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Last winter, the Coast Guard icebreaker POLAR SEA studied ice floes in the Bering Sea. Petty Officer Charles S. Powell photographed this Coast Guard helicopter from the POLAR SEA's deck.
(Official U.S. Coast Guard photo)

The Lift Boat DMC-1

(This article is reprinted from the National Transportation Safety Board's Report No. NTSB/MAR 86/01/SUM, dated June 30, 1986.)

About 0300 on October 16, 1985, the U.S. self-propelled lift boat DMC-1 (see figure 1) departed Port Bolivar, Texas, bound for an offshore job site in High Island Block 139[1] in the Gulf of Mexico, located about 25 nautical miles east-southeast of Galveston, Texas. The DMC-1 was a specialized type of work boat employed in the offshore minerals and oil industry and was fitted with three 114-foot-long jack-up legs which, when lowered to the sea floor, lifted the vessel completely out of the water.

The DMC-1 was equipped with a radar, a long-range navigation (loran)[2] receiver, a fathometer, a gyrocompass, and a magnetic compass. However, only the radar and the magnetic compass were fully operational. The gyrocompass was not operational, the loran receiver would not provide a navigational fix, and the fathometer would give an accurate depth reading only when the vessel was dead in the water. Two 20-man inflatable liferafts also were aboard the DMC-1. Onboard the DMC-1 were a two-man operating crew composed of a master and a deckhand, a cook who was employed by a catering company, and an eight-man crew of industrial workers who had no duties involving the operation of the vessel. The industrial workers had been contracted to perform pile driving operations at the offshore job site.

As the vessel proceeded into the Gulf of Mexico, the industrial workers and the cook were in their quarters asleep while the master and the deckhand were on duty in the pilothouse. The master was at the helm controlling the vessel's movements, and the deckhand stood by to perform duties as directed by the master and to make periodic, routine examinations of the engineroom.

About 0830, the master of the DMC-1 radioed the operator of a passing tug to ask for a position fix. Based on the tug operator's information that the DMC-1 was located in High Island Block 144, the master of the DMC-1 placed the vessel on compass course toward the job site in High Island Block 139.

Shortly afterward, the master ordered the deckhand to conduct a routine examination of the engineroom. When the deckhand arrived at the engineroom, he discovered that a radiator hose to the starboard main engine had split open and that engine cooling water was spilling into the engineroom bilge. The deckhand immediately returned to the pilothouse and reported the condition to the master. The master then ordered the deckhand to return to the engineroom and to insert a garden hose into the radiator of the starboard main engine in order to replace the water flowing from the split radiator hose. The deckhand complied with the order, but the split in the hose enlarged. The starboard main engine began to overheat, and the deckhand returned to the pilothuse to update the master concerning the engine problem. The master then went to the engineroom with the deckhand to evaluate the situation.

The master stated that the cooling system for the starboard main engine was connected to the cooling system for the port main engine by a crossover pipe. To prevent the split radiator hose on the starboard main engine from causing both main engines to overheat, the master closed the isolation valves in the crossover

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[1] The portion of the Gulf of Mexico which is adjacent to the U.S. coast has been divided into offshore mineral leasing areas for the development of offshore minerals and petroleum resources. These areas are further subdivided into sequentially numbered blocks. The offshore mineral leasing areas and blocks are printed on certain charts of the Gulf of Mexico and are used as reference points by some vessel operators.

[2] Loran is an electronic system using shore-based radio transmitters and shipboard receivers to allow mariners to determine their positions at sea.

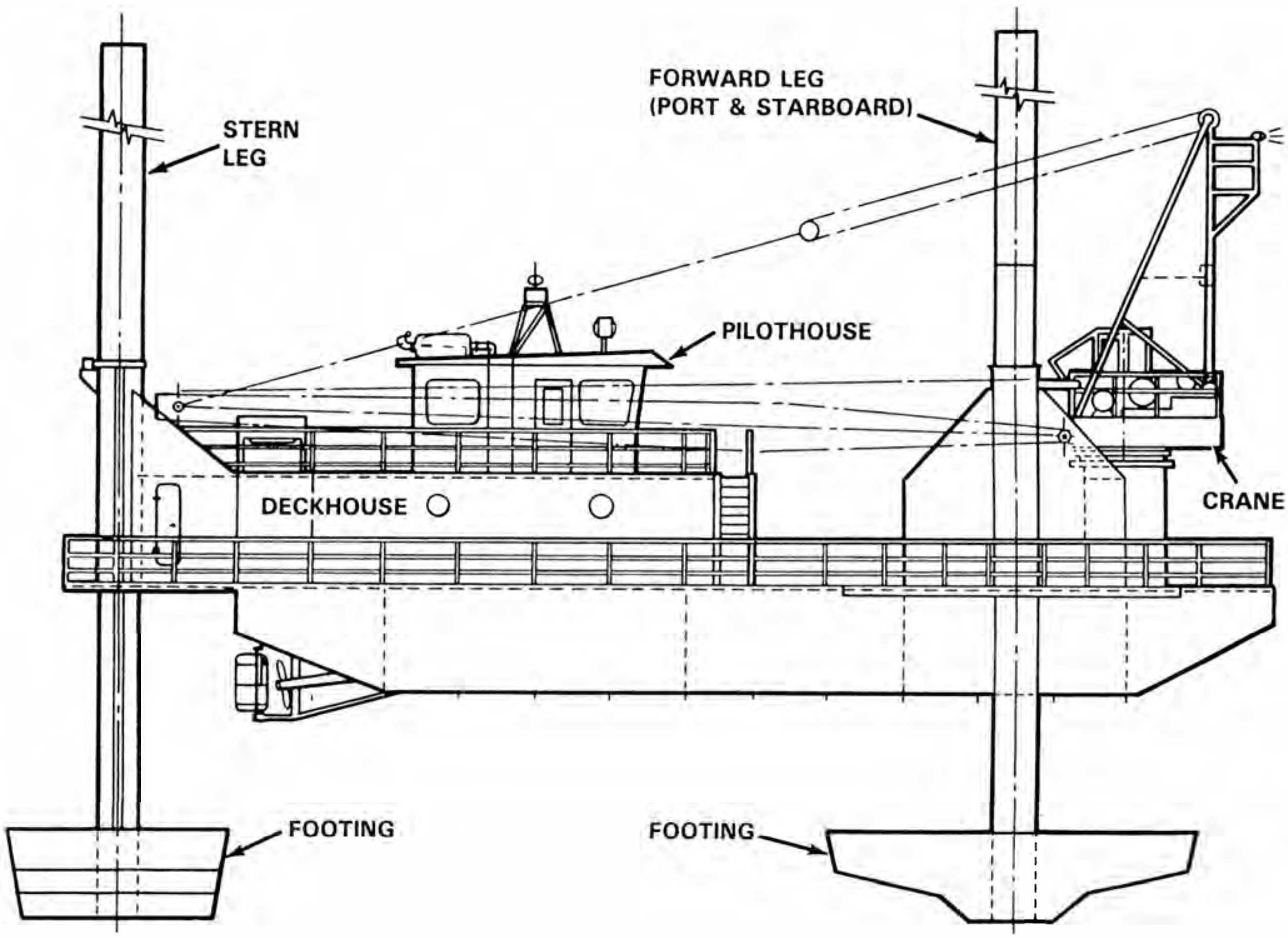

Figure 1.--Outboard Profile of the DMC-1.

