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On 26 February 1984, the tankship AMERICAN EAGLE exploded and sank. Five crewman were killed, nine others were injured, and two remain missing. Several actions may have led up to this accident. The story, which includes a list of "Lessons Learned," begins on page 235.

Sinking of the SS AMERICAN EAGLE

Lawrence David Glass
Marine Investigation Division
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The AMERICAN EAGLE goes down while listing to starboard.

At about 1045 local time on 26 February 1984, the U.S. tankship AMERICAN EAGLE on a voyage, in ballast, exploded and subsequently sank the next day 110 miles south-southwest of Grand Isle, Louisiana, killing five crewmen, injuring nine, and leaving two others missing and presumed dead.

The explosion caused major structural damage to cargo tanks 2, 3, and 4. However, the vessel did not immediately sink; initially its list and trim appeared to be unaffected. An attempted stern tow by an anchor-handling offshore supply vessel to prevent collision with an oil rig was abandoned when the AMERICAN EAGLE began to break up.

The stern section of the AMERICAN EAGLE sank at 1735 on 27 February 1984. The bow sank the following night.

Vessel Data

The AMERICAN EAGLE was an oil tanker whose overall length was 661 feet and gross tons were 20,520. It was propelled by steam turbo reduction and had 13,600 horsepower. The tanker was built in 1959 and was owned and operated by the American Foreign Steamship Corporation in New York.

The AMERICAN EAGLE had a two-house tankship configuration with the engine room located forward of the boiler room. The tanker had a cargo capacity of 280,455 barrels, with 10 compartments, each holding 3 tanks. Each section was served by discharge and loading pipelines. The vessel was not equipped with either crude oil washing, inert gas, or segregated ballast. Since the vessel was not carrying crude oil and was not equipped with high capacity tank washing machines, it was not required under Coast Guard regulations to have an inert gas system (IGS) installed.

The AMERICAN EAGLE had four 24-foot, 25-man lifeboats and two inflatables, one capable of holding 15 men and the other 20 men. Each boat was equipped with Rottmer-type releasing gear.

Routine Voyage

The AMERICAN EAGLE departed Corpus Christi, Texas, on 15 February 1984, loaded with 44,911 barrels of No. 2 oil, 124,857 barrels of unleaded gasoline, and 75,089 barrels of leaded gasoline. It arrived at Port Everglades, Florida, on 19 February 1984, where 43,245 barrels of unleaded gasoline were unloaded. The AMERICAN EAGLE left Port Everglades on 19 February, arriving the following day at Jacksonville, Florida, where it discharged 129,906 barrels of cargo. The tanker left Jacksonville on 21 February, arriving on 22 February at Savannah, where the last of the cargo was discharged.

The captain was ordered to clean and gas free his tanks and proceed to Orange, Texas, to lay up for berthing, stopping off at Sabine Pass to pick up a gas chemist to verify that the tanks were in fact gas free. Tank washing was handled via the Butterworth method using portable machines. Cargo tank gas freeing was done with a steam-driven Coppus Turbine blower and a Lamb air mover carrying the warning label: "This air mover should be properly grounded to prevent static discharge when used in atmospheres containing combustible gases, vapors, or dusts." However, there were no plugs or grounding cables on the unit. The master thought that the blower's contact with the deck was sufficient grounding. It was operated with steam because the air mover used huge amounts of compressed air which was not available in large quantities aboard the AMERICAN EAGLE. The master noted that the manufacturer's brochure, which came with the blower, stated that the unit may be operated in hazardous atmospheres with air or steam. The International Safety Guide for Tankers and Terminals (ISGOTT) procedures manual warns of the hazard of injecting steam into an explosive atmosphere.

By 26 February, all but four of the cargo tanks had been cleaned and gas freed or ventilated. Some difficulty was experienced with stripping slop from amidships tanks. Two separate repairs were made on deck to a steam line. Neither repair involved heat or soldering and did not contribute to the casualty.

Explosion and Subsequent Sinking

At the time of the explosion, the vessel was on auto pilot. A seaman watching from the pilot house observed the steam-driven air mover in a No. 2 Butterworth opening blowing air and steam into the tank and noted that the air mover was very hot (it was being handled with ropes rather than by hand). The air mover, with its long, plastic sleeve, was removed from the No. 2 tank and was placed in the No. 3 center cargo tank, and presumably the steam valve was turned on when a major explosion occurred at 1045 on 26 February. (The radio operator thought there were three distinct explosions.)

The AMERICAN EAGLE's position at the time of the explosion was 27-30N, 91-30W, 110 miles south-southwest of Grand Isle, Louisiana. The tanker was sailing a course of 291° true. The AMERICAN EAGLE's speed was 13 knots, running 75 rpm. The weather at the time was hazy, with 5 to 6 miles visibility and winds of 10 to 12 knots. Seas were from 3 to 4 feet. Temperature was 13°C (65°F).

