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of the Marine Safety Council

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Tanker casualties threaten not only the safety of the crew, ship, and cargo, but also the environment (the beach in the photograph is part of a stretch of 11 oil-coated miles on the coast of Puerto Rico). Beginning on page 293 is a three-article sequence on tanker safety. Roger A. Peterson examines the conditions under which casualties occur, Captain J. V. Caffrey talks about what his company, Mobil, does to promote safety, and Robert J. Lakey discusses the safety record of LNG ships.

A Letter from the Editor

Reader C. E. Hatton of Bailey Controls Company, King of Prussia, Pennsylvania, raised an interesting point in regard to DECK question No. 4 of the Nautical Queries in the August issue (in which "combustible" was defined according to the temperature at which an oil would give off "inflammable vapors"). Is not "flammable" accepted usage? asked Mr. Hatton.

I agree with Mr. Hatton that since most "in" combinations (complete/incomplete, sane/insane) are pairs of opposites, whoever decided that "flammable" and "inflammable" should be synonymous was inviting confusion. Perhaps safety would be better served if we dropped the word "inflammable" from the English language.

Since the Nautical Queries are examples of questions included in licensing examinations, however, I felt I would be doing the readers a disservice by arbitrarily changing the wording. I checked with the Coast Guard Institute in Oklahoma City, which prepares the questions, and was told that the Institute uses the words interchangeably but is probably more apt to use the word "inflammable."

I conducted a brief, informal poll and found that about half of the people I asked were under the impression that "inflammable" meant that something would not burn. This is a mistake that could have serious consequences. Getting questions on an exam right will do the mariner no good if he later incinerates himself. A pointer or two to people working with hazardous cargoes might be in order.

(The Coast Guard, by the way, uses "nonflammable" as the opposite of "flammable" in its regulations.)

Julie Strickler
Editor

If any of you have had occasion to study our masthead lately (inside front cover), you may have noticed that the Marine Safety Council has a new Executive Secretary. Since August, this position has been held by Captain Christopher M. Holland.

While the Marine Safety Council itself is made up of the admirals heading the various offices concerned with regulations (Chief Counsel RADM Edwin A. Daniels is presently serving as Chairman), the Council also has an independent staff. It is this staff, which arranges the monthly meetings of the Council and sees to its ongoing work between meetings, that the Executive Secretary heads. The Executive Secretary also serves as Regulations Officer for the Coast Guard, ensuring that all Coast Guard-issued regulations comply with the requirements of the legislative and executive branches of the government.

Captain Holland, a native of Belmont, Massachusetts, is a graduate of the U.S. Coast Guard Academy in New London, Connecticut, where he earned his B.S. in 1958. He also holds a law degree from the George Washington University Law School in Washington, DC. Before assuming the post of Executive Secretary, he served as Chief of the Legislative Division in the Office of Chief Counsel and as an appellate judge on the U.S. Coast Guard Court of Military Review. In the course of his career, he has also served as Commanding Officer of the Coast Guard cutters CAPE UPRIGHT and ARIADNE, as an instructor in antisubmarine warfare at the U.S. Navy Fleet Sonar School in Key West, Florida, as assistant administrative officer and legal officer at the Coast Guard's recruit training center in Cape May, New Jersey, and as District Legal Officer for the Fifth and Fourteenth Coast Guard Districts.

Captain Holland lives with his wife (the former Julia A. Koontz) and two children, Christopher and Michael, in Vienna, Virginia. ⚓

Maritime Safety Bill Introduced in Congress

On August 19, 1982, Rep. Walter B. Jones (D-North Carolina) introduced H.R. 7038, a bill "to promote maritime safety on the high seas and navigable waters of the United States."

This bill would require that, not less than 60 days before a current certificate of inspection expires, the owner, agent of the owner, or operator of a vessel for which Coast Guard inspection is required submit to the Commandant either a request for reinspection or a notice that the vessel will no longer be engaged or operating. Penalties for knowingly operating such a vessel without a valid certificate would range up to $50,000 a day.

The bill also covers vessel owner reporting requirements. Owners, operators, or agents of the owner would be required to notify the Coast Guard when they had reason to believe a vessel had been lost or imperiled. The Coast Guard would also have to be notified of a lack of communication for more than 48 hours from a vessel required to report to the U.S. Flag Merchant Vessel Location Filing System.

Nominations Open for Shepheard Maritime Safety Award

Nominations are being accepted for the 1982 Rear Admiral Halert C. Shepheard Award for Achievement in Merchant Marine Safety.

The award is given either for a single outstanding contribution to merchant marine safety or for dedication to and constructive participation in activities associated with maritime safety over a period of time. Nominees may include individuals such as ship operators, naval architects, marine engineers, ship repairers, and shipbuilders or those associated with ship operations, government, or marine associations.

The award was established by the American Institute of Merchant Shipping (AIMS) in 1976 in honor of the late Admiral Shepheard, who served in the United States Coast Guard as Chief of the Office of Merchant Marine Safety and who was internationally acclaimed for his work in this field. The award is administered by the American Bureau of Shipping (ABS).

Nomination forms may be obtained by writing to the following address: Rear Admiral Halert C. Shepheard Award, c/o Thomas J. Tucker, Committee Secretary, American Bureau of Shipping, 65 Broadway, New York, New York 10006. The deadline for receiving nominations is January 3, 1983. The award will be presented on April 19, 1983, at the ABS annual meeting at ABS headquarters in New York City.

Retired Admiral Honored by IMO

The International Maritime Organization has awarded RADM Roderick Y. Edwards, USCG (Ret.), its International Maritime Prize in recognition of his significant contribution to the work and objectives of IMO. This is the second awarding of the prize, which was established in 1978, and it is the first time it has been awarded to a U.S. citizen.

RADM Edwards began his active participation in the work of IMO in the organization's earliest years. He provided leadership during the time IMO, formerly the Inter-Governmental Maritime Consultative Organization, was easing the way for cooperation among governments and fostering the development of high standards of maritime safety and pollution prevention.

While representing the U.S. on numerous IMO bodies, RADM Edwards served as vice chairman of the Subcommittee on Marine Pollution, president of the 1974 Safety of Life at Sea Conference and chairman of its steering committee, chairman of the council (four terms), and president of the 11th Assembly.

MarAd Publishes Stowage Guide

A Shipper's Guide to Stowage of Cargo in Marine Containers, a publication of the Maritime Administration, is now available from the U.S. Government Printing Office.

This publication is directed at shippers, loading dock personnel, and others directly involved with the loading of ocean containers. The guidelines provided are aimed at both safety and efficiency. The guide describes the consequences of improper stowage and explains how to avoid them by using the proper size and type of container and properly inspecting and loading it. Also included are stowing and securing guidelines for the eight basic cargo types.

Copies of the guide are available for $4.75 from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The order number is 050-015-00004-1.

Report on Collision Avoidance Released

The Maritime Administration has released a report on advanced technology for investigating open-sea, multiple-ship encounters. This type of investigation was developed to provide a better explanation of such collisions than conventional means do and to serve as a quantitative basis for generating necessary avoidance maneuvers. The study, "Multiple-Ship Collision Avoidance Anclysis in the Open Seas—Phase III," was prepared for MarAd by Systems Control Technology, Palo Alto, California.

The company's approach was to develop a baseline multi-ship collision-avoidance algorithm for use in a computer-based evaluation system. By using this algorithm, operators can evaluate collisions involving as many as six ships. The original closest point of approach (CPA) and time to closest point of approach (TCPA) are identified for each pair of ships, and calculations following changes in ship course and speed are updated based on algorithm recommendations.

A number of sensitivity studies on collision-avoidance factors were done using the evaluation system. Included were rules of the road validity, sensor error effects, maneuver effectiveness, encounter-scenario factors, ship-to-ship communications benefits, and procedural factors. The results of these tests are being provided to the U.S. merchant fleet.

Copies of the report are available through the National Technical Information Service (NTIS), Springfield, Virginia 22161, as follows:

Volume I - Executive Summary - PB 82-207671 - $6.

Volume II - Technical Report - PB 82-207689 - $24.

NFPA Updates Fire Codes

An update to the *1982 National Fire Codes* is now available from the National Fire Protection Association (NFPA). This two-volume set, the *1982 National Fire Codes Supplements*, covers all Codes and Standards approved or revised at the NFPA annual meeting in May 1982. These include NFPA 1 - Fire Prevention Code, NFPA 15 - Water Spray Fixed Systems, and NFPA 72E - Automatic Fire Detectors. The catalog number for the supplements is NFC-S82, and the cost of the set is $40.

Published annually, the National Fire Codes are a product of NFPA's standard-making process. The development of these advisory codes and standards is the responsibility of some 160 technical committees representing various interests affected by the standards.

The *1982 National Fire Codes* features the full texts of all 230 NFPA Codes, Standards, Recommended Practices, Manuals, and Guides and 49 Codes and Standards which were approved or revised by NFPA technical committees during 1981. These include NFPA 56B - Respiratory Therapy, NFPA 256 - Methods of Fire Test of Roof Coverings, NFPA 655 - Prevention of Sulfur Fires and Explosions, and NFPA 1202 - Organization of a Fire Department. The catalogue number for the codes is NFC-Set, and the set costs $150.

For more information on the *1982 National Fire Codes* and the *1982 National Fire Codes Supplements*, contact the National Fire Protection Association, Publications Sales Division, Batterymarch Park, Quincy, Massachusetts 02269; (617) 328-9290.

West Coast residents can order directly from Global Engineering Documentation Services, Inc., 3001 W. MacArthur Boulevard, Santa Ana, California 92704.

The National Fire Codes are also available on microfilm from Information Handling Services, Denver Technological Center, P.O. Box 1154, Englewood, Colorado 80110, or from Showcase Corporation, 1200 Quince Orchard Boulevard, Gaithersburg, Maryland 20760.

Report on Shiphandling Course Available

In March 1981 the Coast Guard sponsored a demonstration course in shiphandling in rough weather. Senior Deck Officers from major U.S. shipping firms and maritime education institutions took part in the course, which was held at the Merchant Marine Academy in Kings Point, New York.

The course in New York was patterned after a similar course developed in Norway.

The Coast Guard has been a co-sponsor of a Norwegian project known as "SO3," which is managed by Det norske Veritas and is aimed at improving the safety of the crew, ship, cargo, and environment in rough weather. Ship motion- and load-monitoring and guidance equipment has been found to provide useful information in such weather, but mariners need to be taught how to use the equipment. The shiphandling course was developed in response to that need.

Among the topics covered during the two-day course in New York were regular and irregular waves; the influence of changes in course, speed, and load condition on seakeeping performance; and the principle of monitoring vessel responses with operation-oriented instruments. Each general session was followed by a problem and solution period.

The report on the course includes an explanation of its background, an abstract of the course content, a summary of the lecture notes, the results of a course evaluation by participants, and a Det norske Veritas guide on rough weather shiphandling. It can be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. Report No. CG-M-7-81, AD A115176 should be specified.

