PROCEEDINGS
OF THE MARINE SAFETY COUNCIL

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COVERS

FRONT COVER: The capsizing of the M/V *Mercator* is the subject of this month's feature article. The cover photo shows the fishing and freight vessel resting on the bottom and listing sharply to starboard while salvage efforts are taking place.

BACK COVER: Miniships have become a familiar sight along the Mississippi River. Here four of them are seen moored together at Vicksburg, Mississippi. Courtesy Vicksburg *Evening Post*.

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PROCEEDINGS

OF THE

MARINE SAFETY COUNCIL

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VESSEL CAPSIZES IN DOCK

THE M/V *Mercator*, a 210-foot, 1258 gross ton vessel, was known as a very temperamental vessel while moored. She was rarely on an even keel; and, when left as a dead ship with a few degrees list to one side in the evening, she would be found the next morning listing 5 to 8 degrees to the opposite side. Occasionally her Operations Manager would receive calls at home from personnel who had seen the vessel listing and who were concerned for her well-being.

At midnight on September 10, 1971, the vessel's chief engineer felt the *Mercator*, moored starboard side to Pier 4, Fisherman's Terminal, Salmon Bay, Seattle, Wash., suddenly heel farther to starboard from a previously starboard list. No one else noticed any movement. A short while later, the engineroom watch stander and two other men went forward to check oil transfer operations which had been commenced to right a starboard list. As they passed down the port side of the main deck, they saw a lug wrench slide off the steel-topped workbench in front of them. The port hatch cover to the No. 2 fuel oil tank

The M/V Mercator is shown listing 60 to 61 degrees to starboard, resting on the bottom and against the pier. The vessel was heavily loaded on the maindeck and above. Some of that cargo such as motor vehicles, steel round stock, and 55-gallon drums of oil can be seen above. Much of this cargo slid into the water as the vessel capsized.

A log boom was rigged around the *Mercator* early on the morning she capsized. It failed to prevent some pollution which necessitated a major cleanup effort.

had fallen closed. Checking the starboard tank, they saw water coming in the scuppers and flowing into the open hatch to Nos. 1 and 2 fuel oil tanks. The men who were aboard quickly abandoned ship to the safety of the pier. Before leaving the ship, the chief engineer looked down the fidley, but saw no water. However, the engineroom deck plates are solid, so the outboard sides of the engineroom are not visible through the fidley.

Just after 12:30 a.m., the watchman at Fisherman's Terminal saw the *Mercator* listing badly to starboard and her crew standing on the pier. He notified his supervisor who came to the scene and watched as the vessel capsized, black smoke pouring from her stack. He returned to the office and called the fire department at 12:40. The vessel continued to roll slowly to starboard, finally coming to rest on the bottom and against the pier with a list of 60 to 61 degrees to starboard.

At about 3:00 a.m., a log boom was placed around the *Mercator* in an effort to abate pollution. At 3:38 a.m., a violent explosion occurred in the fo'csle area of the main deck, throwing a ball of fire 60 feet in the air. The fire department extinguished the resulting fire. At 4:35 a.m., two more explosions occurred in the same area of the ship without resulting fire or appreciable further damage.

The vessel was righted and refloated, but was considered a total constructive loss. In addition, damage to or loss of her cargo was estimated at $192,000 and the resulting oil pollution cleanup cost an estimated $130,000. Fortunately all of the ship's personnel were able to get off her before she capsized.

A history of the M/V *Mercator* and of her preparations for a voyage to Alaska give a better idea of the causes of her capsizing and the resultant extensive property damage. She was built in 1925 as a single-deck tankship with a semi-protected shelterdeck forward, a raised poopdeck aft, and an open well deck aft of the raised superstructure on the forward section. The maindeck was a weatherdeck with many large freeing ports in the side shell in the midships length of the vessel.

After 1956, the *Mercator* was converted to an uninspected crab processing vessel. The freeing ports in the side shell were welded shut and most of the well deck aft was closed so that she became essentially a two-deck vessel by configuration. Nos. 3, 5, and 6 liquid cargo tanks were converted to below main deck reefer and dry cargo spaces. Existing pumproom equipment was removed, as was much of the piping immediately aft of the engineroom. In place of this was installed heavy refrigeration equipment. Fore and aft cargo spaces on the main deck were converted to berthing areas for approximately 50 cannery workers.

In addition, crab processing equipment was installed on the starboard side of the main deck throughout the midships length of the vessel, and several smaller freeing ports (1 to 2 square feet each) were cut in the topsides at the maindeck level in order to allow the water used in connection with the crab processing line to flow overboard.

The *Mercator* had no current loadline certificate and no loadline markings were visible on the hull in the midships area. The last known loadline certificate was issued in 1950 by the American Bureau of Merchant Shipping while the vessel was still in tanker service under the name Penaco. The vessel is not maintained in class by ABS. She is documented by the Coast Guard as a fishing and freight vessel. She was not Coast Guard inspected, nor was she required to be.

The *Mercator* was last admeasured in 1956 prior to her conversion from a one-deck to a two-deck configuration. The conversion increased the vessel's tonnage, yet no application for readmeasurement was on file at the time she capsized.

Having been employed for 4 or 5 months at Adak, Alaska as a king crab processing vessel, the *Mercator* returned to the Seattle area in April 1971. She remained moored there as a dead ship until approximately June 1, when some men were assigned to her to conduct general maintenance and to prepare her for the next season.

In early August the vessel was dry docked for painting, cleaning, and repairs. On August 21, the vessel departed the yard to return to her mooring. At a fueling stop enroute, she took on 16,780 gallons of diesel fuel. During transit from the fueling spot to the mooring, a fire broke out in the main motor which burned out the armature. No other major damage was suffered. The motor was removed for repair.

During the last week of August, the vessel began receiving cargo, consisting of frozen and dry foods, broken down cardboard cartons, paper, and other cannery supplies for her northbound voyage. These were stowed in the holds and on the main deck.

On September 2, the *Mercator* was towed to Fisherman's Terminal where she spent several days onloading 158,906 more gallons of diesel fuel in her tanks. At this point, she was essentially fully loaded with fuel oil, except the starboard double-bottom was only two-thirds full. Though no record of the exact amount of fuel on board was kept, vessel personnel estimated that on September 4, between 161,000 and 166,000 gallons of oil were aboard.

On September 4, the vessel was shifted by tug from Pier 3 to Pier 4, Fisherman's Terminal, where repairs to the main motor were completed.

Cargo loading continued from September 4 through September 9 on orders originating from the superintendent of Pan Alaskan Canneries in Alaska and from various catcher boats operating for those canneries. These requests were submitted to the company's office in Monroe, Wash., where they were approved and referred to the company purchasing agent. As a result, vessel officers were never provided with a complete manifest of all items which would be loaded aboard. They would be told orally the approximate amounts and type of cargo they could expect; but, in most cases, neither the master nor his mate was given weight information. Complete information as to what the vessel was to carry was available to the master upon his request at the company office.

A view of most of the 154,511 pounds of steel round stock which was deck cargo on the weather deck of the *Mercator* at the time she capsized. Improper loading coupled with insufficient knowledge of the vessel's stability characteristics were primary causes of the casualty.

Pan Alaska Fisheries gave the *Mercator*'s master no written guidance for cargo loading, and no stability data were available to or used by the master and the mate who supervised the loading of cargo. The master testified that he believed the vessel could be loaded to a draft of 16½ feet, while the mate indicated he believed she could be loaded to a 17-foot draft. Neither man had any training or experience in cargo stowage on other than fishing vessels. They based their decisions on where to load certain cargo on its physical size, its destination, and "common sense."

Of the crew for the pending northbound voyage, the master, the mate, and the chief engineer possessed licenses for fishing vessels. The remaining 18 crewmembers had neither licenses nor Merchant Mariner's Documents.