After the explosion, cursory observations of the vessel from the pilot house revealed the area forward of the midships house to be severely damaged. There was a large separation in the port side of the deck from the foc'sle to aft of the midships house. Several holes were observed on both sides of the hull with a large tear in the starboard shell plating located above the waterline. The port shell

plating had a pronounced bulge. The midships house was partially collapsed. No damage was noted aft of the midships house. Orange smoke was noted, but there was no sign of fire. No full evaluation of structural damage to the ship was made, fire hoses were not led out, and no fire watch was set. A general alarm was not sounded. There was apparently no sign of vessel instability.

The badly injured radio operator immediately tried to send an SOS, but his effort was not successful. Several attempts were made to communicate visually with rocket-propelled parachute flares and with mirrors. These efforts also failed. One flare backfired, burning the chief engineer. It is clear that at least some of the flares on the EAGLE were too old to be reliable. The AMERICAN EAGLE did not as a matter of procedure throw away flares more than 3 years old. The flares instead were saved for practice.

The portable emergency transmitter in the officer's mess located in the aft house was tried for an hour and a half. It was not clear whether the portable transmitter was working or not. The master tried the battery-powered transmitter; it would not operate. The 2182 transmitter was tried, and it worked; however, the antenna was damaged. When the antenna was temporarily repaired, the radio went dead. Attempts to use the VHF multichannel radio on channel 13 proved futile. The explosion had blown the multichannel VHF radio off the wall, severing all connections. As a last-ditch effort, all connections on the VHF radio were reestablished with a remote on the bridge, and the radio was used to broadcast maydays on channel 16. A faint reply was received from a ship in San Francisco, but lines of communication were not firmly established. Thereafter, response was received from the M/V MOBIL VALIANT. This line was maintained, and the VALIANT was successfully used as a relay to the mainland. At 1543 on February 26, the M/V FORT EDMONTON relieved the MOBIL VALIANT as the radio relay and standby vessel. The Coast Guard and the owner were informed that the AMERICAN EAGLE had a fractured hull and was stopped as a result of the explosion but that the vessel was in no immediate danger.

Two lifeboats were cleared and readied for lowering after the explosion, but they were resecured under orders of the captain in preparation for a Coast Guard helicopter which was on the way to evacuate the injured crewmen. The inflatable liferaft was also lashed down.

The Coast Guard helicopter removed three injured crewmen at 1813. Because the captain felt that the ship would safely tow into Galveston with everyone aboard, no nonessential personnel left the vessel at that time.

The owner, when notified of the explosion, engaged a tug to tow the AMERICAN EAGLE to Galveston for repairs. The SMIT NEW YORK did not arrive on scene until 1900 on 27 February.

The weather deteriorated badly on the 27th, increasing the grinding and the movement of the bow section on the AMERICAN EAGLE. Seas rose to 20 to 30 feet with winds 30 to 40 knots gusting up to 50 knots. The vessel drifted to a point within 1 mile of one of the many exploratory drilling rigs in the area.

The master of the ENTERPRISE, an offshore supply vessel, offered towing assistance to the AMERICAN EAGLE and informed the crew that their ship was on a collision course with several mobile offshore drilling units (MODUs) in the area. On the second attempt, the EAGLE was successfully towed away from the MODUs. However, towing actually hastened the demise of the AMERICAN EAGLE.

The vessel had been somewhat protected while riding with the sea in a trough. Despite worsening weather, the severely damaged hull did not degrade significantly while in the trough. But after being towed for less than an hour, the bow's movement increased dramatically until the port side broke free while the ship rolled and pitched. The crew hoped the bow would break free and that the stern would steady and remain afloat; however, the situation quickly deteriorated, and the captain ordered the crew to abandon ship. Again, no general alarm was sounded, and no formal muster was ordered. The vessel was going down by its head while listing to the starboard.

Abandon Ship

The port lifeboat was useless because of a 25° list to starboard. The inflatables were not used. The starboard lifeboat was not secured to the ship and swung badly, scaring the crew. Five of the crew, including the master, did not enter the lifeboat. Despite considerable effort, the lifeboat would not completely lower, causing confusion and uncertainty. Many of the crew members jumped into the water.

The Rottmer releasing gear finally allowed the boat to touch the water during a wave peak. The lifeboat rolled but then righted itself. Those still in the boat were having a difficult time releasing the sea painter rope toggle, and they were beginning to think the

ship would founder and roll over them.

The crew could not get the lifeboat away from the ship once the umbilical was released. In fact, the crewmen in the water were unable to swim away from the side of the ship because the seas were picking them up and tossing them back. Eventually all crewmen except those still on the EAGLE were swept around and under the stern -- which by this time stuck out of the water with the ship's screws and rudder showing. Heavy oil (bunker C) clung to everything and everyone in 20- to 30-foot seas with wind gusting to 50 knots.

