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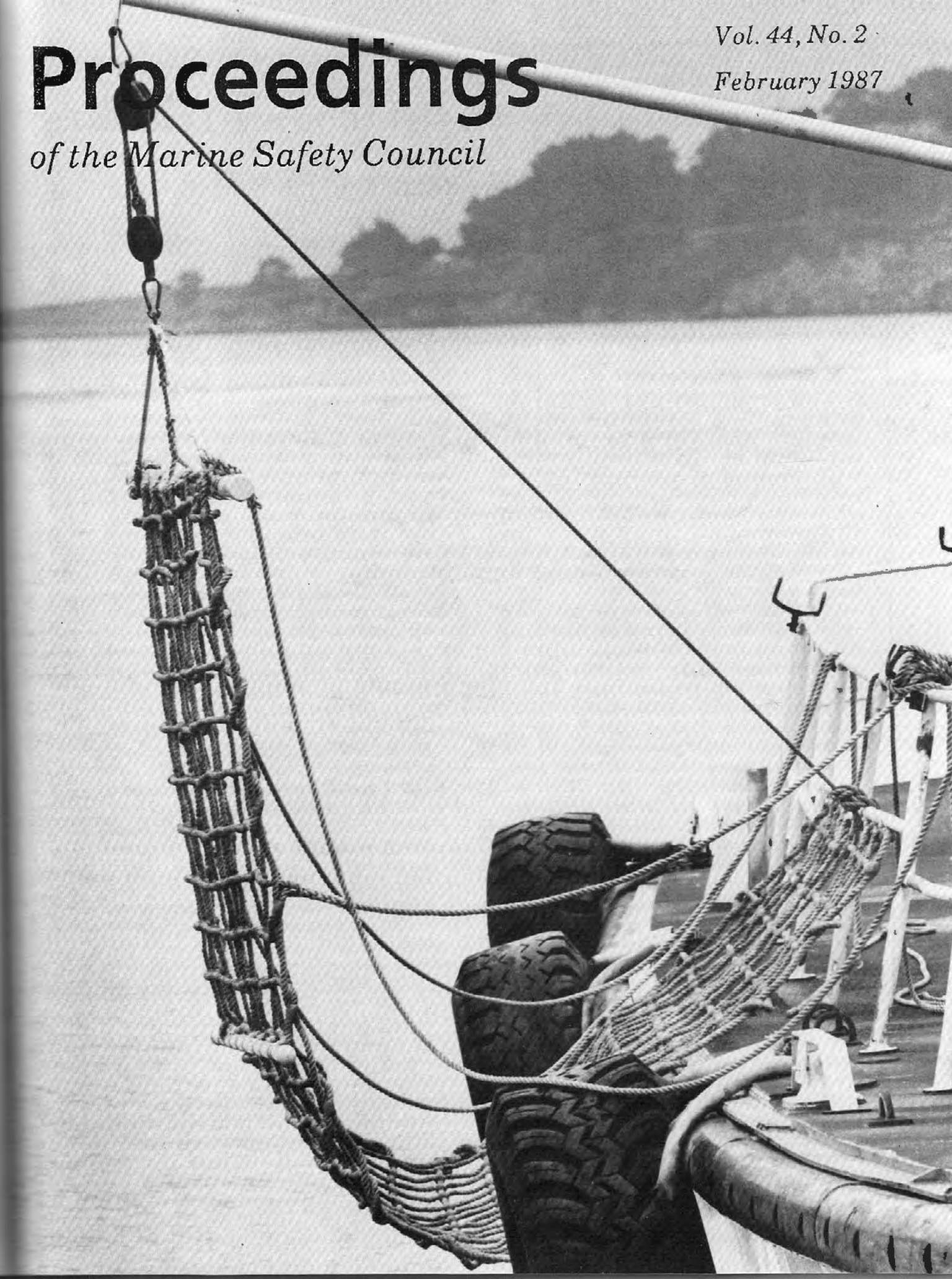

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February 1987 *Vol. 44, No. 2*

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Cover

Even in the best of weather and seas, climbing the pilot ladder can be a dangerous operation. The Jensen Retrieval Net, shown rigged to the pilot boat **San Francisco,** *may be a safety device which can help in man-overboard emergencies. Story begins on page 31. (Official U.S. Coast Guard photo by PA2 Brad Terrill, Twelfth District)*

Man Overboard Recovery Systems

LCDR Bruce Pickard
and
Mr. Milton Daniels

Note: *Information provided by the San Francisco Bar Pilots in their letter to the Coast Guard of 8 July 1985 and with their demonstration of the* **San Francisco's** *equipment on July 16, 1986, was of considerable assistance in the preparation of this article.*

Before pilots can perform their work of guiding merchant vessels into port, they must first overcome a considerable hazard--the climb up the side of a vessel in transit. The act of boarding starts as the pilot leaves an underway boat that may be rolling and heaving while the pilot pulls himself onto the treads of the pilot ladder. Then follows a climb up a ladder that is, in some respects, an act of faith because of unknown factors concerning its condition and attachment to the ship. Overboard discharges, bad weather, darkness, and the rolling of the vessel are other obstacles to the pilot's upward progress. In many ways this climbing by today's pilots is reminiscent of the last century's seamen going aloft in the rigging of sailing ships.

Even in the best of weather and sea conditions, the hazards associated with these transfer and climbing efforts are ever-present in the work of a pilot. A reversal of the above occurs for outbound vessels, but with the same hazards undiminished as the pilot retraces his steps and returns to the pilot boat. Exact figures for the number of pilots falling into the water over the years throughout the country are not available; a New England pilot, in response to this question, could recall two such accidents over an interval of 20 years, one of which may have resulted from a heart attack.

To cope with the above risk to its members, the San Francisco Bar Pilots have installed retrieval net systems aboard their pilot boats, the **San Francisco** and the **California**. The genesis of these retrieval systems is uncertain. It has been suggested that they may have evolved from net systems used aboard tour boats. Another theory made reference to the landing nets used in amphibious assault actions during World War II. One party recalled a rescue of naval personnel that involved a boat boom and landing nets draped along its length.

The main feature of the retrieval gear aboard the **San Francisco** is a 7-foot by 14-foot net formed with cordage, similar in appearance to a cargo net made of 5/8-inch diameter line. The pilot boats have rigged this gear amidships on their main decks with one 7-foot side (the standing end) attached at the vessel's side along the lower course of the handrail, and the other 7-foot side (the "running" part) secured to the lifting gear at the outboard end of the boom. For stowage, the net's bridle is disconnected from the boom tackle, the net is rolled up around the spreader and bridle, and the furled net is then lashed to the rail by several stops with toggles.

The installation demonstrated for the Coast Guard aboard the **San Francisco** uses a 12-foot wooden boom mounted atop the deckhouse to haul the net. The heel of the boom pivots from the top of the deckhouse, approximately 7 feet above the main deck. When not in use, the boom is slewed aft and cradles atop the deckhouse. Other rigging on the boom includes a wire rope topping lift, forward and after vangs for slewing the boom outboard and to hold it in a fixed position, and a gun tackle for hoisting and lowering the outboard side of the net. Two legs of a lifting bridle are attached to the forward and after corners of the outboard side of the net. The

