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Cover

This Coast Guard photo shows the devastating consequences when an oil rig burns. Our story about the GETTY OIL WEST CAMERON 405-A begins on page 123.

Disaster Strikes When Natural Gas Vapors Migrate

Thomas J. Pettin

Around midnight on May 13, 1984, an explosion and subsequent fire occurred on GETTY OIL WEST CAMERON 405-A. One roustabout was killed in the explosion, and another was badly burned. Fortunately, they were the only two workers on the platform at the time. The damage sustained to the platform was estimated at $750,000.

GETTY OIL WEST CAMERON 405-A is a fixed, bottom-founded platform supporting two decks, and it is permanently attached to the seabed of the Outer Continental Shelf (OCS) by steel pilings. The upper deck houses the quarters and the galley, while the lower deck houses production equipment and is located 54 feet 6 inches above mean low water. The platform was constructed on site in the Gulf of Mexico in 1978 and is equally owned by Getty Oil, Cities Service, and Tenneco Oil Companies. The Getty Oil Company began operations on the platform in 1979.

On the night of the casualty, the two men were in the process of flushing sand that had begun to clog the platform test separator. (When both oil and gas are produced, a test separator is employed to separate relatively small quantities of oil and gas which are then diverted through various testing devices.) The two men were alerted by an audible gas detection alarm located on the platform's upper level. The men turned off the water used for cleaning and made their way to the living quarters on the level above them. As both men entered the living quarters, they detected an odor attributed to gas. They propped open the

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The intensity of the explosion and fire caused this damage to the generator wall facing the living quarters. (All photos are from U.S. Coast Guard files)

quarters door and proceeded toward the galley. When the first man reached the galley door, an explosion occurred behind him. A fire immediately erupted, and he escaped the burning structure by exiting through the galley door. After recovering from the initial shock, he made an attempt to locate his colleague, but due to the extreme intensity of the heat, he was unable to approach the building. After failing to locate his companion, he crossed to the other side of the platform to activate the Emergency Shutdown Device (ESD), located next to the down stairway. This device caused the gas coming from the wells into the compressors and test separating units to be shut off, thereby eliminating an additional source of fuel for the fire. While activating the ESD, a second explosion occurred in the living quarters. The man descended to the 12-foot level and lay down on the grating. He then fell asleep or lost consciousness, most probably as the result of shock induced by burns received in the initial explosion and fire.

Sometime later, the man was awakened by a third explosion, and he decided the safest place to be was in the water. Wearing a personal flotation device, he descended the leg ladder, entered the water, and remained there for about 30 minutes until deciding to reboard the platform to try and launch the platform's 28-man Whittaker Survival Capsule. He lowered the capsule by means of the brake lever on the winch, as the primary releasing mechanism was fouled with debris from the explosions, and he feared damage to the launching cable. When the capsule was safely in the water, the man descended the ladder, reentered the water, and climbed into the capsule. He was unable to release the capsule from its launching cable because of burns sustained to his hands, and it remained tethered to the platform. After locating the signaling equipment inside the capsule, he fired several aerial flares.

The crew of an offshore supply vessel (OSV) operating in the vicinity spotted the fire aboard the platform and radioed the U.S. Coast Guard Group in Galveston, Texas. The OSV crew then proceeded to the platform and rescued the man from the capsule, but they were unable to locate the second worker in their search of the platform. The lone survivor was air-lifted to Galveston for treatment of severe burns to 30 percent of his body. The following day, the remains of the missing worker were found in the inside doorway of the quarters. The quarters building had almost been completely destroyed by explosions and fire.

Casualty Analysis

Subsequent investigation into the casualty revealed that the drain piping system leading from the sub-deck to the common drain sump was not equipped in any way to prevent the upward migration of gases or vapors to the upper levels of the platform. When GETTY OIL WEST CAMERON 405-A was constructed, both the living quarters and the generator shelter were positioned over open deck drains which led to the drain sump. The bases of these structures were attached to the deck in such a manner as to prevent ventilation of the space between the flooring and the deck.

The most probable cause of this casualty was the contamination of the living quarters unit and generator shelter with flammable gases or vapors which migrated from the platform's common drain sump, through the common drainage system, and into spaces beneath the quarters unit and generator shelter. The gas was then ignited from an undetermined source. The source of ignition could not be adequately determined due to the degree of damage to the living quarters and associated equipment, although the most probable source of ignition was an electrical spark or discharge originating from the switch contact of the air conditioning or heating equipment located in the living quarters. It is unknown if the opening of the galley door contributed to the explosion by allowing vapors to come into contact with the ignition source.

The U.S. Coast Guard investigating officer reported that, during the attempted evacuation, the releasing mechanism on the Whittaker Survival Capsule failed to release the capsule from its launching cable. Close examination of the releasing mechanism revealed possible disuse and some minor corrosion to the come-along, the mechanism that rotates the hook and releases the capsule from its launching cable. The investigating officer stated in his report that a stronger spring on the take-up reel pawl would have allowed the come-along on the releasing mechanism to operate properly, and release the launching cable.

Regulatory Developments

The Outer Continental Shelf Lands Act Amendments of 1978 states that the Coast Guard or the Secretary of the Interior, individually or jointly, if they so agree, shall promulgate regulations to provide for scheduled onsite inspection, at least once a year, of each facility on the OCS. Inspection shall be made for all safety equipment designed to prevent or ameliorate blowouts, fires, spillages, or other major accidents. These inspections may be made without advance notice to the operator of such facility to assure compliance. The act does not require the Coast Guard to perform these inspections itself but only to "provide for" them by means of regulations. Due to the magnitude of conducting both annual and periodic inspections of all fixed facilities on the OCS, the Coast Guard is considering requiring that annual inspections of fixed facilities be conducted by the facility owner's personnel or by a third party employed by the owner. Under this program the owner would certify to the U.S. Coast Guard that the inspection was performed, that all discrepanices were corrected, and that the facility was in compliance with the regulations.

The efforts of Coast Guard inspectors could then be focused on unannounced inspections of the fixed facilities, particularly on those which are manned or which have a poor safety record. These inspections by the Coast Guard could, in turn, provide a means for monitoring the application and effectiveness of the "self-certification" program. This program was proposed in an Advance Notice of Proposed Rulemaking (ANPRM) published in the Federal Register on March 14, 1985, and comments were solicited. Industry response to this notice has been heavy. Comments are being evaluated and will be considered during the development of proposed rules.

Many of today's large platforms house production facilities capable of handling thousands of barrels of oil and millions of cubic feet of gas daily. There are no provisions for structural fire protection to allow for the escape of persons working on platforms. There are no provisions for fire protection of living areas, no required fire control measures, and no required personnel protection equipment. In the ANPRM of March 14, 1985, the Coast Guard solicited comments with regard to the adequacy of current Coast Guard regulations relative to fire detection, firefighting, and structural fire protection to fixed facilities. These comments will also be considered during the development of proposed rules.

A major concern of the U.S. Coast Guard is in the area of safe evacuation of personnel working on the OCS. The Coast Guard is currently trying to determine the role of standby vessels in an overall evacuation plan. Current regulations for evacuation and lifesaving for personnel working on platforms are essentially unchanged from the original regulations published in 1956 (CGFR 56-4, 21 FR 903, February 9, 1956). These regulations state that all manned platforms be provided with at least two approved life floats. The life floats must have sufficient capacity to accommodate all persons present at any one time and must be distributed in accessible locations. The life floats must be mounted on the outboard sides of the working platform in such a manner as to be readily launched. Approved lifeboats, approved liferafts, or approved inflatable liferafts may be used in lieu of approved life floats. Many companies have responded to the obvious need for improved means of escape by substituting covered lifeboats (escape capsules) for required life floats. Additionally, standby vessels stationed close to platforms have been used to augment the evacuation and lifesaving equipment on board production platforms. On October 4, 1984, and November 12, 1985, the House Subcommittee on the Panama Canal and the Outer Continental Shelf held hearings on proposed bills which would require the Coast Guard to issue regulations requiring standby vessels. The Coast Guard is studying the relationship between standby vessels and the facility's primary lifesaving equipment to determine whether and to what degree standby vessels would be mandatory. In this respect, the Coast Guard is addressing the following items:

A portion of the helo deck was blown into the life capsule support frame by the explosion.