The ENTERPRISE cut the towing cable and maneuvered along with the M/V STARLIGHT and LIBERATOR into a position to rescue survivors. The MODU PENROD 76 alerted the Coast Guard of the worsening situation, and the Coast Guard immediately sent another helicopter which arrived on scene at 1735 and recovered four crewmen.

The three offshore vessels and the helicopter continued to attempt rescue. Ring buoys and PFDs were thrown to survivors, many of whom by this time were unable to help themselves. Because oil-covered victims were difficult to sight, two of the crew could not be located in the water.

Additional aircraft continued to search for survivors until 29 February. The Coast Guard's search covered 3,300 miles. Twelve aircraft search missions flew 20.3 flight hours in unsuccessful attempts to locate survivors.

The stern of the AMERICAN EAGLE sank at 1735 on 27 February 1984, just as the Coast Guard helicopter recovered the last survivors. The bow, in a vertical attitude, was last sighted at 2115 on the same day, and it sank shortly thereafter.

Safety Advisory

As a result of the AMERICAN EAGLE tragedy and the Marine Board of Investigation report, the Commandant of the Coast Guard issued an advisory to alert the marine industry against the advisability of using portable venturi-type air mover units with steam in a gaseous atmosphere. This advisory emphasized the risks of injecting steam into a contained, non-gas free environment and noted the additional danger that a plastic sleeve on an air mover in contact with steam could produce a static charge.

There are numerous procedures to clean and ventilate the cargo tanks to eliminate all flammable or combustible vapors. The AMERICAN EAGLE's owner/operator, the American Foreign Steamship Corporation, had not set a procedure to clean and gas free cargo tanks for the AMERICAN EAGLE. The master and chief mate should have been familiar with the acceptable industry procedures as outlined in the ISGOTT manual (a copy was aboard the vessel). However, as the master of the AMERICAN EAGLE emphasized, the air mover's advertising brochure stated that it could be used with either air or steam. The manufacturer of the air mover has been notified of this apparent oversight in its advertising.

The Lamb air mover carried the warning label, "This air mover should be properly grounded to prevent static discharge when used in atmospheres containing combustible gases, vapors, or dusts." The air mover did not have a lug or a grounding cable to easily facilitate grounding. The air mover was not properly grounded even though the master thought contact with the deck was sufficient grounding. The manufacturer has also been notified that its air movers are not equipped with a grounding apparatus.

It is uncertain what created the static electricity which caused the AMERICAN EAGLE's No. 2 center tank to explode. It may have been that the air mover was in fact not properly grounded. It is also possible that a charge was created when the plastic sleeve came in contact with the steam. However, it is clear that a static electric charge caused an explosion to occur in a contained, explosive, gaseous atmosphere in the AMERICAN EAGLE while a portable venturi-type air blower installed in a Butterworth opening was being used with steam to ventilate a tank.

Lessons Learned

1. Do not use portable venturi-type air movers with steam in an explosive atmosphere.
2. Ensure that connections are properly made when equipment requires grounding.
3. Thoroughly understand and follow the procedures connected with cleaning and ventilating tanks as contained in such authoritative publications as the ISGOTT procedures manual.
4. Dispose of all outdated flares.
5. Conduct regular lifeboat drills, and become thoroughly familiar with rescue equipment.
6. Immediately and at regular intervals as-

continued on page 245

Vehicle Fires Aboard Ship

George J. Munkenbeck, Jr.
and
Gary D. Gerard

Increasing numbers of vehicles are being carried aboard ships today. Formerly only ferry boats had to worry about large amounts of vehicle traffic or cargo, but today vehicles are carried in containers, cruise ships, and RO/RO vessels as well as jumbo car carriers.

Traditionally, we have been concerned with the possibility of carburetor fires, the danger of exploding tires, and the flammability of fuel carried aboard. However, new hazards increase as technology advances. Some of the new hazards are as follows:

- the catalytic converter and modern exhaust systems
- fuel evaporation system
- extra and plastic fuel systems
- energy-absorbing bumpers
- hollow drive shafts
- plastics

The modern motor vehicle can be a time bomb for unwary firefighters. To protect yourself, you must be familiar with these dangers. Let us look at these problems in detail.