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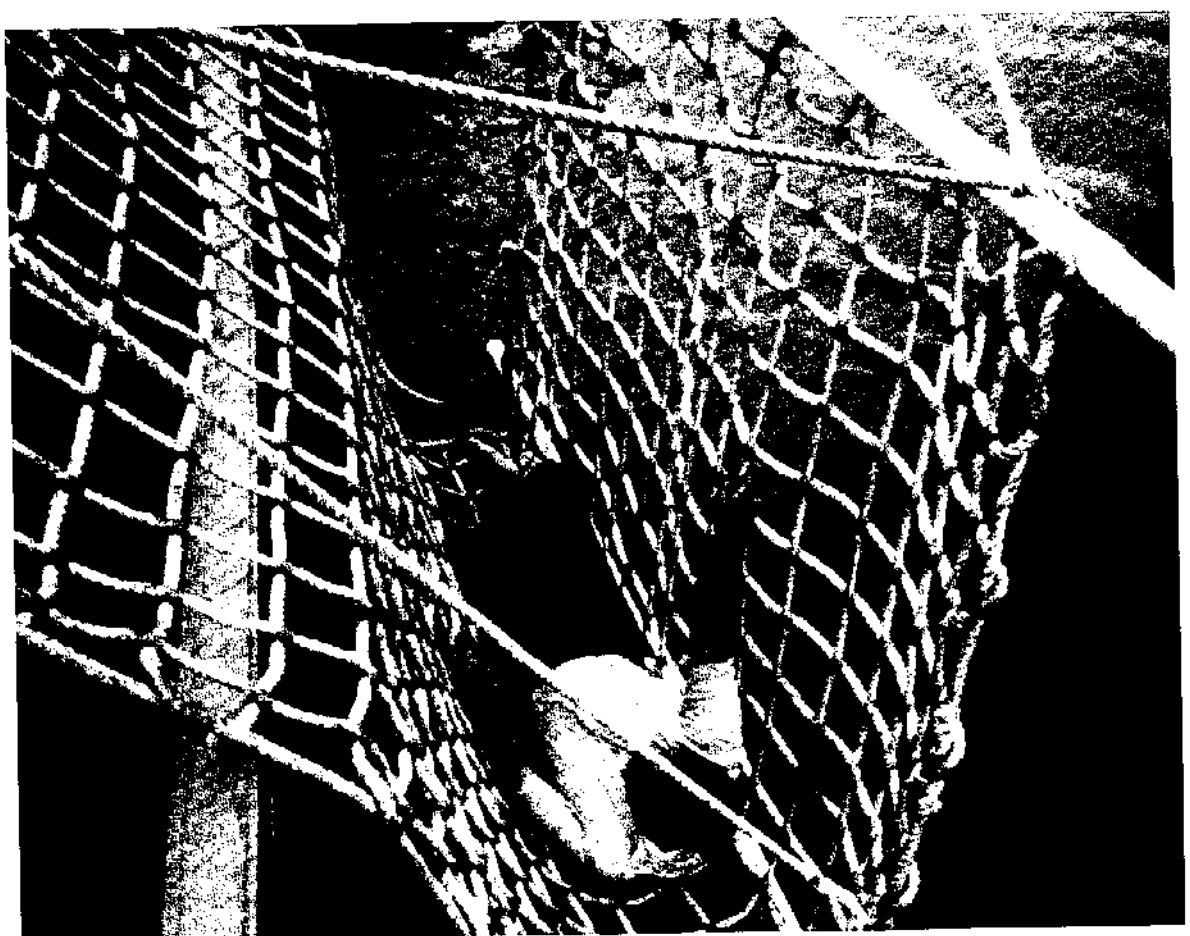
bridle ring is rigged to the hook of the moving block of the boom tackle. Also attached along the outboard edge of the net is a length of 2-inch diameter plastic pipe. When the net is deployed over the side, the pipe keeps the net spread fore and aft and helps keep it immersed in the water. A variation of this net aboard another vessel adds a second length of plastic pipe near the outboard edge of the net as an additional spreader and as extra weight to keep the net below the surface of the water. The accompanying photographs show these details. Note the semblance of the boom and its rigging to the gear commonly used aboard fishing vessels and yachts to launch and recover their small boats and dinghies.

The above arrangement permits the retrieval net to be deployed to its working position so that the pilot boat can maneuver alongside a person or object floating in the water. Once in the net, the boom tackle is overhauled, and the person is lifted out of the water. These actions are similar to "parbuckling," the traditional way of hoisting heavy cylindrical objects from the water line of a vessel to its deck.

In the early morning hours of 31 October 1985, the pilot vessel **San Francisco** was standing by to pick up the pilot from the outbound tank vessel **Puerto Rican**. At approximately 0325, a fire and violent explosion occurred aboard the tanker with a force that cast the pilot, the third mate, and an able seaman into the water from the tanker's main deck. From a distance of about 100 yards on the port quarter of the tanker, the crew of the **San Francisco** could see two persons in the water and deployed their retrieval nets. The third mate from the **Puerto Rican** was the first person rescued after being located with a spotlight. The crew of the **San Francisco** were able to pull him aboard before the retrieval gear



Knud Jensen is pulled aboard the pilot boat **San Francisco** in the rescue net he designed. *(Photo courtesy San Francisco Bar Pilots)*

Knud Jensen demonstrates the operation of the "Jensen Retrieval Net" he designed for the pilot boat **San Francisco**. *(U.S. Coast Guard photo by PA2 Brad Terrill, Twelfth District)*

was fully deployed. Thereafter, with the retrieval gear on the port side of the pilot vessel fully extended, the pilot vessel was able to maneuver its net into the vicinity of the injured pilot who was beginning to suffer hypothermia. He was able to wrap his arms into the openings of the net and drape the upper portion of his body onto the net. The deckhands aboard the **San Francisco** were then able to hoist the net to a level where they could grab the pilot and pull him aboard. Efforts to locate the able seaman were unsuccessful; he remains reported as missing and presumed dead.

The retrieval net system employed by the San Francisco Bar Pilots is an example of the successful adaptation of an old idea to a special situation. The **San Francisco**--a vessel of 85-foot length, 22-foot beam, single rudder, single screw and diesel propelled -- has a low freeboard and sufficient maneuverability to employ its retrieval gear to maximum advantage. But a similar installation on a large high-sided vessel might prove to be unwieldy when attempts are made to move a net under or adjacent to a person in the water. A sufficient number of personnel for handling this retrieval gear is also essential aboard a vessel equipped with it.

The National Transportation Safety Board sees a need for retrieval and lifesaving equipment that would "...require less active participation by the person in the water." The Coast Guard is considering several ways in which this might be accomplished. Rescue boats offer one possibility for recovering unconscious persons from the water, but the efforts necessary to pull a person from the water into the boat require considerable strength. The design of boarding ramps for inflatable liferafts has been modified to accommodate entry by injured persons; rafts can be used to recover persons lost overboard. Retrieval net systems provide another solution to the basic problem, and their use is encouraged by the Coast Guard. The lifesaving equipment industry has demonstrated an interest in further developments of these systems. A net device was demonstrated during the 1984 Texas A&M Sea Grant Program's Marine Safety Seminar conducted in Corpus Christi, Texas. Alternatives to these may also be available.

In the future, vessels not equipped with lifeboats or rescue boats might be required to have some form of equipment for recovering helpless persons directly from the water. The equipment installed onboard the vessels of the San Francisco Bar Pilots offers this potential. The National Transportation Safety Board, as a follow-up to its investigation of the loss of the **Puerto Rican**, wishes to encourage the use of such retrieval equipment on rescue or other types of watercraft. The Coast Guard has taken the opportunity to highlight this equipment as a service to the public and will continue to update the progress of alternative solutions.

Falling into Cold Water

A plane crashes. A car goes off a bridge. A boat capsizes. These are only a few ways you might find yourself unexpectedly plunged into icy cold water.

Once you are in icy water, hypothermia, or rapid loss of body heat, can be more of a danger to you than drowning. In fact, the disorientation and weakness brought on by hypothermia can cause people to drown. When Air Florida Flight 90 crashed in Washington, D.C., in 1982, one victim slipped under water while only inches from a lifeline. Fortunately, a passerby dove into the water and pulled her to safety.

If you see someone in cold water, remember that he may be unable to save himself.

If you find yourself in cold water, swim only as far as the closest object you can hang onto. Try to keep as much of your body out of the water as possible. Swimming pumps the warmer water out of your clothes and lets the cold water in.

A life vest not only keeps you from drowning, but allows you to assume the best position for conserving heat — with your legs close together and raised to almost a sitting position, much like the fetal position.

