A predeparture conference during which the ship's master and the mooring master discuss prevailing weather and sea conditions, the manner of departure, and the timing for passing the conn, would enhance the safety of tank ship departures from the single point mooring buoy.

7. Bridge resource management training provided on a recurrent basis to deck officers would overcome a tendency to revert to individual habits at times of demanding workloads or in emergencies.

8. The Coast Guard's pollution response to this incident was appropriate for the circumstances of the case and was executed in a timely and proper manner.

9. A fathometer suitable for shallow water would have provided the navigation watch standers with an additional cue that the vessel was approaching a shoal.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the grounding of the U.S. tank ship STAR CONNECTICUT was the failure by the STAR CONNECTICUT's master and the Hawaiian Independent Refinery's mooring master to plan and coordinate the vessel's departure from the single point mooring buoy which resulted in the master's inability to focus on and prioritize the critical

tasks associated with departing the spm buoy while maneuvering close to a shoal area known to have unpredictable ocean currents.

RECOMMENDATIONS

As a result of its investigation of this accident, the Safety Board makes the following recommendations:

--to the U.S. Coast Guard:

Promulgate regulations for tank vessel operations at offshore oil transfer facilities located within the territorial sea similar to those presently applied to deepwater ports. (Class II, Priority Action) (M-92-1)

Require all tank ships mooring or unmooring at offshore oil transfer facilities located off the coasts of Oahu and California to be under the navigational control of a Federal pilot. (Class II, Priority Action) (Class II, Priority Action) (M-92-2)

Require that shipmasters and mooring masters conduct a pre-arrival and predeparture conference to discuss the prevailing wind and sea conditions, intended maneuvers, manner and timing for transferring the conn, and any other matters relevant to the safety of operations before mooring and unmooring from offshore oil transfer facilities located within the territorial sea of the United States. (Class II, Priority Action) (M-92-3)

Require tank ships mooring and unmooring at offshore oil transfer facilities located within the territorial sea of the United States to have on board a shallow water fathometer that has readout capability on the navigation bridge. (Class II, Priority Action) (M-92-4)

--to Hawaiian Independent Refineries, Inc.:

Require that, prior to unmooring from the Barbers Point spm buoy, mooring masters participate in a predeparture conference with the ship's master to discuss the weather and sea conditions, and to specify what unmooring procedures they intend to follow, what path the ship will take to sea, when they will pass the conn to the ship's master or navigation watch officer, and any other matters relevant to the safety of operations. (Class II, Priority Action) (M-92-5)

--to the Texaco Marine Services, Inc.:

Require that company masters confer with the mooring master prior to unmooring at all offshore oil transfer facilities to discuss the weather and sea conditions, and to specify what unmooring procedures they intend to follow, what path the ship will take to sea, when the conn will pass to the ship's

master or navigation watch officer, and any other matters relevant to the safety of operations. (Class II, Priority Action) (M-92-6)

Design and develop bridge resource management courses for initial and recurrent officer training that teach principles of resource management and emphasize team coordination in addition to shiphandling skills. (Class II, Priority Action) (M-92-7)

Install a fathometer that is suitable for shallow water service and has readout capability on the navigation bridge on all company tank ships that moor and unmoor at offshore oil transfer facilities located within the territorial sea of the United States. (Class II, Priority Action) (M-92-8)

As a further result of its investigation of this accident, the Safety Board reiterates the following recommendation to the U.S. Coast Guard:

M-91-6

Require bridge resource management training for all deck watchofficers of U.S. flag vessels of more than 1,600 gross tons.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ James L. Kolstad
Chairman

/s/ Susan M. Coughlin
Vice Chairman

/s/ John K. Lauber
Member

/s/ Christopher A. Hart
Member

/s/ John A. Hammerschmidt
Member

January 7, 1992

APPENDIXES

APPENDIX A

INVESTIGATION

This accident was investigated jointly by the National Transportation Safety Board and the U.S. Coast Guard. Sworn testimony was taken from all witnesses pertinent to this accident at a joint NTSB/USCG public proceeding in Honolulu, Hawaii between November 14 and November 16, 1990.