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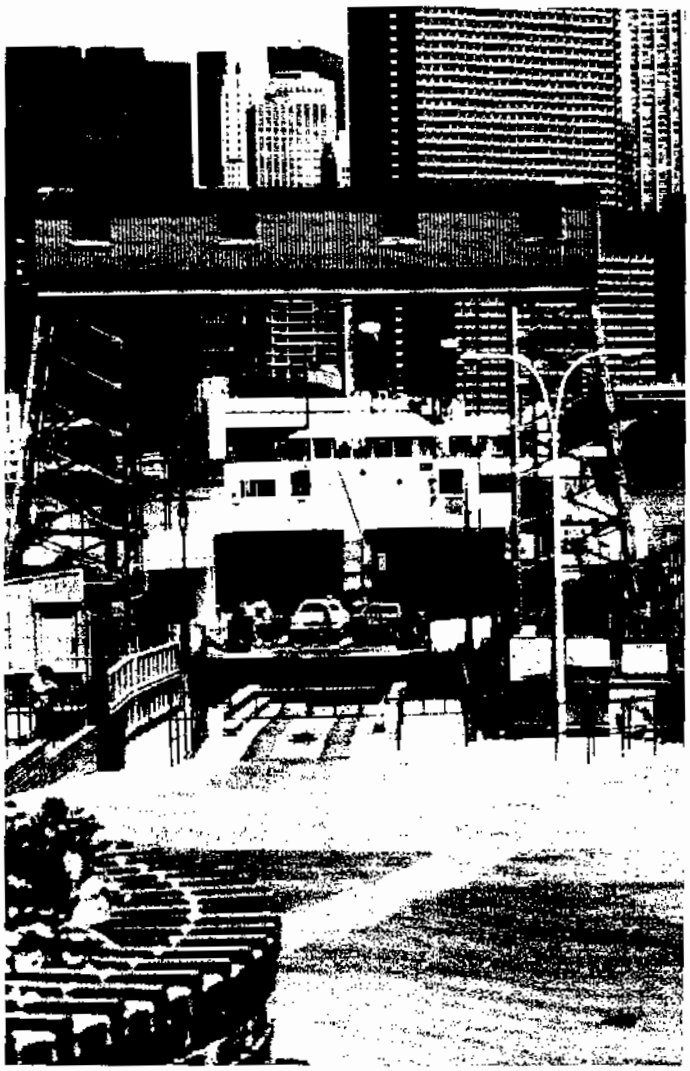
Gary D. Gerard, an instructor at the Seamen's Church Institute, has been a firefighter with the West Sayville, New York, fire department for 17 years. Mr. Gerard served in the U.S. Navy and presently owns a simulation and computer company.

The Catalytic Converter and Modern Exhaust Systems

Modern exhaust systems run hot, which allows them to meet emission standards. The hottest part of this system is the catalytic converter, which operates at an internal temp-



Official Coast Guard photo by PA2 Dupree Davenport.

erature of 1,300°F and an external temperature of 1,000° when the engine is in tune. If as few as two spark plugs are not firing properly, the converter's outside temperature can reach 2,500°F and up. The converter gets hot rapidly and stays hot for a long time. There have been reports of converters remaining hot enough to damage the vinyl tops and asphalt undercoating on new cars on transporter trucks. Machinery at this temperature should never be exposed to flammable liquids. Workers should take great care to avoid any exposure of this type.

The Fuel Evaporation System

The purpose of this system is to prevent vapors from the vehicle's fuel tank from escaping into the atmosphere. The vapors are instead directed to the engine compartment, where they are held in a holding canister and then burned. There is also a flap valve located in the fill pipe of all unleaded fuel caps which further seals in vapors. This fuel evaporation system operates on a pressure of 3/8 psi and will open at 1 psi. As you can see, this system will release when the pressure builds, allowing vapors to cover an area. Since pressure is allowed, tank failures can be violent — one such failure spread burning fuel over a 60-foot radius.

Extra and Plastic Fuel Tanks

In an energy-conscious age, many vehicles are equipped with extra fuel tanks either at the factory or as an owner modification. You may find a vehicle carrying more than two or three times its normal fuel load. For instance, some passenger cars have been modified to carry 50 gallons of fuel instead of the usual 20 gallons. An extra fuel tank in an unexpected position is bad enough, but a home-built tank could prove to be a real hazard. As a group, camper vans and mobile homes form some of the most dangerous vehicles. In addition, some vehicles are being built with plastic fuel tanks which will readily melt in a fire, rapidly releasing large volumes of fuel.

Also, keep in mind that many vehicles are built with fuel tanks in front. Plan your fire defense accordingly.

Energy-Absorbing Bumpers

Bumpers that withstand impact at 5 miles per hour may have reduced auto damage and increased auto safety, but they have created another safety hazard for unwary firefighters. These bumpers operate by means of a liquid-filled piston which absorbs the impact. This same liquid can heat up, expand, and explode, propelling the bumper as if it were shot from a gun.

Hollow Drive Shafts

These present a shrapnel and missile hazard if they heat to the point of explosion. Hollow drive shafts have been known to blow out a roof and fly for a considerable distance.

Plastics

Modern vehicles are full of plastics and other synthetics. Fumes from these parts can be deadly. Be cautious, and protect personnel from these fumes. Many shoreside fire departments are requiring personnel to use a self-contained breathing apparatus when fighting vehicle fires resulting from this hazard.