Watertube/Firetube Hybrid Boilers

LTJG Patrick G. Gerrity
and
LCDR Bruce Pickard

A new type of marine boiler has recently been approved by the U.S. Coast Guard for auxiliary steam use aboard U.S.-flag vessels. It incorporates a hybrid boiler design which combines the concepts of both firetube and watertube boilers. Several Asian shipbuilders and some European companies are employing this design for steam production aboard motorships. The concept makes efficient use of space, and the unit consumes less fuel than a traditional firetube boiler. It is oriented vertically and usually burns number 6 fuel oil, but with a few additional pieces of equipment, it can burn a variety of fuels, including heavy oils, sludge, and solid waste.

Design and Construction

This hybrid design boiler is cylindrical in shape, averaging about 5 feet in outside diameter and 12 feet in height. It consists of upper and lower chambers connected by a tube nest. The burner and register unit is mounted at the boiler front on the lower chamber and is exactly the same type of unit that would be found on a traditional firetube boiler. This design also incorporates standard appurtenances, such as safety valves, water glasses, feed and stop valves, steam gauges, and blow off valves. Manholes have been installed in both the upper and lower chamber to allow access to the inner areas. Several hand holes are usually installed to facilitate cleaning and maintenance.

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Internally, this boiler design is somewhat unique. The furnace, located in the lower chamber, is torispherical in shape, and its bottom is welded circumferentially to an exterior support flange called and "ogee ring." The outer edge of the ogee ring is welded on its top and bottom inner edges to the furnace and on its top and bottom outer edges to the shell.

The boiler furnace is supported by a number of stays that extend from the furnace to the boiler shell. The number of stays used for support depends on the furnace size and the maximum allowable working pressure (MAWP) of the boiler. In some cases, stiffening rings are used to add support to the furnace in lieu of stays.

The furnace is lined internally with brickwork and refractory. At the apex of the furnace, an exhaust gas pipe extends from the furnace into the lower boiler tube sheet. This pipe passes the exhaust gas over the steam generating tubes before the gas exits through the flue. Steam generating tubes connect the lower tube sheet to the upper tube sheet. There are also two downcomer tubes installed in the tube nest between the two tube sheets. Within the tube bundle are several stay tubes whose function is to add support to the tube sheets. Above the upper tube sheet, in the upper chamber, is the steam-generating area. A staybar extends from the upper tube sheet to the boiler head to aid in support of the upper tube sheet. The dry pipe is located near the center of the upper head.

Several other boiler designs which represent variations on the basic theme have not yet been approved by the Coast Guard, but may soon be accepted for use aboard U.S.-flag vessels. Externally, their appearance is similar to the hybrid boiler described above, but they may incorporate a variety of means to extract heat from internal combustion engine exhaust gases. One design type uses tubes surrounded by water, through which exhaust gases pass. Additionally, smaller tubes located within these

"firetubes" in the gas path allow water to circulate and absorb heat from the increased heat-conducting surface area. Another hybrid design forms its furnace with water wall tubes. These vertically oriented tubes, which form the furnace, are exposed to direct flame. These tubes absorb the radiant heat from the boiler and warm the feedwater. Water within the tubes rises as it warms and eventually evolves into steam, exiting through the steam outlet. These tubes are much like screen tubes found in older watertube designs.

Operation

The principle of operation of the hybrid boiler is quite basic. Water is introduced into the upper chamber above the tube sheets, passes through the downcomers and tubes into the lower chamber, where it surrounds the furnace, obtains heat, and begins to warm and rise. The warmed water rises throughout the generating tubes where it picks up additional heat from the tubes that are in the boiler exhaust gas path. As the water continues to warm, it changes phase into steam and passes through the dry pipe in the boiler's upper chamber. In order for this boiler to be a truly natural circulation boiler, the downcomers are off-center from the main heat of the boiler exhaust.

Plan Review

These boilers must be reviewed to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section I, and Title 46, Code of Federal Regulations (46 CFR), Parts 52, 56, and 63. Since ASME does not directly address this type of boiler in its Code, the watertube, firetube, and general sections of the Code were reviewed to extract the pertinent information applicable to this boiler. Recently, ASME proposed a change to the Firetube Boiler Part (PFT) of Section I to eliminate outdated formulas and rules for firetube boilers. The change would eliminate most of the current formulas used to calculate MAWP on firetube boiler furnace plate, tubes, and flues. Instead, new formulas, graphs, and charts, similar to those for pressure vessels of this type construction in Section VIII, Division 1, would be used to review these design calculations.

Inspection

As a result of the design efforts to comply with size restriction imposed by ship builders, the new hybrid boilers are very compact in their construction. They are considered to be auxiliary heating boilers, and their operating controls are regulated under 46 CFR 63.05 or 63.10, depending upon fuel consumption and rated heat output. For inspection purposes, these boilers are considered to be of the watertube type and should be hydrostatically tested in accordance with 46 CFR 61.05-10. Periodic inspections and tests, including hydrostatic tests of these boilers, are required by 46 CFR 61.10. The limited access available for internal examinations of the boilers presents some unique inspection problems. Methods available to perform internal examinations are few, and certain areas of these hybrid designs demand special attention by the marine inspector.

Boiler stays should be carefully examined for cracks, especially in way of the welds. Stays should be examined to detect "neck down" or similar evidence of deterioration. One method to evaluate the condition of a boiler stay is to strike it with a hammer and listen carefully to the sound which results. Generally, if a stay is in good condition, it will make a ringing sound when struck. When a stay has deteriorated, it will not ring true; instead, a dull sound will result. Normally this dull sound is indicative of a cracked or otherwise deteriorated stay, and it should be thoroughly examined for defects. Other forms of non-destructive testing, such as dye penetrant or magnetic particle, can be used to determine the stay's condition. In case several stays in one area are found to be defective, the problem is nearly always due to uneven loading on the support structure. This is a significant problem which should be addressed immediately.

During fireside and waterside examinations, the tube sheet ligaments should be thoroughly examined for cracks, especially near the furnace area, if accessible. To the extent possible, the

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Barge Transportation of Radioactive Materials

Frank K. Thompson

The disposal of spent nuclear fuel produced by nuclear power generators and research reactors is surrounded by controversy. One important facet of this controversy is the method of transporting the spent fuel from its source to a Department of Energy repository site for disposal. In the past, spent nuclear fuel has been moved by truck or rail with no known accidental releases of radiation. Nevertheless, many communities strenuously object to having spent nuclear fuel trucked on their streets and highways. Because of the problems associated with land transportation, shippers of spent nuclear fuel have considered using barges to transport their radioactive material on the inland waterways system or via coastwise shipping routes.

Although only one movement of a radioactive shipment by barge is known to have taken place, an increase in the number of such movements is a possibility. Recent studies on the subject estimate that approximately half of the nearly 90 nuclear waste producers are sited on navigable or potentially navigable waterways,[1] and that 80 percent could make use of water transport as one phase of a multimodal movement.[2] The interest in barge transportation is enhanced by the location adjacent to a navigable waterway of one of the three facilities which the Department of Energy (DOE) is considering as a site for its permanent nuclear waste repository. In addition, a number of potential interim repository sites may be reached by water.

The nuclear industry, sensitive to the public's perception of the dangers of nuclear waste transportation, works through the American National Standards Institute (ANSI) to develop standards for safety of radioactive materials transportation methods and equipment. Among the standards developed by the ANSI Committee on Transportation of Fissile and Radioactive Materials is ANSI Standard N14.24-1985, "Highway Route Controlled Quantities of Radioactive Materials - Domestic Barge Transport," approved by ANSI July 23, 1985. Both the Coast Guard and the DOE are represented on the ANSI Committee and participated in preparing this Standard.