pipe. However, the flow of water from the split radiator hose did not stop, and the port main engine also began to overheat. The master ordered the deckhand to stop the starboard main engine and to reduce the speed of the port main engine. The master said that he intended to jack the vessel out of the water using the port main engine and then stop the port main engine so that repairs to the starboard main engine radiator hose could be made wihout the vessel being adrift. He stated that the vessel was close to the main shipping lanes and that he did not want to vessel to drift in this area for fear that it might result in a collision. He further stated that he could not have anchored because there was no cable attached to the anchor.

About 0840, the master returned to the pilothouse where the leg jacking controls were located. He said that he looked at the navigation chart, saw that the charted water depth in the area was 53 feet, immediately engaged the leg jacking system, and began lowering all three legs at the same time. The master said he did not attempt to obtain a depth reading with the fathometer before he engaged the leg jacking system. While the port main engine was being utilized to operate the leg jacking system, no motive power was being applied to the vessel's propellers, and the vessel drifted toward the northwest under the influence of the 10- to 15-knot southeasterly wind and the 2- to 4-foot southeasterly seas. The master estimated that the DMC-1 drifted at a speed of about 2 to 3 knots.

The master stated that when he began jacking the legs, he was alone in the pilothouse. He said that he had been operating the leg jacking system for 7 to 10 minutes and had lowered the legs about 35 to 40 feet when the vessel took an "immediate jump" and capsized to starboard. He said that there was no forewarning, that there had been no progressively worsening list, and that it was a sudden, unexpected "flip over." The master stated that the vessel capsized before the hull had begun to rise and that the legs had not yet contacted the sea floor.

When the vessel capsized, all of the pilothouse windows broke, and the pilothouse filled with water. The master stated that he did not have time to activate the general alarm. When the pilothouse was completely submerged so that pressure on both sides of the port side pilothouse door equalized, the master opened the door and swam to one of the inflatable liferafts from the DMC-1 that was floating in the water uninflated. The master pulled the cord (sea painter) to inflate the raft and then climbed aboard it.

Sometime before the master had commenced leg jacking operations, some industrial workers and the cook had awakened and left their sleeping quarters. Two industrial workers were outside on deck while another industrial worker, a pile driver hammer operator, was in the galley talking with the cook who was preparing breakfast. Four welders and an assistant hammer operator were still asleep in their quarters.

The hammer operator said that about 0850 he felt the main engines slow down and the leg jacking system engage. He thought the vessel had arrived at the work site. Despite the master's statement to the contrary, the hammer operator said that, while the legs were jacking down, the vessel began to list to starboard. He left the galley, went on deck where everything looked "okay," and then returned to the galley to resume his conversation with the cook. Four to five minutes later, the hammer operator looked at his wristwatch and noted that the time was 0900. He said that moments later the vessel "leaned to starboard real bad," and that he ran out of the galley to the open deck as the vessel capsized. He went to the port side where he encountered one of the other industrial workers who was holding a ring life buoy which had a line attached to it. The industrial worker threw the life buoy into the water and handed the line to the hammer operator. The hammer operator jumped into the water and, using the line, pulled the life buoy to him.

Two welders awoke in their quarters on the starboard side of the deckhouse as the vessel capsized, and they were suddenly submerged as the deckhouse rapidly filled with water. They swam upward and surfaced in an air pocket in a two-man room on the port side of the deckhouse where they were joined by the cook. The three men escaped from the sinking vessel by breaking the glass of a porthole and swimming through it to the surface, where they joined the master in the inflatable raft.

The DMC-1's other liferaft inflated automatically near the vessel's bow, and the deckhand and two industrial workers were able to board the raft. Two other industrial workers, one (the hammer operator) supported by a ring life buoy and the other supported by a piece of flotsam, were not able to reach the rafts. Two welders were not able to escape from the sinking vessel and were drowned. About 0930, the offshore supply vessel PATRICIA M, which happened to be in the area, arrived on scene and rescued all of the survivors.

In November 1985, the DMC-1 was salvaged from the bottom of the Gulf of Mexico. The wreck was found in a capsized position with the leg footings breaking the water surface. The salvors cut the legs at the bottom of the DMC-1 and took them ashore. Measurements showed that the bottom of the stern leg footing had been 42.8 feet below the bottom of the vessel and that, although the forward legs were not identified as to port and starboard, the bottom of the footings of these legs had been 43.2 feet and 46.1 feet below the bottom of the vessel. The leg sections were not bent, and there were no dents, scrapes, or other marks that would indicate they had struck another object with force.

When the master engaged the jacking system, no motive power was applied to the vessel's propellers, and the vessel began to drift with the wind and sea. Since the loran receiver was not functioning properly, the master did not know the vessel's precise position. Thus, the depth (53 feet) that he noted on the chart may have been for a different location. The Safety Board noted that National Oceanic and Atmospheric Administration (NOAA) Chart 11300, which dpeicts the accident site, showed that the charted depth[3] in High Island Block 144 was 7-1/2 fathoms (45 feet) and that there were two charted submerged obstructions in this block. The chart showed the one obstruction had 6-3/4 fathoms (40.5 feet) of water over it and that the other obstruction had 6-1/2 fathoms (39 feet) of water over it. Since the measurements of the leg sections cut from the wreck of the DMC-1 after the accident established that all of the legs extended more than 40 feet below the vessel, it is possible that the legs struck one of the submerged objects as the vessel drifted over it, causing the vessel to