- the distance a standby vessel should maintain near a platform in order to render effective assistance in an emergency,
- the design criteria a standby vessel should meet,
- special equipment that should be aboard standby vessels for effective handling of emergencies,
- how a standby vessel should be named, and
- the special training that should be required of a standby vessel's crew.

A Lesson Learned

This accident illustrates the need for improving safety on the Outer Continental Shelf. Whenever one overlooks safety, whether in design or in the workplace, one runs the risk of tragedy. Many times disaster can be avoided, but there is always the chance that a combination of events will culminate and produce a tragedy.

The gauge board inside the generator room bears mute witness to the fire's severity.

The drainage system on a platform can provide a hazardous path for the migration of natural gas. Owners, operators, and safety inspectors (industry and Coast Guard) should be highly aware of this potential. From the safety standpoint, buildings should not be placed over existing drains, and drains should not be installed under buildings. If the Coast Guard encounters this particular situation during an inspection of the platform and determines the condition to be hazardous, the drains should be ordered removed or plugged. The present system can be made safer. Standard plumbing "P" traps should not be installed in drains under buildings where they tend to fill up with dirt. The American Petroleum Institute states in API RP 14E that consideration should be given to minimizing bends and flow restrictions in gravity drains and in no circumstances should upslopes be permitted.

In the event of an emergency, all electricity should be turned off, with the exception of emergency explosion-proof lighting, and the platform shut down. In the event a gas detection alarm is triggered, employees should be directed to stay out of buildings until the source of gas or flammable vapor can be identi~~fied and eliminated by safe means.~~ Assigned personnel are required, by 33 CFR 146.15, to thoroughly inspect all lifesaving equipment periodically, making sure that all equipment is in good working order. This includes operating it as necessary. Good operating practices require replacement of expended equipment, as well as periodic renewal of those items which have a limited period of effectiveness. In addition, 33 CFR 146.125 requires drills to be conducted on a regular basis by the person in charge of the manned facility. This individual shall instruct personnel as necessary to ensure that all persons are familiar with their duties and stations.

Fixed platforms on the Outer Continental Shelf play an important role in the energy resources of the United States, as well as provide economic opportunity for the local communities. Safety on board fixed platforms can be improved through close cooperation with ~~the oil industry.~~

This article was based on the report of the Investigating Officer, Marine Safety Office, Port Arthur, Texas. The report number is MC85000838, dated April 23, 1985.

The ONDEK Vapor Dispersion Model

Robert H. Trainor
Michael C. Parnarouskis
LCDR Rex J. Prosser

One of the marine transport industry's important functions is the transportation of bulk liquid products in tankers and barges. These bulk liquid cargoes include pure chemicals, gasoline, crude oil, and other common chemical and petrochemical products. More than 600 substances are regulated for marine transport by the U.S. Coast Guard under Title 46 of the Code of Federal Regulations.

The toxicity of bulk liquid cargoes ranges from substances with negligible toxicity, such as edible vegetable oils, to highly toxic substances, such as carcinogens. Many of the cargoes are liquid organic solvents which tend to have significant vapor pressures, and therefore significant potential for being respiratory hazards at ordinary temperatures.

Marine transport personnel who handle these bulk liquid cargoes risk exposure to toxic vapors when performing their normal work. The Coast Guard saw the need to develop an analytical model which would predict the downwind concentration contours of heavier-than-air cargo vapors emitted during tank loading operations, and then graphically represent potentially hazardous areas. This analytical model is referred to as ONDEK.

Dispersion of Chemical Vapor Plumes

Chemical vapors are released during loading at or above deck level by the displacement of the ullage atmosphere in an empty tank. During the loading of a chemical cargo, the chemical will evaporate at the liquid-gas boundary in the tank to form a "vapor blanket" above the liquid surface. The chemical vapor moves away from the liquid surface and mixes with the air or other gases initially inside the tank. As the liquid level rises, this mixture of air, initial gases, and cargo vapor is displaced from the tank as shown in figure 1. This displacement can be through a vent, ullage hatch, or expansion trunk opening. Once released into the atmosphere, the cargo vapors mix with the air and begin to spread out from the vent or discharge point. As the cargo vapors move downwind of the discharge point, they become more dilute in the air. Since most

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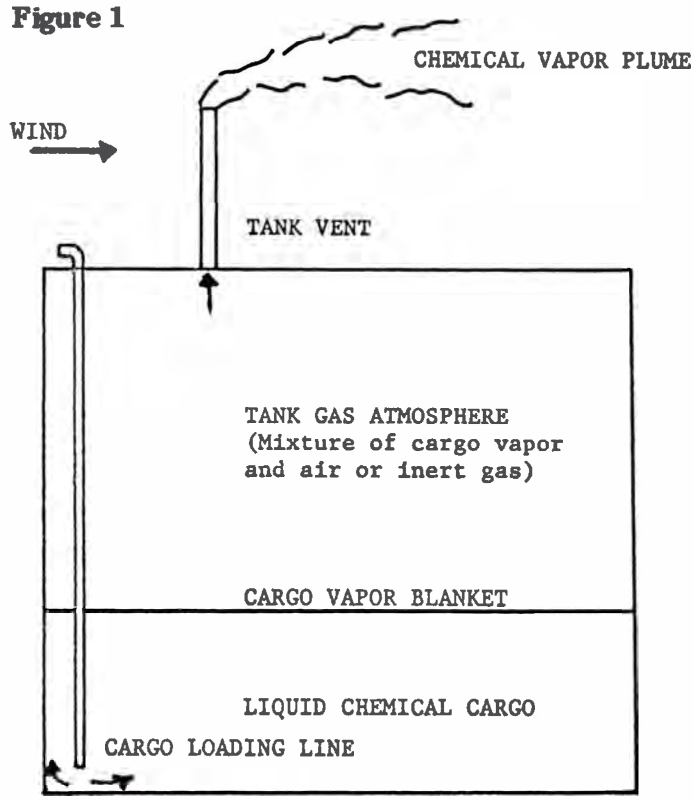
Figure 1



cargo vapors are heavier than air, the cargo vapors will also sink to deck level.

The relative vapor hazards on deck can be determined by estimating the size of the cargo vapor contour at a given concentration over the deck area of the vessel. The ONDEK model can compute the size of the cargo vapor contour and superimpose a plot of the computed contour over a schematic outline of the vessel. At locations within the vapor contour, the vapor concentrations will be higher than the contour concentration value. Likewise, at locations outside of the vapor contour, vapor concentrations will be more dilute than the contour concentration value. Figures 2 through 5 are examples of the different types of concentration plots that the ONDEK model can produce.

Applications

Since the ONDEK model is designed to compute estimated vapor concentrations downwind of a tank vent during tank loading operations, these vapor concentrations can be expressed in terms of health-significant limits for the chemical vapor being emitted. Values for vapor exposure limits, such as the time weighted average-threshold limit value (TWA-TLV), the short term exposure limit (STEL), and the upper and lower flammable limits (UEL and LEL) can be used as input concentration values for ONDEK. The plots of the concentration contours superimposed over a schematic outline of the vessel illustrate how much of a vapor inhalation hazard exists for personnel working on the barge or tank ship during loading operations. Since ONDEK permits the user to designate the concentration and the specific chemical vapor, the model is a very useful tool for conducting vapor hazard assessment studies of marine cargo transfer operations.