Highway Route Controlled Quantity

When used to describe a shipment of radioactive materials, a "Highway Route Controlled Quantity" means a large quantity of radioactive material -- based not on the weight or volume of the material, but on its total level of radioactivity.[3] A shipment of radioactive material that is highway route controlled must, under the U.S. Department of Transportation's (DOT's) Hazardous Materials regulations, be operated on routes that minimize radiological risk. These regulations require highway carriers to consider the accident potential, transit time, and population density of their intended routes; to operate, wherever possible, on preferred routes in accordance with DOT

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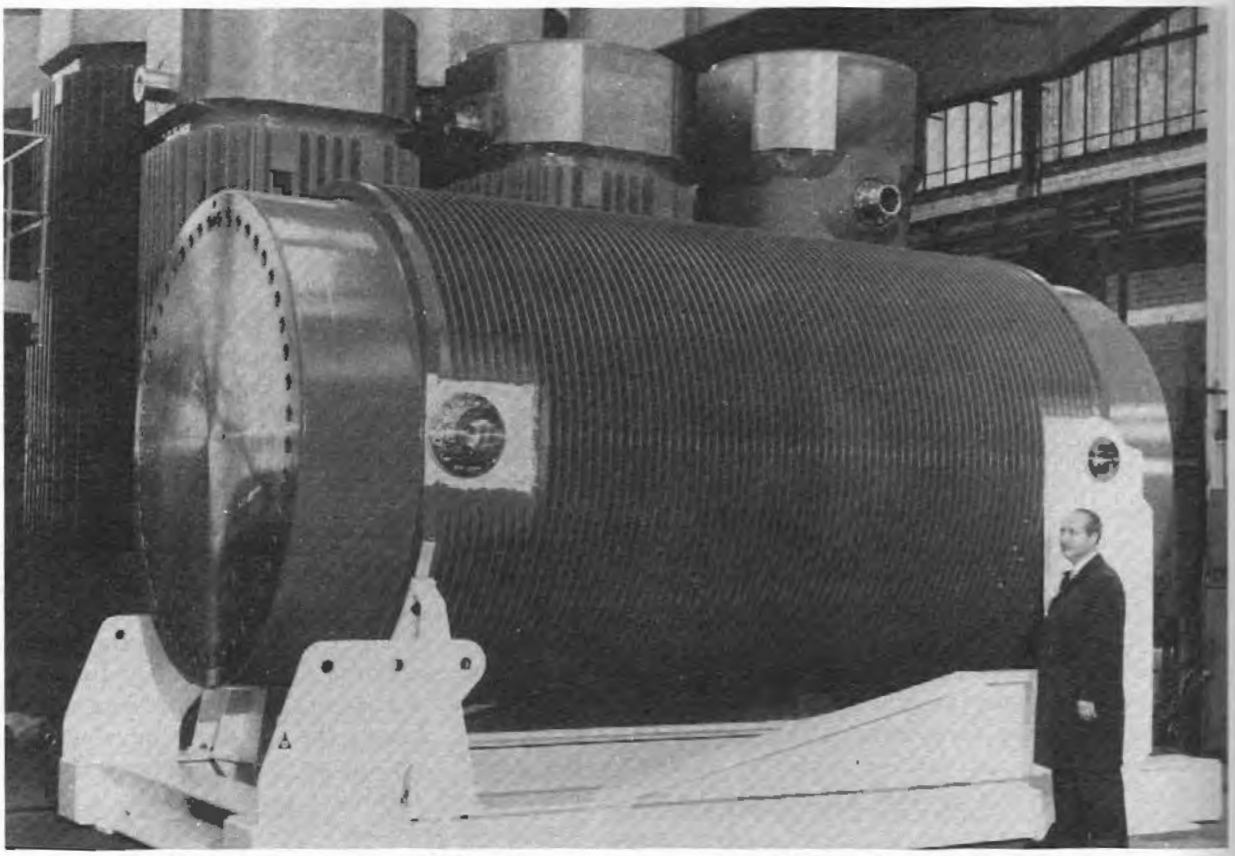
[1] *Anderson, Robert, and Robert Jones,* Transportation of Radioactive Material by Water. *Allied-General Nuclear Services, Barnwell, NC, November 1978.*

[2] *Hutchinson, Bruce,* Barge Collisions, Rammings, and Groundings. *Glosten Associates, Seattle, WA, August 9, 1985.*

[3] See definition at 49 CFR 173.403(1).



Pictured is a cask used for shipping radioactive spent fuel rods. *(Photo courtesy of the Department of Energy)*

guidelines; and to have a written route plan, which must be filed with the DOT's Office of Hazardous Materials Transportation.

A highway route controlled quantity must be shipped in a packaging that maintains its integrity and shielding under serious accident conditions, including an external pressure of 21 psi (gauge) which is equivalent to submersion to 50 feet of water. The shipping container for highway route controlled quantities of radioactive materials is called a "cask." This is typically a steel cylinder weighing anywhere from 13 to 100 or more tons. Much of this weight is from lead shielding, thermal insulation, fire shielding, and impact protection.

Scope of the ANSI Standard

The scope of the ANSI Standard N14.24-1985 is limited to highway route controlled quantities of radioactive material because of the nature of the packagings used to transport these quantities of material. The scope is not, however, restricted only to commercial nuclear spent fuel and defense-related, high-level waste, since the packages for other highway route controlled quantities are generally similar in design to packages used for spent fuel and high-level waste and must meet the same test requirements. Although this standard does not cover barge transportation of contaminated equipment and structures from decommissioned nuclear facilities, its principles and procedures may be followed for movements of that type as well.

ANSI Standard N14.24-1985 identifies the organizations, equipment, operations, and documentation involved in barge shipments of radioactive materials between U.S. ports by inland waterways and in coastwise and ocean service. The standard includes requirements pertaining to

- selection of the cask, barge, and towing vessel;
- certification and documentation;

- radiological and non-radiological operations;
- insurance;
- emergency planning; and
- physical protection and security of the shipment.

These requirements apply to the water mode phase of a typically multimodal operation. Every barge shipment involves an intermodal transfer -- either highway to water, water to highway, or both.

The ANSI Standard describes four phases in a movement of a highway route controlled quantity of radioactive material: the planning phase, the pre-operational phase, the operational phase, and the post-operational phase. The shippers have overall responsibility for ensuring that the shipment is conducted in accordance with the ANSI Standard. They must consult and coordinate with numerous organizations throughout each of the phases of the operation. The Coast Guard is just one of many regulatory, advisory, enforcement, and permit-issuing bodies involved, but it has an important part in each phase.

In the standard, there is guidance for the selection of the barge. Since Title 46 of the Code of Federal Regulations (CFR) contains no specific regulations governing barge design and construction, the shipper is advised to contact the Coast Guard's Marine Technical and Hazardous Materials Division, telephone (202) 267-1577, early in the planning process. The standard specifies the following:

Deck barges similar to these would be used to transport nuclear waste on inland rivers. *(Photo by the author)*

- The barge must be steel, at least 125 feet long, and classed by a recognized classification society.
- It must have **intact stability** that meets Subpart E of 46 CFR Part 172 for a **Type II** hull as defined in 46 CFR Part 151, Subchapter O.
- Its **damage stability** must meet the **one compartment** standard for a Type II hull. This does not mean that the barge must be a Subchapter O barge, merely that it must meet those stability requirements.
- The barge must have, as a minimum, the following **ancillary equipment**: one Class A Emergency Position Indicating Radio Beacon (EPIRB); one passive radar reflector; one sonar pinger with a 1-mile range, good for 30 days; and an emergency towing wire made up and laid out on deck with a messenger line trailing in the water.
- When in coastwise or ocean service, the barge must have a valid **loadline certificate** and a **certificate of inspection** for its intended route.

The standard places a great emphasis on the design and tiedowns for the cask. Tiedown design must be based on **collision accelerations**, modeled on the requirements for independent chlorine tanks in 46 CFR 151.15, and **wave action accelerations** in both head and beam seas.