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[3] *At mean low water.*

capsize. However, because the leg sections cut from the wreck were not bent and did not show any evidence of scrapes or other marks, the Safety Board concludes that the legs did not collide with another object. One of the leg sections cut from the wreck was more than 45 feet below the bottom of the vessel Since the depth of the water in High Island Block 144 was about 45 feet, it is probable that this leg grounded on the sea floor as the vessel drifted at 2 to 3 knots, thereby tripping the vessel and causing it to capsize. If the vessel could have been held stationary in relation to the sea bottom during the leg jacking operation, the vessel would not have been tripped. Under normal conditions, the master could have used one of the main engines to hold the vessel stationary while he used the other main engine to operate the leg jacking machinery. However, in this case, the master had the use of only one main engine, which allowed the vessel to drift over the sea bottom while the legs were being lowered. Had the anchor been fitted with a cable, the master could have deployed the anchor to hold the vessel stationary while repairing the starboard main engine, and there would have been no reason to lower the legs. The lack of anchoring capability limited the options available to the master when the engine problem developed and may have influenced his decision to attempt to jack the vessel out of the water. The Safety Board, therefore, concludes that the inability to anchor the vessel contributed to the cause of this accident. Companies that operate lift boats should recognize that the need to anchor may arise at any time, and companies should not allow their vessels to proceed to sea without the capability to anchor.

Although the vessel was outfitted with the usual navigation equipment necessary for safe operation, much of that equipment was not operating properly at the time of the accident. Navigation equipment deficiencies had no causal effect upon the capsizing of the vessel; however, under other circumstances, properly operating navigation equipment could have been vital to the safety of the vessel. The Safety Board believes that the navigation equipment deficiencies on the DMC-1 indicate a need for improved equipment maintenance procedures to ensure that vital navigation equipment is maintained in good working order.

In this accident, the vessel capsized before the master could activate the general alarm system. Even if sufficient time had been available to activate the general alarm when the vessel started to capsize, there probably was insufficient time for the two deceased welders to have escaped their sleeping quarters in the deckhouse before it filled with water. Even the cook, who was preparing breakfast in the galley when the vessel capsized, barely escaped and then only because he happened to surface in an air pocket with the other two welders when the deckhouse flooded and was able to escape through a broken porthole. The Safety Board believes that the only action the master could have taken to prevent persons from being trapped inside the deckhouse when the vessel capsized was to make sure that everyone was awake and outside the deckhouse before starting leg jacking operations.

Leg jacking operations to lift or lower a vessel are the most dangerous procedures carried out on lift boats. During such operations, lift boats are the most vulnerable to capsizing. Before such operations may be conducted safely, the master must determine that the vessel is not overloaded, that the weight loads are evenly distributed, and that all of the elevating gear is in proper working condition. After these determinations have been made, the master must ensure that the vessel is held as stationary as possible over the proposed jacking site before he starts to lower the legs to the sea floor. Movement of the vessel over the sea bottom during leg jacking operations can result in damage to the legs and footings when they contact the bottom, and such movement can, as was probable in this case, result in the vessel's capsizing.

During its investigation of the accident, the Safety Board reviewed the operation manual for the DMC-1 which set forth the procedure the master was to follow in jacking the vessel out of the water. According to the manual, the vessel "shall be positioned over the work site using the propulsion system" before the leg jacking system is engaged. This instruction is indefinite because it does not state that the vessel must be maintained in this position until leg jacking operations are completed, nor does the instruction explicitly prohibit leg jacking operations when the vessel is moving over the bottom. Furthermore, compliance within this instruction presupposes that the master has full use of both main engines that make up the propulsion system so that he can use one main engine to hold the vessel in position while he uses the other main engine to power the leg jacking system. The instruction, therefore, implies that leg jacking operations to lift the vessel out of the water should not be conducted when the master has the use of only one main engine. The Safety Board believes that instructions to lift boat masters should be stated in a clear and precise manner so that they are easily understood and do not require interpretation. Had the master of the DMC-1 been given specific instructions not to jack the vessel out of the water when it is moving over the bottom or when he does not have full use of both main engines, he might not have attempted to do so, and this accident might have been avoided.

The master of the DMC-1 was faced with an emergency situation, although a minor one, when the radiator hose to the starboard main engine split. This is a common type of equipment failure which should have been relatively easy to correct and which should have taken a short time to complete without necessitating jacking the vessel out of the water. The master should have been able to shut down the starboard engine to close the isolation valves in the main engine cooling water system, and to continue to operate on the port main engine until the repair was completed to the starboard main engine. For some unknown reason, however, the isolation valves apparently malfunctioned, and both main engines had to be stopped. The master stated that he did not want to allow the vessel to drift while the repair work was in progress because of his vessel's proximity to shipping lanes where it might risk collision with other vessels. Because the vessel lacked the capability to anchor, the master believed that his only option for prudent action was to jack the vessel out of the water. However, since it was daylight, since there were relatvely mild wind and sea conditions, and since there apparently were no other vessels in the immediate vicinity of the DMC-1 (as evidenced by the fact that it took approximately one-half hour for the first vessel to arrive on scene after the accident), the Safety Board believes that it would have been more prudent if the master had allowed the vessel to drift while the radiator hose was being replaced. While adrift, the master should have hoisted the signal for "vessels not under command" as specified in the International Regulations for Preventing Collisions at Sea, 1972, so that any vessel approaching would know to keep clear of the drifting vessel. Once the repair was completed, the master could have taken down the "not under command" signal, restarted the engines, and resumed his voyage.

Recommendations

As a result of its investigation of this accident, the National Transportation Safety Board recommended that the lift boat company:

Establish remedial procedures to ensure that necessary navigation and vessel control equipment, including anchors and anchor cables on company lift boats are on board and maintained in good operating condition.

- Amend operating instructions to company lift boat masters to require them to make sure that all persons on board the vessel are awake and outside the deckhouse whenever leg jacking opeations are in progress.

- Amend operating instructions to company lift boat masters to prohibit them from conducting jack-up operations when the vessel cannot be held in a stationary position relative to the sea floor until such operations are completed.

The National Transportation Safety Board determines that the probable cause of the capsizing and sinking of the DMC-1 was the master's decision to attempt to jack the vessel out of the water while the vessel was adrift or moving over the sea bottom. Contributing to the cause of this accident was the master's inability to anchor the vessel when it began to drift. Contributing to the loss of life was the master's failure to require all persons on board to be awake and outside the deckhouse prior to commencing jack-up operations. ⚓

U.S. Merchant Marine Vessels

The privately owned, deep-draft fleet of the U.S. Merchant Marine totaled 579 vessels with a carrying capacity of about 23 million deadweight tons (dwt) on July 1, 1986, according to the U.S. Department of Transportation's Maritime Administration. The total comprised 468 oceangoing ships and 111 Great Lakes vessels.