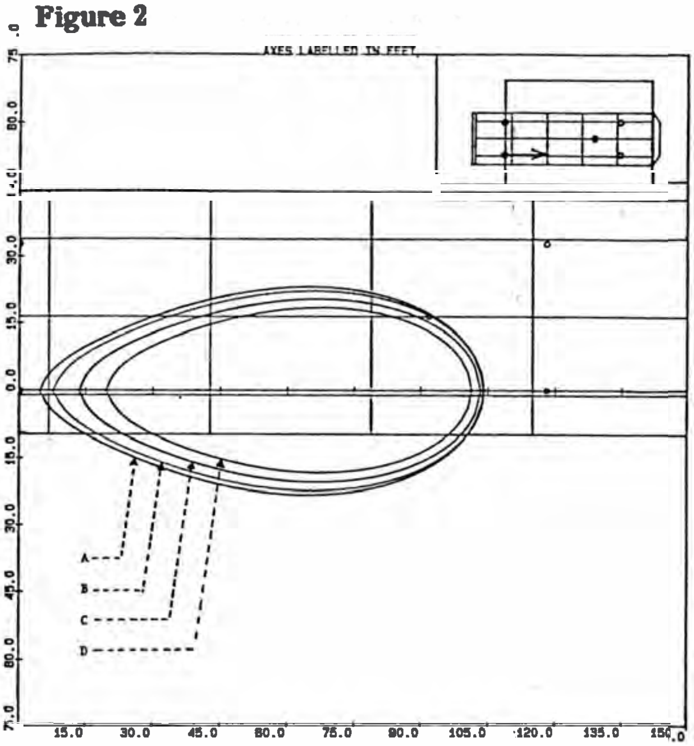
The model can also be used to predict the downwind concentrations of vapors released by accident, such as might occur when a vapor transfer line ruptures or a vapor release valve malfunctions. The predicted concentrations will be useful in formulating response plans and conducting casualty investigations. ONDEK model results were recently used in a major marine casualty investigation to determine whether a flammable vapor mixture was emitted from an open vent and ignited by a source some distance downwind.

Perhaps the most useful application of the ONDEK model is how easily it lends itself to showing how conditions, such as cargo loading rate, vent height and diameter, and wind speed, can increase or decrease the size of a concentration contour.

As an example, the ONDEK model was used to predict the effects of raising the vent heights for 21 test chemicals. The ONDEK tests indicated that increasing vent heights has only a minimal effect on reducing exposure levels. The size of the concentration contours were far more sensitive to wind speed and cargo loading rate. Figures 2, 3, and 4 are contour plots for benzene which were obtained during this study and demonstrate these findings.

The model can also plot multiple concentration contours on a single plot. Figure 5 is a sample plot for benzene. The results indicate that the size of the concentration contour is very sensitive to the concentration value selected. Consequently, determination of the appropriate exposure level standard for employees working in these areas is extremely important.

Figure 2



SEP 20 1984 TEST #1 BENZENE
CONTOUR CONCENTRATION = 10.000 PPM (USER)

CONSTANT PARAMETERS	VARIED PARAMETER
CARGO LOADING RATE = 500.5 BBL/HR	VENT HEIGHT = 10.00 FT (A)
VENT FLOW RATE = 48.8 CFM	VENT HEIGHT = 12.00 FT (B)
WIND SPEED = 2.50 MPH	VENT HEIGHT = 15.00 FT (C)
VENT DIAMETER = 0.8880 FT	VENT HEIGHT = 17.50 FT (D)
VENT VELOCITY = 2.2384 FT/S	

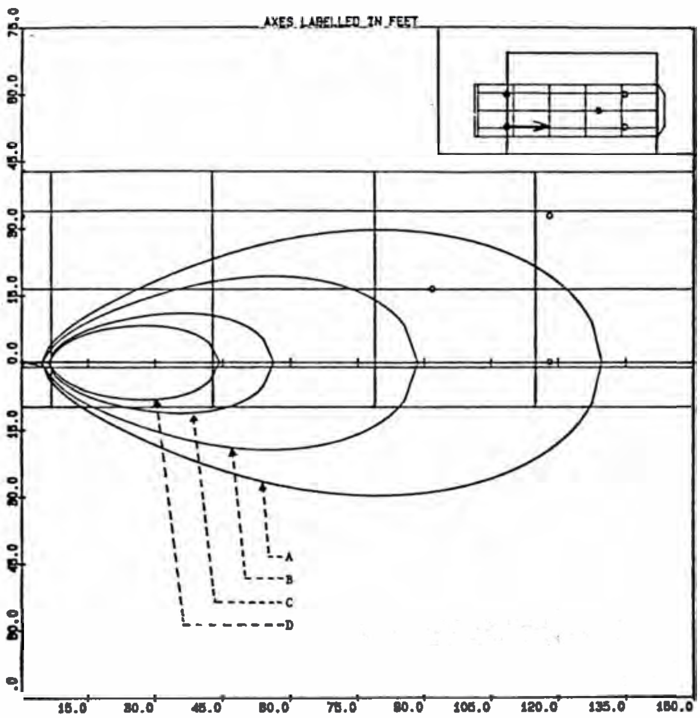
PREDICTED FOR A HEIGHT OF 5.51 FT ABOVE DECK LEVEL

Summary

The ONDEK vapor dispersion model was designed to predict concentrations of vapor released from a bulk liquid cargo tank during cargo transfer operations, and thereby provide a measure of the hazardous vapors to which marine industry employees are exposed. The model was developed as part of the Coast Guard's ongoing occupational health and safety program.

A copy of the ONDEK program will be provided upon written request. Interested parties should supply a blank tape and foward their requests to Commandant (G-MTH-1), U.S. Coast Guard, 2100 Second Street, SW, Washington, DC 20593.

Figure 3



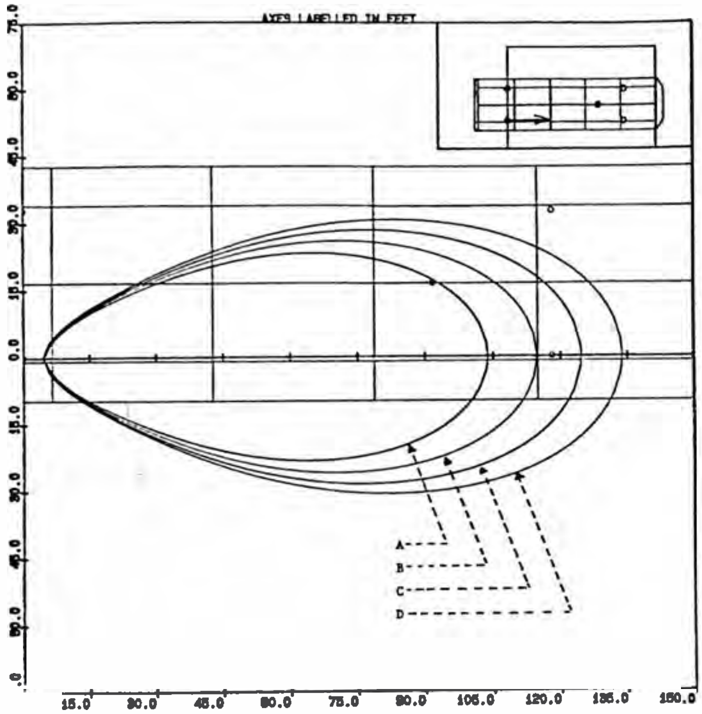
MAR 6 1985 BENZENE BNZ1.INP

CONTOUR CONCENTRATION = 10.000 PPM (TLV)

CONSTANT PARAMETERS		VARIED PARAMETER	
CARGO LOADING RATE =	750.6 BBL/HR	WIND SPEED =	2.50 MPH (A)
VENT FLOW RATE =	70.2 CFM	WIND SPEED =	5.00 MPH (B)
VENT HEIGHT =	10.00 FT	WIND SPEED =	10.00 MPH (C)
VENT DIAMETER =	0.6660 FT	WIND SPEED =	12.50 MPH (D)
VENT VELOCITY =	3.3575 FT/S		