By the time cargo loading was completed, the fresh water draft of the *Mercator* was 14 feet forward and 16 feet aft. A great deal of cargo was stowed on the main and weather decks, including 164,511 pounds of steel round stock and bar stock, a total of 87 king crab pots weighing about 63,000 pounds, lumber weighing 43,000 pounds, barked piling weighing 80,000 pounds, four motor vehicles, 87 55-gallon drums of oil, and oxygen and acetylene cylinders. In addition, five 100-pound cardboard drums with steel ends containing HTH (calcium hyperchlorite) were stowed on the maindeck in the fo'csle area.

Fully loaded and prepared for her voyage, the *Mercator*'s cargo distribution by weight was:

	Pounds
weatherdeck ----	397, 306
maindeck ------	65, 212
cargo holds-----	174, 002

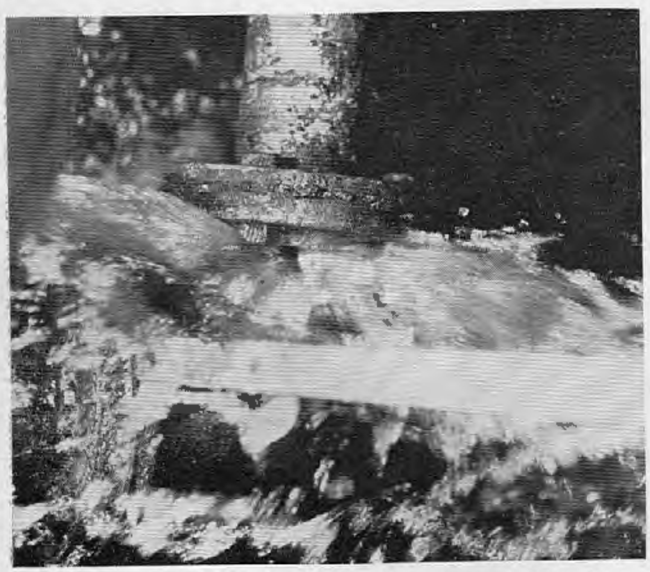
based on a reconstructed loading plan prepared by the mate of the vessel after the capsizing from information furnished him by the Purchasing Agent. No loading plan was kept at the time of the loading, and the crew did not maintain records or make mathematical computations. The above figures do not include the estimated 160,000 gallons of fuel on board or the 74,000 gallons of water in the vessels tanks which had been topped off 12 hours prior to the capsizing.

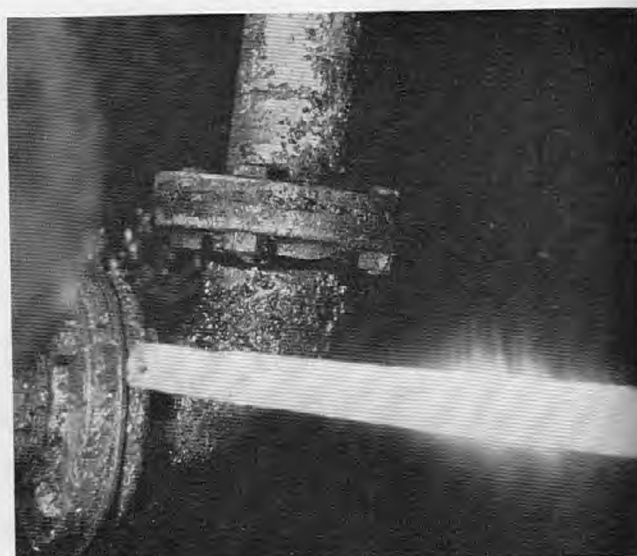
This, then, was the status of the *Mercator* on the day she capsized. On the evening of September 8, the day prior to the casualty, the list of the *Mercator* was reported to be 2 degrees to port. The vessel's cargo booms were used to bring several final items of cargo aboard on September 9. As the booms were shifted, men aboard could notice a change in list. The master estimated that the vessel's list could be changed by 2 degrees with the booms.

On the evening of September 9, the following machinery was operating: two diesel driven auxiliary generators, the fresh water pump, the sanitary pump, and the refrigeration equipment. One man, whose duties were to make hourly rounds of the engineering spaces and to check pressure gauges and meters to be sure the machinery was operating properly, was on watch in the engineroom. The man on watch from 6 p.m. to midnight was standing his first engineering watch aboard a vessel, and a qualified watchstander was assigned to break him in. The qualified man made four rounds of the spaces with the new man prior to 7:30 p.m., and then left him on his own. During these rounds, the bilges in the motor room were noted to be practically dry, having been pumped for reinstallation of the repaired motor. The bilges in the engineroom, however, had water on them to a reported depth of 5 to 6 inches on the side the vessel was listing to.

At 6:00 p.m. that evening the clinometers in the engineroom and on the bridge indicated a 2° port list. The chief engineer began transferring fuel from No. 2 port to No. 2 starboard tanks to reduce the list. He placed a flexible rubber discharge hose through an open hatch in the maindeck into the starboard tank connected to a portable 1½ inch pump rated at 29 gallons per minute. A metal reinforced suction hose was placed through another open hatch into the port tank. At the same time, the master independently moved the two cargo booms to starboard to remove the list. Seeing this, the chief engineer told the master that he would stop pumping since now the vessel was almost on an even keel. Oil was transferred for only about 10 minutes before being secured. The master then returned the booms to port to prevent the vessel from going over to a starboard list. The vessel returned to a port list, and therefore the booms were centered, leaving the vessel on a port list which reached about 3° by midevening.

At about 10 p.m. the chief engineer again pumped fuel oil from port to starboard for about 10 minutes, and the booms were swung to starboard. The vessel slowly shifted to a starboard list which the master noticed before he left the *Mercator* for home at about 10:30. By 11 p.m., the starboard list had increased to 4° and the engineering watchstander mentioned this to the chief engineer. The chief engineer and the engineroom watchstander who relieved the watch at midnight went forward, switched transfer hoses and began transferring oil to port. As we have seen, the *Mercator* began to capsize shortly after midnight while this operation was





The two photos above are taken from above, looking down on a broken 3-inch cast elbow in the auxiliary sea suction line of the Mercator. The photo at the left was taken immediately after the vessel's engineroom was dewatered during salvage operations. The water leakage of less than 50 gallons per minute was considered a contributory cause of the casualty by the investigating officer. The photo at the right clearly shows the ½-inch gap left in the pipe by the fracture.

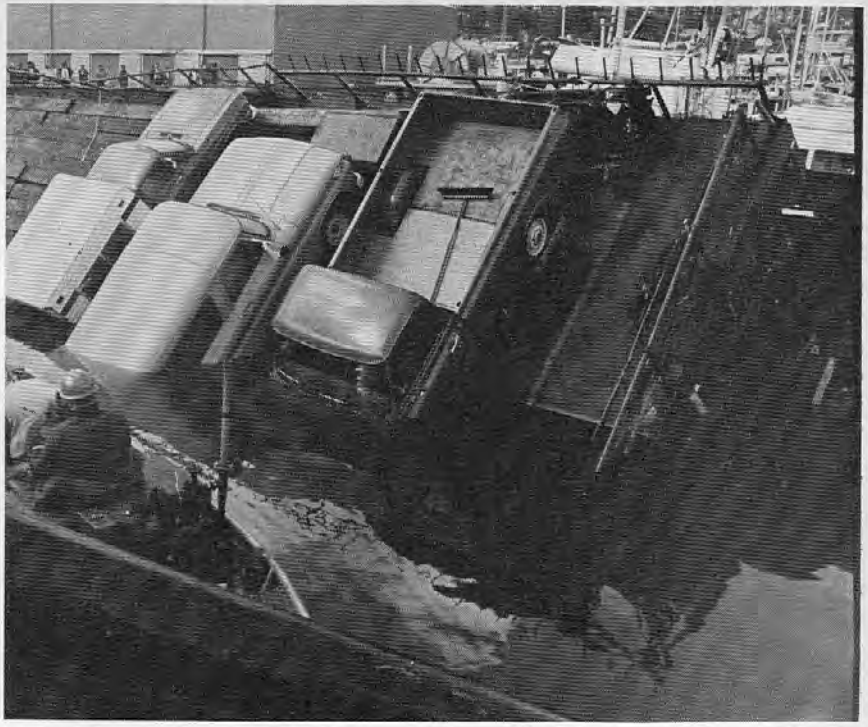
taking place.