Compared with July 1, 1985 totals, the number of ships in the U.S. oceangoing fleet decreased by 32 vessels, and the fleet's carrying capacity decreased by 351,341 dwt.

As of July 1, 1986, 8 merchant ships totaling 498,660 dwt were under construction or on order in U.S. shipyards. The shipbuilding orderbook then consisted of two tankers, three containerships, two incinerator ships, and one dredge. One additional vessel was undergoing conversion.

The vessel at dock at Coast Guard Base Terminal Island following the incident.

Scuttling Doesn't Pay

Lonnie Letz

On September 29, 1982, a distress call was received by Coast Guard Station Channel Islands Harbor (California) from the fishing vessel THE SHRIMPER. The vessel was taking on water 22 miles south of Santa Cruz Island, and the crew was preparing to abandon ship.

The station advised Operations Center Long Beach, which directed a helicopter to launch from Air Station Los Angeles. A 41-foot Coast Guard boat got underway from Station Channel Islands Harbor to assist the helicopter with the case. When the helicopter was about 10 minutes from the sinking vessel, a fire broke out aboard THE SHRIMPER.

This was turning into a real search and rescue case, and the crews of the helicopter and the 41-footer were beginning to feel the adrenalin flow. The helicopter crew plucked the skipper and the only crewman from the deck of THE SHRIMPER, even though the fishing rigging on the vessel and the ever-thickening smoke endangered the hoist operation. The helicopter remained on scene until the 41-footer arrived.

THE SHRIMPER seemed to maintain its buoyancy, and the crew of the 41-footer determined that they could possibly put the fire out and keep THE SHRIMPER afloat. By this time, the 82-foot Coast Guard cutter POINT CAMDEN had been directed to assist by towing the damaged vessel to Coast Guard Base Terminal Island. Everyone did their jobs as they had been trained to do — to save lives and property at sea.

The crew from POINT CAMDEN continued to pump the damaged vessel while towing it to Base Terminal Island.

Mr. Letz is a Special Agent assigned to the Office of Intelligence and Law Enforcement, Eleventh Coast Guard District.

When it was safe to enter the engine room of THE SHRIMPER, running water could still be heard coming into the vessel. The source of the water was easily located, coming in through a cut hose attached directly to the open sea chest valve. The sea chest valve was immediately closed by one of the damage control party members, and the vessel stopped taking on water. Further examination by the damage control party revealed that another plastic pipe, directly connected to the sea chest valve, had been cut, and a flange had been intentionally pried away from a pump housing.

Now the focus changed from search and rescue to the possibility of a violation of Title 18 USC, Sections 2271 through 2275 — intentional destruction of a U.S. vessel.

The crew of POINT CAMDEN requested that Coast Guard intelligence and marine safety office investigators meet them at the dock. A criminal investigation began. Photographs were taken, evidence preserved, statements taken, and assistance from arson investigators was requested. Preliminary investigation revealed that THE SHRIMPER appeared to have been insured for close to $500,000. The FBI was briefed and assumed primary jurisdiction. The FBI investigation continued for more than a year.

In the summer of 1985, Assistant U.S. Attorney Gary Feess, who considered the extreme risk the Coast Guard crews put themselves in, reviewed all the facts. He felt that the Coast Guard and FBI investigation had a good chance of indicting the skipper of THE SHRIMPER.

Eight Coast Guardsmen testified at the trial. On February 12, 1986, the skipper of THE SHRIMPER was convicted in federal court of both attempted destruction of a vessel and setting fire and cutting the plumbing with the intent to damage a vessel.

On March 31, the skipper was sentenced to 3 years in prison. He was also placed on 3 years' probation, which he will serve when released from prison. ⚓

A cut pipe near the sea chest.

Overcurrent Devices

Electrical equipment and principles are often the source of much confusion. This article looks at one type of electrical device and defines it in terms that everyone can understand.

Clayton O. Crapps

Overcurrent devices are an essential part of a vessel's electrical system and are provided for two reasons: to protect electrical equipment from damage and to protect people from injury. The proper use of overcurrent devices can be a major factor in electrical safety and in preventing personal injury and loss of property.

Electrical Faults

Overcurrent devices provide protection from three types of failures, or faults, as they are known in electrical terminology: overloads, short circuits, and ground faults.

An overload is a condition where equipment is operated in excess of its full load rating or a conductor is operated in excess of its rated current-carrying ability (ampacity). If this condition persists for a sufficient length of time, dangerous overheating or damage could occur to equipment.

A short circuit is a condition where a relatively low resistance path exists, either accidentally or intentionally, between two different electrical points. This condition can be extremely hazardous and must be corrected immediately.

A ground fault is an unintentional path of relatively low resistance between the "hot," or line side, and ground. This condition can cause current to flow through the equipment casing and through the hull of metal vessels. This can damage equipment and be especially dangerous to personnel.

Mr. Crapps is an Electrical Engineer in the Engineering Branch, Marine Technical and Hazardous Materials Division, Office of Marine Safety, Security, and Environmental Protection, U.S. Coast Guard.

Types of Overcurrent Devices

The most commonly used overcurrent devices are fuses and circuit breakers, of which there are different types.

One type of circuit breaker is known as a thermal trip breaker. Since current flowing through a conductor generates heat, this type of breaker works similarly to a thermostat. A bimetallic strip is installed in such a way that the flow of current is through the strip. The resistance of this strip is carefully controlled so that a specific amount of current generates the heat required for it to move. This movement will cause the strip to connect with a contact which then causes the breaker to trip. The strip will then cool down, and the breaker can be reset. These breakers can be adjustable. The strip is designed so that a screw can either control the distance between it and the contacts, or it can control spring tension on a spring that holds the strip in place. Another important feature in a thermal trip breaker is the time it takes for the strip to heat up to cause movement. The higher the current, the faster heat builds up, and the quicker the breaker trips. Similarly, if the current is only slightly above the setting, it takes much longer for heat to build up and the breaker to trip. This time delay is necessary in applications involving motors, where the starting current is much higher than the running current. The technical terminology for this type of circuit breaker is "inverse time trip," and the values for time and current can be obtained from the circuit breaker's manufacturer.

A second type of circuit breaker is the magnetic trip variety. This type of trip consists of three major components: a spring-loaded set of contacts, a pivot-mounted latch that is made of a material that is attracted by magnets, and an electromagnet made of a few turns of heavy wire through which all current passes. The spring holds the contacts in place and determines the amount of force required to move the contacts. When the circuit is energized, current passes through the coils of the electromagnet, creating a magnetic field that attempts to move the latch. The strength of this field depends on the amount of current in the circuit. The advantage of this type of trip is that it is "instantaneous." It will immediately remove the high currents that result from a short circuit.