R&D's Rope Lab Evaluates a Rope Safety Problem

Synthetic rope is used extensively for the lines used to moor and tow ships. These lines may be subjected to great tensions (during a ship's maneuvers in approaching a pier or in high wind conditions, for instance). When the tension exceeds a breaking point, a potentially hazardous phenomenon known as "snapback" occurs. Snapback is the recoil of the broken line toward and past the point(s) at which it is secured. This can pose a threat to personnel in the vicinity.

The Coast Research and Development Center has recently developed a technique for evaluating synthetic line samples to determine their potential for snapback. Several types of line were stretched until they snapped using the Center's rope-testing machine. High-speed photographs of the event provided information on the energy released when the rope snapped, the speed of the recoiling line, and the path the line followed.

In addition to establishing a testing technique for evaluating existing or proposed synthetic line materials and construction methods, the researchers made a number of other important findings. They found that lines snap back directly toward a fixed end if breakage occurs in a clear, straight segment of the line. If breakage occurs around a curved surface (such as a bollard), the recoiling line sweeps sideways as well, endangering a wide area.

A final report of this project, entitled "A Snapback Evaluation Technique for Synthetic Line," can be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. Report No. CG-D-29-82 should be specified. ‡

Technician at Coast Guard R&D Center monitors the Center's rope-testing machine.

The following items of interest were published in the FEDERAL REGISTER between August 19, 1982, and September 16, 1982:

Final rules: CGD 09-82-24 LSCORA Southshore Classic, Detroit River, Special Local Regulation, August 19, 1982. CGD 05-81-08R Drawbridge Operation Regulations; Atlantic Intracoastal Waterway, Wrightsville Beach, North Carolina, August 19, 1982. CGD 12-82-01 Drawbridge Operation Regulations; San Joaquin River, California, August 19, 1982. CGD 07-82-11 Drawbridge Operation Regulations; Moser Channel, Monroe County, Florida, revocation, August 19, 1982. CGD 07-82-03 Drawbridge Operation Regulations; Atlantic Intracoastal Waterway, North Palm Beach County, Florida, August 19, 1982. CGD 82-043 Correction of Especially Hazardous Conditions Aboard Boats; editorial change, August 23, 1982. CGD 82-006 Issuance of Bridge Permits, Changes in Procedure, August 23, 1982. CGD 13-82-10 Tacoma Regatta, Washington State, August 26, 1982. CGD 09-82-06 Anchorage Area, Lake Betsie, Frankfurt, Michigan, August 30, 1982. CGD 09-82-02 Anchorage Area, Little Traverse Bay, Lake Michigan, Harbor Springs, Michigan, August 30, 1982. CGD 02-81-04 Drawbridge Operation Regulations; Illinois Waterway, Joliet, Illinois, August 30, 1982. CGD 07-82-05 Drawbridge Operation Regulations; Hillsboro River, Atlantic Intracoastal Waterway Mile 1050, Florida, August 30, 1982. CGD 07-82-08 Drawbridge Operation Regulations, Sarasota Pass, Gulf Intracoastal Waterway, Florida, August 30, 1982. CGD 07-82-12 Drawbridge Operation Regulations, St. Lucie River, Florida, August 30, 1982. CGD 80-001 Unmanned Barges Carrying Certain Dangerous Bulk Cargoes, correction, September 2, 1982. CGD 76-170 Casualty Reporting Requirements, September 9, 1982. CGD 11-79-02 Establishment of Safety Zones Around Structures on the Outer Continental Shelf (OCS) and Navigable Waters of the U.S., September 9, 1982.

Notices of proposed rulemaking (NPRMs): CGD 11-82-01 Anchorage Grounds, Los Angeles/Long Beach Harbor, August 30, 1982. CGD 03-82-017 Drawbridge Operation Regulations; Harlem River, New York, August 30, 1982.

Notices: CGD 82-083 Withdrawal of Notice of Intent to Prepare an Environmental Impact Statement, Proposed Bridge over the Columbia River, August 19, 1982. CGD 82-082 Notice of OMEGA Station Australia Operational Declaration, August 26, 1982. CGD 82-066 Small Vessel Towing and Salvage Policy Study, Notice of Public Meetings, August 30, 1982. CGD 82-088 Houston/Galveston Navigational Safety Advisory Committee; Notice of Establishment, September 2, 1982. CGD 82-089 Towing Safety Advisory Committee; Notice of Meeting, September 2, 1982. CGD 81-058 Boundary Lines, Extension of Comment Period, September 16, 1982. CGD 82-090 Ship Structure Committee; Notice of Meeting, September 16, 1982.

Questions concerning regulatory dockets should be directed to the Marine Safety Council (G-CMC), U.S. Coast Guard, Washington, DC 20593; tel.: (202) 426-1477.

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Radar Observer Endorsement— Demonstration of Skills (CGD 76-193(a))

The Coast Guard published a final rule in the September 16, 1982, edition of the FEDERAL REGISTER amending the testing procedures for a radar observer's endorsement on merchant marine deck officer licenses. Rather than simply gauging ability on the basis of a written examination, the Coast Guard will now require applicants for a radar endorsement to demonstrate their skills.

For further information, contact CDR Scott D. McCowen, U.S. Coast Guard (G-MVP-5/14), Washington, DC 20593; tel.: (202) 426-2251.

Aluminum Hatch Covers Proposal Withdrawn (CGD 78-121)

All newly constructed tankships are required by the Coast Guard to have hatch-covers made of steel (or an equivalent material). This requirement resulted from a National Transportation Safety Board (NTSB) recommendation made after an investigation of a collision between a gasoline-laden tankship and another vessel in 1974. In the accident, the heat of the fire caused the aluminum hatch covers to melt, permitting the fire to spread from tank to tank. On October 21, 1980, the Coast Guard published a proposal that would have required the retrofitting of existing tankships with steel hatch covers. Further economic analysis revealed that this action would not be cost-effective. A notice of withdrawal was published in the FEDERAL REGISTER on September 2, 1982.

For further information, contact Don Kerlin, U.S. Coast Guard (G-MTH-4/12), Washington, DC; tel.: (202) 426-2197.

Requirements for Painters with Float-free Links (CGD 79-167)

On September 16, 1982, the Coast Guard published a final rule that will require life floats and buoyant apparatus on tank vessels, passenger vessels, cargo and miscellaneous vessels, small passenger vessels, and oceanographic vessels to be secured by means of a painter and a float-free link. This will prevent the life floats and buoyant apparatus from drifting away from a sinking vessel. The regulation will also require that each new float be equipped with reflective material to increase its visibility at night.

For further information, contact Robert Markle, U.S. Coast Guard (G-MVI-3/12), Washington, DC 20593; tel.: (202) 426-1444.

Proposal on Visibility from Bridge Withdrawn (CGD 80-134)

The Coast Guard has withdrawn a proposal dealing with the problems of visibility from the navigation bridge. On May 11, 1981, the Coast Guard published an advance notice of proposed rulemaking soliciting comments and suggestions on this matter from the public. The majority of those responding agreed that a problem with visibility did exist but recommended that the Coast Guard work within the International Maritime Organization before issuing regulations. The Coast Guard agrees with this recommendation and, as this issue was going to press, planned to present IMO with a U.S. proposal on visibility from the navigation bridge in October. A notice terminating the rulemaking project was published in the FEDERAL REGISTER on September 2, 1982.

For further information, contact LCDR Robert W. Henry or CDR James A. Sanial, U.S. Coast Guard (G-MTH-4/13), Washington, DC 20593; tel.: (202) 426-2197.

MarAd Consolidates Citizenship Declaration Forms

On August 30, 1982, the Maritime Administration published a final rule in the FEDERAL REGISTER consolidating nine existing forms into one. These are the Documentation, Transfer or Charter of Vessels Consolidation of Citizenship Declaration Forms required under Part 221 of Title 46 of the Code of Federal Regulations.

The new single form (Form 899) "prescribes the declaration of the United States citizenship by a vendee, mortgagee or other transferee of a vessel" owned and documented under American law, as required by section 40 of the Shipping Act of 1916.

Actions of the Marine Safety Council

The Marine Safety Council had one item to consider at its September meeting. That project was:

CGD 82-084 Use of Strobe Lights as Visual Distress Signals

Strobe lights are commonly used as a distress signal in the inland waters of the U.S. Many private boaters believe that strobe lights are safer than flares. They have joined the National Boating Safety Advisory Committee in urging the Coast Guard to allow strobes to meet the requirements for carriage of emergency signaling equipment.

Although the Inland Navigation Rules recognize strobe lights as an emergency signal, the Coast Guard has been reluctant to approve them because they are not recognized as distress signals internationally. The reason for this is that the lights have other uses, such as marking buoys and offshore structures. A mariner seeing a strobe in international waters would probably avoid it rather than investigating it as a possible distress situation.

Accepting the arguments of private boaters and the National Boating Safety Advisory Committee, the Coast Guard proposes in CGD 82-084 that Part 135 of Title 33 of the Code of Federal Regulations (which governs required emergency equipment) be amended to include strobe lights as a recognized emergency signaling device. Their use would be recognized on waters subject to the Inland Rules and the U.S. waters of the Great Lakes. ⌗

Ferreting Out the Facts Behind Tanker Casualties

by Roger A. Peterson

In a memorandum on maritime safety dated May 15, 1981, the Nautical Institute of the United Kingdom called attention to

> "... an unnecessary and excessive loss of life at sea, loss of ships and cargoes, and an increasing potential danger to the marine environment. The effect of the rising level of gross tonnage lost resulting in higher costs of goods and services places an unacceptably high financial burden on the public."

The situation regarding maritime oil tankers is no better. Between 1964 and 1977, 220 vessels of 6,000 deadweight tons or above had to be written off as total losses, and 1,115 persons lost their lives. Environmental damage can only be guessed at, but 1,777,000 tons of oil spilled into the ocean as a result of the casualties.

A study of these casualties reveals certain recurring factors and points to a number of possible preventive measures.

Findings

First and foremost, of all the factors relating to the frequency of oil tanker accidents, I found none to be more critical than the attitude and nature of management. It is management which ultimately controls vessels and their operations, and if any one factor can be considered of primary concern, it is this one. The accident record of reputable owners (for example, Exxon, Japan Lines and Peninsular, and Orient, to name a few) is excellent regardless of the age, size, or flag of vessels involved.

Reputable owners insist on and enforce rigid standards for qualification and licensing of their crews. In addition, such owners were found to require that ship personnel receive thorough and ongoing training. As a further incentive to safety, some operators also insist that chartered vessels be required to meet high standards of safety and qualifications, treating chartered vessels as if they were part of their own fleet.

The next major factor I found was the character of the nation of registry. Principally,

Roger A. Peterson, an Associate Professor of Marketing and Transportation at Eastern Michigan University, conducted a worldwide study of serious maritime oil tanker accidents occuring between 1964 and 1977. The resulting paper, from which this article was adapted, was presented at the October 22, 1981, meeting of the Great Lakes Section of the Society of Naval Architects and Marine Engineers, held in conjunction with the centennial of naval architecture and marine engineering at the University of Michigan.

this relates to the manner in which the flag state administers and enforces safety measures, either its own national regulations or internationally accepted and ratified standards.

