PROCEEDINGS
OF THE MARINE SAFETY COUNCIL

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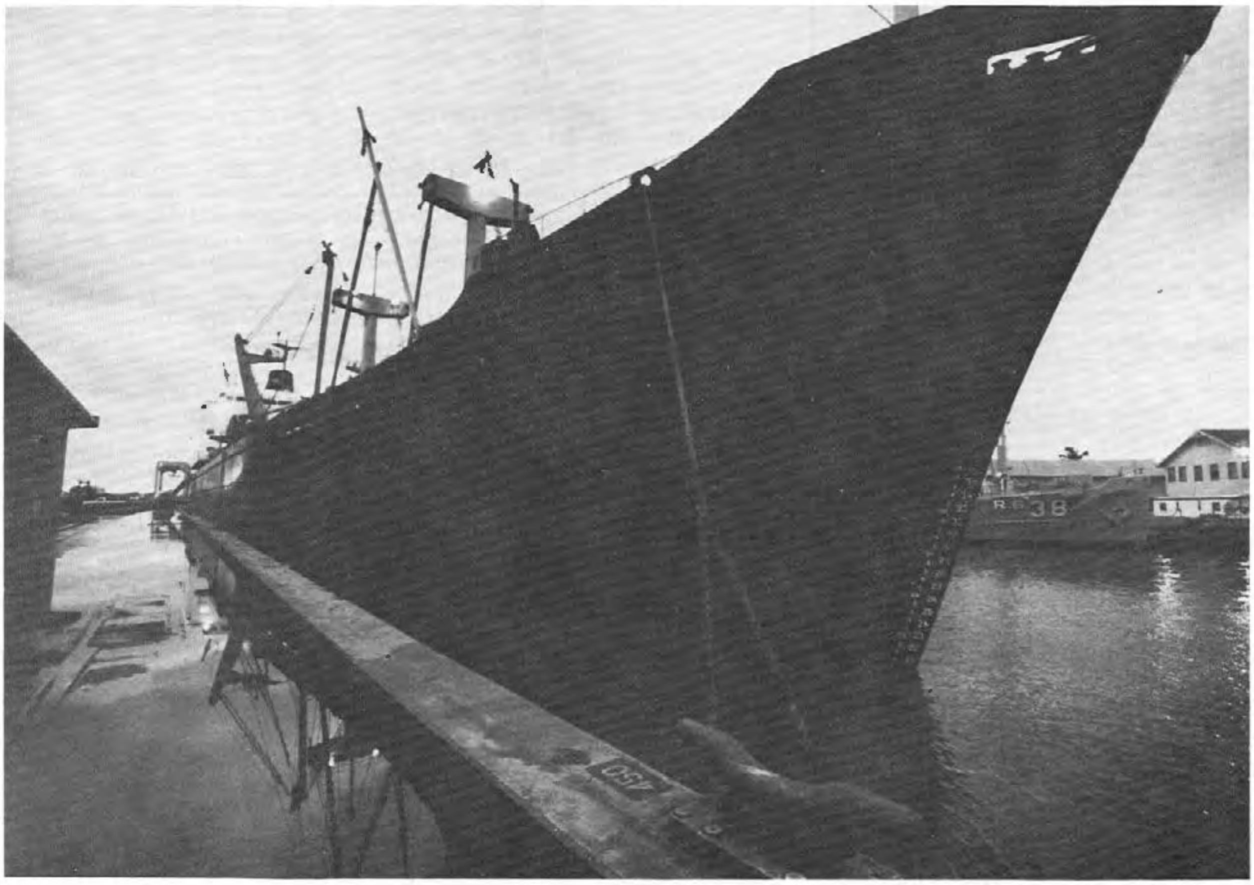

U.S. Department of Transportation **CG-129** United States Coast Guard

PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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Cover

When the Coast Guard Marine Safety Office in Honolulu was notified that the British vessel HEREFORDSHIRE needed firefighting assistance, a difficult decision had to be made: should the ship be permitted to dock at Honolulu Harbor, where chances of saving both ship and cargo would be significantly better? Or was it worth risking a possible uncontrolled shipboard fire in the harbor, which could lead to a serious pollution incident or harbor obstruction? The story begins on page 112. All photos are official Coast Guard photos, taken by Dan Morgan and Jim Harlock of the 14th Coast Guard District in Honolulu.

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THIS COPY FOR NOT LESS THAN 20 READERS— PLEASE PASS IT ALONG

maritime sidelights

NOTE TO READERS

Readers:

I've doubled this issue to make the Proceedings more current. The Government Printing Office has this magazine scheduled so it is printed and released about the third week of the month. Traditionally, the issue published at the end of each month has been dated as that month's magazine; that is, the June issue would be released the third week of June. Often, however, by the time you receive your subscription copy the date month has come and gone--right? Doubling up this time should facilitate your receipt of the Proceedings in a more timely manner.

Remember, your comments and suggestions are always welcome--that's how I found out that the Proceedings was arriving late for many readers. Contributions (articles, photographs, etc.) are encouraged. This magazine exists to provide safety information and other related material to you in the marine industry. If you have something which you feel might be appropriate for publication, please participate and send it in to share with others.

Babs Eason, Editor

SUSPENSION FOR BRIBERY

In September 1978 a merchant seaman entered a Marine Safety Office to take an examination for a "lifeboatman" endorsement on his Merchant Mariner's Document. After taking the practical test on a mock lifeboat the man was informed by the examiner that he had failed and would not be given a "lifeboatman" certificate. The applicant, apparently disappointed, offered an alternative to passing the test by asking "Is there any way that I can buy it?"

There wasn't.

A Coast Guard investigating officer promptly preferred a charge of misconduct against the seaman, alleging that he had attempted to bribe the examiner in an effort to obtain the lifeboatman endorsement. A suspension and revocation hearing, held on January 30, 1979 before an Administrative Law Judge, resulted in a finding that the seaman was guilty of ". . . using corrupting and venal language to the Coast Guard Examiner . . ." in an effort to obtain the endorsement. The seaman's Merchant Mariner's Document was suspended for four months on one year's probation.

This well prepared and effectively presented case evidences an impressive degree of professionalism on the part of the investigating officer, and a sensitive appreciation of marine safety on the part of the Command.

As the Administrative Law Judge stated in his opinion, ". . . (the examiner) performed his examination in the best tradition of the Coast Guard by assuring that the mandate of the Coast Guard to protect the lives of men and ships at sea was properly carried out. It is obvious that in a disaster at sea the duty and reliability of a lifeboatman is vital. He must thoroughly know his job as the lives of crewmembers and others can depend upon his proper functioning as lifeboatman."

Reprinted from the Commandant's Bulletin, issue 16-79.

CORRECTION

An error appeared in the answers to the Personnel Safety Problem Questionnaire, featured in the May issue on pages 82-84. Answer number 17 should be "B., False."

HAZ MAT MAPS

Tentative standardized maps for charting the release and spread of hazardous materials at transportation accident scenes were adopted May 3, 1979 by the National Transportation Safety Board.

Using the maps, the Board will overlay accident gas clouds, flying fragments from explosions, and burn patterns from fireballs on standard scale maps. The resulting plots are intended to help emergency personnel with planning as well as the actual location of police and evacuation lines during future hazardous materials emergencies.

"Accidents resulting in the tragic deaths of at least 50 firefighters since 1968 clearly demonstrate the need for improved methods of handling hazardous materials transportation emergencies," the Safety Board said. "Emergency services cannot be expected to adequately plan for and make life or death decisions at hazardous materials emergencies when information which will help them identify how a given material will probably act in a specific emergency situation is not available."