Fuses are thermal devices. A fuse contains a strip of metal that will melt when the temperature rises to a certain point. There are many different types of fuses serving different purposes. Some of these are current-limiting fuses, dual-element fuses, time-delay fuses, quick-acting fuses, etc. The majority of fuses that will be used are "one-time" fuses, which are designed to interrupt an electrical overload once and then be replaced.

Overcurrent Device Ratings

Overcurrent devices have three important ratings. The first is voltage. An overcurrent device must always have a voltage rating equal to or greater than the voltage of the circuit or equipment it is protecting. The other two ratings address current. These ratings are the continuous rating and the short circuit rating. The continuous rating is the current which the device will carry indefinitely without tripping. The short circuit rating is the value of short circuit current the device will safely interrupt. For example, if the continuous rating of a standard, molded case circuit breaker is 15 amperes, it will not trip until the current exceeds 15 amperes. But, at any value above 15 amperes, the breaker will trip in some specified time. The higher above 15 amperes the current is, the sooner the breaker will trip. (This is the inverse time relationship discussed earlier.) The short circuit rating of this same breaker may be 10,000 amperes. This means that the breaker will open, without exploding, on short circuit currents up to 10,000 amperes. When installing new overcurrent devices, it is important to check that both ratings match the existing installation when replacing overcurrent devices.

Marine Devices

Many people question the difference between a marine fuse or circuit breaker and the standard household item. There really aren't any major differences, but there are a couple of things to be aware of. The first concerns the use of noncorrosive materials. Some manufacturers provide circuit breakers designed for use in an environment similar to that found in marine applications. One way of checking is to consult the manufacturer's catalog. Additionally, almost all molded case breakers sold in the United States meet Underwriters Laboratory Standard 489. There are provisions in UL 489 to test breakers specifically for marine use.

The second concern is temperature. A standard, 15 ampere circuit breaker is designed so that any current greater than 15 amperes produces the heat necessary to move the bimetallic strip. In order to design and test circuit breakers, a standard ambient temperature must be used, usually 25°C (77°F). Therefore, if circuit breakers are used in higher ambient temperatures, they will not carry the rated current without tripping. When using overcurrent devices in areas of high ambient temperature, this must be taken into consideration.

Overcurrent devices must be used correctly for them to properly protect people and equipment. The simplest way to ensure safety is to follow various electrical installation codes and practices, many of which are required by law. For shore use in the United States, the National Electrical Code is most frequently referenced. For marine applications, information can be found in Coast Guard regulations, 46 CFR Part 111, and IEEE Standard 45. ⚓

Permission for Carriage Without Subsidy

The Maritime Subsidy Board (U.S. Department of Transportation, Maritime Administration) has given American Shipping, Inc., permission to use the BEAVER STATE to carry a World Food Program parcel without subsidy at or below the fair and reasonable freight rate for U.S.-flag commercial vessels.

The 75,000-ton parcel consists of bulk wheat to be carried from the U.S. West Coast to Pakistan. ⚓

"Choke Lines" Under High Pressure Sometimes Kill

Thomas J. Pettin

Working around high-pressure systems can be hazardous. On the morning of April 20, 1985, an unfortunate accident occurred to a mud engineer disengaging a connector on a "choke line" aboard the drilling vessel GLOMAR ATLANTIC. The male end of the quick connect test fitting (under 9,000 pounds of pressure) ruptured, and flying debris struck the engineer's skull, killing him instantly.

On the morning of the tragedy, personnel were conducting pressure tests of the choke and kill lines as part of the procedure of installing the marine riser. The marine riser is a sectional assembly that provides a return-flow path between the well bore and the drill vessel and to guide the drill string or casing to the Blow Out Preventor (BOP) stack on the ocean floor. The choke and kill lines are integral parts of the marine riser sections. Choke and kill lines are used in controlling abnormal well bore pressure during drilling operations, thereby helping to minimize blowouts.

Casualty Analysis

On the day of this casualty, a Halliburton pump was used to pump water under high pressure to the choke and kill lines to determine if the assembled lines were properly sealed. The test fitting consisted of a series of reducers, and the male end of a quick connect coupling was attached to a length of small-diameter, high-pressure hose that ran to the Halliburton unit. After the test to 9,000 psi, the mud engineer released the pressure from the test set-up at the Halliburton pump. This action was expected to release the pressure from the entire system, subject to the test pressure. The female connector was subsequently disconnected from the test fitting without incident. The mud engineer started to remove the male quick connect fitting, and it exploded. As a result, the mud engineer received fatal skull injuries. Subsequent investigation revealed that the check valve was missing from the female end of the quick connect coupling. Normally, this type of coupling, when made up, allows bi-directional flow, but with the valve missing from the female end, the coupling would only allow one-way flow. There was no gauge on the test fitting nor was there a valve by which to drain off any pressure before removing the test fitting.

This casualty could have been avoided by testing the choke and kill line with a straight line system. A straight line system doesn't use check valves. The entire line from the pump to the BOP stack is open and free of check valves to inhibit the flow of the test medium. A pressure gauge on the test pump can then be used to monitor line pressure on the entire choke or kill line. Pressure on the entire system can then be released at any time by a valve located on the test pump.

If it is necessary to use self-closing, quick connect couplings on high-pressure lines, a means of releasing residual pressures on either side of the coupling should be provided.

It has been noted that individuals working around these high-pressure systems day in and day out can become complacent about the potential hazards associated with them. Persons working around such high-pressure systems cannot afford to relax their guard at any time. A quick look at the accident data collected on the offshore industry reveals that over 73 percent of the deaths and associated injuries were attributed to human error. The U.S. Coast Guard has been legislated responsibility for workplace safety offshore and has developed regulations and safety equipment requirements as a means of improving safety offshore.

However, safety cannot be mandated purely through regulation. The offshore indus-

Mr. Pettin is a Program Analyst with the Marine Safety Evaluation Branch, Marine Investigation Division, Office of Marine Safety, Security and Environmental Protection.

try deals with volatile fluids, heavy moving equipment, and high-pressure systems in a sometimes hostile ocean environment. Companies must properly educate workers not only to work in a safe manner, but also to recognize unsafe and hazardous situations. Supervisors must actively enforce their company's safety programs. Finally, and most importantly, safety must be forever foremost in each worker's mind.