APPENDIX B

PERSONNEL DATA

STAR CONNECTICUT

The Master.--Captain Ronald L. Pouch, age 53, was the master of the STAR CONNECTICUT at the time of the accident. Captain Pouch held a license issued by the U.S. Coast Guard which qualified him to serve as "Master of United States Steam or Motor Vessels of any Gross Tons upon Oceans." His license was endorsed to show qualification as radar observer.

The Junior Third Mate.--James F. Reardon, Jr., age 27, was the navigation watch officer on board the STAR CONNECTICUT at the time of the accident. Mr. Reardon held a license issued by the U.S. Coast Guard which qualified him to serve as master of ocean steam and motor vessels of not more than 1600 gross tons; also third mate of ocean steam and motor vessels of any gross tons. His license was endorsed to show qualification as radar observer.

MOORING MASTERS

Senior Mooring Master.--Captain Robert G. Rugur, Jr., 36, was the senior mooring master on board the STAR CONNECTICUT on November 6, 1990, when the vessel unmoored from the HIRI spm buoy. Captain Rugur held a valid license issued by the U.S. Coast Guard which qualified him to serve as master of United States steam and motor vessels of any gross tons upon oceans. His license was endorsed to show qualification as radar observer.

Mooring Master-in-Training.--Captain Christian F. Chesley, 36, was the mooring master-in-training on board the STAR CONNECTICUT on November 6, 1990. Captain Chesley held a valid license issued by the U.S. Coast Guard which qualified him to serve as master of United States steam and motor vessels of any gross tons upon oceans. His license was endorsed to show qualification as radar observer.

Captain Chesley had started working as a mooring master at the HIRI spm buoy on October 21, 1990. As of the date of this accident, he had been involved in 7 complete mooring and unmooring operations at the HIRI spm buoy.

APPENDIX C

HIRI GENERAL INSTRUCTIONS, DISCHARGING/LOADING ORDERS AND INDEMNIFICATION SIGNED BY THE MASTER OF THE STAR CONNECTICUT

Hawaiian Independent Refinery, Inc.

PRI Tower 733 Bishop Street
P O. Box 3379 Honolulu, Hawaii 96842
Telephone 808 547-3222 Telex (ITT) 7430292

11-3-90

TO: Master Star Connecticut

SUBJECT: GENERAL INSTRUCTIONS, DISCHARGING/LOADING ORDERS AND INDEMNIFICATION

Welcome to Hawaiian Independent Refinery, Inc. (HIRI) Marine Terminal, Barbers Point, Hawaii. In addition to those regulations mandated by the U.S. Coast Guard for vessels operating in U.S. waters, the following instructions and guidelines are provided to encourage safe operations while your vessel is moored at the HIRI Marine Terminal.

A. GENERAL. It is expressly understood and agreed that at all times and under all circumstances, the Master of the vessel will remain solely responsible to his vessel and her owners 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.

B. POLLUTION PREVENTION. A Mooring Master has been assigned to assist in the mooring of your vessel, connecting of cargo hoses, discharging/loading of cargo, disconnecting cargo hoses, unmooring and departing from the Marine Terminal, and to provide information on matters relating to the Terminal facilities. The Mooring Master additionally will act as a Pollution Prevention Officer. In this capacity, he will maintain surveillance over cargo operations and require that all regulations be observed. The Mooring Master may direct your vessel to discontinue cargo operations or unmoor at any time he deems it necessary for the safety of the vessel or the Marine Terminal, or to prevent violations or infringement of U.S. Coast Guard Regulations or these instructions.