PREDICTED FOR A HEIGHT OF 5.51 FT ABOVE DECK LEVEL

Figure 4



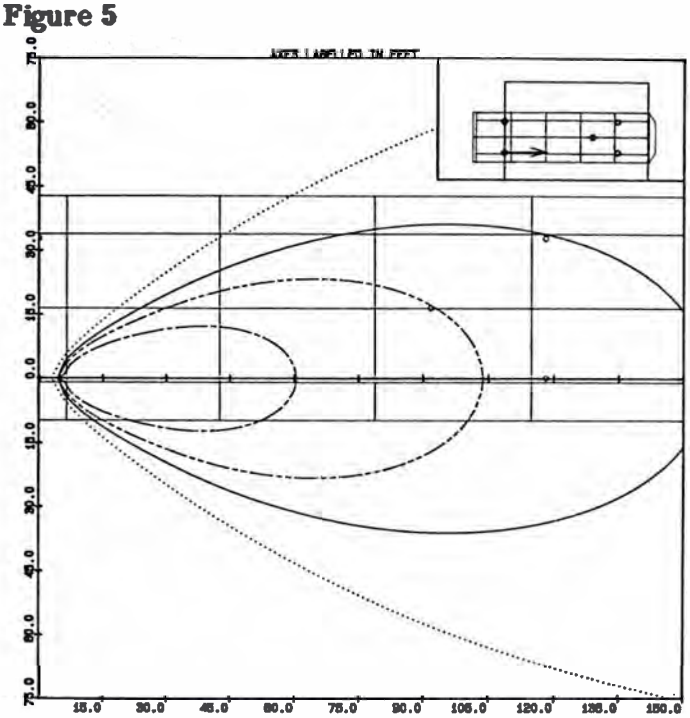
SEP 6 1984 TEST #4 BENZENE

CONTOUR CONCENTRATION = 10.000 PPM (USER)

CONSTANT PARAMETERS		VARIED PARAMETER			
VENT HEIGHT =	10.00 FT	VENT FLOW RATE =	46.8 CFM	=	500.5 BBL/HR (A)
WIND SPEED =	2.50 MPH	VENT FLOW RATE =	56.1 CFM	=	600.0 BBL/HR (B)
VENT DIAMETER =	0.6660 FT	VENT FLOW RATE =	65.5 CFM	=	700.5 BBL/HR (C)
VENT VELOCITY =	2.2384 FT/S	VENT FLOW RATE =	74.9 CFM	=	801.1 BBL/HR (D)

PREDICTED FOR A HEIGHT OF 5.51 FT ABOVE DECK LEVEL

Figure 5



SEP 6 1984 TEST #6 BENZENE

PARAMETERS	
CARGO LOADING RATE =	500.5 BBL/HR
VENT FLOW RATE =	46.8 CFM
VENT HEIGHT =	10.00 FT
WIND SPEED =	2.50 MPH
VENT DIAMETER =	0.6660 FT
VENT VELOCITY =	2.2384 FT/S

CONTOUR CONCENTRATION VALUES			
USER (	1.000	PPM)	....
ODOR (	4.680	PPM)	————
UEL (	71000.000	PPM)	— —
LEL (	14000.000	PPM)	—.—
STEL (	25.000	PPM)	—..—
TLV (	10.000	PPM)	—...—

PREDICTED FOR A HEIGHT OF 5.51 FT ABOVE DECK LEVEL

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Control Data Systems, Inc., *VAX ONDEK 84 System Documentation.* Rockville, MD: Contract W6903-08G, March 1985. (Available through Commandant (G-MTH-1), U.S. Coast Guard, 2100 Second Street, SW, Washington, DC 20593.)

Unseaworthy Barges

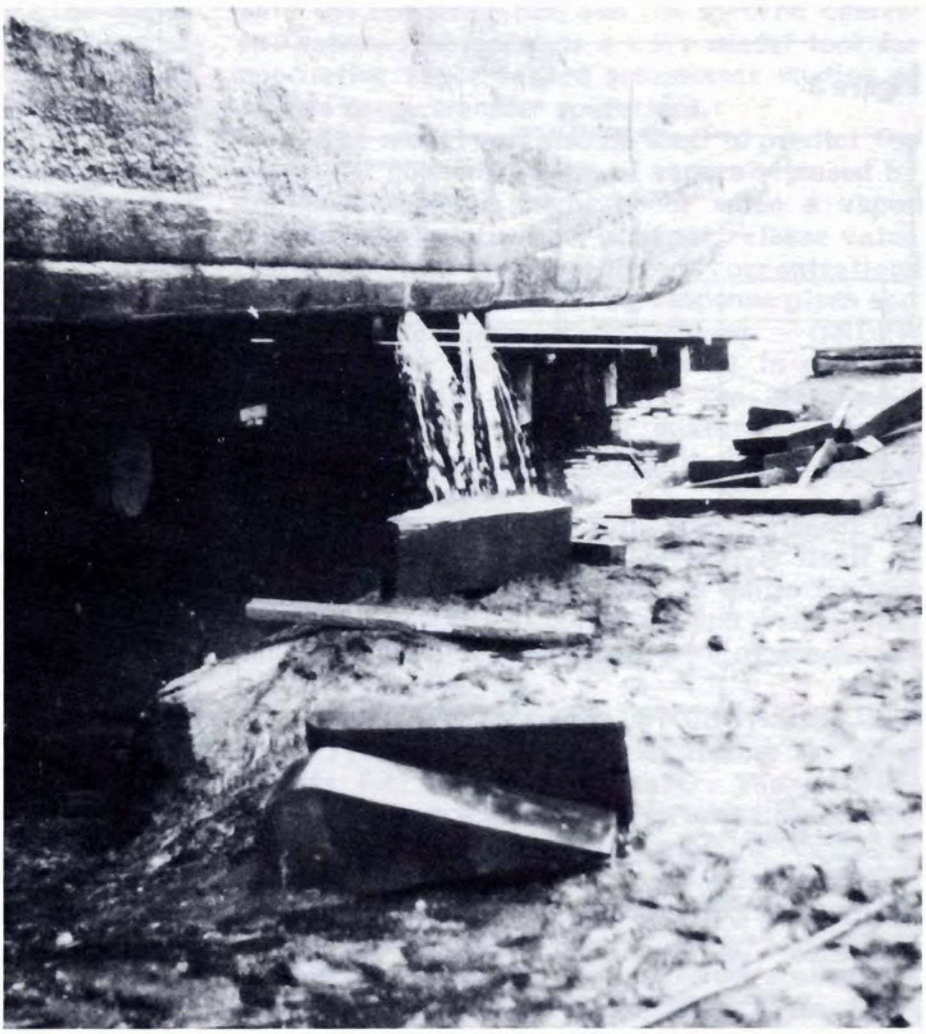
LCDR Christopher Walter

In the evening of 10 December 1984, a barge which was not inspected or certificated by the Coast Guard was loaded with 1,600 tons of liquid fertilizer and pushed out of Hampton Roads enroute to Seaford, Delaware, via Chesapeake Bay. Thirty-two hours later, the crew was desperately trying to keep the barge afloat. Their efforts failed. This is the story of the casualty and the standard of care placed on towing vessel operators for the seaworthiness of their tows.

An Unseaworthy Barge

When the tug and its crew arrived at the loading terminal, the captain noticed that the barge was low in the water. He told a deckhand to pump out a starboard wing tank. Water continued to flow into the wing tank as it was being pumped. The owner and the captain decided to patch this hole before leaving Norfolk. The deckhands placed a sheet of foam rubber over the hole, and the foam rubber was covered by plywood which was braced by a 2x4-inch piece of lumber. The owner provided a 2-ton jack to hold this makeshift repair in place and assisted in making the repair.

LCDR Walter is Chief of the Investigations Department, U.S. Coast Guard Marine Safety Office, Hampton Roads, Virginia.



"When the barge was lifted on the drydock, water poured out of the starboard side in four places." (Official U.S. Coast Guard photo)

Were Appropriate Repairs Made?

The barge was drydocked in mid-November 1984, just weeks before the casualty, for some "band-aid"-type repairs. The barge was then placed back into service and made several trips from the Hampton Roads area. On the trip just prior to the 10 December voyage, the barge was holed, and water leaked into a wing tank. The same captain had to pump out the wing tank to keep this 21-year-old barge afloat.

The Voyage

The tug pushed the barge

away from the fertilizer dock at 1800 on 10 December 1984. The flotilla passed through five bridges and crossed over three highway traffic tunnels on its way out of Norfolk and into Chesapeake Bay. While still in the Elizabeth River, the mate for the voyage boarded the tug and asked the captain about the water being pumped over the side. The captain said the barge was sinking, and he made numerous complaints about the company. The mate discounted these complaints and inquired no further into the barge's condition.