Unlike the procedure for highway shipments, the shipper of a barge shipment must prepare the shipping plan in considerable detail and must provide the carrier with handling instructions and an **emergency response plan** covering both radiological and non-radiological emergencies. In developing the emergency response plan, the standard advises the shipper to consult the Coast Guard Captains of the Port (COTPs) having jurisdiction over the planned shipping route.

The section of the standard relating to **operations** contains requirements for loading and off-loading the radioactive material both as

lift-on/lift-off and roll-on/roll-off cargo. The operations section contains requirements on docking, mooring, and towing conditions, as well as physical protection of the package, security, and radiological monitoring.

This standard is intended to be a voluntary industry standard. Compliance will be enforced by insurers, state and local licensing bodies, and partly by the Nuclear Regulatory Commission. It may also be used by COTPs when issuing permits and controlling the movement of the shipment by water.

At the present time, there is no intention to adopt the provisions of ANSI Standard N14.24 into Title 46 of the Code of Federal Regulations. However, a Navigation and Vessel Inspection Circular (NVIC) essentially similar in content to this article will be issued. If an interest in barge-transported radioactive material develops, the standard could easily be incorporated by reference in the appropriate regulations.

"American National Standard for Highway Route Controlled Quantities of Radioactive Materials -- Domestic Barge Transport" (ANSI Standard N14.24-1985) may be purchased from the American National Standards Institute, 1430 Broadway, New York, NY 10018, Attention: Sales Department. The cost of the standard is $15.00 plus $4.00 for shipping and handling ($19.00 total). Delivery time is approximately 2 weeks after receipt of an order.

Hybrid Boilers

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tube sheets should be examined for distortion or other indications of surface deterioration.

Uptake/flue pipes between the top of the furnace and the lower tube sheet should be examined for out-of-roundness. Any reduction in diameter is an indication that the pipe has been exposed to excessive heat and its metal has begun to yield. This may have resulted from normal firing with a low water level or extreme high firing rates for extended periods of time. The external pressure exerted on the uptake pipe will eventually cause the pipe to fail. The fireside of the furnace should be examined for brickwork damage or deterioration.

All accessible waterside areas of the furnace should be examined for signs of pitting, cracks, and scale. A serious scale build-up or pitting on the furnace plate's waterside can be indicative of a poor boiler water treatment program. During the waterside examination, the furnace and shell surfaces in the vicinity of the ogee ring (and the ring itself) should be thoroughly examined. This area supports the majority of the load and is susceptible to very high stresses. If evidence of deterioration or distortion is found, some type of non-destructive test should be performed on the welds which connect the ogee ring to the shell and to the furnace. Any problem involving the ogee ring should be investigated from both the internal and external vantages, on the ring's inner and outer diameters.

Conclusion

The hybrid boiler concept is presently in its infancy. Only a few designs have yet been submitted to the Coast Guard for approval. These new types have appeared because of a demand for auxiliary boilers that produce steam economically while taking up less space. With the increased use of diesels for main propulsion and the satisfactory performance of these hybrid boiler designs over time, it seems certain that other auxiliary boilers of similar design will be developed.

National Recreational Boating Safety Program

The Coast Guard has fiscal year 1987 funds available to provide financial assistance to national nonprofit public service organizations to help them conduct boating safety activities. This announcement seeks proposals for all types of projects that will promote boating safety on a national level. Innovative approaches are welcome.

Specific information on organization eligibility, proposal requirements, award procedures, and application forms (SF 424) can be obtained by writing Commandant (G-BP/42), U.S. Coast Guard, 2100 Second Street, SW, Washington, DC 20593-0001 or by calling Mr. Ladd Hakes at (202) 267-0954.

Proposals must be received by February 27, 1987.

U.S. Coast Guard Safety Advisory

Beware of Gassy Coal

Most coals contain some amount of methane, formed naturally during the geologic process which originally created the coal. But methane causes problems only in coal mines -- right? Wrong! Dead wrong for one crew member of a Great Lakes self-unloading bulk carrier loaded with coal. The crew member died from severe burns received in an explosion on board the vessel which apparently resulted from the ignition of an accumulation of flammable gas. Following this casualty, the Coast Guard promulgated a safety advisory to make others aware of the potential problems associated with the carriage of coal. That safety advisory is reprinted below.

Safety Advisory: Potential Flammable Gas Hazard Aboard Vessels Carrying Coal in Bulk

This advisory is intended to apprise vessel owners/operators, terminal operators, and merchant mariners of a recent casualty involving the carriage of bituminous coal. On 15 September 1986, an explosion occurred aboard the **SS Middletown** O.N. 251093, a Great Lakes self-unloading bulk carrier, in a storeroom just aft of the number 04 cargo hold on the main deck level. Two crew members were seriously injured. The explosion apparently resulted from the ignition of a flammable gas accumulation in the storeroom.

The cargo on board was hituminous coal mined from Pittsburgh Number 08 coal seam. The most likely source of the flammable gas involved in this accident is the coal cargo. Concentrations of flammahle gas and oxygen deficiencies were subsequently detected at other cargo hold doors and spar deck hatches.

Most coal seams in their natural state contain some levels of methane, an odorless, colorless, flammable gas, adsorbed (adhesion of a thin layer of molecules) in the coal. During mining and processing, most of the methane is normally desorbed and dissipated. Even after mining, however, coal can continue to emit methane for significant periods of time.

Prior to shipping coal in confined or unventilated cargo holds, vessel and terminal operators should know whether or not methane emission will be a problem with the particular coal being shipped. A practical method for determining methane emission rates is described in the Bureau of Mines Report of Investigation/1981 - RI 8515 entitled "Direct Method Determination of the Gas Content of Coal: Procedures and Results." Single copies of this report may be obtained free by writing to the Bureau of Mines, Publication Distribution, Cochrans Mill Road, P.O. Box 18070, Pittsburgh, PA 15236; telephone (412) 675-4338. To obtain meaningful results, anticipate at least 72 hours to complete this test.

If test results or other information indicates methane concentrations too high for shipment, the coal should be allowed to weather in the open until methane levels have receded to within safe limits. This is the preferred way to treat gassy coals.

Alternatively, however, even gassy coals may be shipped safely when certain safeguards are considered and implemented. The following precautions were taken from the International Maritime Organization (IMO) "Code of Safe Practice for Solid Bulk Cargoes," 1983 edition:

- All electrical cables and equipment located in the cargo spaces or adjacent spaces should be free from defects. Electrical apparatus should be approved for use in a methane atmosphere. Alternatively, electrical equipment not meeting this requirement should be de-energized at a location outside the cargo spaces and tagged out of service until the space has been tested and found to be less than 1.5 percent methane in air.

- Warning notices prohibiting smoking or use of open flames should be posted in the cargo area. Smoking, burning, cutting, chipping, or similar activities should not be allowed in the vicinity of the cargo holds or adjacent spaces.

- All access doors or other openings (i.e., pipe and cable penetrations) to the cargo spaces should be securely closed or sealed to prevent passage of flammable gases. All working spaces, storerooms, passageways, tunnels and other spaces adjacent to cargo spaces should be regularly monitored for the presence of methane. If a methane concentration of 1.5 percent (30 percent lower flammable limit (LFL) for methane) or more in air is detected, the space should be thoroughly ventilated. Extreme care should be exercised to avoid the introduction of any sources of ignition in such spaces. If mechanical ventilation is used, the electrical equipment should be approved for use in methane atmospheres.

- At least two portable gas detectors suitable for and capable of measuring 0 to 100 percent of the LFL of methane should be carried on board. At least two officers should be instructed in the use and maintenance of this equipment.

- The cargo should be trimmed reasonably level to the cargo hold boundaries to prevent formation of gas pockets.

- Surface ventilation for the cargo should be provided. If mechanical ventilation is used, blowers should be non-sparking, and electrical equipment should be approved for use in methane atmospheres.