An article on this subject, "The Year of the Tanker, But Mostly for the Wrong Reasons," appeared in the July 17, 1980, issue of *Fairplay International Shipping Weekly*. Evidence cited there indicates that a number of nations (in particular Liberia, Panama, and Greece), while accepting and ratifying international standards of licensing, safety, and inspection, are not making any appreciable progress in improving their safety record. This failure can be attributed to the fact that these nations lack the resources and the administrative machinery required to effectively control such matters. The process of vessel monitoring and vessel inspections has been left almost exclusively in the hands of the classification societies. While certain ship inspection personnel may receive designations as inspectors for these countries, there are no standards or exams for appointment. Recent years have seen a mounting barrage of criticism arising over these practices. In particular, critics have focused on the issues of secrecy and differences in standards between various classification societies.

This can be a very dangerous procedure because these countries lack an effective enforcement agency (such as the United States' Coast Guard). Since these countries enroll tonnage far in excess of their national requirements, many if not most of the vessels under their flag rarely visit the ports in which they are registered. Thus, even if the governments wish to monitor vessel condition, they must do so at ports in other countries. While such a system is possible, it is expensive and difficult to administer and operate effectively.

This tanker, now in two pieces, was bound for Salem, Massachusetts, with a cargo of about 7.3 million gallons of heavy industrial fuel oil when it ran aground on December 15, 1976, causing a major oil spill.

While criticism can and should be leveled at the licensing of ship's officers in almost every nation (because so many lack a requirement that applicants demonstrate practical ship-handling ability), the open-registry nations are particularly deficient in this area. They have a history of adopting a careless approach to the issuance of licenses, issuing credentials on the basis of documents presented as proof, and doing little in the way of checking for authenticity or investigating the character and background of applicants.

In fact, the very existence of open registries poses a serious problem in regard to the issue of safety. Even if one accepts the argument that public pressure has caused Liberia and Panama to improve their systems and that Greece's accession to the European Community will result in an improvement in its system, a problem will remain. The owners of substandard tankers can merely transfer their ships to other emerging open registries (the Bahamas, Bermuda, the Cayman Islands, the Maldive Islands, Somalia, the Seychelle Islands). Even Vanuatu (formerly the New Hebrides), an island nation of only 110,000 people, has announced such a registry and opened a registration office in New York City.

Age was the most prominent vessel-related factor encountered, as older tankers were found to represent the greatest opportunity for loss. The danger begins when a tanker is in the vicinity of 10 years of age and becomes particularly critical in the range of 16 - 20 years of age. Tankers in these age brackets must be maintained in accordance with strict standards of upkeep if breakdowns and accidents are to be avoided. There is strong evidence to indicate that in many instances such is not the case. Certain owners are allowing these older ships to run down and gambling with safety to make money.

While the size of a vessel did not turn out to be a major factor in the frequency of tanker accidents, there is evidence to indicate that it may well be a factor in the severity of an accident. When VLCCs (Very Large Crude Carriers) or ULCCs (Ultra-Large Crude Carriers) get into trouble, the salvage equipment needed to save them is large, sophisticated, and expensive. According to an article in the May 4, 1981, issue of the *Journal of Commerce*, this type of equipment is becoming scarce. Owners of such equipment maintain that the equipment's increasing cost and the increasingly complex environment in which they must operate prohibit further investment. They say major changes are required.

My research also indicated that there are gaps in our knowledge. We lack much in the way of maritime casualty data coverage and dissemination. The human aspect of casualties is an unexplored and greatly neglected area. Little attention has been given to this factor, and we know little about it. This is somewhat surprising, for almost all studies and works in the area of marine casualties point to human error as the cause of the majority of accidents. Further, there is presently no uniform worldwide system for reporting casualties. Consequently, it becomes difficult and expensive to reconcile the many systems, and much of the information is lost. In my study of tanker casualties, for example, the lack of uniformity made it impossible to determine the impact of location on tanker accident frequency.

Recommendations

If we wish to minimize tanker accidents and their consequences, a two-pronged effort will be required: immediate short-term actions designed to have a quick impact and based on what we do know must be coupled with long-term research, especially research into those areas where our knowledge is limited.

Short-term Actions

The first area for immediate action should be that of ownership. Nations must recognize that this is the area offering the best opportunity to administer and enforce safety standards for tankers. However, to accomplish these goals they must be able to identify those who actually control a vessel. Therefore, it is necessary to correct the present situation, in which true ownership and control is sometimes hidden within a maze of interlocking companies. If necessary, the ships of nations which refuse to require identification of owners should be barred from entering other nations' waters. Once identification of ownership has been accomplished, it should be followed by a program of enforcement. Not only should crewmembers be subject to fines and imprisonment for violations of safety standards, but owners and operators also should be held liable. Vessels in substandard condition and their owners must be identified so that steps can be taken to remove the vessels from service and force the owners out of business.

Owners and/or operators who choose to disregard the issue of safety and proceed to operate dangerous vessels should be made liable for their actions in this regard. Evidence of deliberate disregard for safety and environmental concerns by managers, owners, or crews should be grounds for fines, imprisonment, or revocation of the right to operate.

Methods of communication between nations must be developed so that owners under investigation or conviction cannot simply transfer their vessels to a new flag. One proposal, advanced in the May 4, 1978, issue of *Fairplay International Shipping Weekly*, appears to be an excellent one. Under that proposal, a record would be kept of tankers and their safety record. This would permit another recommendation to be put into effect, that of a common chartering policy, suggested by F. M. van Poelgeest, a researcher for the Netherlands Maritime Institute. Under his system, there would be a worldwide common chartering policy for tankers. Before any tanker was chartered, its charterers would investigate the vessel's casualty record, crew competence, vessel condition and inspection condition, and the past record of its owners and/or management.

Actions should also be taken against nations which turn a blind eye to substandard tankers operating under their flag and nations which freely allow the entry of such vessels into their registry. Barring such a nation's ships from trade and/or ports of other states is one such measure.

In regard to crew qualifications, the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers, 1978 is a step in the right direction, but we must follow through with it and improve upon it. All nations should be striving for a set of uniform standards for crew examination, physical fitness, and a demonstration of practical competence by officers, perhaps by means of simulators.

In addition, special endorsements and examinations should be required for various categories of ships and ship sizes. Licenses should be issued for a specified term and require a physical examination for renewal as well as some proof of current competency either by certified service or by examination.

Nations must recognize that while there is nothing inherently wrong with the use of reciprocity in the issuance and acceptance of licenses between nations, checks and safeguards must be employed. First, before any nation issues a license on the basis of another nation's license presented by an applicant, it must establish the authenticity of the credentials and satisfy itself as to the good character of the applicant. While such a background check may take time and cause inconvenience, such problems can be minimized by making the initial license issued a temporary one good for only a very short period. During this period the applicant is investigated, and the license is either revoked, allowed to lapse, or replaced by a permanent one.

It is far cheaper and easier to prevent a tanker accident than it is to clean up the pollution following a loss.

Second, when nations cancel licenses or take other major disciplinary action, they should ensure that information regarding such actions is made readily available to other nations. Such action will make it much more difficult for crewmembers to evade punishment by holding licenses from multiple nations.

In regard to vessel condition, a worldwide system of vessel standards and inspection procedures should be established. These standards and procedures should be developed and detailed at the government level.

The inspection of vessels can be left in the hands of classification societies but must be monitored and spot-checked by government-employed inspectors. Any inspector, either government or privately employed, should be certificated and appointed only after careful screening and examination. Lapses of performance by such personnel should be dealth with by fines, suspensions, or revocation of appointment, as appropriate. Classification societies' operations must be carefully monitored and controlled. Any conflict of interest between their responsibilities as inspectors and their responsibilities as agents of shipowning firms must be prevented by regulatory action, if need be.

Since age is a significant factor in the frequency of serious tanker casualties, special programs of inspection and monitoring must be devised for older tankers. Inspections of such vessels must be more frequent and more detailed.

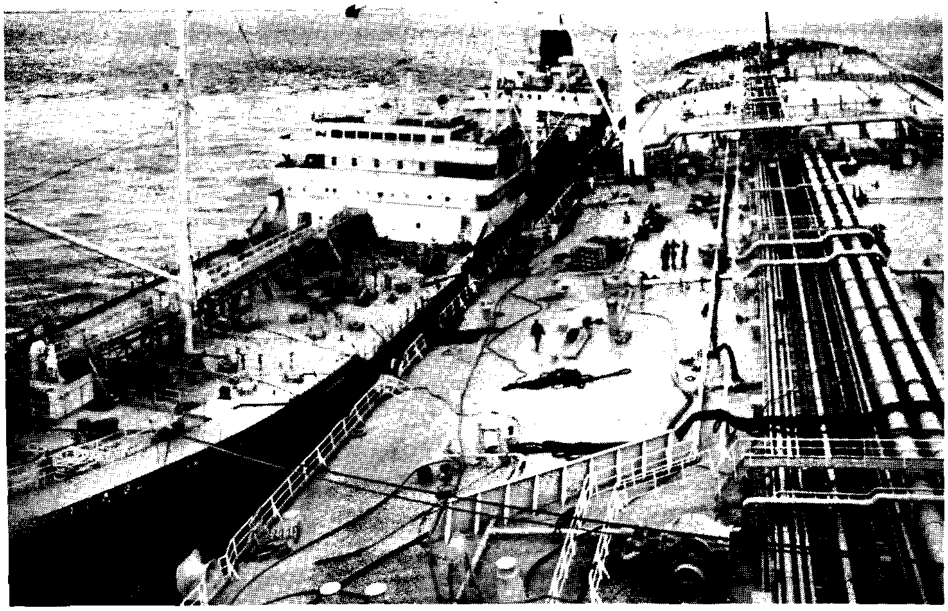
The question of whether such measures are taken may prove to be crucial in the immediate future. The world tanker market is fragmented, and tanker demand has changed drastically. Supertanker supply exceeds demand because of the great number of small cargoes being moved. Consequently, new supertankers are operating at a loss while older, smaller tankers are making profits. If this situation continues, the number of older and smaller tankers being kept in service will increase.

If this situation and its attendant problems are to be resolved, classification society inspections must be backed up by a program of government-conducted inspections. Such inspections can and do have an effect. After 18 months of operation, the tanker boarding and inspection program of the U.S. Coast Guard showed distinct results. The number of safety violations found decreased, and many tankers cited for numerous safety violations left the U.S. trade.

Governments should also recognize that all nations and particularly coastal nations have a vital interest in preventing tanker losses. Since economic and environmental concerns often conflict, governments should be prepared to intervene as necessary. The actions in this regard taken by the French and Somalian governments in hiring salvage tugs to stand by dangerous traffic areas is one such step. It is far cheaper and easier to prevent a tanker accident than it is to clean up the pollution following a loss.

I recommend a program in which governments would agree to cooperate and share the costs of salvage equipment and facilities. For example, it would be in the best interests of many nations to avoid accidents in the English Channel. It would thus appear advisable for a number of countries to collectively agree to provide and fund the equipment and facilities necessary to ensure adequate protection for this area. Another action, suggested by salvage expert, is that certain areas and ports be designated and equipped as havens and refuges for stricken tankers. Such action would reduce confusion and facilitate the salvor's task.