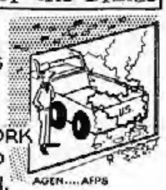
The Board's tentative maps reflect its study of accident scene patterns which varied from several hundred feet to nine miles in size. Maps employed are those of the U.S. Geological Survey.

The Board said it will use the maps to chart the scenes of appropriate hazardous materials accidents which it investigates in the future. The Board also invited each of 17 government and industry agencies and organizations to use the new maps and to share its own accident scene maps with others.

Single copies of the Safety Board's Special Report, "Standardized Hazardous Materials Maps," may be obtained without charge by writing to the Publications Branch, National Transportation Safety Board, Washington, DC 20594. Multiple copies may be purchased by mail from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22151.

Rhymes of the Times

CARELESS MOMENTS
MAY TEAR DOWN
YEARS OF WORK
AND EARNED REKNOWN.



key notes

QUALIFICATIONS OF THE PERSON IN CHARGE OF OIL TRANSFER OPERATIONS, TANKERMAN REQUIREMENTS
CGD 74-44, 74-44a

These regulations would redefine and establish qualifying criteria for certifying individuals engaged in the carriage and transfer of the various categories of dangerous cargoes in bulk.

It has been found that most pollution incidents are the result of personnel error; consequently, the minimum qualifications of persons involved in handling polluting substances should be specified.

As stated in the last issue, these projects have been withdrawn (44 FR 25243). New NPRM's which were anticipated in June have been delayed, but should appear shortly.

REVISION OF ELECTRICAL REGULATIONS
CGD 74-125

This regulation will constitute a general revision and updating of the electrical regulations to conform with latest technology. It will include steering requirements for vessels other than tank vessels.

This revision is occurring because industrial standards for electrical engineering have changed in the past few years, and the regulations must be brought up to date to reflect current industry practices.

An initial NPRM was published on June 27, 1977 (42 FR 32700). A supplemental NPRM will be issued later in 1979.

STANDARDS FOR NEW SELF-PROPELLED VESSELS CARRYING BULK LIQUEFIED GASES
CGD 74-289

These regulations adopt the Intergovernmental Maritime Consultative Organization (IMCO) Resolution, the Code for Construction and Equipment of Ships Carrying Liquefied Gas in Bulk.

The increased use of liquefied gases for energy sources has produced a dramatic increase in the manufacture and use of vessels designed for the cargo. Due to the unusual and unique hazards associated with liquefied gases, these vessels must be addressed in regulations specially tailored to their unique situation.

The final rule was published May 3, 1979 (44 FR 25986).

UPGRADE OF NEW TANK BARGE CONSTRUCTION
CGD 75-083
UPGRADE OF EXISTING TANK BARGE CONSTRUCTION
CGD 75-083a

This action is comprised of two regulatory projects centered on tank barge construction standards which resulted from a Presidential initiative of March 17, 1977, directing study of the tank barge pollution problem. One project will address new barge construction while the other will pertain to existing barges. Regulatory documents for both will be published at the same time and joint public hearings will be held.

In July 1977, the Coast Guard began a reexamination of the tank barge construction standards. It was determined that new construction would be treated separately from existing barges. An advanced notice of proposed rulemaking (ANPRM) will be issued to gather additional data and assess impacts related to existing barges.

As we go to press, the notice of withdrawal of the old NPRM and the new ANPRM are under final review by the Secretary of Transportation and should be published in early June 1979.

Public hearings have been scheduled on the dockets as follows: August 2, 1979, Washington, DC; August 15, 1979, Seattle, Washington; August 23, 1979, New Orleans, Louisiana; and September 7, 1979, St. Louis, Missouri. For further details see meetings and public hearings schedule.

POLLUTION PREVENTION, VESSELS AND OIL TRANSFER REGULATIONS
CGD 75-124a

This regulation would reduce accidental or intentional discharge of oil or oily wastes during vessel operations.

The basis of this regulation is threefold. First, there is the need to reduce the number and incidence of oil spills. Second, this regulation will help to clarify the existing rules. Finally, this regulation covers the additional requirement for oil-water separators under the 1973 International Convention for the Prevention of Pollution from Ships.

The NPRM was published on June 27, 1977 (42 FR 32670). A supplemental NPRM was published October 27, 1977 (42 FR 56625). Currently, the draft of the final rule is under legal review before publication.

OFFSHORE OIL POLLUTION FUND
CGD 77-055

This document established procedural rules concerning administration and operation of the fund, including liability limits for certain facilities, financial responsibility factors, damage claim settlement procedures, et. al.

This regulation was passed in order to implement administration of the fund by creating procedures for prompt settlement of claims arising from damage caused by oil pollution.

The final rule of this docket was published March 19, 1979 (44 FR 16860).

TANK VESSEL OPERATIONS REGULATIONS, PUGET SOUND
CGD 78-041

This regulation would govern the operation of tank vessels in the Puget Sound area. This regulation was initiated in order to reduce the possibility of environmental harm resulting from oil spills in Puget Sound. This is to be accomplished by governing the operation of tankers and reducing the risk of collision or grounding.

Continued on next page....................

KEYNOTES..................................

Secretary of Transportation Brock Adams signed a 180-day Interim Rule on March 14, 1978 prohibiting entry of oil tankers in excess of 125,000 deadweight tons in Puget Sound; this appeared in the Federal Register of March 23, 1978 (43 FR 12257). An ANPRM was published March 27, 1978 (43 FR 12840). An extension of the interim rule was published in the Federal Register in order to allow the Coast Guard adequate time to complete this rulemaking.

Public hearings have been scheduled as follows: June 11, 1979, Seattle, Washington; June 12, 1979, Seattle, Washington; June 13, 1979, Mt. Vernon, Washington; and June 14, 1979, Port Angeles, Washington.

The following three regulations make up the Tanker Safety and Pollution Prevention (TSPP) Regulations. Public hearings have been held on the package, comments were requested and 541 have been received. Final rules on this package are currently being written and are expected in late 1979.

INERT GAS SYSTEM
CGD 77-057

This regulation would require certain oil tankers of 20,000 deadweight tons and over to be fitted with inert gas systems.

As part of the President's initiatives to reduce marine pollution, this regulation will reduce the possibility of in-tank explosions which have been the cause of some pollution incidents.

The Inflationary Impact Statement for this regulation was completed in May 1977. An NPRM was published May 16, 1977 (42 FR 24874). An ANPRM was published February 12, 1979 (44 FR 8984); 136 comments have been received on the docket.

SEGREGATED BALLAST AND
TANK CLEANING REGULATIONS
GCD 77-058(b), (c) and (d)

This four-part regulation was initiated when President Carter directed the Secretary of Transportation to issue new rules for oil tanker standards, which were to include segregated ballast on all tankers and double bottoms on all new tankers which call at American ports. The provisions of these proposed regulations have been changed by the February 1978 Intergovernmental Maritime Consultative Organization (IMCO) Conference to include Crude Oil Washing (COW) and Clean Ballast Tanks (CBT).

The NPRM was published May 16, 1977 (42 FR 24868). As a result of the IMCO Tanker and Pollution Prevention Conference of February 1978, a new NPRM will be issued. This rulemaking was also mandated by the Port and Tanker Safety Act of 1978. An NPRM was published February 12, 1979 (44 FR 8984); 265 comments have been received on the docket.

STEERING GEAR DESIGN
STANDARDS TO
PROVIDE REDUNDANCY
CGD 77-063

As part of the President's initiatives to reduce pollution, this regulation is needed to help reduce the possibility of a marine collision due to a loss of steering.