New Publications

The Complete Book of Anchoring and Mooring

The Complete Book addresses anchoring systems, techniques, and permanent moorings for boats from 12' to 80' in length. It covers monohulls, multihulls, light displacement sailboats, cruisers, sportfishers, passagemakers, and workboats. In short, it is for **all** recreational and working boats in this size range.

The book deals not only with anchor behavior but also with the rode assembly, riding stoppers, and the human factors. What formerly was thought of as strength through size (heavy anchors and large rodes) has been refined to decrease weight, lighten loads on the boat, and reduce difficulty in handling.

Utilizing a systems approach with respect to equipment and techniques and analytical methods for loads, author Earl R. Hinz makes a number of contributions to the state of the art. Among them are bow anchor roller design, elastic anchoring techniques, tandem anchor systems design, and designs for permanent moorings. Most of these designs and techniques are clearly illustrated in the schematic drawings by Richard R. Rhodes. ***The Complete Book of Anchoring and Mooring***, *by Earl R. Hinz. Available from Cornell Maritime Press, P.O. Box 456, Centreville, MD 21617. Price: $22.50.*

BOOZE & YOU

Twelve ounces of 4 percent beer, four ounces of 12 percent wine and 1.2 ounces of 80 proof spirits contain identical amounts of alcohol.

—*Alcohol in America: Taking Action to Prevent Abuse*

Letters to the Editor

We received the following letter from a ***Proceedings*** *reader in response to "Drugs and the Merchant Mariner," published in the August 1986 issue (page 171). Do you share this reader's viewpoint, or is there another opinion you'd like to express? Please send your thoughts to Editor,* ***Proceedings*** *Magazine, U.S. Coast Guard (G-CMC), 2100 Second St., SW, Washington, DC 20593. We will publish your letter anonymously if you request it.*

Dear Editor:

Having read the article "Drugs and the Merchant Mariner," I was impelled to reply on numerous points raised and on others left unsaid.

While drug abuse (alcohol included) has permeated all levels of society and has no doubt been the cause of numerous on-job accidents, does this alone warrant widespread drug testing? From what I understand about urinalysis, it is not 100% accurate, nor does it show up **all** the drugs that can be abused. Cocaine is said to dissipate in 3-5 days. LSD is untraceable. Only marijuana is retained in the fat cells for any long length of time. And the fact one shows positive does not mean one is under the influence at the time of the test, many weeks later. Some tests for marijuana will show positive even if a person was just in a room where it was smoked even if he himself did not smoke it. Now as a Merchant Marine, I realize that we are subject to Federal laws, but let's try and look to see if the crime (smoking marijuana away from work, on leave) justifies the loss of a seaman's livelihood.

Several states (California, Ohio, and Oregon, etc.) have decriminalized possession laws for marijuana. Alaska has legalized its use. So a seaman who lives in Alaska and smokes marijuana while home on leave is breaking no law in Alaska. But say, two weeks later, he gets on a ship and has to submit to mandatory urinalysis and shows positive. Then should he be fined? Should he be sent to a drug rehabilitation center? Is this nit-picking what America's all about? Who's going to foot the bill for the "safety act" welfare system after people have lost their jobs?

Should the Coast Guard subject the Merchant Marines to mandatory, possibly inaccurate urinalysis, placing a man's livelihood on the line? Or should a rehabilitation program solely for seamen be instituted much like the centers for alcoholism? Thousands of people's livelihoods and families will be affected.

During the alcohol prohibition of the 1920s (which firmly entrenched large gangster syndicates through the amassed "bootlegging" fortunes), how many millions were spent to stop the flow of illegal liquor into this country? To what avail? The amendment was repealed, and now while we are faced with a drug "witch hunt" (shades of Joe McCarthy), the TV media commercials tell us "we can have it all" with a shot and a beer.

Am I any safer working for a skipper who is hung over and barely functioning (though not legally drunk) than for one who smoked marijuana the weekend before while off work? Will the Coast Guard also test for alcohol dependency? How will this be determined? I've worked a lot of ships with a lot of drunks and I never saw any get fired. Is the functioning alcoholic somehow left out of this dragnet because alcohol is legal? And alcoholism is recognized as a disease, not a crime. Quite a bit of contradiction here.

I think the way the Coast Guard now operates is fine in respect to drug testing. A person is innocent until proven guilty. Due process still prevails. Surely when a seaman on the job acts intoxicated or is in possession of drugs or alcohol, he should be removed from the vessel. Testing should remain the final step after the seaman has shown probable cause through poor job performance, aberrant behavior, or drug possession on the job. How we perform on the job should be the criteria by which we are judged, not urinalysis.

Sincerely,

(Name withheld)

NOTE: NO PROCEEDINGS MAGAZINE IN DECEMBER

*The November and December 1986 issues of the **Proceedings** are being printed this month as one magazine. Your editor will be using the extra time to learn how to operate a desk-top publishing system. This system will enable us to upgrade the magazine's appearance and, we hope, to make it more readable for you.*

*We are planning to have this new system in use for our next issue. Keep an eye open for the "new and improved" version of **Proceedings** in January 1987.*

Marine Safety Council Membership

CAPT James H. Parent

Captain James H. Parent assumed the duties of Executive Secretary of the Marine Safety Council and Executive Director of the Towing Safety Advisory Committee on September 2, 1986.

CAPT Parent, a native of Greenville, Maine, is a graduate of the U.S. Coast Guard Academy, New London, Connecticut, where he earned his Bachelor of Science degree in 1960. His first assignment was aboard the cutter BARATARIA, homeported in Portland, Maine, where he served in deck and engineering positions. In 1963, he became Industrial Manager at Coast Guard Base San Juan, Puerto Rico. Following a tour of duty as engineering officer aboard the cutter CHEROKEE in Norfolk, Virginia, he was assigned to marine safety duties in New Orleans, Louisiana, and Norfolk, Virginia, from 1968 to 1976. In 1976, he was assigned to Coast Guard Headquarters in the Office of Merchant Marine Safety. CAPT Parent asumed command of Marine Safety Office San Juan, Puerto Rico, in 1980 and returned to Coast Guard Headquarters in 1982 as Chief, Personnel Services Division, in the Office of Personnel. Prior to assuming the duties of Executive Secretary, he served as Deputy Chief, Office of Marine Environment and Systems (G-W).

CAPT Parent's decorations include the Meritorious Service Medal and two Coast Guard Commendation Medals.

He is married to the former Catherine E. McPhee of Portland, Maine. They have two children: Maria, a student at Seneca Valley High School, Germantown, Maryland, and Michael, a student at St. Francis College, Loretto, Pennsylvania.