After the capsizing, a two week salvage effort was begun. During this period fuel oil and lube oil escaping from open tanks, sounding tubes, and vents spread on the surrounding waters necessitating a major cleanup. The vessel was righted while on the bottom and then raised. Inspection by a Coast Guard Investigator during critical parts of the salvage effort revealed the following facts:

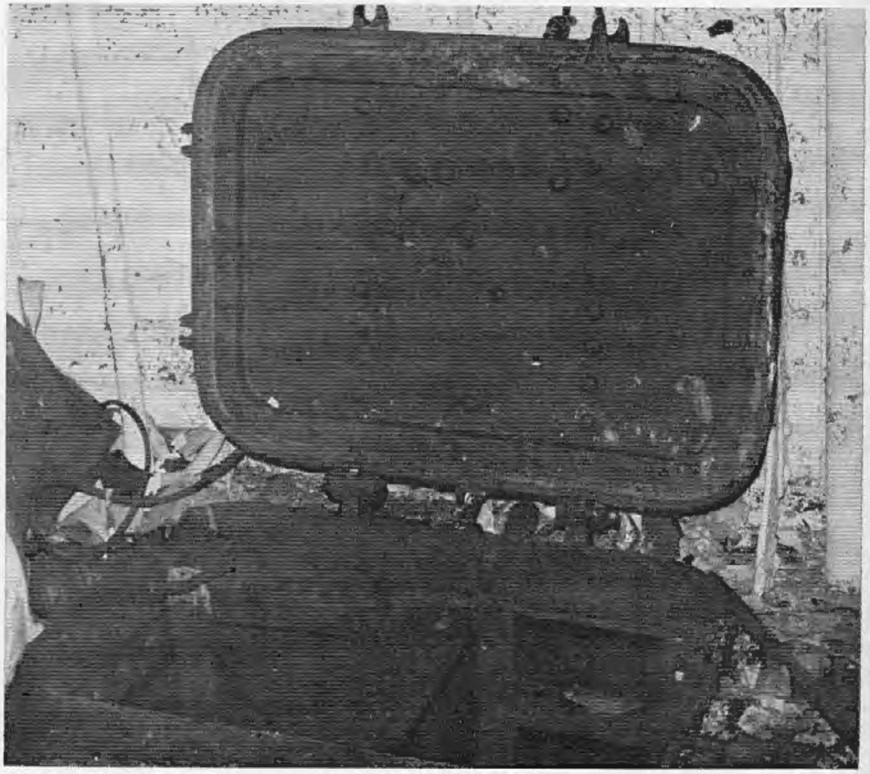
1. The hull of the *Mercator* was apparently intact; deck hatches No. 1 and No. 2 port and starboard fuel tanks were open at the time of the capsizing and the covers to No. 4 fuel oil tanks port and starboard were in place but not bolted. Divers confirmed that the discharge hose of the transfer pump was in the port tanks.

2. As the engineroom was dewatered, a 3-inch cast iron elbow in the auxiliary sea-suction line, located 15 inches above the bilge bottom on the portside of the longitudinal pipe tunnel, was found to be fractured. The elbow had separated ½ inch, allowing water to flow into the port engineroom bilge at a rate estimated to be less than 50 gallons per minute when the vessel was at 15-foot mean draft and when the fracture was above the bilge water level. Analysis of the cast elbow indicated that the fault had originated some years before and that the fracture area had undergone ferrite corroding, leaving the graphite intact. Hence the structure had become porous and had lost some mechanical strength. It was determined that the final fracture occurred within the time frame of the vessel's capsizing, but it could not be established whether it occurred before, during, or after the capsizing.

3. The pipe tunnel in which the fracture occurred ran longitudinally on the portside of the *Mercator* from the after bulkhead of the engineroom to the forward bulkhead. It is about 3 feet high by 4 feet wide, and is located 6 feet from the port skin of the vessel. Its top is just below the engineroom deck plate level. The pipe tunnel was designed to be watertight ex-



These motor vehicles were well enough secured on the *Mercator's* deck to escape complete destruction. The vessel itself was not so lucky. It was considered a total constructive loss.



The starboard hatch cover to Nos. 1 and 2 starboard fuel oil tanks aboard the *Mercator* was open at the time of the capsizing. Water would flow over the hatch coaming when the vessel listed 12 or more degrees to starboard. Crewmembers saw water entering the hatch prior to abandoning ship.

cept at the after end where it is open to the old pump room (now used for refrigeration equipment). A 3-inch pipe penetrates the tunnel transversely through a 5-inch pipeway. The excess pipeway area would permit water to sluice transversely from the portside of the engineroom bilge to the starboard side when the bilge water level reached the pipeway's height. Some leakage on the order of less than 5 gallons per minute in the supposedly watertight pipe tunnel would also permit water to sluice from port to starboard. A 12 inch by 12 inch cutout in the starboard wall of the pipe tunnel, the bottom edge of which is about 21 inches above the bottom of the engineroom bilges would permit water to flow between the pump room and the engineroom through the pipe tunnel when the bilge water level exceeded 21 inches.

4. On the starboard side of the engineroom, a 6-inch pipe, apparently left over from the vessel's previous employment as a tanker, was cut so as to allow water to flow into the pumproom from the engineroom when the bilge water level in the engineroom reached 2 feet.

5. The auxiliary sea-suction line in which the fracture occurred could take suction from the port or starboard sea chests in addition to the main sea-suction line.

6. Two of the five barrels of HTH compound in the fo'csle area were found to have disintegrated. The area had been exposed to water and escaping oil. The bulkhead aft of the area of stowage was bowed aft, and the deck above and associated structural members were bowed upward. Cargo in the area and painted surfaces showed signs of charring.

7. Utilizing the Line Plans of the *Mercator*, it was determined that at a mean draft of 15 feet, approximately 5 degrees of list would place the main deck edge at water's edge (based on a 1 foot 6 inch freeboard at that draft). At approximately 12 degrees list water would flow over the hatch coaming to Nos. 1 and 2 fuel tanks.

Based upon the above findings, the Coast Guard Investigating Officer concluded as follows:

This photo was taken from the port door of the *Mercator's* pilot house, looking inboard. The vessel was listing to starboard some 55 degrees at the time, accounting for the buildup of debris on the far side.

The distribution of the *Mercator's* cargo, with 62% by weight on the weatherdeck and 73% on, or above, the maindeck made the vessel very tender with a small righting arm. A stability test run after the capsizing with much cargo removed and the vessel drawing 13 feet, 3 inches forward and 11 feet, 7 inches aft approximated the metacentric height at between zero and 1 foot. The fact that two of the starboard fuel tanks were empty (down at least 7,000 gallons) while the port tanks were full, yet the vessel was on a relatively even keel prior to the evening of the casualty leads to the conclusion that cargo, most probably deck cargo, was not symmetrically loaded—more cargo being on the starboard than on the port side.

The changes in list on the evening of the casualty are also significant. The fact that the list increased to port between 6 and 10 p.m. causing the chief engineer to twice have fuel transferred to starboard is evidence of a shifting or addition of weight to the port side. The only likely source of this weight change is water entering through the fractured elbow in the auxiliary sea-suction line. It was concluded, therefore, that the fracture must have taken place in the early evening hours prior to the capsizing. Because of the solid deck plating in the engineroom, the water thus entering the bilges was hidden from view; and the noise of the operating machinery hid the sound of the initial waterflow. Given these conclusions, water would have filled the port side of the engineroom bilge outboard of the longitudinal pipe tunnel. When the water level reached 15 inches and the fracture became submerged, the flow rate initially estimated at less than 50 gallons per minute would decrease. Water would begin to sluice to the center of the engineroom bilge through the 5-inch pipeway in the tunnel. If the flow from the fracture was greater than the rate of flow into the center of the bilge, the level of water in the port bilge would continue to rise and eventually water would flow over the pipe tunnel under the deck plates to the center of the engineroom bilges.