- Methane has a specific gravity of 0.55 in air and will rise to the top of the cargo hold where it can displace available oxygen to concentrations too low to support life. Personnel should not be allowed to enter spaces where methane can accumulate unless they are wearing a self-contained breathing apparatus or unless the space has been tested and found to have sufficient oxygen to support life (at least 19.5 percent) and to be gas-free.

Further questions should be directed to Commandant (G-MTH-1) at (202) 267-1577 or (202) 267-1217.

Looking to the Future

The problems associated with the shipment of coal are not new ones. In addition to the release of methane, some coals may be

Methane does not usually form in open coal barges such as these because the cargo is naturally ventilated by the atmosphere. *(Photo courtesy U.S. Naval Institute)*

subject to spontaneous heating, generation of carbon monoxide, or even production of explosive hydrogen. All of these problems were discussed in the August 1983 issue of *Proceedings*. Only by maintaining an awareness of these potential hazards and constant vigilance during the transportation of coal can we hope to preclude future tragedies such as the one aboard **SS Middletown.**

New Publications

Hazardous Cargo Contacts, Second Edition, *published by the* Hazardous Cargo Bulletin, *38 Tavistock Street, London WC2E 7PB, UK. Cost inclusive of post and packing for a single edition £10.50 surface or £11.50 airmail; special price for pack of five £31.90 surface or £36.50 airmail.*

The information required to transport dangerous goods is ever increasing with more and more regulations, rules, certification, testing, and procedures to be satisfied. Whether overland, by sea, or by air, a complex chain of competent authorities, government organizations, or national bodies needs to be contacted. To ubtain a name, telephone, telex, or telefax number in a far-off country in order to speed the flow of goods can be a problem for those concerned with the transport of dangerous goods, especially if a new destination or market is to be opened up.

Following the success of the first edition, the greatly enlarged 1986-87 edition of *Hazardous Cargo Contacts* has been published to provide precisely the kind of information vital to the correct and efficient movement of dangerous goods. The worldwide guide contains relevant details on 2,000 organization in 130 countries, including 950 competent authorities, 390 industry associations, 460 port authorities, 125 training establishments, and 55 labor organizations.

Shiphandling With Tugs, *by Captain George H. Reid. Cornell Maritime Press, P.O. Box 456, Centreville, MD 21617. Price: $18.00.*

A new book on the use of tugs in handling ships has been published by Cornell Maritime Press. It is *Shiphandling With Tugs*, by Captain George H. Reid.

Although the small, stoutly built tug (originally steam-powered) has been around as the workhorse of the world's rivers and harbors for more than 170 years, its functions have become far more complex in recent decades.

Reid discusses in detail the various kinds of modern tugs, their propulsion and steering systems, and their handling characteristics. He then gets down to specifics. With more than 115 precise diagrams, illustrating each point as he makes it, he describes basic tug handling for shipwork, communications, working tugs alongside, on a towline, using torque to advantage, using tugs in current, handling dead ships, using tugs in exposed waters, tugs and anchors, tugs and tailboats, the handling of the integrated tug-barge, and more.

The book's author, Captain Reid, has been a licensed officer in the U.S. Merchant Marine since 1944. He has served as mate and master aboard tankers, freighters, windjammers, fishing vessels, and tugs. In addition, he has been a pilot, docking master, and salvage master. About half his time at sea, however, has been spent aboard tugs.

Maritime Notes

Red Drum Commercial Fishery Curtailed

The Commerce Department, in an effort to prevent dangerous depletion of the red drum fishery, has banned its directed commercial harvesting during 1987 in the Gulf of Mexico federal waters.

A fishery management plan, designed by the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service, was activated by Secretary of Commerce Malcolm Baldridge under the Magnuson Fishery Conservation and Management Act. He termed the action "a matter of simple prudence," and asked the cooperation of all fishing interests involved.

The following terms are in effect under the plan:

- An estimated 200,000 pound "incidental catch" of red drum may be landed, in compliance with state law, by shrimpers who catch the fish accidentally.

- Other commercial fishermen are limited to a 100,000 pound "incidental catch" of red drum. These fish, legally caught in federal waters by commercial fishermen, may be landed without regard to state laws, until the quota is reached.

- A one-fish bag limit per person per trip is set for recreational fishing in federal waters of the Gulf, unless state laws prohibit such landings. This quota is expected to result in an annual decrease in the red drum harvest from an estimated 800,000 pounds to 325,000 pounds in federal waters.

- An extensive research program, with a minimum of red drum taken for this purpose, has been instituted by NOAA to determine the status of the stock. An annual quota adjustment provision will allow resumption of a limited catch in 1988 if scientific analysis warrants it.

The action was taken because the popularity of red drum, better known as "blackened redfish," has brought alarmingly high harvests, and scientists do not know whether there are enough red drum to allow fishing to continue without depleting the species.

Commercial landings from state and federal waters rose from 2.7 million pounds in 1980 to 8.3 million pounds during the first half of 1986. During this time, the catch from federal waters skyrocketed from 3.3 percent to almost 55 percent of the total taken. (Federal waters extend beyond 9 miles off Texas and Florida, and beyond 3 miles off the other states).

In June 1986, Secretary Baldridge imposed a 90-day emergency plan setting a quota of one million pounds of red drum commercially caught in federal waters. The quota was reached in less than a month, and further commercial fishing for red drum was prohibited. A second 90-day emergency plan, which expired in December 1986, extended the ban.

The Secretarial action was taken after public hearings and lengthy discussion with state officials and fishing interests.

Creation of Artificial Reef

The Maritime Administration has agreed to transfer to the State of North Carolina the fish reef ex-USNS **Aeolus** (ARC-3) for use as an offshore artificial reef for the conservation of marine life.

North Carolina has certified that the vessel will be properly charted when sunk; that the vessel will be accepted at fleetside of the James River National Defense Reserve Fleet in an "as is, where is" condition; and that the state will secure all licenses and permits which may be required under other applicable federal laws.

The use of surplus ships for artificial reefs is authorized by Public Law 92-402, as amended.

U.S. Merchant Marine Fleet

The privately owned, deep-draft fleet of the U.S. merchant marine totaled 570 vessels with a carrying capacity of about 23 million deadweight tons (dwt) on October 1, 1986, according to the U.S. Department of Transportation's Maritime Administration. The total comprised 465 oceangoing ships and 105 Great Lakes vessels.

Compared with October 1, 1985 totals, the number of ships in the U.S. oceangoing fleet decreased by 41 vessels, and the fleet's carrying capacity decreased by 924,506 dwt.

As of October 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.

Automated Port Pricing Model

The Maritime Administration has announced the availability of a two-volume research report, "Automated Port Pricing Model," prepared by Applied Systems Institute. Included are a computer model developed for application on a personal computer and a manual version using a desk-top calculator. Both methodologies contain the basic cost elements to determine rates for dockage and

wharfage, crane rental, and leased facilities. The model is based on a 1981 MARAD report entitled "Usage Pricing for Public Marine Terminal Facilities."

Stage 1 of the model calculates gross revenue requirements that reflect the cost of facility usage. Stage 2 performs the pricing analysis which involves specifying usage prices, estimating revenues based on forecasted usage, and calculating revenue surpluses or deficits. A unique feature of the model is the ability to calculate three different levels of gross revenue requirements, which reflect various phases of development leading toward self-sustaining operations.

The report consists of two volumes and three diskettes. Volume I contains the Executive Summary and the Main Report; Volume II is the User's Manual for the model. The three diskettes contain the automted version of the model and the required port data.

Copies may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; telephone (703) 487-4650. The order numbers are as follows: Volume I (Executive Summary and Main Report) - PB87-131033, $18.95. Volume 2 (User's Manual) - PB 87-131025, $11.95. Three diskettes - PB87-131041, $105.00.