An NPRM was published May 16, 1977 (42 FR 24869). As a result of the IMCO Tanker Safety and Pollution Prevention Conference of February 1978, a new NPRM was issued on February 12, 1979 (44 FR 8984); 138 comments have been received on the docket.

All comments on proposed rulemakings should be submitted to:
Commandant (G-CMC/81)
U.S. Coast Guard
Washington, DC 20590

Comments are available for examination at the Marine Safety Council (G-CMC/81), Room 8117, Department of Transportation, Nassif Building, 400 Seventh Street, SW, Washington, DC 20590; phone (202) 426-1477.

**MEETINGS AND
PUBLIC HEARINGS**

JUNE 1979

11-14: Public Hearings, Puget Sound (Tank Vessel Operations):
11: 9:00 a.m., north and south auditorium, Federal Building, Seattle, Washington.
12: 1:00 p.m.; same as address above.
13: 1:00 p.m.; Town and Country Motor Inn, Mt. Vernon, Washington.
14: 1:00 p.m. Coast Guard Air Station, Port Angeles, Washington.

20: Committee Meeting; New York Harbor Vessel Traffic Service Advisory Committee, 10:00 a.m., Conference Room on second floor of U.S. Coast Guard Marine Inspection Office, Battery Park Office Bldg., New York, New York.

AUGUST 1979

2: Public Hearing on Tank Barge Construction Standards, 9:00 a.m., room 22332 Coast Guard Headquarters, 400 7th St., SW, Washington, DC.

15: Public Hearing on Tank Barge Construction Standards, 9:00 a.m. in the Williamsburg Room, Olympic Hotel, Fourth and Seneca Sts., Seattle, Washington.

23: Public Hearing on Tank Barge Construction Standards, 9:00 a.m. in the Russel B. Long Room, Holiday Inn Superdome Downtown, 1111 Gravier Street, New Orleans, Louisiana.

Cont'd on page 110..........................

WATERBORNE COMMERCE IN THE HEARTLAND OF AMERICA

The following speech was presented by Admiral John B. Hayes to the Ohio Valley Improvement Association, Pittsburgh, Pennsylvania on October 26, 1978. Admiral Hayes was appointed the 16th Commandant of the United States Coast Guard on June 1, 1978.

In planning for my job as Commandant, I knew that very early on I would have to shape the goals and objectives of the Coast Guard for the next four years. Quite naturally, then, I have spent a good deal of time traveling about the Coast Guard . . . to feel the pulse so to speak . . . talking to as many of our people as possible and seeing the operations that were unfamiliar to me. On these visits I have also had the opportunity to meet and talk with many people in the private sector. Last September I visited our Second District, which encompasses the "river country." That trip was quite a revelation for me. I had never before looked at the inland waterways from a professional point of view; my assignments simply had not exposed me to our river operations. Indeed, I found out that the Ohio River just isn't the same as the Pacific Ocean.

The river may generate the same general concerns as our ocean approaches and seaports, but the pieces of the puzzle certainly do fit together differently. As an agency with some of those pieces, we obviously share with you some serious responsibilities. The inland waterways are a vital national asset, and facilitation of waterborne commerce in the heartland of America is a most important role.

When I first decided on a Coast Guard career, the service was far smaller than it is today. Practically everything the Coast Guard did involved ships and boats rendering assistance to the mariner. The heroic tasks of legendary cutters and surfmen had earned us the reputation as a lifesaving organization, and the hectic period of chasing the rum runners was a dim memory. Even the dramatic build-up in the size of the service during the turmoil of World War II did not change the essential character of the organization. So when I was commissioned in 1946, I entered a service almost entirely oriented to seagoing operations.

Even then, however, the seeds of change were being planted. The decision had already been made to permanently transfer the Bureau of Marine Inspection and Navigation to the Coast Guard. A new perspective of maritime safety--the elimination of life-threatening conditions on ships--became a part of the everyday life of a Coast Guardsman, along with lifesaving. Prevention, as a cooperative effort, meant that a new era of close contact with the Merchant Marine, it's operating problems, and it's economics was upon us. It took awhile to completely meld this new responsibility into our organizational fabric, but in that relatively quiet period in our history the problem could be tackled deliberately. Later, as bridge administration joined with an existing aids to navigation function, we began to look at our waterways as a transportation system.

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"...we have seen a growing number of laws and regulations affecting maritime transportation."

More recently, the nation's belatedly awakened sense of concern for the environment--and the significant potential of effective regulation of marine transportation as a means to control pollution--created a feverish air of having to do something *instantaneously*. Longstanding problems were made more acute by the dramatic rise in this nation's requirements for imported oil, which could only be moved economically in increasingly large tankers. The Coast Guard's quiet success in its role of regulating vessel safety and its emergence as the premier maritime safety agency in the world did not pass unnoticed. We were tasked with a major pollution control role, not only in respect to vessel design, construction, and operations, but also in responding to pollution incidents. To cope with increasing congestion of the nation's ports and waterways, the Coast Guard was also given comprehensive authority to oversee vessel traffic. Vessel traffic services, incorporating some controls and mandatory features where needed, are now in operation on the rivers in New Orleans and Morgan City, Louisiana and during high water at Louisville, Kentucky.

There has been a dramatic rise in the smuggling of drugs into the United States by sea--sort of a return engagement of the old battle with the rum runners. However, the territory now includes vast expanses of the ocean. Our rapid transition from "lifesavers" to a triad of roles: "lifesavers," regulators, and "smokies of the sea," has not been easy--and it is not always completely comfortable. Yet the logic of our current role is irrefutable, and the competency with which we discharge our tasks is unquestioned.

I am often asked if, with all the increase in drug traffic, the Coast Guard will be putting more of its resources into the interdiction effort. We have, throughout our history, found the need to periodically shift emphasis under our broad statutory umbrella to meet situational needs. However, I intend to maintain a proper balance between all our programs and will not let one particular program be the driving force behind the acquisition of resources. Our aircraft, ships and stations will continue to be multi-mission in nature, because our involvement is very diverse: search and rescue, marine safety, port safety and security, pollution prevention, drug interdiction, and fisheries enforcement, to name a few. All are uniquely different and require different approaches.

Approximately one-half of our programs are in response to statutory regulatory responsibilities which affect maritime commerce and the rapidly changing environment in which it is conducted. Our nation has learned--painfully at times--that our waterways, oceans, and their resources must be shared by a whole host of legitimate interests. There are outspoken advocates for commerce, transportation, energy, recreation, naval forces, and just the plain enjoyment of looking at the water. Along with such interests, we have seen a growing number of laws and regulations affecting maritime transportation.

For years, the Coast Guard looked at its maritime safety role in only the narrowest of terms; *safety was paramount*. As we look at the Coast Guard's regulatory responsibilities, it's clear that we can no longer afford the luxury of drawing a fence around safety and isolating it in the regulatory process. Like our nation, we must deal with a number of conflicting concerns: the economy; the need for energy; our environment; safety; and, pervading all of these, the need for government to be more responsive to the concerns of a wide variety of interests, both individual and organized, in both the private and public sectors.

The principal problems associated with our economic system are inflation and, to some degree, over-regulation. It has been estimated that the cost of regulating business in 1979 will be an incredible \$135 billion--\$96 billion to comply, \$32 billion in overhead, \$2 billion in lost productivity, and \$5 billion for government administration. You may argue with the figures, but certainly the general trend is appalling--even if it is only half that much. Since most regulatory actions are basically inflationary in nature, it is clear the Coast Guard must consider the impact of its regulatory actions on the economy.