Richard W. Sanders

Butyl Acrylate (monomer)

Butyl acrylate belongs to a family of compounds known as acrylics. These compounds are used extensively in manufacturing a variety of products, including finishes, paints, textiles, and paper. Of this family, butyl acrylate is second in production only to ethyl acrylate.

Butyl acrylate is a colorless, flammable liquid. It boils at 148.8°C (299.8°F) and is odorless. Butyl acrylate is an ester (a class of organic copounds) and contains carbon, hydrogen, and oxygen. Structurally, there is a three-carbon and four-carbon chain, connected by an oxygen molecule. There is also an oxygen bonded to the inner carbon of the three-carbon chain. When reacted, the chemical forms long carbon chains between the different molecules. These polymers are mixed with other materials to form the desired characteristics of a product. For example, the polymers give acrylic paint its stretchiness, hardness, gloss, and resistance to fading. Butyl acrylate polymers are used in coatings, especially for vehicle paint. These materials impart clarity, toughness, ultraviolet protection, stability, and chemical inertness. Primers and topcoats containing butyl acrylate are very durable. Similarly, acrylate polymers applied to textiles give fabrics a desired type of feel: ranging from soft to crisp, or rubbery to leathery. The polymers are used in place of natural and artificial rubbers, as paper saturants, and on pigmented coatings. Other uses include leather finishing and acting as modifiers for cement, where they impart strength and improve adhesion to substrates.

Butyl acrylate is polymerized through a method known as transesterification. Both heat and a catalyst are employed. There are two important methods of production for this chemical. The Reppe process employs a nickel catalyst and uses carbon monoxide, acetylene, water, alcohol, and acid. A newer method, propylene oxidation, is carried out with a catalyst at high temperatures in the presence of steam.

Butyl acrylate is corrosive to the eyes and poses a flammability hazard. Threat of fire or explosion is most acute during the production of acrylic polymers (linking of the molecules into long chains.) Environmental legislation governing air quality has resulted in completely "closed kettle" processes for polymerization reactions.

In contrast, butyl acrylate polymers are considered to be nontoxic. The FDA allows products made from butyl acrylate to be used in the packaging and handling of food.

The reported exposure limit in the workplace to butyl acrylate is 10 ppm (parts per million). This value corresponds to the concentration of the chemical over an 8-hour shift. Work involving butyl acrylate should proceed in areas of adequate ventilation, and employees should avoid contact with the liquid. If the chemical is spilled on the skin, the exposed area should be washed thoroughly with soap and water. If butyl acrylate gets into the eyes, the the victim should rinse the eyes with water for 10 minutes and seek medical aid. In the event of a spill, an all-purpose canister mask should be worn, and ignition sources should be secured. The National Response Center should be called to obtain further information and assistance with the situation.

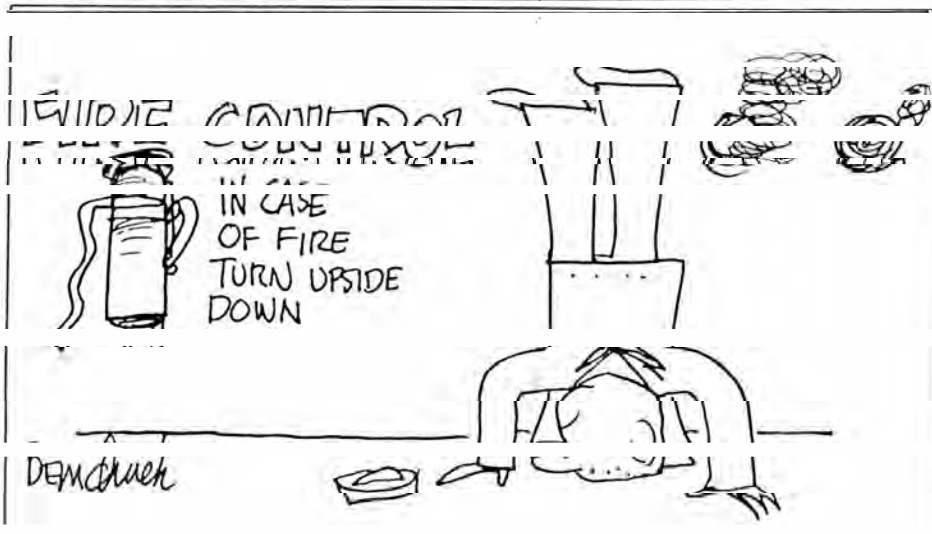
Butyl acrylate is shipped in a variety of containers. One- to five-gallon cans are used for small quantities. Fifty-five gallon metal drums are also used. For large amounts, tank trucks, tank cars, and tank barges are employed. In normal practice, inhibitors are used to stabilize the chemical during shipment or storage. Inhibitors reduce the chance of an unwanted reaction or explosion.

The U.S. Coast Guard lists butyl acrylate as a Grade D combustible liquid. Bulk regulations governing it can be found in Title 46, Subchapter O, of the Code of Federal Regulations. The International Maritime Organization

Richard W. Sanders was a Second-Class Cadet at the U.S. Coast Guard Academy at the time this article was written. It was written under the direction of LCDR J.J. Kichner for a class on hazardous materials transportation.

includes it as a Class 3.3 chemical in Chapter 6 of its Chemical Code. The U.S. Environmental Protection Agency regulates butyl acrylate under Title 40, Subchapter D. The Department of Transportation regulations are found in Subchapter C of Title 49 of the CFR.

Chemical name:	n-Butyl Acrylate
Formula:	$CH_2CHCOOC_4H_9$
Synonyms:	acrylic acid n-butyl ester
Physical Properties:	
boiling point:	148.8°C (299.8°F)
freezing point:	-64°C (-83°F)
vapor pressure:	
20°C (68°F)	3.2 mmHg
46°C (115°F)	0.4 psia
Threshold Limit Values (TLV)	
time-weighted average:	10 ppm
Flammability Limits in Air	
lower flammability limit:	1.5% by vol.
upper flammability limit:	9.9% by vol.
Combustion Properties	
flash point:	39°C (102°F)
autoignition temperature:	297°C (567°F)
Densities	
liquid (water=1):	0.90
vapor (air=1):	4.4
U.N. Number:	2348
CHRIS Code:	BTC
Cargo compatibility group:	14 (Acrylates)



Nautical Queries

The following items are examples of questions included in the Third Mate through Master examinations and the Third Assistant Engineer through Chief Engineer examinations:

ENGINEER

1. An automatically fired auxiliary boiler is required by Coast Guard regulations to be shut down by

A. low boiler pressure
B. low water level
C. wide flame cone angle
D. high fuel oil pressure

Reference: 46 CFR 63.05-40(B); 46 CFR 63.10-40(A)