When the mate went on watch at noon the next day, the captain told him to keep an eye on the barge's stern cleat and to call him if the bottom of the cleat went underwater. About an hour later, the captain retuned to the pilothouse and told the mate that the barge was sinking and pulling the tug underwater. He ordered the mate and the deckhands to pump out the barge. When the towing cables were slacked to ease the submerging force of the barge, the starboard deck of the barge immediately went underwater for about two-thirds of its 195-foot length. The men on the barge couldn't pump the starboard side, so they pumped out a stern compartment. Despite their efforts, the barge continued to sink. The towlines were slacked again, and water began to flood into the open stern compartment manhole. The barge was put on a hawser and intentionally grounded to keep it from sinking.

The crew put lights on the barge and stood by until another barge offloaded the cargo and salvage operations were started. The grounded barge was taken to Norfolk for drydocking and survey. When the barge was lifted on the drydock, water poured out of the starboard side in four places.

Two marine surveyors examined the underwater body of the barge for damage caused by the grounding and for any pre-existing deterioration. One of the surveyors took a small inspection hammer and pushed it by hand through the hull at the bilge turn and, with very little effort, ripped open a 12-inch hole. The surveyors determined that he hull deterioration had been present for quite some time and that the grounding and subsequent salvage effort had not caused this damage.

Seaworthiness

After investigating the casualty, the Coast Guard Investigating Officer charged the tug captain under the provisions of Title 46 United States Code (U.S.C.) 7703 for misconduct, i.e., taking an unseaworthy vessel to sea in violation of 46 U.S.C. 10908.

46 U.S.C. 10908 states

> *A person that knowingly sends or attempts to send, or that is a party to sending or attempting to send, a vessel of the United States to sea, in an unseaworthy state that is likely to endanger the life of an individual, shall be fined not more than $1,000, imprisoned for not more than 5 years, or both.*

During the suspension and revocation hearing in Norfoilk, two elements of the offense had to be proved. The first element was to prove that the barge was unseaworthy. The second dealt with proving a knowing violation; that is, did the tug captain know that the barge was unseaworthy?

"Seaworthiness, as that term has been defned and redefined, is reasonable fitness to perform or do the work at hand."[1] The seaworthiness element was proved through the testimony of the two marine surveyors who examined the underwater body of the barge after it was salvaged. In their expert opinions, the barge was not seaworthy at the time of their survey, had not been seaworthy for some time, and the deterioration they had observed was not caused by any sinking, grounding, or salvage effort. Their opinions were based upon the extensive hull corrosion, the presence of widespread and undisturbed marine growth on the underwater body, and the lack of any "bright" metal that would indicate a recent penetration of the hull from a grounding. The testimony of a crew member about the holed condition of the wing tank and the need to pump the barge before and after the casualty was also used. Also, in other cases it has been held that "when there is a sinking of the barge as this barge did with no apparent reason in normal use, there is a presumption that it is unseaworthy..."[2] The respondent was unable to over-

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[1] *Lamar Towing, Inc.* **v.** *Fireman's Fund Insurance Company, 1973 AMC 1844, 1855, 352 F. Supp. 652, 661.*

[2] *Consolidated Grain & Barge Company* **v.** *Marcona Conveyor Corporation, et al., 1985 AMC 121, 716 F. 2d 1077.*

come either the presumption of unseaworthiness or the testimony provided by the marine surveyors and the deckhand.

Did The Operator Know?

The proof of knowledge was more difficult. The master of a vessel is responsible for knowing the condition of his vessel. However, is a towing vessel operator responsible for knowing the condition of each barge he undertakes to tow? That question played an important role since the charge would have been dismissed if the operator was not required or did not know about the barge's condition. In this case, the operator did know and should have known of the barge's condition. First, he had pushed the barge previously and had to pump it to keep it afloat. Prior to departing the fertilizer terminal, he had ample opportunity to examine most of the barge's hull before it was loaded. He directed his crew to pump out a wing tank. Later, his entire crew, along with the owner of the barge, was engaged in patching a hole in one wing tank. In addition, he gave operational orders to the mate to call him if the stern cleat on the deck of the barge went under. Clearly, the operator knew that the barge was not seaworthy.

Standard of Care for Towing Vessel Operators

The Administrative Law Judge addressed the issue of the respondent's knowledge of the barge's condition as well as a standard of care to be followed by tug operators with regard to their tows when he wrote the following in his Decision and Order:

> *The testimony indicates that neither the respondent nor any other reasonable operator would conduct an underwater inspection of a barge he intended to take to sea. He is, however, required to exercise reasonable judgment as to whether the barge is in a seaworthy condition. In this case, the respondent knew or should have known that one of the void tanks was leaking and that the owner had undertaken to patch the hole with foam rubber, plywood, and a jack. Secondly, the respondent was not unfamiliar with the barge and was aware that on a previous trip a short time ago the bottom was holed while dragging bottom.*

The Administrative Law Judge suspended the tug operator's license outright for a period of 9 months.

Summary

No one was killed in this casualty only through a combination of circumstances and luck. Tug operators must take seriously the responsibility placed upon them and exercise reasonable caution regarding the seaworthiness of their tows.

The importance of ensuring that a barge is seaworthy is illustrated in another casualty which ended in tragedy. Less than a month before this case, on 17 November 1984, the M/V CELTIC was towing the uninspected barge CAPE RACE in Long Island Sound when the barge suddenly sank. The tug was pulled down by the barge, and all six crew members died. The National Transportation Safety Board's detemination of the cause of this casualty perfectly summarizes the problem:

> *...the probable cause of the sinking of the tug CELTIC and barge CAPE RACE was the failure of the owner of the barge to maintain the barge adequately, which allowed the internal structure and shell plating of the barge to deteriorate until the barge sustained a hull fracture, resulting in the flooding of the forward part of the barge, causing the barge to plunge underwater bow first and sink. The tug was pulled underwater by the sinking barge.*[3]

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[3]*Marine Accident Report, Sinking of the U.S. Tug M/V CELTIC and Barge CAPE RACE, Long Island Sound, Connecticut, November 17, 1984, Report No. NTSB/MAR-85/12, National Transportation Safety Board, Washington, DC, 1985, p. i.*

Editor's Note: The owner's responsibility with regard to the sinking of the unidentified barge is currently under investigation by the Coast Guard Marine Safety Office, Hampton Roads, Virginia. The Coast Guard encourages mariners to report defects in a vessel, such as the one highlighted in this article, by calling the 24-hour, toll-free hotline, 1-800-323-SAFE.

Yost Takes the Helm

ADM Paul A. Yost, Jr., is scheduled to be sworn in as the eighteenth Commandant of the Coast Guard on May 30, 1986. He succeeds ADM James S. Gracey, who is retiring after 37 years of service. The ceremony will be held at the Washington Navy Yard, Washington, DC.

Prior to being appointed Commandant, ADM Yost had been Commander of the Atlantic Area; Commander, Maritime Defense Zone Atlantic; and Commander, Third Coast Guard District since June 1984. In these capacities he was responsible for Coast Guard operations in the Atlantic, Caribbean, and the Gulf of Mexico. As Commander Maritime Defense Zone, he was responsible to Commander Atlantic Fleet for full use of all available Coast Guard and Navy assets for maritime coastal defense. Prior to this assignment, he was Chief of Staff of the Coast Guard in Washington, DC, for 3 years after having served as Commander, Eighth Coast Guard District, in New Orleans, Louisiana, since 1978, when he ws promoted to Flag Rank.

ADM Yost has held a wide range of key management and operational positions, including Chief of Staff and Chief of Operations of the Seventeenth Coast Guard District in Alaska and Commander of a combat task group in Vietnam. He has had command of three Coast Guard cutters, and he has served as a Special Assistant to the Deputy Secretary of Transportation and Alternate Delegate on the U.S. Law of the Sea Delegation.

A native of St. Petersburg, Florida, ADM Yost holds a Bachelor of Science Degree from the Coast Guard Academy, a Master of Science Degree in Mechanical Engineering from the University of Connecticut, and a Master of Arts Degree in International Affairs from George Washington University. ADM Yost is also a graduate of the U.S. Naval War College in Newport, Rhode Island.