We're also concerned with the environment, and actions to preserve the environment don't necessarily support economic or energy goals. We need to find new kinds of energy to replace those that have been the basis for our national economy for a good many years. Meanwhile, oil, coal and water are our energy mainstays. Energy, safety, and the environment are clearly in conflict in many directions.

Finally, we must deal with the political system--not only because of the parochial interests inherent in the separation of powers, but also because of the conflicts which occur within the executive branch itself. There are political problems in the private sector, as well.

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"...actions to preserve the environment don't necessarily support economic or energy goals....energy, safety and the environment are clearly in conflict in many directions."

"Too often, the professional voice of those who rely on the waterways for a livelihood has been drowned out by other, more vocal constituencies."

As the economic importance of water resources grows--and it will--pressure from all legitimate interests will continue. I see a need for a new balance of concern on the part of all involved--one formed between those who understand the needs of maritime commerce and those who wish to use the waters for other purposes. When we include the oceans of the world, the problem is indeed international in scope. In my view, the orderly solution lies in well coordinated efforts at both the international and national levels. Although the Coast Guard is deeply involved in the international regulatory process, it is the national effort that I know is of most interest to you, so let me conclude with a few comments on what I think needs to be done. On the national level, I see the need for:

* administrative streamlining in the regulatory process, including increased delegation to federal field activities;

* more participation at the grass-roots level by industry, local government, labor and private interest groups in formulating the initial drafts of certain regulations;

* better information processing and systems analysis in regulatory decision making . . . to validate the realism, practicality, and economic feasibility of what is being considered.

Also, we need to treat our waterways and ports as a transportation system of equal stature with the railways, highways and airways. I emphasize the word "system." Elements of that system include channel and harbor design criteria, aids to navigation, navigation facilities such as locks and dams, vessel traffic services, safety fairways and anchorages, port safety, port and cargo security, port citing standards . . . in short, everything that directly affects transportation in that system needs to be more carefully coordinated.

Too often, the professional voice of those who rely on the waterways for a livelihood has been drowned out by other, more vocal constituencies. The Coast Guard is very much aware of this tendency and is, hopefully, attaining a more equitable balance of viewpoints. Before making final rules, we hold hearings to receive public interest comments. In a typical case we may receive 13 statements supporting a ruling and 1 against; very convincing on the surface. However, when you realize that the one negative position represents over 200 shipping companies and the other 13 are all relatively small but vocal special interests, it puts a little different light on the relative merits of the proposal.

Our administration of regulatory programs seems to work well because we deal in the attainable, not in theoretical perfection. The requirements we impose take into consideration economic reality and operational practicability. We have successfully avoided the dilemma which many agencies have encountered, where, for want of practical knowledge on the part of program managers, lawyers have taken unbridled charge of regulating many technical areas and come up with the "perfect" regulation--only to find that its enforcement has been enjoined by a court. We cannot afford that approach. In river country, the entire economy still revolves around the river and its adjacent valley industries, and the bureaucracy must behave responsibly in deference to this fact.

Lastly, I see the need for integration of waterborne commerce concerns into national transportation policies. To this end, Secretary of Transportation Brock Adams has established an Office of Maritime Policy within the Department of Transportation, and is in the process of establishing an Office of Assistant Secretary for Marine Transportation. He is deeply committed to making transportation decisions in a coordinated fashion and providing proper emphasis for the marine mode. I might add that a Coast Guard Rear Admiral serves on the Secretary's immediate staff as a maritime policy advisor, and our recent successes in the international arena with respect to tanker safety could not have been achieved without his support and participation.

As creaky as the bureaucracy seems at times, *it can work!* I am dedicated to keeping the Coast Guard on the rational side of the regulatory process. Bureaucracy is not the sole province of government; I have worked with the fine people on the civilian side long enough to know that, although we in government are bureaucratic by definition, business and industry also can be prone to the same tendencies.

In conclusion, I see no great hurdles that are not man-made and which cannot be solved face to face in a constructive dialogue. Hopefully, we can together ply the waterways safely with minimum regulation and use our environment wisely--and do so while we facilitate commerce, protect the strategic importance of marine transportation, and enhance the economic value of the waterways.

"...we deal in the attainable, not in theoretical perfection."

Lessons from Casualties

A 70,000-gross-ton oil tanker sustained a major internal explosion within the starboard boiler while dockside repairs were being made.

The vessel has two automated tube-type propulsion boilers, each with a maximum allowable working pressure of 1,100 PSI. Each boiler has three burners and can be controlled from the boiler front console or remotely from the engine room.

On the morning of the casualty, both boilers had been shut down for 6 hours. The chief engineer brought up the port boiler to 900 PSI and shifted the boiler to black oil fuel from diesel fuel at this time. When the port boiler reached 900 PSI, the chief engineer started the starboard boiler using diesel fuel. It is believed that only one burner was in use on each boiler. A short time later, both boilers shut down by themselves. The chief engineer and an automation manufacturer representative went to the port boiler to ascertain the cause of the shutdown. The chief engineer noted a feedwater pressure problem and went below deck to inspect the feedwater pump. The automation representative went to the starboard boiler front and glanced through one of the peepholes. He thought that the fire was out. The chief engineer then directed the automation representative to the boiler front control board, whereupon he pushed the air register button on the No. 1 burner in order to purge the starboard boiler. Major structural damage was sustained by the boiler in the ensuing explosion.

This casualty demonstrates the importance of taking precautions by monitoring boilers while they are fired on diesel oil and under boiler front control. This operating condition presents an abnormal operating situation with the master fuel oil valve bypassed. Pressing the air register button added air to the boiler which was sufficient for ignition of diesel fuel that was still being pumped into the boiler. In this particular operating condition, the fuel can only be shut down manually by the diesel oil bypass valve. The chief engineer should have recognized the potential for a hazardous situation and closely monitored the boiler front. A warning to this effect was included in the chief engineer's Engineering Technical Manual.

295-253 O - 79 - 2

BARGE INTE

Another Tank Barge Explos

Commander Fred H.
Lieutenant Commander R

The opinions or assertions con
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or the Coast Guard at large.

On November 6, 1977, a series of explosions inside the cargo tanks occurred on a manned tank barge transporting an elevated temperature Grade E combustible petroleum cargo. This unusual event and subsequent evaluation of the flammable properties of this Grade E product reemphasizes that the flashpoint test is not an absolute index of hazard potential and that vapor explosions can occur at temperatures well below the measured flashpoint.

BACKGROUND - THE BARGE

Barge INTERSTATE 71 is a steel, single skin, manned petroleum tank vessel certificated for carriage of Grade E combustible liquids at elevated temperature. The barge measures 380 feet by 76 feet by 27.9 feet and can carry 81,759 barrels of product in 10 cargo tanks, numbers 1 through 5 port and starboard. Cargo pumping equipment consists of two deepwell pumps located over the after cargo tanks (No. 5 cargo tanks). Prime movers for the pumps are directly coupled diesel engines located on the main deck just forward of the deepwell pumps. The deepwell pumps are mounted in cylindrical casings extending into the No. 5 cargo tanks.

The normal products carried aboard the INTERSTATE 71 are number 6 heating oil and asphalt. Number 6 heating oil is a thick, black, viscous residual oil. Both asphalt and number 6 heating oil characteristically have flashpoints well above 150 degrees Fahrenheit (F.). The main use of the lighter grades of residual oil is for firing stationery boiler plants. Heavier grades are used for road surfacing. Asphalt is also used for roofing. During moderate and low temperature periods, both number 6 heating oil and asphalt must be heated to facilitate and, in some cases, permit pumping. For this purpose, INTERSTATE 71 has a cargo thermal fluid heater located in the after rake space which heats and circulates heat transfer fluid through heating coils inside the cargo tanks. Each cargo tank is equipped with a pressure-vacuum valve (PV valve). Grade E products do not require the use of PV valves (see Table II). PV valves were installed aboard this barge as original equipment because the barge was built for Grade A flammable service and subsequently reduced to Grade E service to take advantage of longer Coast Guard inspection intervals.