C. INDEMNIFICATION. It is understood and agreed by you on behalf of the vessel and its owners that the Mooring Master, operators and crew of the tugs, assist and standby launches, and said launches and tugs, are supplied upon the condition that in the performance of any service they may render to your vessel, that they are the servants of the vessel and its owners in every respect and not the servants of Hawaiian Independent Refinery, Inc., Pacific Resources Terminals, Inc., Pacific Resources, Inc., or its subsidiaries, or the owners of said launches. It is further agreed that the vessel and its owners shall indemnify and hold harmless Hawaiian Independent Refinery, Inc., Pacific Resources Terminals, Inc., Pacific Resources, Inc., and its subsidiaries, and the owners of the assist and standby launches, from any liability, loss, claims or damages arising out of the rendering of services to your vessel by said Mooring Master, operators, crews and launches, whether or not arising out of the fault of said Mooring Master, operators, crew or said indemnitees. In addition, it is

expressly agreed that the presence of the Mooring Master on board in no way relieves you, the Master of the vessel, of any legal responsibilities. FINAL DECISIONS REMAIN YOUR PREROGATIVE.

D. CHARGES. Charges for the service of the Mooring Master will be for the account of your vessel and owners.

E. LANGUAGE OF PORT. The official language of the Marine Terminal is English. The ship will provide personnel available at all times capable of communicating in English with the Mooring Master and between the ship and personnel ashore.

F. DISCHARGING. After your vessel is properly moored at the Marine Terminal, cargo hose(s) will be connected to the ship's manifold. The ship's crew will be required to perform this function, supervised by a qualified Deck Officer. When the vessel is ready in all respects to commence cargo operations, and the HIRI personnel have indicated their readiness to receive cargo, the vessel shall commence the discharge of cargo at the rate of approximately 12,000 U.S. barrels per hour in order to displace the material in the pipeline. Thereafter, upon receipt of instructions from the Mooring Master, vessel shall increase to maximum pumping rate using all main cargo pumps, but not exceeding either 225 p.s.i. at the vessel's rail or a flow rate of 34,000 BPH per 12-inch cargo hose.

G. LOADING. After your vessel is properly moored at the Marine Terminal, cargo hose(s) will be connected to the ship's manifold. The ship's crew will be required to perform this function, supervised by a qualified Deck Officer. Prior to commencement of loading, the tanks must be inspected by an independent third party inspector to determine whether the tanks are in suitable condition to receive cargo. When the vessel is ready in all respects to receive cargo, it must notify the Mooring Master who, in turn, will coordinate the commencement of loading with the refinery. The refinery will commence loading at a rate acceptable to you and will increase the loading rates as per your instructions. The maximum refinery loading rate is approximately 12,000 BPH.

H. BALLASTING. For the safety of your vessel and at your 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 ballast as required to produce a mean draft of approximately 25 feet and, in a trim condition, not to exceed 6 feet by the stern upon the completion of discharging operations. The independent third party inspector will conduct the inspection of the tanks prior

to the loading of ballast and again upon the completion of discharge of all cargo.

I. OIL SPILL. It is unlawful to pollute the waters adjacent to the State of Hawaii. It is the responsibility of the Master of the vessel to assure that no oil (crude oil, bunker fuel, diesel, bilge oils, etc.) is spilled or pumped overboard. Drip pans must be provided at the flange connections. In the event of an oil spill, or any other occurrence which results in pollution of the sea, the U. S. Coast Guard, the Mooring Master, and the vessel's "Agent" must be notified immediately. The Mooring Master will notify the U. S. Coast Guard immediately if the ship's Master fails to do so. By Federal Order CFR 153.305, no dispersants will be applied to an oil spill without U.S. Coast Guard approval. Failure to report pollution, regardless of the extent thereof, will result in severe penalties being imposed by the State of Hawaii and the U.S. Coast Guard. No garbage or trash will be discharged in the mooring.

J. 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. Under no circumstances are engine repairs to be undertaken while the vessel is moored in the sea berth.

K. MISCELLANEOUS. We desire that the discharging and/or loading of cargo will be done safely and efficiently, and that your stay in Hawaii will be pleasant. To this end, please do not hesitate to call upon us for any assistance we may be able to render.

You are requested to sign and return the attached copy of these instructions in acknowledgement of receipt, understanding, and agreement therewith.