The role of the International Maritime Organization also requires modification. IMO should be given the power to monitor and enforce compliance. Member nations should no longer be allowed to make only a show of compliance. The Maritime Safety Corps should be expanded and its present passive and advisory role modified so that the Corps would function as an inspecting and monitoring agency, reporting noncompliance and violations by member nations. IMO should be given authority to use fines, suspension, and expulsion against members that do not comply with the safety measures that have been ratified.



The 206,000-ton VLCC on the right dwarfs the 19,000-ton tanker which has come to off-load its cargo. The VLCC was carrying 1.58 million barrels of crude oil before it ran aground; 300,000 leaked into the water, polluting 40 miles of shoreline.

The achievement of these goals is bound to be difficult because of the politics involved. IMO is a political creation and politically motivated. If the United States, Canada, France, and other safety-oriented nations use both their political power and their economic power, however, they can force changes to be made. The developed nations which regulate their fleets possess tremendous economic and political leverage. It is the attitude of the United States and France and their threats of severe unilateral action that have created an atmosphere in which certain conventions and expensive retrofitting measures have been accepted in the name of safety.

Long-term Actions and Future Research

My study pointed to two areas of research which should be explored further: information on casualties and the role of human factors.

We lack detailed, usable information on maritime tanker casualties. This situation has become serious enough to justify concern and discussion at a major conference of the tanker industry, the Safe Navigation Symposium held by the Oil Company International Marine Forum in January 1978. The data that are available are all too often incomplete or outdated, making analysis difficult. Further, there is a lack of standardized definitions and terminology. As a start, we need a commonly accepted definition for "serious accident." Since it is impossible to cope with every possible contingency, we must have a system of priorities to help us distinguish between major and minor concerns.

We also need to develop common and accepted definitions for vessel class and size limits so that it will be easy to use data from differing sources in an efficient manner. Without such standardization, it is difficult, if not impossible, to use data derived from different sources.

Finally, information is required in sufficient detail to enable us to answer the following questions about any tanker accident:

- What caused the accident? (Human error, mechanical, failure, etc.)
- What type of accident resulted? (Grounding, collision, etc.)
- What events followed the accident? (Oil spill, explosion, etc.)

- What damage and losses were involved? (Loss of life, structural damage, environmental damage, etc.)

- What secondary factors may have contributed to the accident? (Weather, navigation aids, etc.)

If these questions are to be answered, we need an orderly and systematic method for collecting casualty information. While not intended to be exhaustive, the following list, developed by William O. Gray, Senior Adviser for Marine and Terminaling at Exxon Corporation, shows what type of information is essential for proper analysis of a tanker casualty.

Human factors

Was the Master on watch?
If not, who was in charge of watch?
His rank
His training and experience
Fatigue factor
Was a pilot aboard?
If so, did the pilot have the conn?
Were proper procedures followed?
Training and experience of crew
What country issued the original license?

Vessel factors

Design (clean tanker, dirty tanker, combo)
Size
Product on board (crude, refined, etc.)
Equipment status (navigation, cargo, machinery, etc.)
Maintenance and repair status (age, overall condition)
Flag of registry

Environmental factors

Time of accident
Weather conditions
Location (at sea, coastal, in-port)
Other vessels involved

The human side of tanker casualties has been seriously neglected. While almost all authorities agree that human error is a major cause of tanker accidents, little has been done to identify the reasons why this is so or what steps could be taken to improve the situation.

I believe that we should take the aviation industry as a model. The human factor has long been recognized as a crucial ingredient in any aviation safety program, and large amounts of time and effort have been devoted to its study. A similar approach should be adopted in the maritime field, and the concept of human factors should be accepted as one of major importance. We need to objectively study human factors in the context of the design and operation of tankers. Further, it is absolutely essential that more work be done in the area of the Master-pilot relationship, a relationship that appears to be a particularly frequent factor in casualties.

Implications

I concluded from my study that the major factors in the frequency of oil tanker accidents are:

Who owns the tanker?
In what nation is it registered?
How old is the tanker?

The implications of the importance of these factors are somewhat ominous. The first generation of VLCCs is already in the over-10-years-of-age category and in a few years will be reaching the 16-and-over age group. The first ULCCs are now entering the 10-years-and-over category, and some are already being sold off or scrapped. If these huge vessels are allowed to deteriorate and nonetheless remain in service, the potential for disaster will be great.

While the statistical data in my study goes only as far as 1977, events since then have been far from encouraging. Oil tanker accidents hit a new high in 1978 and then went even higher in 1979, the worst year ever for tankers. Major accidents alone accounted for the loss of 12 tankers totaling over 1.9 million deadweight tons.

Unless things change, society faces a twofold threat. Many tankers entering the dangerous-age categories are of increasingly large size. Thus, when they get into trouble they are harder to save or salvage. Since they also contain more oil, they pose a bigger pollution threat.

A Closing Note

My research indicates that oil tanker accidents can be minimized. While it is not reasonable to expect that there will never be an accident, preventive measures can reduce the risks involved in this type of operation. Liquefied natural gas tankers, for example, have a very good safety record *(see the article beginning on page 305)*. Recognizing the potential for disaster presented by their cargo, the owners, insurers, operators, and crews of the LNG ships have worked together to develop a set of stringent standards for the design, construction, and operation of these ships as well as equally strict standards of qualification and training for their crews. Since 1959 these vessels, 10 in number, have made over 2,700 voyages with only one serious incident and without the loss of a single vessel. In the one serious incident that did take place, the grounding of the LNG carrier EL PASO PAUL KAYSER, experts agree that the extensive training and preparation that had gone before prevented a major disaster.

(For a discussion of the safety record of chemical tankships, see box below.)

If the lessons from this study are taken seriously, future research is carried out, and corrective actions are taken, there is no reason why equally impressive results cannot be accomplished with oil tankers. On the other hand, if it is felt that no special measures need to be taken and that maintaining the "status quo" is an acceptable course of action, the future can hold only an increasing number of tanker accidents. ⚓

High risks make for a low casualty rate

Chemical tankships have an admirable safety record. This is perhaps surprising in view of the potential hazards associated with shipping chemicals. The transport of chemicals is more complicated than the transport of oil (crude/product) for a number of reasons:

- First, the primary hazard to be dealt with on crude/product tankers is flammability. Chemicals, on the other hand, may be not only flammable but also toxic, corrosive, self-reactive, and reactive with water, air, and common materials of construction.
- Second, unlike crude/product tankers carrying one or two products (exhibiting similar hazard characteristics), the chemical tankship may carry 10 to 20 different products on each voyage, some of which may be flammable, some of which may be toxic, and some of which may be reactive.
- Finally, it is common practice for chemical tankships to change cargoes from voyage to voyage. In many cases, this calls for tank cleaning procedures even more sophisticated than those used on crude/product tankers.

These differences, and the complications which they can cause, pose threats to the safety of personnel and the environment beyond those posed by crude/product tankers. The transport of chemicals thus requires measures of control beyond those provided by the Safey of Life at Sea (SOLAS) convention.

The Coast Guard regulates the shipment of chemicals in bulk on chemical tankships in Part 153 of Title 46 of the Code of Federal Regulations (46 CFR 153), "Safety Rules for Self-Propelled Vessels Carrying Hazardous Liquids." These regulations implement the internationally accepted standards of the International Maritime Organization (IMO) Chemical Code. All foreign-flag vessels transporting bulk chemicals and liquefied gases in U.S. waters are certificated and inspected under the Letter of Compliance (LOC) program administered by the Coast Guard's Marine Technical and Hazardous Materials Division. This program ensures that, for each chemical to be carried, the ship meets the design standards specified in the IMO Chemical Code and 46 CFR 153. These standards cover ship type, tank type, venting, tank environmental control, electrical instrumentation for hazardous areas, level control, vapor leak detection, and firefighting systems. The standards are maintained by stringent regular inspections of the LOC ships by local marine inspectors.

The LOC program, combined with the relatively young age of the present chemical tankship fleet and the industry's incentive to protect its sizable investment in the design and operation of chemical tankships, has served to effectively counteract the risks inherent in transporting chemicals by ship.

How Mobil Manages to Improve Safety

by Captain J. V. Caffrey, USCG (Ret.)

In the never-ending attempt to reduce casualties and polluting incidents at sea, most ship operators have adopted safety programs of varying styles and content. Many attempts to improve safety have been ad hoc in nature, made in response to the crisis of the moment, whether it be "radar-assisted collisions," "intentional discharge of tank washings," "propulsion failures," or the like. While many such responses have served their purpose, this approach lacks the element of planning and anticipation which is so vital to achieving the goal of safer and cleaner seas.

Accordingly, we at Mobil have chosen the word "comprehensive" as best describing the desired approach to safety. We view safety in its broadest sense. In marine operations, safety is made up of the following elements: the ship and its hull integrity, the machinery/equipment and its proper maintenance, and the people (crew) and their competent performance. None of these components can be treated in isolation if we are to achieve the desired degree of safety. Interwoven in our safety concept are the related concerns of industrial hygiene and protection of the environment.

Although all of this might sound like a cumbersome package, it is in reality a very manageable one. Safety can be defined as "the control of accidental losses." Unsafe conditions, known or deduced, can be addressed by new strategies and actions which we can plan, program, and budget for. Planning enables us to apply risk-analysis techniques to come up with preventive measures of acceptable cost. Such measures might range from discontinuing a practice or operation at one end of the spectrum to retaining the practice but introducing engineering controls at the other, with various safeguards and precautions in between.

Such a scheme requires the participation of a large number of players. Continuing communication among them is a must. Within Mobil, the broad corporate directives on safety are written down in a series of Management Guides containing general requirements applicable to all facilities and affiliates. Compliance is effected through safety groups in each of the divisions. In marine transportation, experienced personnel serve as both vessel inspectors and program administrators.

The Program

For any company operating tankers, towboats, and barges worldwide, incidents involving injuries to personnel, occupational illness, marine property damage, and marine environmental pollution are always a possibility. The goal of the Mobil Marine Safety Program is to minimize the frequency and severity of such incidents.

The principal elements of Mobil's Marine Safety Program are:

1. Vessel safety inspections
2. Vessel industrial hygiene inspections
3. Crew training in safety-related skills
4. Coordination of ship/shore safety meetings

This article was adapted from a paper delivered by Captain Caffrey at the 1982 American Petroleum Institute Tanker Conference, held May 9 - 12, 1982, in Boca Raton, Florida. Captain Caffrey is Manager of Maritime Relations for Mobil Oil Corporation.

In support of our safety program, we also:

1. Participate in government and industry forums,
2. Assist in the development of new technology in safety and industrial hygiene,
3. Assist fleet managers in special circumstances,
4. Analyze accident/injury statistics,
5. Implement performance recognition programs, and
6. Produce safety and health publications.

I have chosen three of our activities to describe in greater detail.

Vessel Inspections

On-board vessel safety inspections are conducted on all Mobil-owned vessels. The tasks assigned to the inspector are as follows:

TASK ONE: To ensure that safe practices and procedures are followed in all operational and maintenance matters

TASK TWO: To ensure that hazards to personnel are reduced to the minimum possible levels

TASK THREE: To ensure that all lifesaving and fire protection systems operate and are in conformance with the standards of the Mobil Tanker Manual and are maintained in satisfactory material condition

TASK FOUR: To report on noted deficiencies and assist fleet managers in instituting corrective actions

Walter C. Mink, Jr., President, Mobil Shipping and Transportation, accepts the AMVER Award from VADM R. I. Price, USCG.