ERSTATE 71
sion with a New Concern

I. Halvorsen
Rene N. Roussel

ontained herein are the
d are not to be construed
iews of the Commandant

THE OCCURRENCE

At about noon on November 3, 1977, INTERSTATE 71 was taken under tow and departed the Atlantic Richfield facility at Point Breeze, Philadelphia for Providence, Rhode Island, with about 68,000 barrels of heated asphalt (Arco asphalt type AC 20). The flashpoint of the asphalt was measured at 630 degrees F. by the Cleveland Open Cup Method. The asphalt was maintained hot by the onboard heat transfer system. Company operating procedures were to keep the asphalt no higher than 325 degrees F. Practically, as evidenced by log records, the temperature of the asphalt was approximately 262 degrees F. throughout the voyage. The towing vessel was the tug MARINER. Aboard the barge were the barge operating personnel, consisting of a barge master and two tankermen.

During the voyage, rough seas were encountered; otherwise, the voyage was uneventful until the afternoon of November 6. By this time, the tug and tow had entered Narragansett Bay and were proceeding to the offloading point, Hudson Terminal of Providence, Rhode Island.

In preparation for offloading, the two barge tankermen began readying mooring lines and cargo transfer hoses aboard the barge. One of the tankermen was working amidships at the cargo manifold and the second was working on the after portion of the barge near the port deepwell pump. The barge master was in the quarters taking a shower. Two couples in a small sailboat passing close aboard the barge at about 1230 noted that the tankerman on the after section of the barge was crouched in the area between the deepwell pumps. When the tankerman stood up, the two men in the sailboat observed what they thought to be a small propane torch in his hand. At the time, the men on the sailboat expressed concern to one another than the man on an "oil" barge was using an open flame in the cargo area.

At about 1245, with the tankerman still in the area, an explosion occurred in the No. 5 port cargo tank. Flames rose 20 feet into the air and a black cloud was created from the burning oil. The barge master and other tankerman attempted to extinguish the fire by discharging the two CO_2 fire extinguishers into the fire, but this had little effect. The tankerman who had been in the area was apparently killed outright by the explosion. His body was blown onto the

Continued on next page...

pumphouse, where it was found hanging upside down. Seeing that the survivors required assistance, the tug came alongside the barge at the starboard bow and removed the two barge men. The tug was then moved well away from the barge. About 10 minutes later, a second explosion occurred--this time in the undamaged No. 5 starboard cargo tank. This explosion blew the port pump enginehouse overboard and the starboard pumphouse forward and upside down. The fire in the two after tanks continued for about an hour until the fire was extinguished by three Coast Guard small boats.

Damage to the barge was limited mainly to the port and starboard No. 5 cargo tanks. A fore and aft tear, about 40 feet long, was located along the main deck centerline of the port and starboard tanks. The main deck was deformed upward around this tear. The side shell in the area of the No. 5 tank was buckled outward from force of the explosion. Also, the fore and after aft cofferdam bulkheads were breached and hot asphalt flowed into the after rake.

WHAT HAPPENED?

It is most probable that the explosion resulted from a direct flame applied to an external tank surface. In the past, the propane torch which the tankerman was apparently using at the time of the casualty had been used to melt cargo which had solidified in a pump drain line.

This 1-inch drain line returned product to the tank from the pump casing, which had leaked past the pump packing gland during offloading. The drain lines (one on each pump) were approximately 6 feet long and valved with a single gate valve. The drain lines were not insulated or traced with heat so it was normal for product to solidify in the lines. Apparently, it was also normal to use the propane torch to liquefy product which had solidified in these lines. When the line was heated, an explosion apparently originated in this drain line, propagated into the port cargo tank, and caused the vapor in the ullage to explode.

HOW DID THIS HAPPEN?

There are two questions which must be answered. First, why were there flammable vapors above a Grade E cargo? And, second, how did an external source of heat ignite the hydrocarbon vapors inside the closed cargo tank?

Why were there flammable vapors? The answer to this question is relatively simple. Combustible and flammable liquids generate vapors which, in a closed space, are present in a predictable dynamic equilibrium between the vapor and the liquid. This concentration of vapors is a function of temperature. Essentially, in a closed space, the vapor concentration increases as temperature increases. When the vapors reach a certain concentration, they can be momentarily ignited by an ignition source, such as an open flame. The temperature at which this momentary ignition occurs is the "flashpoint"[1] of the liquid. This temperature is normally felt to be the temperature at which the product becomes hazardous during transportation if the vapors are exposed to a direct source of ignition.

Unfortunately, the flashpoint test temperature is not necessarily the lowest temperature at which the product can be ignited. If the product vapors are confined, as within a cargo tank or storage tank, and the tank contents are heated and/or agitated, flammable vapors may be concentrated in the vapor phase and explosive concentrations can be found at temperatures well below the measured flashpoint. This does not apply to a pure chemically distinct product, but does apply to any petroleum mixture such as asphalt, crude oil, and the like. This may be especially difficult to comprehend in light of the fact that the flashpoint of the product was 630 degrees F. (Cleveland Open Cup) and the product was heated to only about 260 degrees. However, when a marine chemist checked the undamaged cargo tanks two days after the accident, he found flammable vapors ranging from 40 percent to 100 percent of the lower flammable limit (LFL) in the remaining tanks. At that time, the liquid temperature was about 200 degrees F. (The tank vapor phases were immediately vented and the flammable concentration reduced.)

One other factor aboard INTERSTATE 71 would have contributed to the high flammable vapor concentration--the PV valves. The PV valves which were installed (although not required by regulation) would tend to prevent any cargo tank "breathing." Very little outside air could enter the tanks to reduce the flammable vapor concentration.

There are other possibilities which could tend to raise the flammable vapor concentration inside cargo tanks. One is the presence of cargo residues from previous, more flammable cargoes. The posibility that the Arco product had a lower flashpoint than 630 degrees F. must also be considered. Tests conducted by Atlantic Richfield after the accident showed appreciable flammable vapor concentrations in the ullages of land storage tanks from which the asphalt loaded aboard INTERSTATE 71 was drawn. Concentrations up to 50 percent LFL were present above the unagitated liquid at a temperature of 335 degrees F. Still another possibility could be the presence of a highly reactive contaminant such as hydrogen sulphide (H_2S). However, the presence of H_2S would be readily detectible by smell as well as by chemical analysis. Although H_2S was considered as a possible culprit in this explosion, subsequent chemical analyses of the product on INTERSTATE 71 and the land storage tanks

Continued on next page

[1] For a discussion of the significance of the flashpoint and also the RVP test, see the July 1976 issue of the Proceedings, "Another Big Bang Out of Crude Oil."

could not support this claim. More practically, for H_2S to be present in flammable concentrations, at least 1.4 percent by volume (LFL), the acute toxicity problem would be frighteningly obvious. At 700 parts per million (ppm) (0.07 percent by volume), H_2S is almost immediately fatal.