Keynotes

Notice of Proposed Rulemaking

CGD 86-100, Compatibility of Cargoes (December 8)

This proposed rule amends the requirements for compatible stowage of bulk liquid hazardous materials on tank vessels by adding materials recently authorized by the Coast Guard for carriage and by making minor technical changes. This action would update the current regulations and better inform persons loading bulk liquid chemical cargoes of their compatibility.

Discussion of Proposed Amendments

Coast Guard requirements for compatible stowage of bulk liquid hazardous materials on tank vessels are found in 46 CFR Part 150. This part contains a "Compatibility Chart" for use in determining whether any two classes of materials will react dangerously if accidentally mixed. This allows cargo handlers to stow incompatible materials so as to minimize the possibility of contact. Each year, the Compatibility Chart and its companion tables and appendices are revised by the Coast Guard to include new chemical cargoes authorized for carriage under other regulations within Title 46. The previous revision was published August 16, 1985 (50 FR 33037).

In this proposed revision, the Compatibility Chart would he amended to delete all footnotes which no longer apply. Tables I and II and Appendix I at the end of Part 150 would be amended to include chemical cargoes recently authorized for carriage by the Coast Guard and to correct various spelling errors. Items added or changed by this proposal, other than editorial corrections, are printed in boldface type in Table I and Appendix I and indicated hy bullets (•) in Table II to attract the reader's attention to the changes.

Comments on this notice were due on or before January 7, 1987.

Notice of Renewal

CGD 86-071, National Boating Safety Advisory Council; Charter Renewal (December 8)

The Secretary of Transportation has approved the renewal of the Charter for the National Boating Safety Advisory Council. The purpose of this Council is to advise the Secretary of Transportation with regard to

major boat safety matters related to the Federal Boat Safety Act of 1971 (as recodified in Subtitle II of Title 46, U.S. Code).

Advance Notice of Proposed Rulemaking

CGD 81-010, Servicing of Inflatable Liferafts; Notice of Public Meeting and Extension of Comment Period (December 22)

This is a notification to the public that the Coast Guard held a public meeting to discuss some of the issues raised by its Advance Notice of Proposed Rulemaking (ANPRM) published on August 14, 1986. This ANPRM generated comments from all facets of the industry. The responses were mixed, raising new issues, and some of the respondents requested a public meeting. Accordingly, the Coast Guard extended the comment period to February 10, 1987, and held a public meeting to allow participants to present data, views, and comments on the issues.

Notice of Availability

CGD 84-025, Incinerator Vessels, Safety Rules (December 29)

In FR Doc. 86-18660, beginning on page 30241 in the Federal Register issue of Monday, August 25, 1986, the Coast Guard published a comprehensive set of proposed safety rules (NPRM) for incinerator vessels carrying bulk hazardous wastes for the purpose of incineration at sea. A draft evaluation of economic and environmental impact associated with the NPRM was prepared along with a statement announcing a finding of no significant environmental impact (FONSI). These documents were placed in the rulemaking docket and made available for public comment during the 60-day comment period provided for the NPRM. However a specific statement giving public notice of the availability of the FONSI in the docket was not included in the preamble to the NPRM. To ensure full public participation with respect to the environmental considerations involved in this rulemaking, the Coast Guard gave specific notice of the FONSI's availability for an additional 45-day comment period. Comments were due on or before February 12, 1987.

Notice

CGD 86-073, Policy for Implementing the Vessel Load Line Amendments of 1986 (December 29)

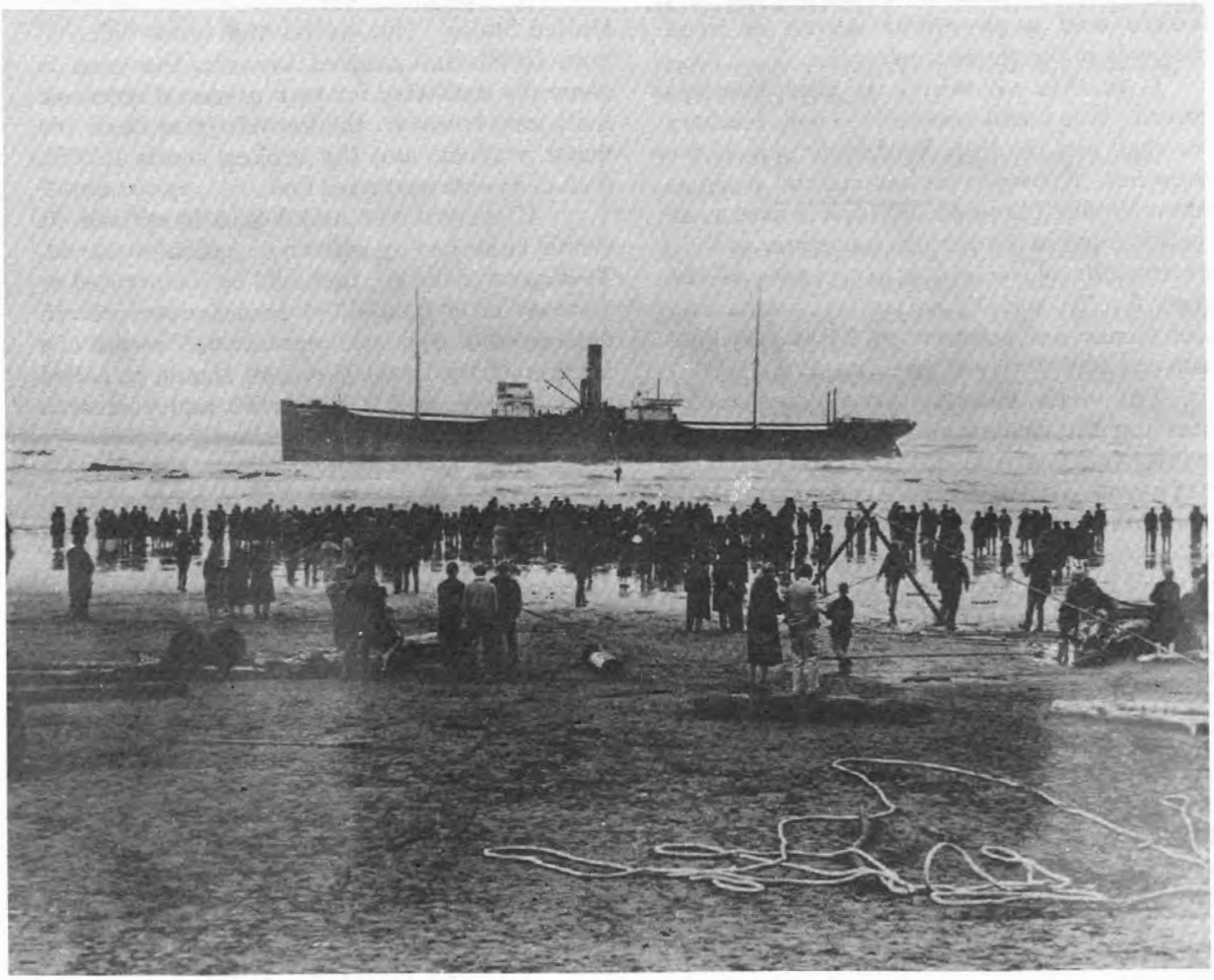
The laws related to the assignment of load lines for vessels have been revised and renumbered, ultimately requiring a revision of Coast Guard regulations. Until promulgation of new regulations, the present regulations continue in effect under the corresponding provision of this legislation. This notice sets forth Coast Guard policy applicable during the transition period and information on future rulemaking.

"You forgot the area code."

Shipwrecks!

Mr. William P. Quinn of Orleans, Massachusetts, maintains a large collection of photographs depicting old shipwrecks, and he has been kind enough to send us several photos to print in future issues of *Proceedings*. Other readers who may possess historical maritime photographs are encouraged to submit them for publication. Photos should be identified on the back with a caption, photo credit, and the name and address of the sender. We will return photographs after publication.

Our thanks to Mr. Quinn for sharing his photograph collection with *Proceedings* readers.