He is married to the former Jan Worth of Wakefield, Massachussetts. Mrs. Yost is a graduate of the University of Maryland with a degree in Communications and Journalism. They have five children: Linda L., Paul A. III, David J., Lisa J., and Christopher J.

ADM Paul A. Yost, Jr.

Limitations of Exposure Suits

LCDR William M. Riley

A recent study by the Commander, Seventeenth Coast Guard District, found an alarming number of deaths occurred in fishing vessel capsizings and sinkings in Alaskan waters, in spite of the availability of exposure suits. The District Commander's report concluded that more public education is needed to ensure that the suits are properly maintained, readily accessible, and that the crew knows when and how to use them to best effect.

The most common problem noted in the District Commander's study was a person becoming trapped in the pilothouse or cabin of a fishing vessel when the boat capsized or sank. In three of the cases studied, crewmen were either in the process of donning an exposure suit before exiting the pilothouse, or were reentering a cabin to get an exposure suit, when they became trapped. In the one other case, a crewman was eventually found trapped in the engine room of the vessel, wearing an exposure suit. It is impossible to say whether any of these victims could have found their way out of the submerged, inverted compartment, even unencumbered by the exposure suit with its inherent buoyancy. The kind of emergency egress training needed to survive such a situation has traditionally only been available to military aircrews, although some offshore oil industry workers have now started to receive similar training. It is good advice, therefore, to get to an open deck whenever the vessel is in distress, and to don your exposure suit only after you are in the open. Of course, the suits should be stowed where they are readily accessible on the way out.

In two cases, crew members were found floating face down wearing exposure suits, in each case with head injuries which probably rendered them unconscious immediately. In at least one other case a crewman, wearing an exposure suit, was caught in the rigging and pulled under, never to be seen again. A person wearing an exposure suit is less likely to be rendered unconscious from hypothermia, leading to drowning, but being struck by the vessel's hull, superstructure, or rigging may bring immediate unconsciousness and eventual death. Exposure suits will not turn an unconscious wearer face up in the water, and wave action will periodically turn even a conscious wearer face down. You must remain conscious to survive. One way to increase your chances of survival is by early abandonment into a liferaft or boat which then gets clear of the distressed vessel's rigging. In most capsizing and sinking cases, there was some foreknowledge that the vessel was taking on water and in trouble; a distress call was made; but the crew waited until the vessel finally rolled over or sank before abandoning. The decision to abandon ship is always a hard one, but once a distress call has been made and help is on the way, abandonment to the safety of a liferaft, standing off a safe distance from the sinking vessel, must be seriously considered to avoid being trapped. Just be sure to include this intention in your distress message.

The victims of the cases studied did the best they could to save themselves. "Monday morning quarterbacks" can always find something to criticize, but fixing blame should not be our goal. Rather, we should learn from past casualties anything which might help us minimize future deaths and injuries.

LCDR William M. Riley is a Staff Engineer in the Coast Guard's Survival Systems Branch, Merchant Vessel Inspection Division, Office of Merchant Marine Safety, U.S. Coast Guard Headquarters.

Medical Emergencies at Sea

Here in one place the yachtsman will find a comprehensive, up-to-date, informative manual on how to recognize and treat medical emergencies on board a boat. Dr. William Kessler, the author, concerns himself with emergencies and with the prevention and treatment of such seagoing calamities as sunburn, seasickness, hypothermia, dehydration, broken bones, heart attacks, severe cuts and punctures, and drowning.

The book utilizes the latest research, compiled by a doctor who has been practicing medicine and sailing for more than 25 years. His specific purpose in writing the book was to instruct the yachtsman at sea on how to handle medical problems when a doctor or hospital is hours, or even days, away. Dr. Kessler's step-by-step instructions and detailed illustrations make the book invaluable, and his advice about which drugs and other treatments will work and which won't strkes a fine balance between old wives' tales and solid medical consultation.

Chapters on burns, venomous marine animals, fractures, and head and spinal cord injuries fill out this readable, thought-provoking, and concise guide.

Copies of **Medical Emergencies at Sea** may be ordered from Hearst Marine Books, 105 Madison Avenue, New York, NY 10016. The price is $18.95.

Study Guide

Another volume in the Cornell Maritime Press series of study guides for professional mariners has been published. It is the **Study Guide to the Multiple-Choice Examinations for Lifeboatman and Able Seamean,** by William B. Hayler (Capt., USN, Ret.) and Paul M. Seiler (Chief Warrant Boatswain, USCG, Ret.). Both authors are on the faculty of the California Maritime Academy.

Containing more than 600 multiple-choice questions and answers, the book is designed to help young mariners prepare for the Coast Guard examinations. Divided into separate sections for each rating, the questions cover all areas from which the Coast Guard chooses subject questions. Some of the topics covered are emergency and lifesaving signals, regulations, davits, lifeboats, rules of the road, helicopter operations, and nautical terms.

The sources of this compilation are varied: candidates who have recently sat for the test were queried; approved textbooks and the Code of Federal Regulations were consulted, and finally, the authors relied on their own experience and backgrounds in developing questions in areas not sufficiently covered by other means.

This book is priced at $12.50 and is available from Cornell Maritime Press, Box 456, Centreville, Maryland 21617.

Maritime Affairs-- A World Handbook

The world's oceans and seas cover about 71 percent of the earth's surface, yet only in the last few decades has a major effort been undertaken to explore and understand the role of the sea in the life of mankind.

Maritime Affairs — A World Handbook (412 pp.) covers a wide range of subjects relating to oceans and seas, including international maritime law, sea transport and communications, the exploitation and conservation of marine natural resources, scientific research, boundary disputes, and the military dimension of the sea.

The text of the book provides up-to-date data on each subject area covered. In addition, there are directory sections giving descriptions, names, and addresses for major international maritime organizations, major organizations for each subject, and maritime publications arranged by subject and by country.

An appendix furnishes the full text of the United Nations Law of the Sea Convention, and the subject-arranged bibliography cites appropriate books for further reading. Completing the work is a detailed index. Order from Gale Research Co., Book Tower, Detroit, Michigan 48226; price $90.00.

MARAD Reports

The Maritime Administration has announced the availability of three technical research

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Coast Guard Awards Presented to Civilians

Distinguished Public Service Award

In March 1986, RADM Theodore Wojnar, on behalf of ADM James S. Gracey, presented the Coast Guard Distinguished Public Service Award to Gordon W. Paulsen, admiralty lawyer with the firm of Healy and Baillie in New York City, and past president of the Maritime Law Association of the United States. This honor is the highest recognition of its kind the Coast Guard may award a civilian.

Paulsen was cited for his extraordinary efforts in support of the Coast Guard while serving as Chairman of the Rules of the Road Advisory Council from 1982-85. According to the citation, Paulsen displayed exceptional leadership ability and professional knowledge which was responsible for the Council's successfully accomplishing numerous major initiatives which have improved navigation safety.

Gordon W. Paulsen accepts the Distinguished Public Service Award from RADM Wojnar.

Meritorious Public Service Award

RADM Wojnar also presented the Coast Guard Meritorious Public Service Award to Captain Charles F. Lehman, Vice President, American Commercial Barge Line, on behalf of ADM James S. Gracey. This honor is the second highest recognition of its kind the Coast Guard may award a civilian.

Captain Lehman was cited for his contributions to the Coast Guard while serving as Vice-Chairman of the Rules of the Road Advisory Council from 1982-85. According to the citation, Captain Lehman distinguished himself while serving as the Chairman of the Barge Sidelight Working Group and Rule 24 Working Groups. He continuously provided invaluable experience and knowledge while serving as a member of other Council working groups.

RADM Wojnar affixes the silver Meritorious Service Award medal to Captain Lehman's lapel.

Public Service Commendations

Ms. Georgia Volakis, Program Coordinator for the American Waterways Operators, accepts the Public Service Commendation Award from ADM James Gracey as Mr. Joseph A. Farrell, AWO President, looks on. Mr. John Rivers, Vice President and Secretary, accepted for the Shipbuilders Council of America. (The third award, made to Mr. George J. Ryan, President Lake Carriers Association, by RADM A.M. Danielson, Commander of the Ninth Coast Guard District, is not pictured.) These awards were made to honor over 90 years of combined service in providing Coast Guard officers with Merchant Marine Industry Training.