When oil was transferred at 10 p.m. and the booms were swung to starboard, the vessel slowly came over to a starboard list which, aided by the free surface effect of the water in the center of the engineroom bilge, increased to 4 degrees by 11 p.m. The water in the port side of the engineroom bilge would continue to flow through and over the pipe tunnel to the starboard side. By midnight the list would have increased further and water would flow in the freeing port amidships on the maindeck unnoticed. The midnight attempt to stabilize the vessel through oil transfer would be too late. Twenty minutes later, water was noticed on the maindeck, flowing through the open hatch into the fuel tanks. By this time the list to starboard exceeded 12 degrees.

Events proceeded rapidly. At 12:30 a.m. all hands were ashore unharmed as the *Mercator* slowly rolled to starboard and came to rest on the bottom.

A 2-week salvage effort succeeded in righting the *Mercator* and refloating her. Here she is righted, but still sitting on the bottom. The damage done to the starboard wing of the bridge was caused by her coming to rest against the pier. Salvage water can be seen being pumped overboard.

An aerial view of Fisherman's Terminal showing the capsized M/V *Mercator*.

The explosions at 3:38 a.m. and again an hour later were caused by a combination of calcium hyperchlorite, oil, and water. (Calcium hyperchlorite normally used as bleach, is a powerful oxidizing agent which, by reacting with a combustible such as diesel fuel, will generate heat enough to cause ignition—ed.)

The property damage resulting from this casualty was unfortunate. Yet, that the casualty might have taken place a few days later on the

(*Continued on page 75*)

RULES OF THE ROAD UNDER REVISION

PREPARATIONS ARE NOW being made for an international conference for revising the International Regulations for Preventing Collisions at Sea. The Regulations (commonly called the International Rules of the Road) are part of an international agreement reached at the 1960 International Conference on Safety of Life at Sea. They are not presently subject to amendment without a full diplomatic international conference, since there are no provisions for amendment within the Regulations. Some time ago it was determined that the Rules of the Road needed revision. The preparations now being made for an international conference to be convened by The Intergovernmental Maritime Consultative Organization in the Autumn of 1972 are the result of this determination.

To understand how revisions are made, it is first necessary to review the structure of IMCO.

IMCO is a specialized agency of the United Nations, and the only one concerned exclusively with maritime affairs. IMCO has hosted many international maritime-related conferences since 1958, when the convention setting IMCO up was finally ratified by the number of nations required to render it operative. More than 70 nations comprise IMCO's membership, including not only big shipowning nations, but smaller ones; not only nations providing shipping services, but those which use them; not only developed nations, but developing ones. IMCO is an example of an international body in which nations of all political persuasions have been able to cooperate successfully.

IMCO is composed of three major organizations:

1. *The Assembly* is the main body of IMCO which must approve any action to be taken by the Organization. It is comprised of all members of the Organization, one of which is the United States.

2. *The Council* is primarily concerned with non-technical matters, and it acts for the Assembly when the latter is not meeting. There are 18 member nations, including the United States, represented on the Council which meets twice a year.

3. *The Maritime Safety Committee*, comprised of the representatives of 16 member nations including the United States, meets twice a year and handles all technical matters for the Organization. Under the Maritime Safety Committee are a number of subcommittees, each meeting once or twice a year.

The U.S. Coast Guard, along with others, provides representation at each of the various IMCO bodies including the subcommittees under the Maritime Safety Committee and their working groups.

One of the subcommittees, the Subcommittee on Safety of Navigation, has been delegated the responsibility to develop a draft convention to be used as the basic working paper at the international conference updating the present International Rules of the Road. The proposed convention is being considered in three parts, namely: The Articles, the general section including definitions, and the actual rules. To assist in this work, a special Ad Hoc Working Group on Revision of the Collision Regulations was established. The subcommittee, in addition to its other work, has studied proposals to revise the general section of the Rules of the Road. It has also drafted proposed Articles for the convention which will contain procedures for the coming into force of the convention and for the amendment of the proposed new rules once they are adopted.

The revision of the actual Rules, including lights and shapes, sound signals and conduct in restricted visibility, steering and sailing rules, and sound signals for vessels in sight of one another, was the task of the Ad Hoc Working Group. At five sessions of this working group, suggested revisions to the present rules in the form of position papers submitted by participating nations or oral suggestions made during the sessions have been considered.

As the result of the sessions of the subcommittee and its working group through February of 1972, a conference document, or draft of the proposed Articles and Rules has been written. Where a substantial majority of nations has agreed to a single wording of a proposed rule, only that wording has been included in the document for consideration at the international conference. Where, however, controversy in the form of a substantial minority opposed to a wording supported by a bare majority remains, the conference document contains both the majority text and an alternate text. As was hoped at the outset, alternate texts are present for very few of the proposed rules. This conference document will be the point of departure for the full diplomatic conference now scheduled for October 1972.

Perhaps of more interest are the preparations which have been and are being made in this country for the International Conference. The U.S. Department of State is responsible for all official United States positions presented at diplomatic conferences. In the case of the necessary technical preparatory work to revise the Rules of the Road, the State Department has delegated to the Coast Guard the task of preparing the United States views.

In performing this task, the Coast Guard has called on numerous sources of input, including the public (primarily by means of a widely distributed questionnaire), industry, and various government agencies. A major source of input has been the Industry Advisory Committee on Rules of the Road. Formerly known as the Rules of the Road Coordinating Panel, the Industry Advisory Committee on Rules of the Road is one of the six advisory committees to the Coast Guard Marine Safety Council, which advises the Commandant on matters affecting the maritime community. The Industry Advisory Committee on Rules of the Road specifically advises the Coast Guard regarding proposals affecting any of the various Rules of the Road. Its membership is designed to encompass the broadest possible range of interests in the Rules—pilots, ship's officers, recreational boaters, marine underwriters and naval officers, to name a few.

The Advisory Committee has considered drafts of the proposed new International Rules and made its recommendations to the Coast Guard. Using this and other input, the Coast Guard has formulated positions and submitted them through the State Department in order to help shape the proposed new International Rules of the Road.

Within the Department of State, the Shipping Coordinating Committee (SHC) is directly responsible for making policy recommendations on IMCO matters. The SHC is composed of representatives of all government agencies having an interest in the matters the committee considers. In addition, representative industry organizations are included in an advisory capacity. The Coast Guard coordinates the input to the SHC.

The SHC's decisions are normally final; but in case of conflict, the Department of State has the final authority for policy decisions. In preparation for the International Conference on the International Rules, the State Department will approve the United States positions with respect to the proposed rules. These positions will be communicated by means of formal Notes from the Government of the United States which are distributed by IMCO to all participating nations, and by formal oral presentations at the IMCO meetings and the international conference.

The Department of State will appoint the U.S. delegates to the international conference.

It is hoped that the Autumn International Conference will result in a broadly based convention which is readily usable and understandable by the mariner and one which can be readily accepted by all maritime nations. It is also hoped that the new convention of International Rules for Preventing Collision at Sea will be difficult to amend for purposes of continuity and stability, yet easier to revise than the present Rules which require a full diplomatic conference for that purpose.

Once the conference produces an international convention which embodies the new Rules of the Road, the convention will not automatically be binding on the various governments. First the convention must come into force through its ratification by "substantial unanimity" among nations. Exactly how many nations controlling what percentage of the world's merchant fleet tonnage will constitute the required substantial unanimity to bring the convention into force is one of the questions to be resolved at the international conference this Autumn.