The interaction between our safety inspectors and ship's personnel is of paramount importance. Our men go aboard not so much to find out what is wrong but, together with the Master and crew, to identify weaknesses which can be eliminated. We attempt to create an atmosphere in which all issues will be voluntarily disclosed and corrective actions amicably initiated. We strive to increase safety awareness and get across the message that safety and good seamanship are synonymous, so that the benefits of the inspection visit endure beyond the visit itself.

The time the inspector spends on board ship with the crew and hardware is the single most important part of the program. The inspector will join a vessel for three to five days, which will include both in-port and at-sea periods, enabling him to observe the interaction of people and hardware over the full range of vessel operations. Although this inspection is personnel- and equipment-oriented, the examinations include walk-throughs of all available spaces within the ship so that the inspector can examine general material conditions as well as the operating status of the firefighting, lifesaving, and other emergency systems. The status of such health-related features as sanitation, noise levels, toxicity, light, heat, and vibration is also noted. All vessels are scheduled for a full industrial hygiene baseline survey. On these surveys, the safety inspector, who is qualified as an industrial hygiene monitor, is accompanied by a certified industrial hygienist from the corporate staff.

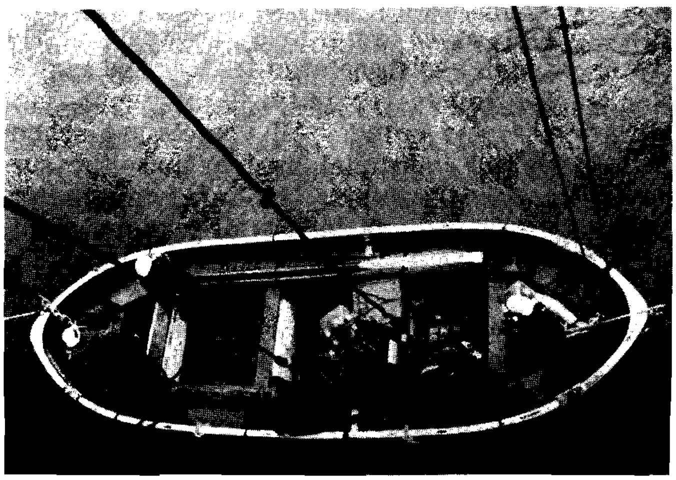
All pertinent observations are recorded. For this purpose we have developed a standard inspection-report pamphlet which is completed by the inspector during the trip. He notes his findings and includes suggestions for improvement, as may be appropriate. His comments are not limited to negative findings; he will also report, for example, that an observed operation, such as mooring, taking a pilot on board, or transferring cargo, was handled in conformance with the doctrine of the Mobil Tanker Manual (our comprehensive manual prescribing all shipboard functions).

Prior to leaving the vessel, the inspector will discuss his findings with the Master. Since deficiencies may have been identified, the key to the success of the program is handling the matter in such a way that the whole event is viewed as being of benefit to the crew and the ship. The report is sent to the fleet managers, who review it with their staffs and determine the action to be taken. Some items are referred back to the ship to be carried out, others to purchasing agents for contracting. Still others are deferred until the next shipyard repair period. In any case, the safety group is kept informed and is able to maintain a progressive record of each Mobil vessel.

. . . safety and good seamanship are synonymous . . .

The credibility of the program derives from evidence visible to the Master and crew that action is taken, at whatever level is appropriate, to put deficiencies in order at the earliest practicable time.

We emphasize the progressive nature of the operation. The first inspection is the most difficult. Later inspections benefit from the prior documentation and the records of interim actions. The frequency of inspections serves to preclude the unexpected, and we normally do not uncover any major defects.



A standard criticism of lifeboat drills is that they are pointless if later, during an emergency, the lifeboat is frozen in the davits or the engine does not work. In Mobil's drills, boats are lowered into the water and their engines tested.

Crew Training

Tasks to be carried out under this part of Mobil's safety program are:

TASK ONE:	To conduct training in safety, health, and emergency procedures with the crew during vessel inspection visits
TASK TWO:	To provide a resource to serve with industry groups which are developing training programs and courses
TASK THREE:	To promote the assignment of key personnel to shoreside training facilities such as firefighting, medical assistance, radar, and tanker safety schools

Training's tie-in to safety is that the crew must be able to perform in an organized and efficient manner with the equipment at hand. Training is therefore an ancillary function to inspection. Safety instruction is provided in asociation with emergency drills and exercises, abandon-ship procedures, and the use and handling of all firefighting and lifesaving equipment. Emergencies are simulated to give crewmembers realistic experience. Some drills are scheduled beforehand and are conducted to satisfy company and regulatory requirements. Others are unannounced and serve to test readiness in unexpected emergencies. In all cases, critiques following the drills are used to evaluate the benefits derived, as well as identify any deficiencies of conduct or equipment. Any action to be taken is instituted before the shiprider disembarks. The appearance of the safety inspector on a periodic basis encourages automatic response in all of the above areas.

In our view, refresher training has no equal.

Great emphasis is placed on the need for firefighting training, both aboard ship and ashore at fire schools. Our aim is to see that all Mobil crews are trained and confident firefighters. Other shoreside training stresses bridge organization (teamwork) and voyage planning. Recognizing that collisions and groundings are two of the most prevalent types

Watch Officer Siegfried Zoernack helps adjust a Draeger compressed-air breathing apparatus on the back of the No. 1 pumpman during a lower level pumproom rescue drill. Later, he instructs and directs crewmembers after the "victim" has been recovered from the lower level of the pumproom.

of casualties, the vessels' navigating teams are all given the chance to work with shiphandling and radar simulators. In our view, refresher training has no equal.

Over the past five years, Mobil's training budget, on the average, has exceeded $500,000 annually. We believe that we can attest to value received.

Performance Recognition

No program can succeed without a strong demonstration of support from top management. If efforts to improve safety go unrecognized, employees will rapidly lose interest—or remain indifferent from the start. Although we do not employ any of the incentive or reward programs, we acknowledge excellence in the area of safety in a number of ways. Among these is our participation in the National Safety Council and American Institute of Merchant Shipping awards contests, which bring winners the recognition of their peers. The AMVER system for ship locating is another program where faithful participation is recognized. In addition, we have internal programs. Lesser but still noteworthy performance is recognized by modest, company-styled awards, such as framed photos of the ships involved. All activities in connection with the presentation of these awards are photographed, and an account of them appears in Mobil publications. Since formal initiation of the Marine Safety Program, the number of awards earned has been on the rise.

Conclusion

Mobil's comprehensive approach to shipboard safety attempts to incorporate all significant elements of marine safety. We believe that safety should be managed like any other company function. The safety effort should be planned and organized to achieve desired results.

It must be recognized, however, that safety is difficult to quantify. Questions arise as to whether the perceived dividends justify costs. The issue is further clouded by international conventions and domestic regulations which impose costs separate from those of our own programs. How do the results of enforced measures compare to those of voluntary schemes? Things of this nature make it difficult to develop proposals for management decisions.

We suggest that safety planners sketch a basic outline, perhaps patterned on the Mobil Plan. Resources can then be allocated according to the size of the fleet and the disposition of top management. Given the cooperation and encouragement of the senior people, it is a simple matter to insert the appropriate resources (dollars and people) to arrive at a suitable plan.

Our methods parallel those advocated in the "Code of Good Management Practice in Safe Ship Operation," published jointly by the International Chamber of Shipping and the International Shipping Federation. These organizations, like Mobil, stress the importance of communication up and down the line from senior shoreside management to junior shipboard rated personnel.

By adopting these concepts, we have affirmed our commitment to safety. Has the "payback" met our expectations? Thus far, we are pleased with the results; the record is good. Not that we are satisfied to the point of complacency—our efforts must be ongoing and improvement continually sought. At the moment, however, Mobil ships are safe places to work; they are not polluters, and we have had no record of any recent casualties. We are doing our utmost to keep it that way.

Companies or individuals wishing to know more about Mobil's Marine Safety Program should contact Captain Caffrey at Mobil Oil Corporation, Marine Transportation Department, 150 East 42nd Street, New York, New York 10017; (212) 883-5548. ⚓

The following two items are reprinted with permission from the Chevron Shipping Company's Safety Bulletin.

Cover up and Button up for Safety under Bridges

In March 1982, an explosion occurred on a coastal gasoline tanker while it was passing under New York's Williamsburg Bridge. The explosion killed the Chief Engineer and sank the vessel in the East River.

The tanker was empty at the time, having discharged its gasoline cargo earlier. It was reported that the cargo tank hatches were closed but not dogged and the ullage screens were in place on the open ullage holes. The explosion was linked to "hot work" construction on the bridge. It was theorized that slag or sparks fell from the bridge and ignited cargo vapors at the tanker's deck.

* * *

A fleet manager recalls a trip on the Connecticut River aboard a gasoline barge many years ago. It was July 4, and the local kids celebrated by tossing lighted firecrackers onto the barge from a bridge.

* * *

Tanker people should keep in mind that whenever their vessel passes under a bridge it is a potential target for objects dropped or thrown from the bridge; the danger is the same whether it happens by accident or on purpose.

Take commonsense precautions for safety under bridges. Secure the cargo tanks and get under cover.

Someone up there may be careless—or may not like you.

Tend the Lines

A recent accident involving a VLCC (non-Chevron) at a crude terminal (also non-Chevron) illustrates the extent of damage that can result from inattention to mooring lines.

According to the report, the VLCC was alongside a jetty, discharging. The vessel moved out of position and, in the process, broke a loading arm. Crude oil flooded onto the vessel and the jetty. Fire broke out.

The vessel was taken off the jetty, and the fire aboard was brought under control by ship's staff. The jetty was almost totaled by the fire. The damage was estimated at $12 million, and the jetty was put out of service for one year.

The Officer of the Deck on a tanker moored alongside and transferring cargo has to be ready to anticipate changes in tide, wind, and current, alterations in draft, and the effects of passing traffic on his vessel's moorings.

He must take whatever measures are necessary to ensure that his vessel is kept secure to the berth.

He must tend the lines. ⚓

The LNG Peril: Fact or Fiction?

by Robert J. Lakey

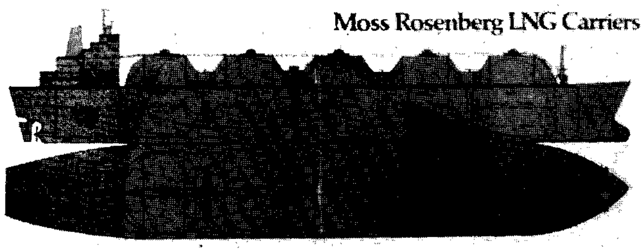
From the beginning, safety has been the major consideration in liquefied natural gas shipping. This is best evidenced by the excellent safety record the industry has established. Yet, no other form of shipping has come in for greater criticism. LNG accidents seem to be a favorite subject of writers of disaster epics. Such fictional accounts, while they make for gripping reading, are based on improbable premises and do not reflect industry practices. The purpose of the following article is to present an overview of the LNG shipping safety record. It is the author's hope that it will eliminate any doubt as to its excellence.