How were the vapors ignited from an external heat source? It is presumed that the flammable vapors inside the cargo tank were not present outside the tank and thus direct ignition of the vapors from the propane torch is an improbability. In that event, the most likely way that the liquid was ignited was through autoignition of the liquid in the 1-inch drain line caused by the direct heat of the propane torch. Autoignition is a phenomenon which occurs as a result of heating a flammable or combustible liquid. No ignition source need be present--the heat alone ignites the liquid. The autoignition temperature of asphalt is in the range of 900 degrees F. A propane torch can generate temperatures up to 2,500 degrees F. If the torch flame was held against the pipe for some time, it is probable that 900 degrees F. could be reached on the interior wall. Asphalt has good insulating properties and this would enhance the heat transfer qualities at a single location if heat were sustained for some time.

Another possible explanation for which asphalt might ignite under these circumstances is "coking." As the asphalt is heated, the lighter constituents are driven off, leaving only the heavier residues. Further heating initiates a reaction in which this residue becomes red hot and begins to glow. This could be accomplished (in theory) by the tankerman heating the drain line with the propane torch.

MOST PROBABLE CAUSE

It appears most likely that autoignition or coking of the product inside the port pump casing drain line, caused by the propane torch heating the outside metal, initiated an explosion in the flammable vapors above the asphalt cargo in the No. 5 port tank. The second explosion then resulted from direct ignition of vapors in the starboard tank vapor space, or, if the starboard tank was undamaged, then by autoignition of the vapors from direct impingement of the fire on the external tank wall, top or side.

It should be noted that any fire-producing operation on the deck of any tank vessel is specifically prohibited unless an NFPA certified marine chemist (or equivalent) has indicated such action can be safety done. While a Grade E combustible normally would not be expected to present a significant flammable vapor hazard, under the circumstances thus noted, one can obviously exist. Use of a propane torch on an external tank part does constitute a fire-producing operation.

Unfortunately, 46 CFR Part 36 authorizes certain exemptions for tank vessels transporting Grade E liquids at elevated temperatures if the flashpoint exceeds 300 degrees F. Among these exemptions is included a relaxation of the requirement to test the tank atmosphere prior to hot work. Apparently, it was felt that the flammability hazard was negligible for such products. Obviously, this assumption must be re-evaluated.

HOW ARE COMBUSTIBLE AND FLAMMABLE LIQUIDS CLASSIFIED?

Number 6 heating oil and asphalt fall within the regulatory definition of a Grade E combustible liquid under Parts 30-40, Title 46, Code of Federal Regulations. These regulations directly apply to the marine transportation of flammable and combustible liquids in tank barges and tankships and have been developed over the past four decades.

For regulatory purposes of classification, flammable and combustible liquids are based on the Reid Vapor Pressure and flashpoint. Table I summarizes these classifications.

Based on the grade of cargo involved, design construction requirements for a tankship or tank barge are outlined in 46 CFR 30-40.

Design requirements vary for the various grades of flammable and combustible cargoes. The design requirements for a barge certificated for Grade E products is summarized in Table II.

As can be seen from Table II, the cargo containment system requirements of a Grade E barge is minimal and based on the recognized low volatility of the product involved.

Any tank vessel carrying an "oil" must also comply with pollution prevention regulations in 33 CFR 154-156, but since these regulations do not bear on the discussion, they will not be considered.

The conventional usage of the terms "combustible" and "flammable" is essentially that flammable products can burn under normal conditions of ambient temperature while combustible liquids must be heated in order to be able to burn. In reality, in a closed environment such as that found in a cargo tank with PV valves during transport, Grade A and Grade B flammable products shown in Table I are probably "safe,"[2] with the vapor concentration being well above the upper flammable limit. Depending on the volatility, a Grade C flammable may or may not be "safe," that is, the vapor in the ullage space may be above or within the flammable range. Grade D combustibles may be within or below the flammable range depending on the volatility of the specific product and the ambient temperature. As we have seen from this accident, Grade E combustible, under certain circumstances, may also be found within the flammable zone.

Continued on next page..

[2]The term "safe" is used only in a relative sense. Obviously, if the vapor was diluted with air, the "safe" atmosphere would become unsafe.

CONCLUSION

This accident apparently resulted from the use of a direct source of ignition on an external surface of a piping system containing a Grade E combustible liquid carried at an elevated temperature (but below its flashpoint). The hazardous properties of the product asphalt were not indicated by the tested flashpoint and flammable vapor concentrations were present at temperature almost 300 degrees F. below the Cleveland Open Cup flashpoint. These vapors were the result of confinement (by PV valves), product heating, and product agitation. Personnel aboard the barge may not have been aware of the significance of the flashpoint test which is used by the Coast Guard to classify petroleum cargoes for maritime transportation and is not an absolute index of the hazardous flammable properties.

This accident has caused concern within the Coast Guard and a study of the problem will be made. A report is expected within six months. The study will consider possible implications, solutions, and determine whether regulatory changes will be required. The Commandant (G-MHM) is heading the investigation. Interested parties can contact Coast Guard Headquarters directly.

(Tables I and II are shown on page 111)

About the Authors

LCDR Rene N. Roussel

LCDR Rene N. Roussel is a 1977 graduate of Western State University College of Law at San Diego, California. He holds an LLB degree and is a member of the California Bar. For the past five years, he has primarily functioned as a casualty investigator.

LCDR Roussel is presently serving as Executive Officer of the Marine Safety Office at Providence, Rhode Island. Comments may be directed to him at that location: Federal Building & USPO, Exchange Street, Providence, RI 02903.

CDR Fred H. Halvorsen

CDR Fred H. Halvorsen is a 1964 graduate of the U.S. Coast Guard Academy. He holds a Ph.D. in chemical engineering and is a registered professional engineer. During the past 10 years, CDR Halvorsen has worked almost exclusively in the area of hazardous materials; he frequently contributes articles to the Proceedings.

CDR Halvorsen is presently attached to the Coast Guard's Marine Safety School at the U.S. Coast Guard Reserve Training Center, where he is the Senior Instructor in the Hazardous Chemicals Training Course. Comments can be forwarded to him at the U.S. Coast Guard Reserve Training Center, Yorktown, VA 23690.

KEYNOTES......................................

SEPTEMBER 1979

7: Public Hearing on Tank Barge Construction Standards, 9:00 a.m.; Jefferson A and B Rooms of the Stouffer's Riverfront Towers, 200 South Fourth Street, St. Louis, Missouri.

Companies or individuals wishing to speak at public hearings should notify LTJG John Holmes (G-CMC/81), U.S. Coast Guard Headquarters, 400 Seventh St., SE, Washington, DC 20590; (202)426-1477.

"I HATE TO SOUND MORBID, BUT I THINK WHAT WERE ABOUT TO WITNESS HERE IS AN EXAMPLE OF WHAT IS KNOWN AS ECOLOGICAL COÖRDINATION."

TABLE I
SUMMARY OF FLAMMABLE LIQUEFIED GAS, FLAMMABLE LIQUID, AND COMBUSTIBLE LIQUID CLASSIFICATION UNDER 46 CFR 30-40 (SUBCHAPTER D - TANK VESSELS)

FLAMMABLE LIQUEFIED GAS	RVP(1) 40 psia
Flammable Liquids:	
Grade A	Flashpoint(2) 80 degrees F. and RVP 14 but 40 psia
Grade B	Flashpoint 80 degrees F. and RVP 8.5 but 14 psia
Grade C	Flashpoint 80 degrees F. and RVP 8.5 psia
Combustible Liquids:	
Grade D	Flashpoint 150 degrees F. but 80 degrees F.
Grade E	Flashpoint 150 degrees F.

NOTES: (1) RVP is Reid Vapor Pressure

(2) Flashpoint tests are all open cup tests.