Not only must the new rules come into force internationally, but to be binding on this country, the State Department must first recommend the subject of the convention to the President. The President, with the advice and consent of the U.S. Senate will then either ratify it or refuse to do so. Once the President ratifies an international convention and once that convention has come into force, it becomes the law of the land and U.S. Mariners must obey it. ⚓

SHIPBOARD FIRE AND SAFETY TESTING FACILITY

Donald J. Kerlin,
Office of Boating Safety, U.S. Coast Guard Headquarters

THE ESTABLISHMENT OF the Fire and Safety Testing Facility at Mobile, Ala., offers to interested people a ship to be utilized for systematic destruction. It is felt that full scale testing will provide an avenue for significant advances in marine safety as it has done in the past. Over 25 years have passed since the last full-scale marine tests were conducted in the United States. The time appeared ripe to begin again full-scale marine testing. This article describes the facility and the excellent industry/government cooperation which helped to make the facility a reality as well as to permit successful conduct of the first three test programs. The presentation will discuss the two phases of machinery space fire detecting tests, machinery space fire extinguishing tests utilizing HALON 1301 and carbon dioxide and miscellaneous testing. It will also explore future testing possibilities.

BACKGROUND

The Coast Guard's involvement in full-scale fire testing came about as a result of our responsibility for safety of life and property at sea. Fire aboard ship has always been one of the events most dreaded by seamen. The last full-scale testing which was conducted aboard actual vessels was some years ago, e.g., the *Nantasket* tests in 1934, and the *Ft. McHenry* and *Phobus* [1] tests during the 1940's. The *Nantasket* tests served as the basis for present structural fire protection standards for passenger vessels as well as other types of vessels. The standards have withstood time and now have been accepted on an international basis.[2]

The *Ft. McHenry* and *Phobus* tests were used in development of extinguishing system standards and in measuring the systems' effectiveness for machinery spaces and cargo holds.

The present facility provides an avenue whereby new safety techniques may be evaluated in an actual full scale marine environment.

FACILITY

The facility contains many components, the foremost being the M/V *Rhode Island*. This vessel is an old T-1 Tanker on long-term loan from the U.S. Maritime Administration. The tanker is located in Mobile, Ala., in a slip dredged in Little Sand Island and surrounded by a shell dike. The test vessel, which can only be reached by water, is supported by 2 LCM's, 1 barge, 1 small boat and numerous other pieces of equipment. The facility is maintained by a small group of Coast Guard personnel located at Mobile. The newest addition to the facility is the *Mayo Lykes,* a victory ship also on loan from the Maritime Administration. It is expected that this vessel will replace the *Rhode Island* when she has served her purpose and is returned to MARAD.

The facility was first borne in the minds of three dedicated industry people: the late Mr. Charles Culver (Atlantic-Richfield); Captain Kent Savage (NFPA); and Mr. Paul Hammer (Marine Consultant). Due to a great number of difficulties they were unable to fully complete the venture. However, their ground work made the Coast Guard's task easier when they assumed direction of the project in 1968.

Planning for tests is handled through the Ad Hoc Advisory Group. This group is composed of experts in the marine and fire protection fields including representatives from the Navy, American Petroleum Institute, Maritime Administration, National Bureau of Standards, NASA, Underwriters Laboratories, and the National Fire Protection Association. In addition to this permanent group specific individuals or groups may be called upon for each testing program.

Since a more detailed description of the facility is available,[3] this article will concentrate on actual testing results and author conclusions.

DETECTION TESTS

The machinery space fire detecting tests were divided into two phases. The phase I [4] testing program was undertaken during the week of May 26, 1970. The testing in phase I was designed to measure the relative performance of various types of detecting devices and develop information on detector placement as related to environmental conditions. Due to limited instrumentation capabilities at the time it was necessary to define the general area in which the fire would originate, thus limiting application of test results.

For Phase II [5] the participants were to fully engineer a system having no idea where the test fires would be located. The purpose of this phase was to determine the feasibility of total machinery space detection protection and again as in Phase I to measure relative performance of the various devices.

PHASE I

The machinery space of the test ship was divided into three fire zones. One zone was located in the after portion, one in the forward portion and the third zone was located in the upper forward regions of the space.

The basic test series was comprised by 18 fires. Three fires were conducted in each of the six locations. Four locations were in zone 1, one each in zones 2 and 3.

The "standard" fire consisted of approximately 1.25 quarts of No. 2 diesel oil primed with several ounces of naphtha. These fuels were floated on water which filled a 2-foot diameter, 12-inch deep steel pan to an approximate depth three inches below the upper lip. This "standard" fire represented a free burning fire of about 4 to 5 minute duration. Most of the ignitions were by means of a match dropped into the pan.

For each pan fire location, tests were conducted under three ventilation conditions:

Ventilation off, skylights closed
Ventilation on, skylights closed
Ventilation on, skylights open

Ventilation consisted of two 37,500 cfm fans providing power intake through two ducts at opposite corners of the space. Exhaust was by natural means (two ducts and skylights).

There were six basic types of individual detection devices installed; smoke (reflective), ultra violet, infrared, combustion products (ionization), rate anticipation and rate of temperature rise. There were two different models for UV, smoke, and combustion products. Approximately 80 devices were installed. Fire detectors were wired such that individual detection devices responded. Response caused illumination of a single lamp on a response panel located in the National Bureau of Standards instrumentation van. Response readings were manually taken by various Coast Guard supervised personnel.

Systems installed were not intended to represent actual shipboard installations other than in general placement and sensitivity adjustments. Also no attempt was made to measure service life of the detectors.

The report of Phase I [6] judged the various detectors on a 1 minute time response. In other words, detectors responding to a fire in 1 minute or less were acceptable, those responding later than 1 minute were judged as not responding satisfactorily.

In general, the ultra violet systems responded to all fires within seconds of ignition. The combustion type detector responded satisfactorily with the exception of a few tests where the test fires were located near an exhaust duct. It is believed that the products of combustion were drawn through the exhaust duct away from the detector. The smoke detection devices responded sporadically. The infrared devices in general gave an acceptable indication of fire, responding slightly slower than the ultra violet devices. The rate anticipation devices responded fairly well to certain fires and the single rate of temperature rise device failed to respond at all.

From the results it appeared that fires were remarkably reproducible as measured by response times. Environmental (ventilation) conditions have a pronounced effect on detector response. The large number of obstructions in an actual machinery space made careful placement of line-of-sight detectors imperative. It would appear that some adjustment to the sensitivity setting, especially for line-of-sight detectors, would be required for actual shipboard use. These devices responded to matches, etc. possibly indicating operating difficulties due to false alarms. It was also concluded that further full scale work should be undertaken.

PHASE II

Unlike Phase I, there was no need to divide the machinery space into various fire zones. Manufacturers were instructed to install a completely engineered fire detection system for the machinery space. The basic setup for Phase II [7] was almost identical to that of Phase I. One or two of the test pans were relocated. The fires themselves, ventilation, etc. were identical to those described previously for Phase I.

There were four basic devices tested: smoke (reflective); ultra violet; combustion products (ionization); and infrared. There were two different models for smoke, UV, and combustion products. One hundred and five detection devices were installed.

All but one type (a UV) were wired such that individual detectors responded. The UV system responded by zones (two to six detectors per zone). The response of all devices caused illumination of a light on the response panel, located in the van, which was photographed by a time sequence camera. A timing clock was located adjacent to the response panel.

Again as for Phase I the results of the testing were judged on the arbitrary 1 minute response criteria. One of the UV systems responded quite well to all but one test while the other UV system did not pass the criteria in four tests. Number and arrangement of devices is believed to be the difference. None of the UV devices responded to the bilge fires, since no devices were located within the bilge area. The infrared system responded fairly well to most fires although it failed to respond to a rerun of one of the fires it previously responded to. No explanation is available to describe this difficulty. The reflective smoke system responded fairly well as did the combustion products detector system.