From left: Mr. Joseph Farrell, Ms. Georgia Volakis, and ADM Gracey.

Mr. John Rivers and ADM Gracey.

Keynotes

Final Rule

CGD 85-057, Private Aids to Navigation (April 3)

The Coast Guard is amending the private aids to navigation regulation. Currently, electronic private aids to navigation, with the exception of shore-based radar systems, are prohibited (33 CFR 66.01(d)). Requests from the offshore industry, and favorable experience with radar beacons (racons) as federal aids to navigation have caused the Coast Guard to recognize the desirability of allowing racon use as private aids to navigation. This rule will provide that racons are excepted from the general prohibition against electronic private aids to navigation. This regulation becomes effective on May 5, 1986.

CGD 85-048a and CGD 85-048b, Coast Guard Plan Review; Change of Address for Submission of Plans (April 24)

These rules change the address for submitting vessel plans for Coast Guard review. The plan review duties previously performed by the Merchant Marine Technical Branches of the Third Coast Guard District in New York, New York, the Eighth Coast Guard District in New Orleans, Louisiana, and the Twelfth Coast Guard District in Alameda, California, are being assumed by the Marine Safety Center located in Washington, DC. The effective date is June 1, 1986.

Supplemental Notice of Proposed Rulemaking

CGD 81-057, General Bridge Permit Program Regulations (24 April)

This proposed rule would establish a General Bridge Permit and the procedure for receiving authorization to proceed with the construction or modification of bridges under the Permit. The General Bridge Permit Program would eliminate the unnecessary burdens under the present program, while maintaining an adequate level of review of navigational and environmental concerns by the Coast Guard. Comments must be received on or before June 23, 1986.

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New Federal Regulations--Oily Waste Reception Facilities

LT G.M. Jacobson

Oily waste reception facilities. Certificates of Adequacy. MARPOL 73/78-Annex I. COA Worksheet.

If these terms are new to you, two workshops held in December 1985 by Captain of the Port New York may have interested you, particularly if you operate a terminal that receives oceangoing vessels. On December 3 and 10, 130 individuals from the New York/New Jersey maritime community went to Governors Island to review new U.S. regulations. Of the 292 terminals within the port, currently 130 of these are affected by the new regulations. At the workshops, the terms above and the regulations in Title 33, Code of Federal Regulations, Parts 151 and 158 (33 CFR 151 and 158) were studied and discussed.

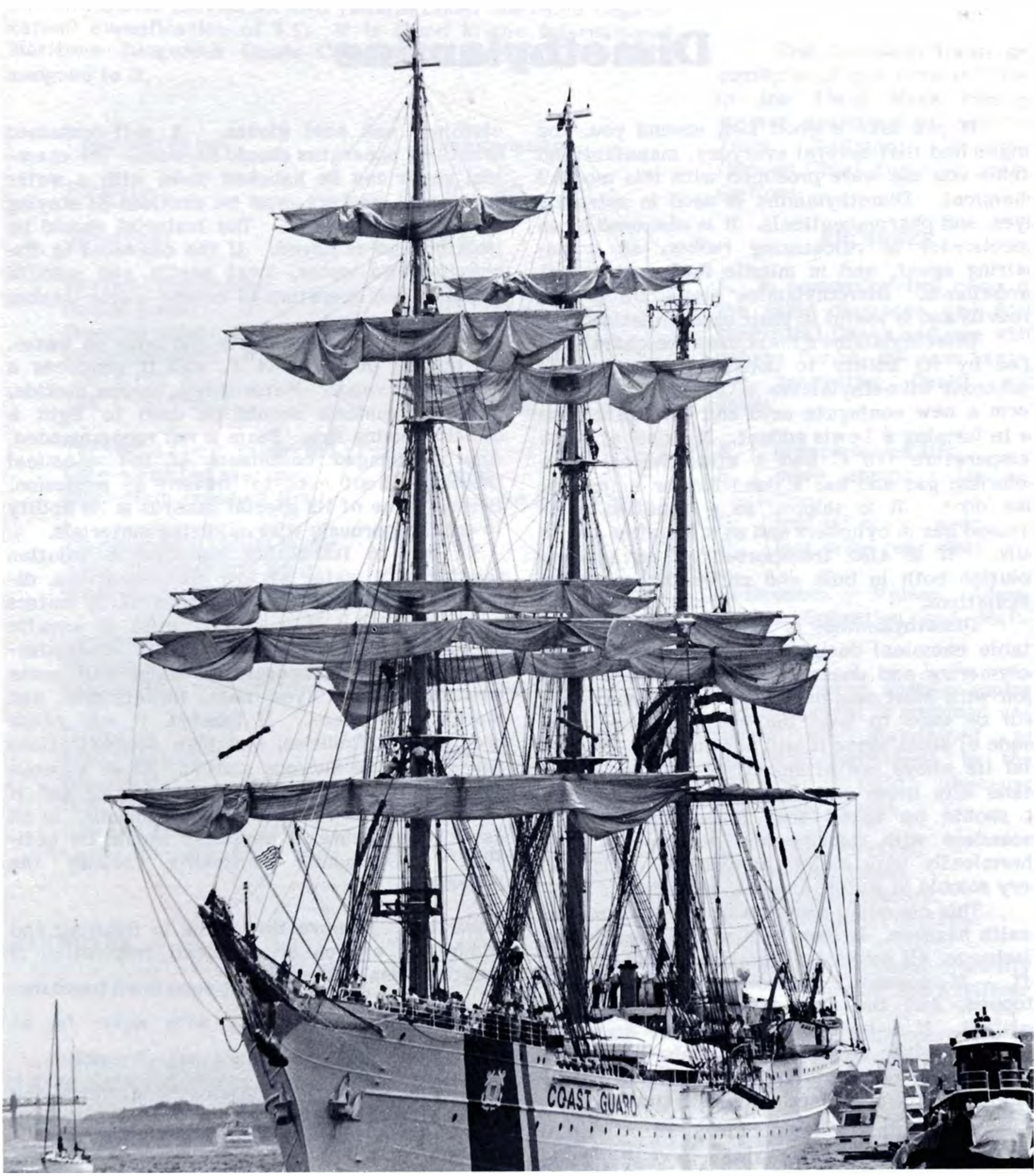
Commencing 10 March 1986, all terminals that receive oceangoing vessels over 400 gross tons and oceangoing tank vessels of all sizes will have to provide a service of receiving oily wastes from those ships. Their terminal can receive the waste, or they can have an outside vendor come to the terminal to receive the waste. This service for the ships is intended to help reduce the pollution of our oceans. The maritime countries of the world, through the international agreement known as MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978), established this and other standards of care to help stop pollution from ships.

The United States as a signatory nation to this international agreement (MARPOL 73/78) must ensure waste reception facilities are readily available and services do not delay the vessel's movements. To ensure this, the Department of Transportation, through the Coast Guard, promulgated regulations that establish the criteria for these waste facilities (33 CFR 151 and 158). The Coast Guard will be enforcing the regulations through the Captains of the Ports (COTPs). The COTP representatives will be inspecting the terminals to ensure their reception facility services for the ships are adequate in size and capability. After the inspections, the Coast Guard will be issuing Certificates of Adequacy as outlined in Commandant Instruction M16450.27.

LT Jacobson, U.S. Coast Guard, is assigned to the Captain of the Port, New York.

LTJG Jeff McCarthy discusses COTP enforcement authority for waste reception facility regulations.

The EAGLE Visits Washington



The U.S. Coast Guard Academy's training barque, the EAGLE, visited Washington, DC, on May 31 and June 1, 1986. The EAGLE was docked at the waterfront at 7th and Maine Streets in southwest Washington and was open to tours by the general public.