The Japanese freighter **SS Tenpaisan Maru** struck on Copalis Beach, Washington State, on December 1, 1927. The crew had to be brought ashore by the U.S. Coast Guard via the breeches buoy as a large crowd gathered to watch the action. The ship was built in Sunderland, England, in 1911 and was of 5,019 tons. She was owned by the Mitsui Bussan Kaisha, Ltd. The vessel was never pulled off and sanded in on the beach. *(Photo from the collection of William P. Quinn)*

Chemical of the Month

Scott Rogerson

Cashew Nutshell Liquid

The Cashew Tree Anacardium Occidentale belongs to the Anacardiaceal family of plants which includes pistachio, mango, and poison ivy. Its bark supplies chemicals for the field of medicine, its fruit is edible, and the nut supplies a seed or kernel which is a popular hors d'oeuvre and a chemical which is used extensively in the plastics industry.

It is this oil which is this month's chemical. It is found between the soft, leathery outer shell and the thin, hard inner skin of the cashew nut. Known in the commercial world as Cashew Nutshell Liquid (CNSL), it is used as an insecticide and in the varnish industries as well. Like the oils of certain other plants of the cashew family, such as poison ivy, poison oak, poison sumac, and poison wood, CNSL can cause a rash and a blistering of the skin.

The oil's caustic properties make processing the cashew nut difficult, but it is possible to get nearly all of the valuable products out of a crop. One of the more common methods of removing CNSL from the cashew nut is by heating the nuts in previously extracted CNSL. The shell softens, and about 25 percent of the available liquid is collected. The edible kernel is then removed and roasted. The remaining CNSL is removed by either a solvent extraction or by a pressing operation.

The raw CNSL is a dark brown liquid and contains rougly 10 percent cardol. The chemical name for this fraction is 5-pentadecadienyl resorcinol. The balance is anacardic acid, which during the heating operation is decarboxylated to cardinol. As mentioned, the oil is a valuable by-product of the nut. At present, no acceptable substitutes have been developed to replace it in its uses in the field of plastics.

In recent times the output of CNSL has been over 30,000 tons per year, about half of which is imported by chemical companies in the United States. Due to the high sales value of both CNSL and roasted kernels, the crop is generally marketed for both products. In some instances, however, the kernels have been the major product, and the broken shells (CNSL included) were burned as fuel.

If cashew nutshell liquid is spilled, it should be soaked up with an absorbent material. To dispose of the oil, it should be incinerated or disposed of in landfall in accordance with all federal, state, and local regulations. In case of a large spill, the fire department should be called immediately, and local health and pollution control agencies should be notified. Every attempt to isolate and remove the caustic material should be made, and wildlife officials and operators of nearby water intakes should also be notified if the spill is in natural waters. Anyone working in the area should wear a chemical protective suit (including gloves and goggles) and use a respirator with an organic vapor cartridge. An eye wash and safety shower should follow exposure to CNSL as a safety precaution.

In case of exposure to the oil, a doctor should be called. The skin should be washed with soap and water immediately, and the eyes should be flushed with water for 15 minutes. All affected clothing and shoes should be removed and either thoroughly cleaned or disposed of properly.

If the oil is swallowed and the victim is conscious, vomiting should be induced. If unconscious, the victim should be kept warm and those giving first aid should wait for professional assistance for further treatment.

Scott Rogerson was a Fourth-Class Cadet at the Coast Guard Academy when this article was written. It was written under the direction of LCDR J.J. Kichner for a class in hazardous materials transportation.

Fires containing cashew nutshell liquid should be extinguished with carbon dioxide, water fog, or polymer foam. Firefighters should follow the same precautions as mentioned for those working on a chemical spill

Cashew nutshell liquid is very stable, and hazardous polymerization will not occur. It is to be stored in closed containers at all times, due to its caustic properties. Neither the Environmental Protection Agency nor the Department of Transportation regulate CNSL as a pollutant, but precautions in the transportation of the oil should be taken to avoid the possibility of a spill. The U.S. Coast Guard requires that the liquid be stored in a suitable container at all times. It is regulated by the Coast Guard under Subchapter O of Title 46, Code of Federal Regulations.

Chemical Name
Cashew Nutshell Liquid

Composition
Anacardic Acid 90%
Cardol 10%

Synonyms
nutshell oil

Physical Properties
melting point: 105°C (221°F)
freezing pont: not available
vapor pressure: not available

Threshold Limit Values
time-weighted average: unknown
short-term exposure limit: unknown

Flammability Limits in Air
lower flammability limit: not available
upper flammability limit: not available

Combustion Properties
flash point (c.c.): above 205°C (400°F)
autoignition temperature: unknown

Densities
specific gravity (water = 1): 0.96
vapor (air-1): unknown

U.N. Number: not assigned
CHRIS Code: OCN
Cargo Compatibility Group: 4 (Organic Acids)

Nautical Queries

Engineer

1. What part of the main feed and water cycle separates the condensate system from the feedwater system?

A. Main condenser
B. Deaerating feed tank
C. Atmospheric drain tank
D. Boiler drum

Reference: *Principles of Naval Engineering* - NAVPERS 10788-B

2. The main function of piston compression rings is to _____.

A. prevent excessive cylinder liner wear
B. reduce friction losses in the engine
C. seal the space between the piston and the liner
D. limit upward flow of lube oil into the combustion space

Reference: Maleev, *Diesel Engine Operation and Maintenance*

3. The effect of high superheat of the vapor in a refrigeration system would be _____.

A. increased capacity of the compressor
B. more efficient operation of the thermal expansion valve
C. decreased capacity of the compressor
D. loss of receiver capacity

Reference: Dossat, *Principles of Refrigeration*

4. What effect does operating an evaporator at reduced vacuum have on the unit?

A. The quality of the distillate is improved
B. The heat level is decreased throughout the unit
C. The tendency for scale to form is increased
D. The need for chill shocking is reduced

Reference: Osbourne, *Modern Marine Engineer's Manual, Vol. 1*

5. A transformer works on the principle of

A. Self induction
B. Attraction and repulsion
C. Mutual induction
D. Increasing power

Reference: Mileaf, *Electricity One-Seven*

Deck

1. One gallon of low expansion foam solution will produce about

A. 10 gallons of foam.
B. 25 gallons of foam.
C. 100 gallons of foam.
D. 500 gallons of foam.

Reference: MARAD, *Marine Fire Prevention, Firefighting, and Safety*

2. Which of the following diagrams, as depicted in the *Nautical Almanac*, represents the sun when it is circumpolar?

A.

B.

C.

D. none of the above

Reference: *Nautical Almanac*

3. You have a marine portable tank mounted on deck. It is cylindrical, 12' in diameter, and 27' long. The vessel's displacement before the tank is filled is 5960 tons. If the center of gravity of the tank, when filled, is 56' above the base line, how much will G shift if the tank is filled with fresh water?

A. .26 foot
B. .40 foot
C. .79 foot
D. .81 foot

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

4. You are underway on the high seas in restricted visibility and hear a fog signal consisting of one prolonged and two short blasts. It could be any of the following *except* a vessel

A. engaged in mine clearance.
B. engaged in fishing.
C. constrained by her draft.
D. being towed.

Reference: COMDTINST M16672.2A

5. In what direction do air masses usually move?

A. Easterly
B. Southerly
C. Northerly
D. Southwesterly

Reference: Donn, *Meteorology*

Answers

Engineer
1-B;2-C;3-C;4-C;5-C
Deck
1-A;2-A;3-C;4-D;5-A

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.

BOOZE & YOU

Approximately 30,000 Americans die each year from advanced cirrhosis of the liver, one of the leading causes of death among middle-aged men in much of the industrialized world. A person generally has to drink very heavily for about 15 or more years before cirrhosis becomes not only a disability but a threat to life.

—Alcohol in America: Taking Action to Prevent Abuse

U.S. Department
of Transportation

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