2. On a diesel engine equipped with a hydraulic speed-control governor, hunting can be corrected by adjusting the

A. accumulator spring tension
B. balance piston
C. compensating needle valve
D. proportioner piston

Reference: Kates and Luck, Diesel and High Compression Gas Engines; Maleev, Diesel Engine Operation and Maintenance

3. The amount of cushioning effect within a hydraulic cylinder is determined by the

A. position of the directional port in the cushion cavity
B. adjustment of the cushion cavity check valve

C. design shape of the cylinder ends
D. position of the cushion adjustment needle valve

Reference: McNickle, Simplified Hydraulics

4. On a cargo vessel, Coast Guard regulations permit which of the following to be used for emergency bilge suction?

A. Main fire pump
B. Fuel oil service pump
C. Main bilge pump
D. Fuel oil transfer pump

Reference: 46 CFR 56.50-50(F)

5. The function of a step-down potential transformer is to reduce load

A. voltage and current
B. voltage and increase line current
C. current and increase line voltage
D. power

Reference: Mileaf, Electricity One-Seven

DECK

1. Which loadline is indicated by the number 4?

A. WNA
B. W
C. S
D. F

Reference: Ladage, Modern Ships

2. In order to check your vessel's stability, a weight of 40 tons is lifted with the jumbo boom, the boom head being 50 feet from the ship's centerline. The clinometer is then carefully read and shows a list of 5 degrees. The vessel's displacement is 8,000 tons including the suspended weight. What is the metacentric height of the vessel at this time?

A. 2.74 feet GM
B. 2.80 feet GM
C. 2.86 feet GM
D. 2.93 feet GM

Reference: Ladage, Stability and Trim for the Ship's Officer

3. On a worldwide tramp steamer, which of the four navigational systems mentioned would be most advantageous?

A. Decca
B. Satellite
C. Loran-C
D. Consol

Reference: Bowditch, American Practical Navigator

4. You are in charge of a power-driven vessel navigating at night. You sight the red sidelight of another vessel on your port bow. Its after masthead light is to the right of the forward masthead light. You should

A. hold course and speed.
B. alter course to port.
C. stop engines.
D. sound the danger signal.

Reference: COMDTINST M16672.2A

5. River charts (maps) are prepared and distributed by the

A. Maritime Administration
B. U.S. Army Corps of Engineers
C. U.S. Coast Guard
D. Regional Waterways Council

Reference: Mississippi River Maps

ANSWERS

ENGINEER
1-B;2-C;3-D;4-A;5-B
DECK
1-C;2-C;3-B;4-A;5-B

If you have any questions about "Nautical Queries," please contact Commanding Officer, U.S. Coast Guard Institute (mvp), P.O. Substation 18, Oklahoma City, Oklahoma 73169; telephone (405) 686-4417.

Saari Is New MARAD Official

Maritime Administrator John Gaughan has announced the appointment of James E. Saari as Secretary of the Maritime Administration and the Maritime Subsidy Board.

Saari was most recently a consultant on maritime matters to the law firm of Kominers, Fort, Schlefer & Boyer. He previously served as General Counsel at WFI Industries, Inc., a marine shipbuilding and transportation company, and as Assistant Chief Counsel for MARAD.

Saari earned a B.A. degree from the University of Miami and a J.D. from Cleveland-Marshall Law School. He is a member of the Ohio Bar.

Keynotes

Notice

CGD 86-042, Vessel Certificates and Exemptions Under the International Regulations for Preventing Collisions at Sea (72 COLREGS) (September 8)

This notice lists commercial vessels granted Certificates of Alternative Compliance between May 20, 1982, and October 22, 1985. This notice was effective as of September 8, 1986.

Notices of Proposed Rulemaking

CGD 85-092, Puget Sound Vessel Traffic Service (September 12)

The Coast Guard proposes to amend the regulations for the Puget Sound Vessel Traffic Service (PSVTS). This proposal is intended to update the reporting requirements to reflect the Vessel Traffic Center's increased radar coverage capabilities, clarify the wording throughout the regulations, and reorganize and reword the regulations to make them compatible with the proposed Cooperative Vessel Traffic Management System regulations which will apply to waters adjacent to those covered by the PSVTS regulations.

CGD 80-101, Pollution Rules for Ships Carrying Hazardous Liquids (September 26)

The Coast Guard is implementing Annex II of the 1978 Protocol to the International Convention for the Prevention of Pollution from Ships, 1973 [MARPOL 73/78] by proposing design and operating requirements for all ships that are oceangoing United States ships or are foreign ships and are trading in United States waters, and that carry bulk cargo of noxious liquid substances. Comments must be received on or before November 10, 1986.

CGD 85-010, Control of Residues and Mixtures Containing Oil or Noxious Liquid Substances (September 26)

The Coast Guard is proposing to amend the pollution regulations. These amendments are necessary in order to implement the Annex II port and terminal backpressure requirements and reception facility requirements of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto [MARPOL 73/78]. These amendments would reduce the amount of residues remaining in ships' cargo tanks, limit the amount of noxious liquid substances (NLS) discharged into the sea, and ensure that ships would suffer no undue delay while waiting to discharge this material to a reception facility. Comments must be received on or before November 10, 1986.

Affirmation of Interim Final Rule

CGD 78-035, Reception Facility Requirements for Waste Materials Retained On Board (September 18)

This document affirms without change the interim final rule published on September 9, 1985, which put into effect the requirements of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol relating thereto [MARPOL 73/78]. This rule was effective as of September 18, 1986.

Final Rules

CGD 80-159, Damage Stability and Flooding Protection for Great Lakes Vessels (September 18)

The Coast Guard is amending the stability requirements for bulk dry cargo vessels operating on the Great Lakes of North America to impose a one-compartment damage stability standard for Great Lakes bulk carriers. These standards are intended to reduce vessel loss or at least slow sinking enough to allow the crew to safely abandon ship. Effective November 17, 1986.

CGD 86-037, Documentation of Vessels (September 19)

The Coast Guard is revising the regulations concerning the documentation of vessels forfeited for a breach of the laws of the United States. These changes will improve the marketability of vessels forfeited and allow vessel purchasers to realize the full benefits of a vessel with a clear title and domestic trade entitlements. Effective September 19, 1986.

Requests for copies of NPRMs should be sent to Commandant (G-CMC), U.S. Coast Guard, 2100 Second St., SW, Washington, DC 20593; telephone (202) 267-1477.