TABLE II
CARGO CONTAINMENT SYSTEM FOR BARGE CARRYING GRADE E COMBUSTIBLE LIQUIDS

Barge Hull	Single Skin
Venting*	Open/With Flame Screens
Gauging	Open

*As previously noted, Grade E combustibles carried at elevated temperatures with a flashpoint greater than 300 degrees F. are given some regulatory relaxations. Flame screens can be omitted as part of this relaxation.

FIRE IN THE HOLD

Harvey Scott, PA3, USCG
14th Coast Guard District
Honolulu, Hawaii

VALENTINE'S DAY, FEBRUARY 14, 1979 . . . *An oil pollution tragedy of immense proportions struck Honolulu Harbor today when the British vessel HEREFORDSHIRE, engulfed in flames, capsized and sank in the harbor, dumping 300,000 gallons of oil and partially blocking the harbor entrance.*

The scenario outlined above never happened, but it could have had it not been for the efforts of Fire Fighter Coordinator First Class Bob Ludwick of the 14th Coast Guard District's Active Reserve. Here's the story the way it actually happened:

On Sunday, February 11, the Coast Guard Marine Safety Office (MSO) was notified that a 528-foot vessel had a fire in the No. 2 hold at a location 300 miles north of Honolulu. The Commanding Officer of the MSO, Commander Alfred D. Utara, had to decide whether or not to allow the ship into Honolulu Harbor to fight the fire. That would increase the chances of saving the ship and its cargo; however, if the ship came into the harbor and the fire could not be controlled, HEREFORDSHIRE could capsize and sink in the harbor causing a grave pollution problem as well as a serious obstruction to the harbor. If HEREFORDSHIRE were not allowed to dock at the harbor, the replacement of CO_2 gas cannisters, which were being used to control the fire, would be very difficult--if not impossible. With the shipboard CO_2 supply running low, the crew would not be able to control the fire and the ship could be lost.

Utara needed expert information as to the true state of the fire and the ability to fight it in Honolulu Harbor.

To help make this decision the Commander turned to Petty Officer First Class Bob Ludwick, the Honolulu Coast Guard Reserve's new Fire Fighting Coordinator. In civilian life, Bob Ludwick is a fire inspector with the Honolulu Fire Department. His experience with the department has given him expertise fighting land fires, but Fire Fighting Coordinator training has also made him an expert at fighting shipboard fires.

This is a skill which most department firefighters do not possess, but is essential in extinguishing shipboard fires. The basic principal in fighting a land structure fire is to get to the source of the fire and put it out. In fighting a shipboard fire, it is essential to contain the fire in an area as small as possible and seal off the area to cut off its air supply. Shipboard fires also have to be fought with a minimum of water to prevent filling the ship to the extent that it sinks in the process of extinguishing the fire.

It is the shipboard firefighting expertise demonstrated by Bob Ludwick which is credited with saving HEREFORDSHIRE and averting a serious disaster.

Shortly after word was received that HEREFORDSHIRE was aflame and headed for Honolulu, Petty Officer Ludwick was called to temporary active duty and airlifted to the endangered vessel. Inspection aboard the ship revealed that the fire was sufficiently under control to not pose an immediate threat to Honolulu Harbor if the HEREFORDSHIRE were allowed into port. Ludwick also discovered that the fire was not completely out, but was just being contained by CO_2 gas in the No. 2 hold. The

It was finally decided that the HEREFORDSHIRE could safely be allowed into Honolulu Harbor, where firefighters were better equipped to extinguish the fire in the No. 2 hold.

ship is equipped with direct CO_2 feed lines into the various compartments. The problem was that the shipboard CO_2 was dwindling to the extent that the supply would soon be gone. To replenish the CO_2 bottles at sea would be extremely difficult, at best. If the CO_2 supply were allowed to run out and the CO_2 in the hold became depleted the fire might rekindle, set the hold ablaze and possibly spread to the rest of the ship.

As a result of Ludwick's fact-finding mission, Commander Utara decided to allow HEREFORDSHIRE to dock at Honolulu Harbor, while Ludwick would act as the eyes and ears of the Coast Guard.

While on board HEREFORDSHIRE prior to its arrival in Honolulu, Ludwick discovered that the fittings through which the CO_2 gas was to be piped aboard were of a different thread and size than is standard in the United States. An adapter pipe was constructed and ready upon the ship's arrival, and CO_2 hookup with the adapter took only 20 minutes. The adapter saved many precious hours of delay.

On Tuesday, the day following HEREFORDSHIRE's arrival in Honolulu, the Honolulu Fire Department, the State Harbor Division and the Coast Guard had their first meeting to decide the immediate course of action. The Fire Department wanted to open the hatch to the No.2 hold and fight the fire directly from above. The Coast Guard Fire Fighting Coordinator disagreed with this plan due to the possibility of a flashback when the CO_2 escaped and the fresh air reached the fire. The hatch takes 20 minutes to fully open and another 20 minutes to close. If a flashback did occur there would be no time to close the hatch before the fire would begin to spread throughout the ship. As a safety measure, Ludwick suggested directly entering the hold through a special airtight access to determine the condition of the fire.

On Wednesday, Ludwick and HEREFORDSHIRE's Chief Mate, John Lowe, entered the special double doored sealed access to the No. 2 hold wearing fire suits and self-contained breathing units. In the hold, the discovery was made that a number of the 500-pound cotton bales had broken from their restraining straps and were smoldering on the deck.

According to Ludwick, upon entering the hold he and the Chief Mate found themselves walking in the fire. The only factor that saved their lives was that, in the CO_2 enriched environment, the fire could not actually "burn" in the true sense of the word but formed sparks. However, had the main hatch been opened, the sparks would have been replaced by a roaring inferno when the oxygen in the air replaced the CO_2 gas.

While walking in the "sparking fire" in the bottom of the hold, Chief Mate Lowe suddenly experienced difficulty with his breathing apparatus. A moment later he was lying in the fire and close to death. Petty Officer Ludwick immediately sprang into action, and, using their safety line, was able to get Lowe out of danger in the hold and begin emergency resuscitation treatment and oxygen. This immediate emergency action is credited with saving Lowe's life.

On Thursday, two firefighters reentered this same below-deck sealed hatch and extinguished the cotton bale fire with a special chemical. Later that same day the main hatch was opened and the fire fought from topside as well.

Upon entering the hold, it was discovered that a number of the 500-pound bales of cotton had broken from their restraints and were smoldering on the deck.

On Thursday night, after the fire was thought to be out, a flareup occurred but was easily extinguished because the proper steps had been previously taken by experienced personnel at the scene.

Petty Officer Ludwick's first official job for the Coast Guard Reserve as Fire Fighting Coordinator was a memorable one, and one which the Coast Guard has saluted with the traditional "Well Done."

Sailor: "Gosh, baby, I'm glad I'll be the first sailor you've ever been out with. Where shall I meet you?"
Doll: "How about the starboard side of Pier 7, about 2100?"

* * *

Nautical Queries

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

DECK

(1) In which month will the equatorial counter current be strongest?

A. January
B. April
C. August
D. October

Reference: Bowditch

(2) Which statement is true concerning "night effect" and the reception of radio signals?

A. "Night effect" is most prevalent late at night.
B. "Night effect" is caused by rapid changes in the ionosphere.
C. During "night effect," polarization error is at a minimum.
D. All of the above.

Reference: Bowditch.