Dimethylamine

If you take a good look around you, you might find that several everyday, manufactured items you use were produced with this month's chemical. Dimethylamine is used in solvents, dyes, and pharmaceuticals. It is also used as an accelerator in vulcanizing rubber, as a dehairing agent, and in missile fuels and rocket propellants. Dimethylamine also attracts boll weevils and is useful in their extermination.

Dimethylamine's main uses are characterized by its ability to donate a lone pair of electrons (dimethylamine is a Lewis base) to form a new conjugate acid and conjugate base or in forming a Lewis adduct. It exists at room temperature (15°C and 1 atmospheres) as a colorless gas and has a dead-fish or ammonia-like odor. It is shipped as a liquefied compressed gas in cylinders and as a liquefied gas in bulk. It is also transported as an aqueous solution both in bulk and under the packaged regulations.

Dimethylamine is considered to be a stable chemical during transport. It does not polymerize and does not have hazardous reaction with most common materials. Tanks that will be used to hold the chemical should be made of steel, since it will not corrode. Copper and its alloys are attacked readily, and tanks made with these materials should not be used. It should be noted that dimethylamine will incandese with fluorine and decomposes exothermically with maleic anhydride. It is also very soluble in water, alcohol, and ethers.

This chemical presents dangerous fire and health hazards. In case of a spill or accidental discharge, all sources of ignition should be shut off. If possible, the discharge should be stopped, and the fire department should be notified. It is best to evacuate the area and restrict further access. Personnel can be protected from contamination by wearing chemical goggles with full face shield, rubber overclothing, and acid gloves. A self-contained breathing apparatus should be worn. The chemical vapor can be knocked down with a water spray, and workers must be cautious of staying upwind of the vapor. The material should be isolated and removed. If the chemical is discharged into water, local health and wildlife officials and operators of nearby water intakes should be notified.

Dimethylamine floats and boils on water. Its boiling point is 44°F, and it produces a flammable vapor. Water spray, carbon dioxide, or dry chemicals should be used to fight a dimethylamine fire. Foam is not recommended. Any undamaged containers of the chemical should be kept cool to prevent an explosion. Beware: one of its special hazards is its ability to react vigorously with oxidizing materials.

Due to its ability to form a solution readily with water at low concentrations, dimethylamine may be dangerous if it enters water intakes. It is also harmful to aquatic life; however, there is no food chain concentration potential. Exposure to vapor will cause irritation to the eyes, nose, throat, skin, and mucus membranes. If inhaled, it will cause breathing difficulties, and high concentrations can affect the nervous system. As an aqueous solution, it will burn the eyes and skin, and if swallowed, it is assumed to be poisonous. In all cases of exposure, a physician should be notified. On-scene treatments include the following:

Inhalation. Remove the victim to fresh air and administer oxygen or artificial respiration if breathing has stopped.

Eyes. Flush continuously with water for at least 15 minutes.

Skin. Remove all contaminated clothing and shoes. The affected area should be flushed with water then washed with water and soap.

Swallowing. If conscious, the victim should drink water or milk.

The U.S. Coast Guard regulates both an-

Larry R. Kennedy was a Third-Class Cadet at the U.S. Coast Guard Academy at the time this article was written. It was written under the direction of LCDR J.J. Kichner for a class on hazardous materials transportation.

hydrous dimethylamine and aqueous solutions of dimethylamine under 46 CFR as Subchapter O commodities. Anhydrous dimethylamine is listed in 49 CFR 172.101 as a flammable gas and aqueous solutions of dimethylamine as a flammable liquid. Dimethylamine carries an IMO (International Maritime Organization) classification of 2.1. It is found in the International Maritime Dangerous Goods Code with a Hazard Class of 2 assigned to it.

Chemical name:	Dimethylamine
Formula:	$(CH_3)_2NH$
Synonyms:	DMA
Physical Properties:	
boiling point:	6.9°C (44.42°F)
freezing point:	-92.2°C (-134°F)
vapor pressure:	
20°C (68°F)	1900 mmHg
46°C (115°F)	2999 mmHg
Threshold Limit Values (TLV)	
time-weighted average:	10 ppm
short-term exposure limit:	20 ppm for 5 minutes
Flammability Limits in Air	
lower flammability limit:	2.8
upper flammability limit:	14.4
Combustion Properties	
flash point:	7°C (45°F)
autoignition temperature:	430°C (806°F)
Densities	
liquid (water=1):	0.6804
vapor (air=1):	1.55
U.N. Number:	1032
CHRIS Code:	DMA
Cargo compatibility group:	7 (Aliphatic Amines)

KEYNOTES

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Requests for copies of NPRMs should be directed to the Marine Safety Council. The address is Commandant (G-CMC), U.S. Coast Guard, 2100 Second Street, SW, Washington, DC 20593; telephone (202) 426-1477. The office, Room 2110, is open between the hours of 8:00 a.m. and 3:00 p.m. Monday through Friday. Comments are available for inspection or copying during those hours.

Nautical Queries

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

ENGINEER

1. In comparing two cams of the same diameter, one with tangential flanks and one with convex flanks, the cam having the tangential flanks will cause

A. greater valve lift.
B. more abrupt valve action.
C. less valve seat wear.
D. less valve gear wear.

Reference: Maleev, Diesel Engine Operation and Maintenance

2. Hydraulic system piping and equipment is designed and should be maintained to minimize turbulence in the hydraulic fluid because turbulence causes

A. fluid vibration.
B. energy losses.
C. erratic pressure.
D. mechanical damage.

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

3. The boiling temperature of a refrigerant with oil in solution has a

A. higher boiling temperature for a given pressure than does a pure refrigerant.

B. lower boiling temperature for a given pressure than does a pure refrigerant.
C. boiling pressure equal to that of a pure refrigerant at a given pressure.
D. lower boiling temperature than does a pure refrigerant, but the refrigerating effect is less.

Reference: King, Modern Marine Refrigeration Practice

4. What will be the frequency of a three-phase, six-pole, A.C. generator operating at 1800 revolutions per minute?

A. 60 hertz
B. 90 hertz
C. 120 hertz
D. 180 hertz

Reference: Hubert, Preventive Maintenance of Electrical Equipment

5. Most main reduction units employ double helical cut gears rather than single helical cut gears because they

A. eliminate the need for a turbine dummy piston.
B. eliminate the need for spherically seated bearings.
C. prevent unequal tooth contact.
D. prevent end thrust.

Reference: NAVPERS 10788-B, Principles of Naval Engineering

DECK

1. Which of the following would **not** be a treatment of a person who has received a head injury and is groggy or unconscious?

A. Give a stimulant
B. Elevate the victim's head
C. Stop severe bleeding
D. Treat for shock

Reference: The Ship's Medicine Chest and Medical Aid at Sea

2. You are steering 001° by magnetic compass. The variation is 2° west and the deviation is 1° east. The true course being steered is

A. 359°
B. 000°
C. 002°
D. 003°

Reference: Bowditch, American Practical Navigator

3. One of the requirements necessary to satisfy a general average act is

A. a successful venture.
B. no losses.
C. no imminent peril.
D. all of the above.

Reference: Marton, Tanker Operations

4. A special flashing light is used on a vessel

A. being pushed ahead.
B. towed alongside.
C. towed astern.
D. any of the above.

Reference: COMDINST M16672.2A

5. Before gasoline can burn, its temperature must be

A. below its flash point.
B. equal to or above its flash point.
C. above the explosive range.
D. none of the above.

Reference: Baptist, Tanker Handbook for Deck Officers

ANSWERS

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

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

NEW PUBLICATIONS

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reports available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA, 22161.

"At-Sea Test and Demonstration of Petroleum Coke-Oil Mixtures (PETCOM)" presents the results of burning petroleum coke/oil mixtures at sea onboard the SS MARINE DUVAL. (Order number PB86-153897; price $28.95). A second report, "Performance Characteristics of an Alternatively Configured Fluidized Bed Superheater Subjected to Simulated Ship Motions, Volume I," reflects research conducted by the Webb Institute of Naval Architecture under MARAD's University Research Program. (Order number PB86-155470; price $11.95). "Development of Accuracy Control Computer Programs, Data Management and CAD/CAM Interfaces" covers work performed by the University of Washington. (Order number PB86-152956; price $16.95).