* * *

Fire is a very real hazard when carrying vehicles aboard ship. Lightweight magnesium parts used on newer vehicles can complicate matters by creating a fire which is hotter and more intense than normal. But fire is not the only hazard. Split rims on trucks, trailers, and heavy machinery can blow off when a tire lets go, and the resulting shrapnel can kill. Glass, even if it is safety glass, can still cause injuries if it blows out. And the presence of any tank on a vehicle should always alert crew members and firefighters to the possibility of explosion.

Fire in a motor vehicle is not something to be treated lightly. Even a small fire in a modern vehicle can cause serious property damage and personal injury.

Safety Hints

When faced with a vehicle fire either on deck or below deck, take precautions:

Ensure that all personnel in the fire party are equipped with good protective gear.

Keep everyone not directly involved in firefighting as far away from the fire as possible.

Attack the fire from the front of the vehicle. On most vehicles, the gas tank is in the back.

If possible, attack the fire from an angle, and watch for exploding bumpers.

Use a two-hose attack — one with low velocity fog and one with high velocity. If you can't easily reach the vehicle, use a straight stream to bank off overheads and other vehicles or cargo. Keep the water fog ahead of you; it will protect you from a fireball.

Cool the vehicle. Locate the source of the fire for a direct attack. Be sure to cool the fuel tank. On a passenger vehicle with a rear gas tank, use the applicator or access tools to punch out the tail lights and get water into the trunk area. Cool the underside of the vehicle and the bumpers, drive shaft, and tanks. If necessary, bounce a straight stream off the deck.

Do not fill the fuel tank with water or puncture it to drain the fuel. This will only increase the danger of an explosion. Just cool the tank, keeping it intact.

When the fire is out, search the vehicle. Ensure there is no one in the trunk or in the passenger compartment. Stowaways have been found inside vehicles on ocean voyages, and parents have been known to allow children to sleep in the car while on ferries.

When the fire is out, disconnect or cut the battery cables, negative terminal first. Disconnecting the negative terminal prevents a possible spark, and disconnecting the battery will prevent the vehicle from accidentally starting due to fused wiring.

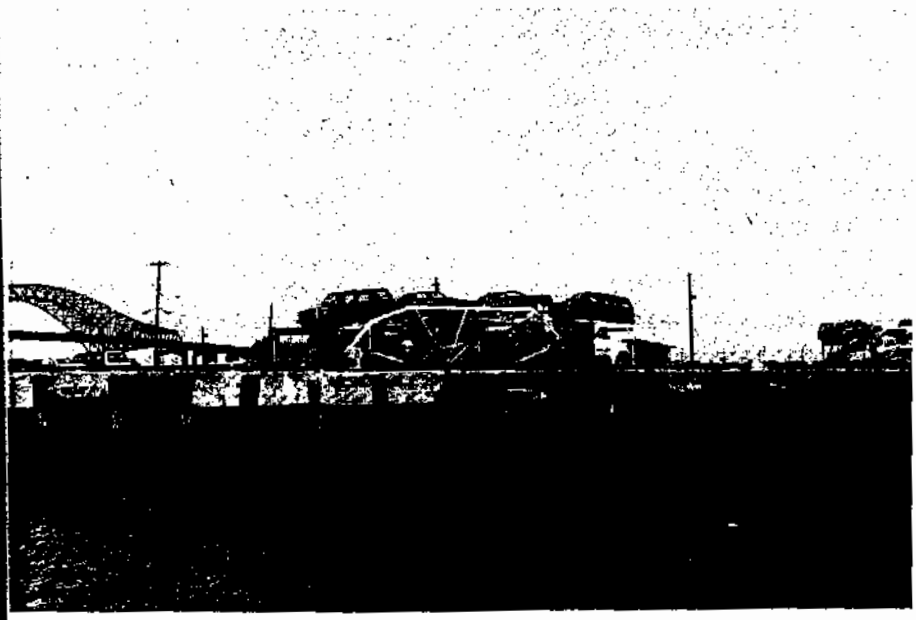
Chock the wheels in case the brakes do not hold.

The most common fire in gasoline-powered vehicles is caused by operators removing the air filter from the carburetor. This fire is most easily handled by use of an extinguisher, but provide backup.

Access to the engine compartment can be a problem. This is especially true of vehicles with inside releases. Most grills of modern passenger vehicles are plastic. Behind this grill is a cable which operates the catch from the inside release. Cut or break the grill (you can sometimes reach under the car and get your hand between the grill and radiator and pull the cable, but don't count on this) and cut the cable or pull to release. You may still have to pry it open, as the heat of a fire will warp and possibly weld the latch.

Use a breathing apparatus, if it is available, on a confined vehicle fire. Remember that plastics can kill.

A shoreside fire department has choices on approach and can take many precautions you can't because these departments have the equipment for it. On a ship, we face the same problems that firemen ashore face when a vehicle burns in a parking garage. A fire in a vehicle on a car or cargo deck will spread quickly. Often more than one vehicle will be involved, or the fire will affect vital ship systems. Many of these spaces are equipped with CO_2 flooding or sprinkler systems; however, always be prepared for an emergency with a back-up system and plan. With practice and training, you will be able to quickly act with confidence. Beware and be aware — remember:



Official Coast Guard photo by PA2 Dupree Davenport.