Phase II again demonstrated the need for proper concern of ventilation conditions as well as determining obstructions when installing detection devices. The fires appeared to be reproducible as measured by response times. Again as in Phase I, the line-of-sight devices appeared to be too sensitive for actual shipboard condition without compensating circuitry.

It appeared from the results that it would be possible to engineer a detection system. Although none of the systems as installed was adequate, better placement of existing devices or additional devices may improve the system response. The information contained in Phase I and Phase II reports is not sufficient to allow an individual to design an acceptable system, although certain portions of these reports may be useful in actual shipboard design.

The importance of engineering and installation testing of individual systems was dramatically demonstrated. All possible fire areas must be evaluated, ventilation flow must be studied, and obstacles (blind spots) must be prevented. The acceptance of detectors must be accomplished on a total system approach. Wiring, panels, etc., although not a part of this testing, are important facets of the total package and must be evaluated.

EXTINGUISHING TESTS [8]

In the fall of 1970 a several week long testing program was undertaken to develop information on carbon dioxide and HALON 1301 as extinguishing agents. The basic purpose was to determine extinguishing system effectiveness for machinery space fires.

The first test series utilized a carbon dioxide system. The system was a low pressure system that also served as a back-up system for the HALON 1301 tests. Instrumentation was utilized to measure oxygen, carbon dioxide, and carbon monoxide levels.

The first three carbon dioxide tests utilized standard concentrations and discharge times, i.e., the system was designed in accordance with current requirements for merchant ships. For a space such as this the Coast Guard regulations would require a volume factor of 22 (one pound of CO_2 per 22 cubic feet of space). This factor would then give a concentration of CO_2 of approximately 33.5 percent. The Coast Guard requires that 85 percent of the required quantity of CO_2 be released within two minutes. The last two tests utilized non-standard concentration (22 percent) to determine what effect varying the concentration has on system effectiveness.

The various carbon dioxide tests are summarized in *Table I*.

Two types of HALON 1301 systems were tested. The first series of HALON tests utilized a super-pressurized system, while the second series utilized a heated system.

During the HALON 1301 tests, instrumentation was provided to measure concentrations of HALON 1301, hydrogen fluoride and hydrogen bromide. Since toxic products of decomposition generated were of great concern to us, let us look at the results of the first 10 minute preburn test. The HALON 1301 concentration was 5.65 percent, the hydrogen fluoride varied from 1.0 ppm to 3.5 ppm and the hydrogen bromide from 0.4 ppm to 0.9 ppm. These values were considerably lower than had been anticipated. In comparing this with the results from the CO_2 tests, it can be said that the gases normally present during the first were more toxic than the products of decomposition of the HALON 1301. The remaining tests of the super-pressurized system gave similar results.

The test scheduling of HALON 1301 was as in *Table II*.

The 20-minute preburn test proved to be quite an experience. The HALON 1301 tanks on deck had to be cooled by hand lines to keep the relief valves from releasing due to the intense heat developed. Temperatures in excess of 1200°C were recorded. However, the 1301 extinguished the fire and the products of decomposition were in the range of the above-reported acceptable results.

The third series of tests was conducted utilizing the low pressure CO_2 system which was charged with HALON 1301 in lieu of CO_2. The only alteration necessary was the addition of an electric heater to produce an autogenous agent pressure in the range of 300 psi. A one minute and ten minute preburn test were conducted. Concentrations were 3.39 percent and 4.64 percent by volume respectively. Discharge times were 18 and 28 seconds respectively. At the longer discharge time (28 sec.) HF measured 230 ppm and HBr 68 ppm. This verified the theory that the longer the discharge time, the greater the concentrations of toxic products. The results for the 18-second discharge were comparable to the super-pressurized results.

Table I

Preburn length	Discharge time	Concentration
(minuts)	*(minute)*	*(percent)*
10	1	34
10	2	34
20	1	34
10	1	22
1	1	22

One could conclude from these tests that:

1. Carbon dioxide is an effective agent for shipboard machinery space fires and that the present system requirements are adequate;

2. HALON 1301 is as effective an agent as CO_2 for extinguishing large scale machinery space fires and products of decomposition are no more severe on a quantity basis providing discharge of 1301 is accomplished in less than 15 seconds.

MISCELLANEOUS TESTING

Much interest has been raised in the past few years with regard to the possible use of fiberglass fuel tanks and polyvinyl chloride (PVC) piping aboard merchant vessels. The largest drawback, of course, is the low resistance of these materials when exposed to fire. To gather data the Coast Guard conducted two separate test programs.

The first program was a study of the effects of using fire retardant paint on polyvinyl chloride (PVC) piping. Two separate runs, one capped and filled with water and one capped and empty, were placed in the machinery space. From the results of 4 minutes of fire exposure to pan fires, it was concluded that fire retardant paint offered no significant protection to PVC pipe under fire conditions. The softening temperature of the pipe is well below the intumescing temperature of the paint. Additionally, the PVC piping was a smoke and fire hazard to such an extent that its use aboard ship should be seriously questioned. The tests demonstrated that the pipe would sag at temperatures less than 200°F, and that the water-filled and empty pipes performed comparably.

The second program [9] consisted of a series of fire tests on coated and uncoated fiberglass fuel tanks. Eight cylindrical 24 gallon tanks, four painted and four unpainted, were tested. The tanks were either full, ¼ full, or empty when exposed to an open pan diesel fuel fire for 6 to 11 minutes of exposure.

The testing determined that fire retardant paint gives significant short-time fire protection to fiberglass Both material integrity and heat insulation benefits can be realized.

FUTURE TESTING

The next immediate testing will evaluate low expansion protein foam systems installed for protection of cargo tanks on tankers. The application rate will be varied from 0.06 to 0.35 gpm/ft^2. Fire sizes will range from 500 to 4500 square feet. The fuel to be utilized will be primarily JP–5. These tests will be followed by similar tests in the engine room. Later tests of high expansion deck and machinery space foam systems will complete the foam series. As you can see our work is rather heavy for the next few months. Other possibilities include light water, dry chemical systems, construction assemblies, tank venting, and countless more.

The test possibilities are limited only by the imagination and by the commitment of groups such as those involved in the National Safety Council which are dedicated to advancing safety.

REFERENCES

1. William T. Butler, "Evaluation of Cotton Cargo Fire Extinguishing Tests conducted on the S.S. *Phobus*" pp 119–123, and Lloyd Layman, "Control and Extinguishment of Fires on Cargo Vessels" pp 128–133, Proceedings of the Fifty-first NFPA Annual Meeting (May 1941).

2. R. I. Price, "Fire Safety in Future Passenger Ships," Fire Journal, January 1969, Vol. 63, No. 1.

3. Dale E. McDaniel, "Marine Environmetal Fire and Safety Test Facility" pp 183–187, Proceedings of the Merchant Marine Council (CG–129), October 1970, Vol. 27, No. 10.

4. Donald J. Kerlin and Dale E. McDaniel, "Report of Machinery Space Fire Detecting Tests, Phase I," Project 713109, prepared for COMDT (DAT) USCG Headquarters, Washington, D.C. 20590.

5. Donald J. Kerlin, "Report of Machinery Space Fire Detecting Tests, Phase II," Project 713109 prepared for COMDT (DAT) USCG Headquarters, Washington, D.C. 20590.

6. Kerlin and McDaniel, *op. cit.*

7. Kerlin, *op. cit.*

8. Daniel F. Sheehan, "Large Scale Fire Testing, U.S. Coast Guard Shipboard Fire and Safety Testing Facility" a Speech delivered to the NFPA Annual Meeting in San Francisco, Calif., dated May 19, 1971.

9. LTJG J. D. Richard, "Fire Testing of Independent Fiberglass Fuel Tanks With and Without Protective Coating of Fire Retardant Paint," Project 713109/001, prepared for COMDT (DAT) USCG Headquarters, Washington, D.C. 20590

NOTE: The above article is from a paper presented to a Session of the 1971 National Safety Congress and exposition (Marine Section) in Chicago, Ill., on October 27, 1971.