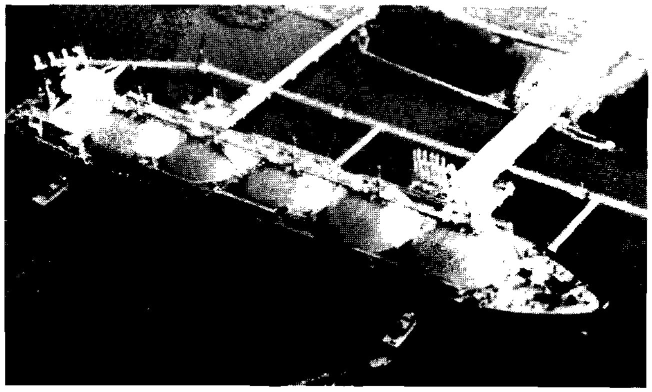
The technology involved in transporting LNG had its start near Lake Charles, Louisiana. There, some 30 years ago, a group of scientists and engineers gathered under the sponsorship of the Union Stockyard of Chicago to investigate the possibility of transporting LNG by barge. The project's plan was to liquefy natural gas and transport the LNG by barge to the stockyard. The stockyard planned not only to use the LNG as fuel but also to make use of its "cryogenic value" (or low temperature) in refrigerating its meat. This far-sighted project did not come to fruition, but it did establish many of the basic guidelines followed in LNG ship design today.

The first shipment of LNG took place in 1959 when the METHANE PIONEER transported 5,000 cubic meters of LNG from Lake Charles to the Canvey Island terminal located just outside London in the Thames River. The METHANE PIONEER used a cargo containment system that can be considered a direct offshoot of the earlier Lake Charles investigation. The METHANE PIONEER made several trips across the Atlantic and clearly established the feasibility of safely transporting LNG by ship. (The METHANE PIONEER remained in active service for many years before being retired to floating storage service.)

The first commercial LNG project began in 1964. It involved transporting LNG from the Camel plant in Algeria to the Canvey Island terminal. Two 27,400-cubic-meter ships, the METHANE PRINCESS and the METHANE PROGRESS, were built specifically for the transport of LNG. Their cargo containment system designs evolved from the system used in the prototype METHANE PIONEER. The

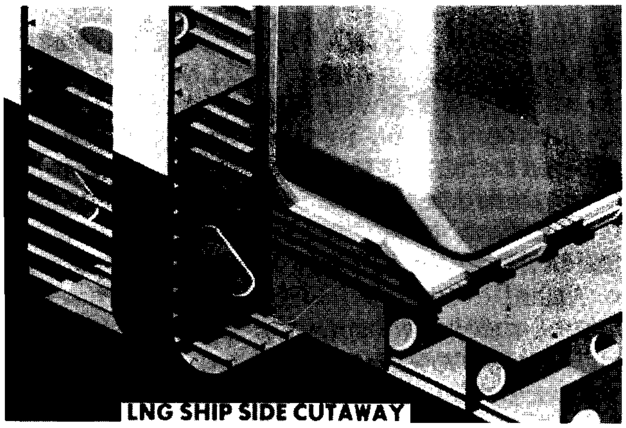
Robert J. Lakey is President of Robert J. Lakey and Associates, Inc., Marine Consultants, of Houston, Texas. *This article is adapted from a paper he delivered at the 5th Annual Energy-Sources Technology Conference & Exhibition, Pipeline Engineering Symposium, held in New Orleans March 7 - 10, 1982.*





The Moss Rosenberg spherical system has been dubbed a "no leak" tank design. Engineers have studied the system and satisfied themselves that a) any leak would be picked up by thermal and gas detection systems and that b) the design of the tanks is such that it would take years for a crack to reach the point where a tank would spill its contents.

The figure on the left shows a side profile and arrangement of Moss Rosenberg's pressure vessel-type LNG cargo tanks. The ship in the photo to the right is the 125,000-cubic-meter GOLAR FREEZE, a Liberian-flag LNG tanker built in 1977. (Ten U.S. LNG ships, built by General Dynamics/Quincy, are equipped with this system.)



This cutaway shows the side of a double-hull LNG ship. The LNG is carried in independent cargo tanks like the one occupying the upper right-hand quarter of the picture. The tank sits freely on "structural support keys," a feature which allows the tank to expand or contract with temperature changes. The layer of insulating material around the tank protects the steel used in the rest of the ship from the extremely low temperatures at which the LNG is kept. The spaces between the tank and the sides and bottom of the vessel afford the tank protection in the event of a collision or grounding. To date, no LNG tanks have been punctured in the three such major accidents which have occurred.

METHANE PRINCESS and METHANE PROGRESS have been in continuous service since 1964, making over 800 voyages from Algeria to Canvey Island. They have transported over 21 million cubic meters of LNG.

In 1965, the JULES VERNE (25,800 cubic meters) began carrying LNG between Algeria and France. The JULES VERNE remains in active service on that route today. The entry of the JULES VERNE into service marked the beginning of the French shipbuilding industry's dominant role in LNG tanker construction.

Between 1965 and 1970, LNG shipping was limited to the Algeria-Canvey Island and Algeria-France routes. This is not to say that there was no other activity; it was simply more of a planning and designing nature.

The period of greatest activity began in 1970. Two 71,500-cubic-meter ships went into service in the U.S./Japan trade, marking the beginning of the LNG supertanker era. By 1975, seven 75,000-cubic-meter LNG ships were operating between Brunei and Japan, and in 1978 the first 125,000-cubic-meter ship began to operate. During the period 1970 - 1980, some forty 120,000-cubic-meter (or larger) LNG ships were constructed or placed on order.

The period 1965 - 70 was also one of great advancement in LNG containment system technology. Engineers and naval architects throughout the world focused on LNG technology. Four basic containment systems evolved:

(1) Moss-Rosenberg Spherical System (Norway)

(2) Conch System (U.K.)

(3) Technigaz Membrane System (France)

(4) Gaz-Transport Membrane System (France)

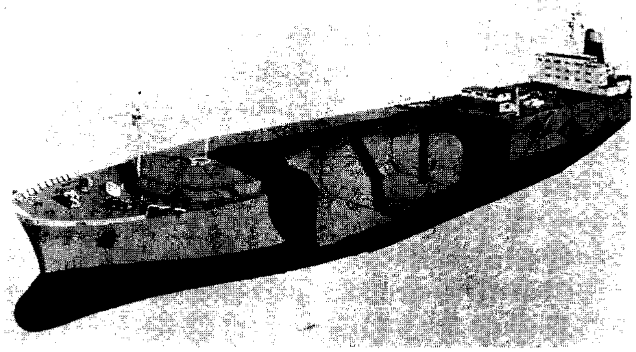
As can be imagined, when the orders were placed for the larger ships, there was keen competition between the makers of the various systems.

At the beginning of 1982, there were 71 LNG ships either in operation, laid up awaiting service, or under construction. Forty-seven of the ships have a capacity of 120,000 cubic meters or more. The breakdown by type of containment system used is as follows:

Moss-Rosenberg Spherical	23
Gaz-Transport	19
Technigaz	5

(In addition, three large ships were ordered with the Conch system. These three ships were not completed because of a failure of the polyurethane insulation.)

The operating history of the Moss-Rosenberg and Technigaz containment systems has been good. Users of the Gaz-Transport system experienced some difficulties. The difficulties did not affect the safety of the ships, but significant modifications had to be made for each ship if the ship was to remain in service. These modifications have now been made, and the ships have returned to satisfactory service.



Gaz Transport uses a membrane system for its LNG tanks; this consists of a primary barrier, a layer of insulation, and a secondary, back-up, barrier. This cutaway shows what is in essence a "two-tank system." If the inner wall is damaged, the outer tank is designed to hold all leakage. In some of the early designs, sloshing of the LNG resulted in damage to the inner tank walls. The outer wall held all leakage until the cargo could be safely off-loaded. (Current designs have substantially eliminated this problem.)

It should also be noted that there are other cargo containment systems available which have received government and classification society approval. Notable among these is the McDonnell Douglas/Gaz-Transport system. This system was designated for use in the Pacific Lighting/Alaska Project, which has yet to materialize.

The NORMAN LADY is an 87,000-cubic-meter LNG/LPG carrier. It, like the GOLAR FREEZE, uses the Moss Rosenberg system, but its spherical tanks are covered with flat plates.

The Record Today

It is estimated that since 1964 LNG ships have made over 5,400 ocean voyages, safely transporting in excess of 280 million cubic meters of LNG. (The gas equivalent is 6.2 trillion cubic feet.)

LNG is currently exported from 10 liquefaction terminals. These are located in the United States, Abu Dhabi, Algeria, Brunei, Indonesia, and Libya. There are 16 receiving terminals, located in the United States, France, Italy, Japan, Spain, and the United Kingdom.

LNG ships are also involved in several projects currently under development. Among these is the Arctic Pilot Project. This project is unique in that icebreaker-type LNG ships will be used to transport the LNG from Melville Island, deep in the Arctic, to an eastern Canadian port.

The LNG Tanker Safety Record

During the period 1965 - 1981 there were 16 casualties involving LNG tankers. The casualties are summarized in the table to the right. Among the more notable are the grounding casualties involving the EL PASO PAUL KAYSER in 1979 and the LNG TAURUS in 1980.

The EL PASO PAUL KAYSER was grounded on La Perla in the Strait of Gibraltar on June 29, 1979. The grounding caused major structural damage to the outer hull from the bow to cargo tank No. 6. The cargo tanks were not breeched, and no LNG was released. The ship was refloated and anchored off the coast of southern Spain, where the LNG cargo was safely transferred to a sister ship, the EL PASO SONATRACH. Subsequently, the EL PASO PAUL KAYSER was towed to Dunkerque, France, and repaired. It is reported that about 800 tons of steel were replaced.

The LNG TAURUS was grounded off Kammon Kaikyo, Tobata, Japan, on December 12, 1980. Its outer hull was severely damaged, causing flooding of most of the ballast tanks. However, no LNG cargo was released. Subsequently, the LNG TAURUS was refloated, and it proceeded to the Kita Kyushu LNG terminal, where the cargo was off-loaded. Afterwards, the ship steamed to a Japanese shipyard and was repaired. The amount of steel replaced is estimated at 2,300 tons.

To reiterate, while both the EL PASO PAUL KAYSER and the LNG TAURUS sustained major structural damage to their outer hulls, no LNG cargo was released in either casualty. This demonstrates the ruggedness of the double-hull construction required for LNG ships.