- Become familiar with the hazards present in a modern vehicle.
- Wear protective clothing and equipment.
- Use water to cool and keep it cool.
- Use a low velocity (or wide fog pattern on adjustable nozzles) to protect the fire team.
- Approach on an angle if possible.

- On oceangoing vessels, remember that rarely do the vehicle owners or dock personnel have any idea or care to prepare a vehicle for sea shipment — check it yourself.

- For ferry vessels, an ounce of prevention is far better than fighting a fire. Get "No-flash" (a vapor barrier chemical) or "AFFF" (Aqueous Film Forming Foam) to quickly cover a spill. Be careful in loading, and watch campers and vans.

- REMEMBER: SAFETY IS OF THE FIRST IMPORTANCE IN THE PERFORMANCE OF DUTIES. ↥

This article was printed with permission of SCI Maritime Training, a division of The Seamen's Church Institute of New York and New Jersey. Special thanks to Carlyle Windley, editor of the SCI magazine, ***The Lookout.***

U.S. Naval Institute Announces Annual Essay Contest

The U.S. Naval Institute recently announced that the top prize for its annual Arleigh Burke Essay Contest will be $2,000, a gold medal, and a USNI Life Membership.

Three winning essays will be selected for their analytical and interpretive qualities. The Institute will award $1,000 and a silver medal to the first honorable mention winner and $750 and a bronze medal to the second honorable mention winner.

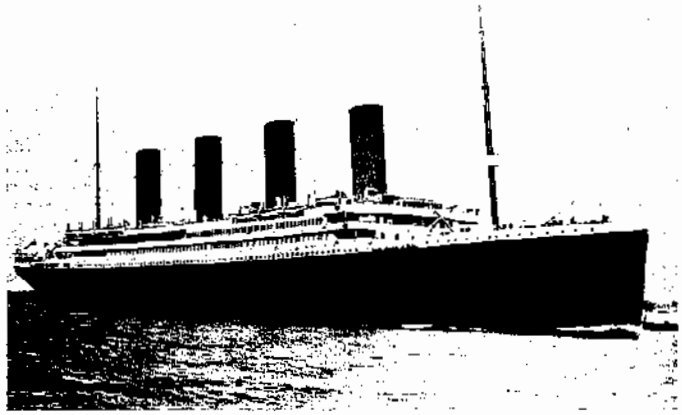
All submissions must further the mission of the Naval Institute — "The advancement of professional, literary, and scientific knowledge in the naval and maritime services, and the advancement of the knowledge of sea power."

There are no restrictions on who may enter the contest. Entries must not exceed 4,000 words and must be received at the Naval Institute on or before December 1, 1985.

Additionally, the winning essays will be published in **Proceedings,** the Institute's monthly magazine. The magazine's editorial board may also purchase, at standard rates, a number of essays not among the prize winners for subsequent publication in **Proceedings.**

For complete entry rules and further information, write to Arleigh Burke Essay Contest Information, U.S. Naval Institute, Annapolis, Maryland 21402, or call (301) 268-6110. ↥

Full Speed Ahead on TITANIC Memorial



Legislation to designate the TITANIC as a maritime memorial and defer any tampering with the site pending an international agreement on the shipwreck's future was introduced early in September by Walter B. Jones (D-NC), Chairman of the House Merchant Marine and Fisheries Committee.

"The significance of the TITANIC transcends national borders. Its discovery has piqued the interest of the general public as well as the historical, scientific, and cultural communities. And, at long last, survivors and the family and friends of those who perished on the TITANIC can now perhaps put one final issue to rest, explained Chairman Jones.

The bill directs the Secretary of State to begin negotiations with interested nations and directs the Administrator of the National Oceanic and Atmospheric Administration (NOAA) to develop guidelines governing activities at the site which (1) are consistent with the ship's historical and cultural significance, (2) promote the safety of individuals involved in any operations, and (3) recognize the sanctity of the shipwreck TITANIC as a maritime memorial.

Further, the bill expresses the sense of the Congress that pending an international agreement, no nation should undertake any activities at the site which are not in compliance with the NOAA guidelines.

Finally, the bill commends the members of the expedition which discovered the TITANIC and "urges that this cooperative effort serve as a model for future international activities related to this memorial."

A date for hearings has not yet been scheduled. ↥

Thinking Ecologically in Lakes Protection

Lee Botts

Ms. Botts founded the Lake Michigan Federation, a citizen's group concerned with Great Lakes cleanup. She is also the former Chair of the Great Lakes Basin Commission, a water planning agency, and is now research associate at the Center for Urban Affairs and Policy Research of Northwestern University.