Table II

System	Preburn	Release time	Concentration (*percent*)
Super-pressure	No fire	System check	5.65
Super-pressure	10 min	7.5 sec	5.65
Super-pressure	10 min	7.5 sec	4.4
Super-pressure	1 min	7.5 sec	4.4
Super-pressure	20 min	7.5 sec	5.65
Heated	1 min	18 sec	3.39
Heated	10 min	28 sec	4.64

VESSEL CAPSIZES

(*Continued from page 69*)

high seas and resulted in injuries and lost lives gives more reason to look carefully at its causes and possible prevention.

NOTE: In the past, the *Proceedings* has published feature articles on casualties reported by formal Marine Boards of Investigation and by the National Transportation Safety Board. By far the majority of the casualties reported to the Coast Guard are handled by an investigating officer without resort to the formal Boards. Many casualties of this type are worth publicizing in the interest of safer future operations. The above article is taken from the Report of the Investigating Officer of such a casualty.

WHEN YOU ENCOUNTER AN OIL SPILL

John D. Harper
President, The Marsan Corporation

WATERWAYS OPERATORS are finding, on most rivers and inland waterways, increasing activity in the containment and clean-up of hazardous materials or oil spills. This clean-up activity and the working of accidental oil spills is destined to become more frequent as Federal and State Governments become increasingly concerned with this form of pollution.

For those using the waterways, there are a number of things to be on the lookout for when approaching an area in which an oil spill has occurred. First, and of prime importance, is to be aware that there may be oil barriers deployed in the waterways, possibly across navigable channels and blocking the sailing line. Often, there are several of these oil barriers deployed downstream from an oil spill to divert the flow of the pollutant to a collection point on one of the banks. These barriers or booms are usually bright international orange or yellow, and can be seen during daylight hours as an orange or yellow line extending across the channel.

Different Story at Night

At night it is an entirely different matter. All oil barriers or booms that are deployed at night are *supposed* to be marked, in conformance with United States Coast Guard regulations, with special-purpose buoys as specified in Title 33, Code of Federal Regulations, Part 62 (33 CFR 62.25–35).

Also these barriers or booms are *supposed* to be manned. That is, personnel with a small boat are supposed to be available 24 hours a day to open or otherwise remove the oil barrier, when conditions permit, so as not to interfere with navigation or the free passage of commercial traffic.

There are occasions when an oil barrier will be deployed across a channel, and will not be opened upon signal. This is because the hazards associated with the pollutant are so extreme as to jeopardize the safety of any vessel entering the waters where the accidental spill has occurred. This has happened in the Chicago area, when a benzene spill on the Calumet-Sag Canal closed the canal traffic for a period of several hours.

A Matter of Safety

It is a rare occurrence when traffic is prohibited the right of free passage, but it is an action taken at the request of regulatory agencies for the safety of all concerned. Consistent with the deployment of oil contaminated barriers or booms across navigable channels is usually a security warning broadcast to all mariners on VHF channel 16.

When passing through an area where an oil spill incident has occurred, all hands should be on the lookout for personnel in small boats that frequently are used in working these spills. A properly executed oil spill recovery operation will be equipped with VHF radios (FM) in order to communicate and advise river traffic of existing conditions at the scene of the spill.

Unfortunately, this is not always the case, as this type of radio equipment to communicate with upbound and downbound traffic is not always available. In certain areas, for example the North Branch of the Chicago River, large signs have been posted during oil spills, reading: "Caution, Oil Spill Area, Proceed Slowly;" or "Stop, Oil Barrier Blocking Channel, Signal for Opening;" or signs with similar wording.

Typical Oil Spill Scene

A typical oil spill scene in which oil barriers have been deployed in several locations across a channel can be described as follows. The oil barrier shows up as an orange line with a freeboard of 8 inches, with oil, straw or debris on the upstream side. Usually there is a boat in attendance, which is used to open one side of the barrier to permit the passage of traffic. Often there are two barriers, one above the other, to permit a "locking through" operation.

If a tow or other boat does accidentally broach or ride up over an oil barrier, it may be expected that several hundred feet of ⅜ or ½-inch galvanized chain will be caught up in and wrapped around the propeller or rudder post, with a subsequent expensive removal therefrom and the additional costly replacement of the barrier. The chain is used in a number of types of oil barriers as ballast and runs continuously along the bottom edge of the boom, to keep it vertical in the water and aid in trapping the oil, oil soaked straw and debris that is present.

The Final Word

The final word is: when approaching an area where an oil spill is being worked, be extremely cautious. The techniques used by various cooperatives and government agencies in working an oil spill vary as conditions demand, and because this activity is all so relatively new, many of the refinements in techniques, such as properly lighted and marked oil barriers and communication equipment, may not be present.

Pass Information Along

After a tow goes through an oil spill area, it is helpful to pass on to other boats or tows that are expected to move through the same area information about what is going on. If you encounter an oil spill or a spill of other hazardous materials that is not being worked, contained or cleaned up, on any waterway, it is mandatory under Federal law that notification be made to the nearest U.S. Coast Guard facility.[1] The following must be reported: the location; size/color; substance; suspected source; time observed; and observer's identity (optional). Caution; Do not take samples of any chemical spill. If uncertain as to volatility, avoid flame. ⚓

—Courtesy The Waterways Journal

[1] The Coast Guard, as the authority to which spills are reportable, encourages prompt notification of spills by those who encounter them. It is to be noted, however, that the Federal Water Pollution Control Act, as amended, imposes a penalty only on those who create an oil spill and fail to report it. In addition, the "other hazardous substances" referred to in the article above have not yet been defined by appropriate regulations.

AMENDMENTS TO REGULATIONS

Approved Equipment

Commandant Issues Equipment Approvals; Terminates Others

U.S. Coast Guard approval was granted to certain items of lifesaving, and other miscellaneous equipment and materials. At the same time the Coast Guard terminated certain items of lifesaving, and other miscellaneous equipment and materials.

Those interested in these approvals and terminations should consult the Federal Registers of February 4 and 19, 1972, for detailed itemization and identification.

Helicopter Evacuation Check List

This list was prepared with U.S. Coast Guard helicopters in mind. However, much of this information will prove valuable for any helicopter evacuation.

REMEMBER

As master, you feel the responsibility for the welfare of each crewmember acutely. In difficult situations, the Coast Guard, doctors, and other agencies will do everything possible to assist you.

Helicopter evacuation is a hazardous operation to the patient *and* to the flight crew, and should only be attempted in a matter of life or death. Provide the doctor on shore with all the information you can concerning the patient, so that an intelligent evaluation can be made concerning the need for evacuation.

Most rescue helicopters can proceed less than 150 miles off-shore (a few new helicopters can travel 250 miles out to sea), but only if weather conditions permit. If an evacuation is necessary, you must be prepared to proceed within range of the helicopter.

WHEN REQUESTING HELICOPTER ASSISTANCE

(a) Give the accurate position, time, speed, course, weather conditions, sea conditions, wind direction and velocity, type of vessel, voice and CW frequency for your ship.

(b) If not already provided, give *complete* medical information including whether or not the patient is ambulatory. Refer to the chapter "Medical Advice by Radio" in the United States Government text, "The Ship's Medicine Chest and First Aid at Sea" for detailed instructions, if it is on board.

(c) If you are beyond helicopter range, advise your diversion intentions so that a rendezvous point may be selected.

(d) If there are changes to any items reported earlier, advise the rescue agency immediately. Should the patient die before the arrival of the helicopter, be sure to advise those assisting you. Please remember, this operation involves risking the flight crews lives as well.

PREPARATIONS PRIOR TO ARRIVAL OF THE HELICOPTER

(a) Provide continuous radio guard on 2182 kHz or specified voice frequency, if possible. The helicopter normally cannot operate CW.