(3) When a hurricane passes into high latitudes over colder water and the source of heat is disrupted, the storm assumes the characteristics of

A. a high pressure area.
B. an extratropical cyclone.
C. a tropical storm.
D. an easterly wave.

Reference: Meteorology, W. L. Donn, 3rd Edition

(4) A body will be above and below the horizon for an equal amount of time if the

I. body's declination is 0 degrees.
II. observer's latitude is 0 degrees.

A. I only
B. II only
C. Both I and II
D. Neither I nor II

Reference: Bowditch

(5) As a ship moves through the water, it drags with it a body of water called a wake. The ratio of the wake speed to the ship's speed is called

A. wake distribution.
B. wake fraction.
C. propeller velocity.
D. speed of advance.

Reference: Knights

ENGINEER

(1) Allowances may be made for expansion and contraction in piping by the use of expansion joints or

A. unions.
B. retractable flanges.
C. union bulkhead fittings.
D. bends or loops in the line.

Reference: Principles of Naval Engineering, page 366

(2) What is the purpose of a back pressure regulating valve in an R-12 refrigeration system?

A. prevent liquid freon from slugging the compressor
B. maintain a constant presure in the evaporator regardless of load
C. throttle refrigerant returning to the compressor to subcool it
D. protect the low pressure switch from excessive pressure

Reference: Commercial and Industrial Refrigeration, Nelson, page 241

(3) Part of the cargo of an LNG carrier boils off during each voyage. This cargo boil off is normally

A. compressed, condensed and returned to the cargo tanks.
B. vented to the atmosphere.
C. burned in the boilers.
D. mixed with nitrogen and recirculated through the primary barrier.

Reference: Marine Transportation of LNG and Related Products, Wooler, page 57

(4) What is a common cause for a blown fuse?

A. loose fuse clips
B. excessive vibration
C. sustained overload
D. any of the above

Reference: Preventive Maintenance of Electrical Equipment, Hubert, page 348

(5) A tank which has been sealed for a long period of time could be dangerous because

A. steel surfaces consume oxygen by rusting.
B. a vacuum usually forms in a sealed tank.
C. moisture condenses in the tank displacing the oxygen.
D. most tank coatings give off poisonous vapors in the presence of moisture.

Reference: Modern Marine Engineers Manual Vol. I, Osbourne, pp. 1-15

ANSWERS

Deck
1. C; 2. B; 3. B; 4. C; 5. B

Engineer
1. D; 2. B; 3. C; 4. D; 5. A

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications may be obtained from the nearest marine safety office or marine inspection office of the U.S. Coast Guard. Because changes to the rules and regulations are made from time to time, these publications can be kept current between revisions only by referring to the Federal Register. (Official changes to all federal regulations are published in the Federal Register, printed daily except Saturday, Sunday, and holidays.) Following the title of each publication in the table below are the date of the most recent edition and the dates of the Federal Registers affecting each.

The Federal Register may be obtained by subscription ($5 per month or $50 per year) or by individual copy (75 cents each) from SupDocs, U.S. Government Printing Office, Washington, DC 20402.

CG No.	TITLE OF PUBLICATION
101-1	Specimen Examinations for Merchant Marine Deck Officers (2d and 3d Mate) (4-1-77).
101-2	Specimen Examinations for Merchant Marine Deck Officers (Master and Chief Mate) (4-1-76).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (4-1-72). FR 7-21-72, 12-1-72, 6-18-75.
*115	Marine Engineering Regulations (8-1-77). FR 9-26-77, 10-10-78, 12-4-78, 3-12-79.
*123	Rules and Regulations for Tank Vessels (8-1-77). (Ch-1, 4-28-78). FR 8-17-77, 9-12-77, 9-26-77, 10-25-77, 12-19-77, 3-12-79.
169	Navigation Rules - International - Inland (5-1-77). FR 7-11-77, 7-14-77, 9-26-77, 10-12-77, 11-3-77, 12-6-77, 12-15-77, 3-16-78.
169-1	Colregs Demarcation Lines (7-15-77).
172	Rules of the Road - Great Lakes (7-1-72). FR 10-6-72, 11-4-72, 1-16-73, 1-29-73, 5-8-73, 3-29-74, 6-3-74, 11-27-74, 4-16-75, 4-28-75, 10-22-75, 2-5-76, 1-13-77, 11-3-77, 12-6-77.
174	A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products (9-1-76).
**176	Load Line Regulations (2-1-71). FR 10-1-71, 5-10-73, 7-10-74, 10-14-75, 12-8-75, 1-8-76.
182-1	Specimen Examinations for Merchant Marine Engineer Licenses (2d and 3d Assistant) (2-1-78).
182-2	Specimen Examinations for Merchant Marine Engineer Licenses (First Assistant) (3-1-78).
182-3	Specimen Examinations for Merchant Marine Engineer Licenses (Chief Engineer) (3-1-78).
184	Rules of the Road - Western Rivers (8-1-72). FR 9-12-72, 12-28-72, 3-8-74, 3-29-74, 6-3-74, 11-27-74, 4-16-75, 4-28-75, 10-22-75, 2-5-76, 3-1-76, 6-10-76, 7-11-77, 12-6-77, 12-15-77.
*190	Equipment Lists (5-1-75). FR 5-7-75, 6-2-75, 6-25-75, 7-22-75, 7-24-75, 8-1-75, 8-20-75, 9-23-75, 10-8-75, 11-21-75, 12-11-75, 12-15-75, 2-5-76, 2-23-76, 3-18-76, 4-5-76, 5-6-76, 6-10-76, 6-21-76, 6-24-76, 9-2-76, 9-13-76, 9-16-76, 10-12-76, 11-1-76, 11-4-76, 11-11-76, 12-2-76, 12-23-77, 4-4-77, 4-11-77, 4-21-77, 5-19-77, 5-26-77, 6-9-77.
191	Rules and Regulations for Licensing and Certification of Merchant Marine Personnel (11-1-76). FR 3-3-77, 8-8-77.
227	Laws Governing Marine Inspection (7-1-75).
239	Security of Vessels and Waterfront Facilities (5-1-74). FR 5-15-74, 5-24-74, 8-15-74, 9-5-74, 9-9-74, 12-3-74, 1-6-75, 1-29-75, 4-22-75, 7-2-75, 7-7-75, 7-24-75, 10-1-75, 10-8-75, 6-3-76, 9-27-76, 2-3-77, 3-31-77, 7-14-77, 7-28-77, 9-22-77, 9-26-77, 12-19-77, 1-6-78, 1-16-78, 3-2-78, 11-16-78.
257	Rules and Regulations for Cargo and Miscellaneous Vessels (9-1-77). FR 9-26-77, 9-29-77, 12-19-77, 3-12-79.
258	Rules and Regulations for Uninspected Vessels (4-1-77). (Ch-1, 3-17-78). FR 9-26-77.
259	Electrical Engineering Regulations (7-1-77). FR 9-26-77.
268	Rules and Regulations for Manning of Vessels (7-1-77).
293	Miscellaneous Electrical Equipment List (7-2-73).
* 323	Rules and Regulations for Small Passenger Vessels (Under 100 Gross Tons) (7-1-77). (Ch-1, 3-17-78). FR 9-26-77, 12-15-77, 12-19-77, 7-17-78, 3-12-79.
329	Fire Fighting Manual for Tank Vessels (1-1-74).
439	Bridge-to-Bridge Radiotelephone Communications (12-1-72). FR 12-28-72, 3-8-74, 5-5-75, 7-11-77.
467	Specimen Examinations for Uninspected Towing Vessel Operators (10-1-74).
497	Rules and Regulations for Recreational Boating (7-1-77). FR 7-14-77, 8-18-77, 3-9-78.

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*Temporarily out of stock
**Under revision—can be found in Title 46 CFR Parts 41-69

No Changes Published During May

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