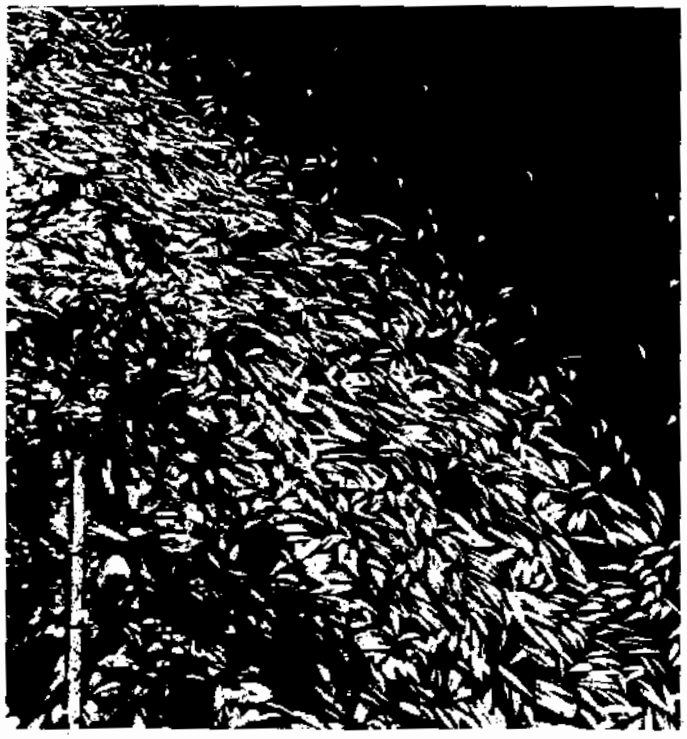
A dozen years ago, Canada and the United States agreed to clean up the Great Lakes, and much progress was made. But...

While most beaches are now open to swimming, more fish have tumors than before.

Algae are less abundant since the amount of phosphorus coming into the lakes has been reduced, but evidence is piling up that growing toxic contamination threatens the health of the Great Lakes ecosystem and its inhabitants.

For example, direct discharges of industrial wastes are largely controlled under the permit system of the Clean Water Act, yet toxic chemicals and heavy metals are still entering the lakes from the atmosphere. Research fostered by the Great Lakes agreement with Canada has shown that atmospheric deposition must be the only source of many toxic contaminants to the upper Great Lakes (Lake Superior, Lake Huron, and northern Lake Michigan). Studies indicate that even in the case of Lake Michigan, with many industrial sources at the southern end, half the total load of toxic contaminants and heavy metals may now be entering the lake from the air. How these contaminants got into the air is not fully understood. The routes are believed to include evaporation from agricultural spraying and landfills, vaporization in industrial treatment systems, and incomplete combustion.

Could it be that prevention of direct discharges of industrial wastes into waterways has displaced more toxic chemicals into the atmosphere?



Dead alewives float on the Chicago shoreline. In "the great alewife dieoff" of 1967, Lake Michigan beaches were unusable for a summer and drinking water intakes were clogged for weeks. (Photo courtesy U.S. Environmental Protection Agency, Region 5)

The diversion of industrial wastes into publicly owned treatment plants creates another dilemma when the result is concentration of toxic chemicals in the sewage effluent. The St. Louis River is the largest tributary flowing into Lake Superior. Since Duluth built its huge, new sewage treatment plant, the river is so much cleaner insofar as conventional pollutants are concerned that the walleye have returned, and fishing is better than it has been

for years. Nonetheless, a recent study found that the sewage treatment plant is now a large source of toxic chemicals going into the St. Louis River and Lake Superior.

Since the cleanup of the conventional pollutants from the river, the sea lamprey has also begun to spawn there. This means that the sea lamprey is now spreading throughout the Great Lakes system. The lamprey is the parasitic invader from the ocean that first entered the Great Lakes through the St. Lawrence Seaway and earlier manmade canals. By attaching itself to large fish, the sea lamprey kills them. It had almost destroyed the lake trout in Lake Michigan by the 1940s.

That removal of lake trout as Lake Michigan's leading predator was followed by explosive growth of the lake alewife population. The alewife is a small Atlantic herring that also entered the Great Lakes through canals but is not well-adapted and tends to die off in the spring. "The great alewife dieoff" in Lake Michigan in 1967 was one of the all-time Great Lakes ecological disasters.

Thousands of tons of decaying alewives clogged drinking water intakes for weeks and made beaches unusable all around the lake all summer. Public fear was intensified when botulism caused a massive dieoff of fish-eating birds. When the State of Michigan introduced coho and chinook salmon from the Pacific Northwest into Lake Michigan in the mid-1960s, the chief reason was to provide new predators to reduce the number of alewives. Then the plan was to reestablish the lake trout population.