(b) Select and clear the most suitable hoist area, preferably aft on the vessel with a minimum of 50 feet radius of clear deck. This must include the securing of loose gear, awnings, and antenna wires. Trice up running rigging and booms. If hoist is aft, lower the flag staff.

(c) If the hoist is to take place at night, light the pickup areas as well as possible. Be sure you *do not shine any lights on the helicopter,* so that the pilot is not blinded. If there are any obstructions in the vicinity, put a light on them so the pilot will be aware of their positions.

(d) Point search lights vertically to aid the flight crew in locating the ship and turn them off when the helicopter is on the scene.

(e) Be sure to advise the helicopter of the location of the pickup area on the ship *before* the helicopter arrives, so that the pilot may make his approach to aft, amidships or forward, as required.

(f) Remember, there will be a high noise level under the helicopter, so voice communications on deck are almost impossible. Arrange a set of hand signals among the crew who will assist.

HOIST OPERATIONS

(a) If possible, have the patient moved to a position as close to the hoist area as his condition will permit—TIME IS IMPORTANT.

(b) Normally, if a litter (stretcher) is required, it will be necessary to move the patient to the special litter which will be lowered by the helicopter. Be prepared to do this as quickly as possible. Be sure the patient is strapped in, face up, and with a life jacket on (if his condition will permit).

(c) Be sure that the patient is tagged to indicate what medication, if any, was administered to him, and when it was administered.

(d) Have patient's medical record and necessary papers in an envelope or package ready for transfer *with* the patient.

(e) Again, if the patient's condition permits, be sure he is wearing a life jacket.

(f) Change the vessel's course to permit the ship to ride as easily as possible with the wind on the bow, preferably on the port bow. Try to choose a course to keep the stack gases clear of the hoist area.

(g) Reduce speed to ease ship's motion but maintain steerageway.

(h) If you do not have radio contact with the helicopter, when you are in all respects ready for the hoist, signal the helicopter in with a "come on" with your hand, or at night by flashlight signals.

(i) *Allow basket or stretcher to touch deck prior to handling to avoid static shock.*

(j) If a trail line is dropped by the helicopter, guide the basket or stretcher to the deck with the line; keep the line free at all times. This line will not cause shock.

(k) Place the patient in basket, sitting with his hands clear of the sides, or in the litter, as described above. Signal the helicopter hoist operator when ready for the hoist. Patient should signal by a nodding of the head if he is able.

(l) If it is necessary to take the litter away from the hoist point, unhook the hoist cable and keep it free for the helicopter to haul in. *DO NOT SECURE CABLE TO THE VESSEL OR ATTEMPT TO MOVE STRETCHER WITHOUT UNHOOKING.*

(m) When patient is strapped into the stretcher, signal the helicopter to lower the cable, hook up, and signal the hoist operator when the patient is ready to hoist. Steady the stretcher so it will not swing or turn.

(n) If a trail line is attached to the basket or stretcher, use it to steady the patient as he is hoisted. Keep your feet clear of the line.

SAVE THIS CHECK LIST

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications of marine safety rules and regulations may be obtained from the nearest marine inspection office of the U.S. Coast Guard. Because changes to the rules and regulations are made from time to time, these publications, between revisions, must be kept current by the individual consulting the latest applicable Federal Register. (Official changes to all Federal rules and regulations are published in the Federal Register, printed daily except Sunday, Monday, and days following holidays.) The date of each Coast Guard publication in the table below is indicated in parentheses following its title. The dates of the Federal Registers affecting each publication are noted after the date of each edition.

The Federal Register will be furnished by mail to subscribers, free of postage, for $2.50 per month or $25 per year, payable in advance. The charge for individual copies is 20 cents for each issue, or 20 cents for each group of pages as actually bound. Remit check or money order, made payable to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Regulations for Dangerous Cargoes, 46 CFR 146 and 147 (Subchapter N), dated January 1, 1971 are now available from the Superintendent of Documents price: $3.75.

CG No.	TITLE OF PUBLICATION
101	Specimen Examination for Merchant Marine Deck Officers (7–1–63).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (5–1–68). F.R. 6–7–68, 2–12–69, 10–29–69, 12–30–70, 3–20–71.
115	Marine Engineering Regulations (7–1–70). F.R. 12–30–70.
123	Rules and Regulations for Tank Vessels (5–1–69). F.R. 10–29–69, 2–25–70, 6–17–70, 10–31–70, 12–30–70.
129	Proceedings of the Marine Safety Council (Monthly).
169	Rules of the Road—International—Inland (9–1–65). F.R. 12–8–65, 12–22–65, 2–5–66, 3–15–66, 7–30–66, 8–2–66, 9–7–66, 10–22–66, 5–11–67, 12–23–67, 6–4–68, 10–29–69, 11–29–69, 4–3–71.
172	Rules of the Road—Great Lakes (9–1–66). F.R. 2–18–67, 7–4–69, 8–4–70.
174	A Manual for the Safe Handling of Inflammable and Combustible Liquids (3–2–64).
175	Manual for Lifeboatmen, Able Seamen, and Qualified Members of Engine Department (3–1–65).
176	Load Line Regulations (2–1–71) F.R. 10–1–71.
182	Specimen Examinations for Merchant Marine Engineer Licenses (7–1–63).
184	Rules of the Road—Western Rivers (9–1–66). F.R. 9–7–66, 2–18–67, 5–11–67, 12–23–67, 6–4–68, 11–29–69, 4–3–71.
190	Equipment Lists (8–1–70). F.R. 8–15–70, 9–29–70, 9–24–71, 9–30–71, 10–7–71, 10–14–71, 10–19–71, 10–30–71, 11–3–71, 11–6–71, 11–10–71, 11–23–71, 12–2–71, 1–13–72, 1–20–72, 2–4–72, 2–19–72.
191	Rules and Regulations for Licensing and Certificating of Merchant Marine Personnel (5–1–68). F.R. 11–28–68, 4–30–70, 6–17–70, 12–30–70, 6–17–71, 12–8–71.
200	Marine Investigation Regulations and Suspension and Revocation Proceedings (5–1–67). F.R. 3–30–68, 4–30–70, 10–20–70.
220	Specimen Examination Questions for Licenses as Master, Mate, and Pilot of Central Western Rivers Vessels (4–1–57).
227	Laws Governing Marine Inspection (3–1–65).
239	Security of Vessels and Waterfront Facilities (5–1–68). F.R. 10–29–69, 5–15–70, 9–11–70, 1–20–71, 4–1–71, 8–24–71.
249	Marine Safety Council Public Hearing Agenda (Annually).
256	Rules and Regulations for Passenger Vessels (5–1–69). F.R. 10–29–69, 2–25–70, 4–30–70, 6–17–70, 10–31–70, 12–30–70.
257	Rules and Regulations for Cargo and Miscellaneous Vessels (8–1–69). F.R. 10–29–69, 2–25–70, 4–22–70, 4–30–70, 6–17–70, 10–31–70, 12–30–70, 9–30–71.
258	Rules and Regulations for Uninspected Vessels (5–1–70).
259	Electrical Engineering Regulations (6–1–71).
266	Rules and Regulations for Bulk Grain Cargoes (5–1–68). F.R. 12–4–69.
268	Rules and Regulations for Manning of Vessels (10–1–71). F.R. 1–13–72
293	Miscellaneous Electrical Equipment List (9–3–68).
320	Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf (11–1–68). F.R. 12–17–68, 10–29–69, 1–20–71, 8–24–71, 10–7–71.
323	Rules and Regulations for Small Passenger Vessels (Under 100 Gross Tons) (7–1–69). F.R. 10–29–69, 2–25–70, 4–30–70, 10–31–70, 12–30–70.
329	Fire Fighting Manual for Tank Vessels (7–1–68).

CHANGES PUBLISHED DURING FEBRUARY 1972

The following have been modified by Federal Registers:

CG–190, Federal Registers February 4 and 19, 1972