Of the other casualties shown in the table, the valve failure which occurred on the MOSTEFA BEN BOULAID was potentially the most serious. In this casualty, failure of a check valve caused approximately one gallon of LNG to be released. The leak sprayed the nearby deck, causing significant structural cracking in the immediate area. This casualty clearly demonstrates what kind of structural damage LNG can cause if it is permitted to come into contact with materials not capable of withstanding its extremely low temperatures. In this instance, only the excellent response of the crew in activating the emer-

LNG Tanker Casualties

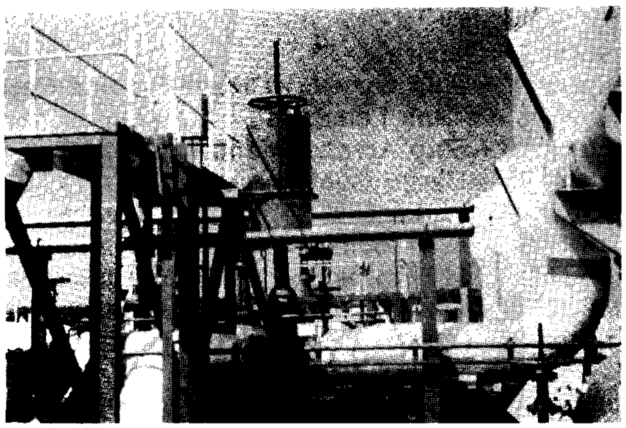
Ship	Accident or Incident
METHANE PROGRESS	Deck cracked by minor LNG spill
DESCARTES	Loss of rudder at sea; towed to port
METHANE PROGRESS	Deck cracked by spill of liquid nitrogen
JULES VERNE	Minor LNG spillage caused by overflowing of tanks
METHANE PROGRESS	Ran aground; damaged rudder
METHANE PRINCESS	Rammed at berth, Canvey Island, England
EUCLIDES	Minor damage as a result of contact with another vessel
EUCLIDES	Ran aground at Le Havre; damaged bottom and propeller
KHANNUR	Collided with cargo ship near Singapore; minor damage
LNG CHALLENGER	Struck by floating crane; minor hull damage
EL PASO PAUL KAYSER	Grounded near Gibraltar; bottom severely damaged; no LNG spill; cargo transferred to EL PASO SONATRACH
LNG LIBRA	Damaged drive system; cargo transferred to LNG LEO
LNG TAURUS	Grounded at Tobata; no LNG spill; vessel refloated and cargo off-loaded at Tobata LNG terminal
EL PASO CONSOLIDATED	LNG leakage from flange; deck cracked
MOSTEFA BEN BOULAID	LNG valve failure; deck cracked
LARBI BEN M'HIDI	LNG vapor released during transfer arm disconnect, exposing terminal employee to frostbite

The BEN FRANKLIN uses a membrane system developed by Technigaz. This "two-tank" system has a stainless steel primary barrier, balsa wood insulation, and a plywood secondary barrier. Three U.S. tankships built by Newport News Shipyard are equipped with this system.

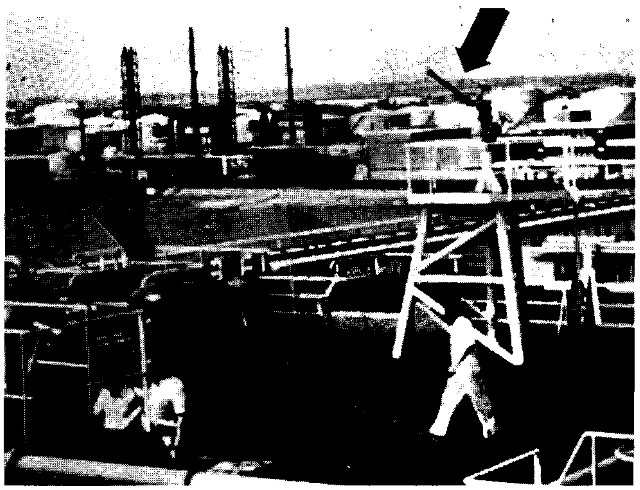
gency-shutdown system and the water-spray system kept the casualty from turning into a major incident.

As in any industry, LNG carriers experience incidents and events which are not considered accidents or marine casualties. Among these are leaking valve seals and gaskets, minor leakages from other cargo valves, and various types of equipment failures. These kinds of incidents sometimes require that operations be temporarily stopped in order to rectify the malfunction. In some instances, even small amounts (several drops) of LNG are released, but such releases are easily controlled by the water-spray systems aboard the ship.

Often in the past, the ignition of LNG vapor at the top of the vent mast has been referred to as an accident. This is an incorrect characterization. What has happened in these incidents is that LNG vapor being released through the vent system has been ignited by lighting—an uncommon, but not unexpected, occurrence. Many shipowners elect to equip their vessels with vent masts designed for such occurrences; such vent masts are fitted with extinguishing (snuffing) devices.



LNG carriers are the only tankships allowed to burn their own cargo as fuel. The vapor that builds up in the tanks would otherwise have to be vented to the atmosphere. Since the vapor is flammable, the Coast Guard has led the way in requiring LNG carriers to consume the vapor when in U.S. waters. The vapor is drawn off, heated so that the pressure builds up, and piped to the boilers. Shown in the picture here is the "remotely operated, quick-closing shut-off valve." LNG ships are required to have such a valve outside the engine room for use in emergency shutdowns.



The arrow in the upper right-hand corner points to a dry chemical firefighting monitor, while the arrow on the left points to the dry chemical storage container. The dry chemical system is intended for use in combating small fires on deck. The arrow on the bottom points to the supply for the water-spray system. Water is kept under pressure on some LNG carriers for two reasons: to disperse flammable vapors until a leak can be stopped and to cool the deck area in the event of a fire. The combination of water spray and dry chemical will serve to control minor fires, but there is no way to extinguish a truly large LNG fire (short of letting it burn itself out). Prevention of such a fire has thus been built into LNG ships in the form of additional safety features (special materials, double hulls, leak containment and detection systems, etc.).

It is also acknowledged that non-cargo-related events occur aboard LNG ships. Examples of these types of events are the various types of machinery malfunction. Such events are not normally considered marine casualties unless they lead to or contribute to a major failure of a ship.

The LNG tanker industry has an excellent safety record. There are many reasons for this; however, much of the enviable record can be attributed to the industry itself. Industry officials have realized from the start that safety must be paramount. Considerable research has been conducted on the hazards associated with LNG. In addition, industry and government cooperation at the national and international level has led to the development of a large body of legislation, standards, and codes which are applicable to LNG ship design and operation. Among the more notable are the standards developed by the International Maritime Organization (IMO). These are as follows:

The IMO Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

The IMO Code for Gas Ships contains detailed standards for the design, construction, and equipment of an LNG ship. To illustrate the breadth of the Code, its Table of Contents is reproduced at the end of this article. Notable among the many requirements is that an LNG ship must be of double-skin construction. This means that the ship has an outer hull, an inner hull, and then the cargo containment system. Double-skin construction is not unique to LNG ships; however, this design is not often used in the oil tanker industry. As was evidenced during the grounding casualties mentioned earlier, double-hull construction provides a high degree of protection for the cargo containment system.

International Convention for the Safety of Life at Sea, 1974 (SOLAS 74) and Protocol of 1978 Relating to the International Convention for the Safety of Life at Sea, 1974

SOLAS 74 and its 1978 Protocol contain the basic international standards for shipping safety. SOLAS addresses lifesaving and fire protection (passive and active), as well as navigational safety. As a result of the 1978 SOLAS amendments, there has been a substantial upgrading of the requirements for electronic navigation equipment (collision-avoidance radar is now required on the large ships), design of steering-gear systems, and safety in general. All of the requirements are applicable to LNG tankers.

In the United States, the Coast Guard administers the LNG ship standards. The Coast Guard is recognized as an international leader in LNG ship safety.

Of the Coast Guard's safety programs, two have been especially important in improving the industry's safety record. These are the ship design review and the port control programs. Through these programs, the Coast Guard ensures that all LNG ships (regardless of flag) that operate in U.S. waters do so in compliance with rules and regulations. In addition, the navigation and cargo operations of LNG ships are monitored and controlled during their time in U.S. ports.

Conclusion

The LNG shipping industry has developed an enviable safety record. The industry has willingly cooperated with regulatory bodies at both national and international levels, and stringent (but effective) legislation, standards, and codes have been developed. The safety record of LNG ships should come as no surprise. This is an industry where safety and reliability of service are considered inviolate.

The challenge that lies ahead for the industry is to maintain its excellent safety record.

IMO Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

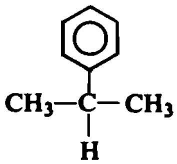
Table of Contents

Cumene: $C_6H_5CH(CH_3)_2$

This is the final article in our series of four discussing derivatives of the chemical benzene.

Synonyms:	isopropylbenzene 2-phenylpropane cumol
Physical Properties	
boiling point:	152°C (306°F)
freezing point:	-96°C (-141°F)
vapor pressure at	
20°C (68°F):	8 mm Hg
38°C (100°F):	10 mm Hg
Threshold Limit Values (TLV)	
time weighted average:	50 ppm; 245 mg/m^3
short term exposure limit:	75 ppm; 365 mg/m^3
Flammability Limits in Air	
lower flammability limit:	0.9% by vol.
upper flammability limit:	6.5% by vol.
Combustion Properties	
flash point (o.c.):	25°C (77°F)
flash point (c.c.):	44°C (111°F)
autoignition temperature:	424°C (795°F)
Densities	
liquid (water = 1.0):	0.86
vapor (air = 1.0):	4.14
Identifiers	
U.N. Number:	1918
CHRIS Code:	CUM
Cargo Compatibility Group:	32 (Aromatic Hydrocarbons)

Cumene (CUE-mean) is a clear, colorless liquid that is used largely as a chemical intermediate—a substance formed as a step in the production of another substance. Ninety percent of the cumene produced today is used in the making of the chemicals phenol (the caustic, crystalline alcohol derivative of benzene used in such things as disinfectants and pharmaceuticals) and acetone. The majority of the remainder is used in the production of alphamethylstyrene, an ingredient in resins. Minor amounts are used as a solvent or are added to gasolines to improve octane ratings. In terms of volume produced, cumene ranked 31st among chemicals in 1981, according to the May 3, 1982, issue of *Chemical and Engineering News.* In the most commonly used production process, pure cumene is derived from a benzene-propylene reaction.



Cumene is one of the "aromatic hydrocarbons." As such, it has a distinctive odor. In their vapor form, most hydrocarbons (organic compounds made of carbon and hydrogen) are heavier than air. Cumene, although it produces relatively little vapor, is no exception. This means that its vapor will sink to the ground or deck and, if it comes into contact with a source of ignition, could "flash back" to its source and set the entire container of cumene afire. Effective firefighting agents are water spray, dry chemical, foam, and carbon dioxide. Firefighters should use respiratory protection such as a self-contained breathing apparatus and full protective body clothing.

Cumene can affect the body through skin and eye contact, ingestion (swallowing), and inhalation. The effects of short-term overexposure are irritation of the skin, eyes, and upper respiratory tract. Dizziness, incoordination, drowsiness, and unconsciousness may occur. Long-term skin exposure may cause a skin rash. Cumene can be absorbed through the skin more rapidly than any of the other three chemicals in this series and is considered a primary skin and eye irritant. Cumene has also been shown to be a potent narcotic when inhaled, but this problem is mitigated by the combination of its low vapor pressure and low odor threshold. A substance with a high vapor pressure would rapidly evaporate and saturate the air; cumene, on the other hand, is unlikely to be inhaled in significant amounts because it is very slow to vaporize. The low odor threshold (a mere 1 - 2 parts per million will serve to alert someone of cumene's presence) is well below the exposure limits prescribed by the American Conference of Governmental Industrial Hygienists.