Very truly yours,

HAWAIIAN INDEPENDENT REFINERY, INC.

E. D. Lewis
Refinery Manager

Master

11-3-90 — 1100
Date and Time

HIRITERM\REVISION 1/87

APPENDIX D

HISTORY OF PREVIOUS ACCIDENTS

1. Date: March 2, 1989
   Time: 2006 (local)
   Vessel: EXXON HOUSTON
   Oil Spill Estimate: Approximately 16,800 gallons of crude oil
   Approximately 8,400 gallons bunker oil
   Damage Estimate: Vessel - Constructive Total Loss
   Master: Captain Kevin Dick
   Mooring Master: Captain Steven D. Marvin

   Details: The U.S. tank ship EXXON HOUSTON was offloading 490,000 barrels of Alaskan crude oil to the HIRI refinery while it was moored at the spm buoy. The vessel broke free of the mooring in severe weather and sea conditions and later ran aground while its master was attempting to maneuver the vessel into deep water.

2. Date: January 29, 1990
   Time: 1830 local
   Vessel: U.S. Tank ship TEXACO CONNECTICUT (previous name of STAR CONNECTICUT)
   Weather Information: 5-7-foot ESE seas, clear, 12 miles visibility, air temperature 67 F, wind easterly at 20-22 kts, "changing" current
   Oil Spill Estimate: 10 to 400 bbls. of light cycle oil
   Damage Estimate: $28,000 vessel
   $20,000 cargo
   Master: Captain Andrew D. Chester
   Mooring Master: Captain Stephen D. Marvin

   Details: While moored to the HIRI spm buoy, the vessel rode up on the mooring hawser and collided with the buoy, causing a fracture approximately 10 inches long and 1/2-inch wide to the vessel's hull in the No.1 starboard cargo tank, which contained light cycle oil. At the time, no bridge watch was required and no bridge watch was in place when the accident occurred. Both the vessel master and the mooring master stated that the ship's movement caused it to come into contact with the buoy was contrary to the direction of the wind and seas.

APPENDIX E

NTSB MAJOR MARINE ACCIDENT REPORTS INVOLVING LACK OF COMMUNICATION AND PLANNING ON THE PART OF SHIPS' MASTERS AND PILOTS

1. SS AFRICAN NEPTUNE: Collision with the Sidney Lanier Bridge at Brunswick, Georgia, on 7 November 1972 with Loss of Life (USCG/NTSB - MAR-74-4)

2. SS EDGAR M. QUEENY - S/T CORINTHOS: Collision at Marcus Hook, Pennsylvania, on 31 January 1975 With Loss of Life (USCG/NTSB - MAR-77-2)

3. Spanish Motor Tankship RIBAFORADA, Ramming of Barge MB-5, Three Wharves, and Cargo Ship TIARET, New Orleans, Louisiana, December 4, 1977 (NTSB-MAR-79-15)

4. Collision of American Containership SS SEA-LAND VENTURE and Danish Tanker M/T NELLY MAERSK, Inner Bar Channel, Galveston, Texas, August 27, 1978 (NTSB-MAR-79-16)

5. Collision of Greek Bulk Carrier M/V IRENE S. LEMOS and Panamanian Bulk Carrier M/V MARITIME JUSTICE, Lower Mississippi River Near New Orleans, Louisiana, November 9, 1978 (NTSB-MAR-80-4)

6. Ramming of the Sidney Lanier Bridge by the Polish Bulk Carrier ZIEMIA BIALOSTOCKA, Brunswick, Georgia, May 3, 1987 (NTSB/MAR-88/03)

7. Striking of a Submerged Object by the Bahamian Tankship ESSO PUERTO RICO, Mississippi River, Kenner, Louisiana, September 3, 1988 (NTSB/MAR-89/02)

8. Collision Between the Greek Tankship SHINOUSSA and the U.S. Towboat CHANDY N and Tow Near Red Fish Island, Galveston Bay, Texas, July 28, 1990 (NTSB/MAR-91/03)