To protect themselves from exposure to liquid cumene, personnel should wear impervious clothing, gloves, and face shields/splash-proof safety goggles. Contaminated clothing should be removed and thoroughly washed before being reworn. Affected skin areas should be washed with soap and water. The eyes, if affected, should be flushed with plenty of water. In cases of ingestion, vomiting should not be induced because of the danger of aspiration, which could lead to lung congestion. Inhalation overexposure (which might be a problem in an enclosed space, where the vapor could saturate the air) is treated by removal of the victim to fresh air and, if necessary, artificial respiration.

Cumene is regulated by the U.S. Coast Guard as a Subchapter D commodity, Grade D flammable liquid. The International Maritime Organization (IMO) does not regulate cumene carried in bulk.

Throughout this series of articles, we have attempted to show that several chemicals related to benzene do not exhibit benzene's chronic (long-term) health hazards. To be sure, each of these chemicals has its own hazards, and these hazards are such that if you might be exposed to the chemicals you should treat them with respect. If you recognize and understand the hazards presented by the individual chemicals, you can easily avoid them, generally by simply exercising some common sense. This applies to just about any chemical commodity you would care to name. In other words,

read the Cargo Information Cards

and

don't drink the chemical,
sniff it,
or swim in it.

Hazard Evaluation Branch
Marine Technical and
Hazardous Materials Division

Tank Coatings

Don't Hazard a Guess on Hazards

by LT M. J. Pontiff

LT Pontiff was recently transferred from the Marine Safety Office in Port Arthur, Texas, to the MSO in Hampton Roads, Virginia.

While working at MSO Port Arthur, I learned that several of our Coast Guard Marine Inspectors were concerned about health hazards connected with exposure to certain marine protective tank coatings. Questions about such hazards usually arise during an internal examination of a ballast tank or void on a vessel that has been in service for a while. This is particularly applicable to the inland and offshore tank barges in the Gulf Coast area, where the owners have had the steel bulkheads and bottom plating coated to prevent deterioration. When the vessels are in a shipyard for routine maintenance and dry-docking, the tanks are coated as a rust-prevention measure or recoated after hot work and repairs have been completed. We all know how *messy* it is to examine internally a ballast tank that has been coated with "inspection repellent," but what about toxicity and flammability?

I did a little research by talking to our local paint and coatings vendors and with the local Occupational Health and Safety Administration (OSHA) office. They were more than willing to help me. All of the vendors with whom I spoke provided me with Material Safety Data Sheets on their respective products. I found out that OSHA requires that such a sheet be available for all chemical compounds. I gathered several of these sheets from companies whose products I knew were used in our area. The table accompanying this article is a summary of the data on these sheets. (Of course, this is only a representative sampling.) In general, the health hazards shown are a concern mainly during the application process. However, even after the coating has been applied and cured for the proper period of time, precautions to ensure adequate ventilation and prevent the spread of fire may be indicated. This is especially important when hot work is done on a coated tank *(see this month's Lessons from Casualties section)*.

When an inspector, owner's representative, or shipyard worker is in doubt about the toxicity or flammability of a protective tank coating, he should ask to see the Material Safety Data Sheet. The sheets vary in form but, basically, all have the same information, including trade names and synonyms, manufacturer and phone number, health hazards during application, fire protection information, and any special precautions to be taken.

There is no need to guess what the hazards may be where protective coatings are concerned. Our office policy now requires that, when questions arise, Coast Guard Marine Inspectors consult the Material Safety Data Sheet before entering a coated tank. The vessel's owner may not have the data sheet readily available, but it is easily obtainable from the vendor who supplied the protective coating.

Tank Coatings Safety Data

TRADE NAME	MANUFACTURER	FLASH POINT	EXTINGUISHING MEDIA	HEALTH HAZARD DATA/ ADDITIONAL COMMENTS
1976 Rust Proof Compound L	TEXACO, INC. P.O. Box 509 Beacon, NY 12508 (914) 831-3400, ext. 406	125°F Combustible	Water spray, DC (dry chemical), foam, CO_2	Minimally irritating. Use with adequate ventilation. Avoid prolonged breathing of vapor or mist. Avoid prolonged contact with skin. Not recommended for coating the interior of potable-water tanks. Exposed employees should maintain reasonable standards of personal cleanliness. Protective goggles or face shield may be worn during appliation.
1977 Rust Proof Compound H	TEXACO, INC. (as above)	425°F	Water spray, DC, CO_2 (Caution: water or foam may cause frothing)	Minimally irritating. Not recommended for coating the interior of potable-water tanks.
1995 Floatcoat	TEXACO, INC. (as above)	325°F	same as preceding item	Minimally irritating.
Magnakote	MAGNUS MARITEC INTERNATIONAL, INC. Osborn Building St. Paul, MN 55102 (612) 293-2233	325°F	Water spray, DC, foam, CO_2. Use air-supplied rescue equipment for enclosed areas.	Mild skin irritation after prolonged skin contact. Avoid prolonged breathing of vapors. Do not store or mix with strong oxidants. Store and use away from heat, sparks, and open flames.
Bio-Kote	ESGARD, INC. P.O. Drawer 2698 Lafayette, LA 70502 (318) 234-6327	450°F	CO_2, DC	None
Bio-Gel	ESGARD, INC. (as above)	450°F	CO_2, DC	None
Interfilm Type II	ESGARD, INC. (as above)	100°F	CO_2, DC, water fog. A straight water stream will spread fire.	Use with adequate ventilation. Avoid heat, sparks, and open flames. Use a positive-pressure mask in enclosed areas during application.
Bar-Rust	DEVOE MARINE COATINGS CO. 1616 W. Loop So. Suite 301 Houston, TX 77027 (713) 626-3971	None	None	Nontoxic. Do not store under freezing conditions or apply below 45°F.
Bar-Rust 235	DEVOE MARINE COATINGS CO. (as above)	101°F	CO_2, DC	Use with adequate ventilation. Keep away from excessive heat and open flame. Applicators should be provided with suitable protective gear in accordance with U.S. Dept. of Labor's Safety and Health Regulations for Ship Repairing.

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

DECK

1. You are using an oxygen indicator to determine whether it is safe to enter a tank. The minimum percentage of oxygen that will sustain life is

A. 8%.
B. 11%.
C. 16%.
D. 21%.

REFERENCE: MTAB Firefighting Manual

2. In waters where the cardinal system of buoyage is used, you would expect to find the danger

A. lying to the south of an eastern quadrant buoy.
B. lying to the south of a northern quadrant buoy.
C. lying to the east of an eastern quadrant buoy.
D. beneath or obviously directly adjacent to the buoy.

REFERENCE: Bowditch

3. The Flinders bar is installed to compensate for

A. induced magnetism in vertical soft iron.
B. induced magnetism in horizontal soft iron.
C. permanent magnetism in horizontal soft iron.
D. residual magnetism.

REFERENCE: Bowditch

4. When a block and tackle is "rove to advantage," this means that the

A. blocks have been overhauled.
B. hauling parts of two tackles are attached.
C. hauling part leads through the movable block.
D. hauling part leads through the standing block.

REFERENCE: Merchant Marine Officers Handbook

5. The celestial coordinate of a star that is relatively constant in value is the

A. Greenwich Hour Angle.
B. local hour angle.
C. sidereal hour angle.
D. meridian angle.

REFERENCE: Bowditch

ENGINEER

1. What is the advantage of a flash-type evaporator compared to the submerged-tube type?

A. High operating temperatures prevent a loss of vacuum.
B. Chemical feed is required only every 10 days (at a steady rate).
C. The requirement for a three-way dump valve is eliminated.
D. Low operating temperatures decrease scale formation.

REFERENCE: Harrington

2. In the event of a power failure to the salinity panel on a flash-type evaporator, the three-way solenoid valve will

A. be frozen in its last position.
B. direct distillate to the fresh-water tank.
C. dump distillate to the bilge.
D. dump distillate to the make-up feed tank.

REFERENCE: NAVPERS Engineman 3 & 2

3. If sea-feed temperature in a flash evaporator falls below 160°F,

A. distillate will be directed to the contaminated drain tank.
B. the automatic solenoid valve will direct distillate to the bilge.
C. the demesters will become scaled.
D. priming will occur in the first effect.

REFERENCE: Harrington

4. In a flash-type evaporator, heated water under pressure is converted into vapor by a sudden

A. decrease in density.
B. decrease in pressure.
C. increase in velocity.
D. increase in temperature.

REFERENCE: Harrington

5. The process of boiling sea water in order to separate it into fresh-water vapor and brine is usually defined as

A. evaporation.
B. condensation.
C. dehydration.
D. osmosis.

REFERENCE: Principles of Naval Engineering

ANSWERS

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

Lessons from Casualties

Tank Preservative Catches on Fire

by LT Ruben H. Arredondo
Marine Safety Office
Port Arthur, Texas

On February 20, 1982, a large flash fire occurred in the No. 3 port ballast tank of a Liberian-flag tanker while the vessel was moored in Port Neches, Texas. Several men were inside the tank conducting repairs on a side frame and cutting with a torch on the upper portion of the tank. Suddenly a large flash fire started in the lower portion of the tank and spread through the port bulkhead. The fire lasted only several minutes and self-extinguished. The repairmen escaped without any injuries.

The incident was reconstructed as follows: while the side frame was being trimmed, a piece of hot slag landed on a sidelong which contained residue of tank corrosion preservative ("Corrosion Master," white). The hot slag caused the residue to ignite and create the flash fire. Contributing to the casualty was the failure of the repairmen to place a fire shield underneath the repair area to prevent the hot slag from landing on the preservative.

A "gas-free" certificate for the tank had been issued the morning of the casualty, as the tank had been found to be gas-free. The marine chemist stated that he issued the certificate based on his findings that the oxygen content and the explosion level were "safe for hot work." Also, he and an owner's representative had tested the tank preservative previously and found it to have an extremely high flash point and be self-extinguishable. The following day the tank was re-examined and still found to be gas-free. There was no structural damage noted in the tank. The only damage was localized charring of the tank coating.

LESSONS LEARNED:

1. Even though most tank preservatives have an extremely high flash point, care must be taken when conducting hot work around them.

2. Flash fires from tank preservatives may be prevented by either completely cleaning the preservative underneath the repair area or placing a fire shield of noncombustible material directly underneath the repair area.

3. These precautionary measures can prevent serious injuries.

DATA ON "CORROSION MASTER" (WHITE)

Manufacturer:	Clearkin Chemical Corp. P.O. Box 14817 Philadelphia, PA 19134 (215) 426-7230
Flash Point:	375°F
Extinguishing Media:	CO_2 or dry chemical
Health Hazard:	None. It is nontoxic, non-irritating, and does not contain solvents.
Additional comments:	Product is self-extinguishable. It is recommended that a fire shield be used during hot work. ⚓

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