Now, 20 years later, there are only about a tenth as many alewives, but the lake trout are not yet reproducing well enough to sustain themselves naturally. Researchers at the University of Wisconsin have found evidence that something, presumably a toxic chemical that inhibits reproduction, is passed from the adult fish to their eggs. The Fish and Wildlife Service Great Lakes Laboratory at Ann Arbor found that survival of young fish seemed to be related to levels of toxic substances.

To dredge or not to dredge? Another dilemma is how to clean up places where high concentrations of contaminants and metals have settled out into sediments. Most such "toxic hot spots" are in harbors or near the mouth of tributaries. The highest rates of fish tumors found so far have been among bottom-feeding fish like bullheads in the Buffalo River where sediments have high levels of chemical contaminants. The worst accumulations resulted from past direct discharges, like the high levels of PCBs (polychlorinated biphenyls) in Waukegan Harbor, Illinois, and the dioxins in Saginaw Bay, Michigan. Because physical removal by dredging can cause resuspension of some of the contaminants in the water, it was formerly thought better to leave the sediments undisturbed once the pollutants had settled into them.

With dredging for navigation, the polluted sediments that were removed were placed in secure landfills or in diked disposal areas. Now no landfill is thought to be permanently secure, and pollutants often escape from diked disposal sites. Biological recycling of organic contaminant sediments back into the water also occurs. In the 1960s, mercury discharges into Lake St. Clair and the Detroit River had to be stopped because bacteria converted the metal into poisonous methylated mercury.

Now it has been shown that gases excreted by bottom-feeding organisms can pass into the atmosphere through the water. In this way, and also by evaporation from the surface, it is conceivable that chemicals that may have entered the water from the air can be recycled back into the atmosphere.

Although hundreds of chemicals have been found in the Great Lakes, in many cases the levels in the water are so low that they can be measured only by sophisticated techniques such as gas chromatography. There is much concern

Malformations in fish and birds, such as the crossed bill of this Caspian tern chick, have prompted concern about toxic substances in the Great Lakes. (Canadian Wildlife Service photo)

about persistent organic chemicals that concentrate in fatty tissues and bioacculmuate up the food chain, like PCBs.

Because treatment removes many chemicals from drinking water, humans receive the greatest exposure to chemical contaminants from eating fish. Concentrations of PCBs, dieldrin, mirex, or chlordane exceed Food and Drug Administration standards in trout and salmon and are the reason fishing licenses for all the lakes except Superior advise limiting consumption of certain fish. Because of the special vulnerability of the young, several states advise that women of childbearing age and children under five should never eat these fish.

The economic contribution of sport fishing in a region that has been losing its industrial base adds to the dilemma. The coho and chinook salmon introduced to eliminate the alewife are now the most prized sport fish. But epidemiological studies have shown that levels of PCBs in humans are related to the quantity of Great Lakes fish they eat. Stocking fish thus increases human exposure to contaminants if the health warnings are not heeded.

Concern about human exposure has also been intensified by a high rate of genetic defects in fish-eating cormorants that nest on islands in Green Bay. It is suspected that the cormorants now born with crossed bills have been affected by dioxins or dibenzofurans.

The Clean Water Act regulates the quality of effluent in direct discharges from municipal sewage treatment systems and industrial sources. No such discharges flow into Lake Siscowet on Isle Royale (which has been a wilderness national park since 1910). Yet high levels of PCBs were detected in trout from the isolated lake in 1975, and high toxaphene levels were found in 1980. The toxics obviously could only have come from the air. Yet chemicals can only be classified as hazardous under the Clean Air Act if they pose a hazard from **direct** exposure. Neither law takes bioaccumulation in the food chain into account, although this is the way human health effects are most likely to be caused by toxic contamination of the Great Lakes.

In summary, the experience with the Great Lakes is a lesson in how some solutions to environmental problems may make others worse. The crux of the lesson is that solutions to single problems must be considered in light of their impact on the whole ecosystem. Some of the most serious damage can be caused indirectly. Moreover, degradation that is caused indirectly can be more difficult to reverse. Still, the success in reducing phosphorus loadings to the Great Lakes suggests that, with enough research and determination, an ecosystem approach to management that would prevent continued toxic contamination of the lakes is also possible. ⚓

This article was reprinted from the ***EPA Journal****, Vol. 11, No. 2, March 1985.*

EAGLE

continued from page 238

certain the extent of structural damage to your vessel if it suffers damage.

7. Secure all hatches, watertight doors, and Butterworth plates after any situation which may affect the seaworthiness of your vessel.
8. Seriously consider the early removal of nonessential personnel if there is any risk that your vessel may sink.
9. Conduct a full accounting of all personnel and plan an orderly evacuation if you determine that evacuation of the vessel is necessary. ⚓

Mr. Glass, a frequent contributor to the "Lessons from Casualties" column, extracted this article from a U.S. Coast Guard Marine Board of Investigation Report.

Tacoma Fireboat Report Available

The Maritime Administration has released a two-volume study, the "Tacoma Harbor Service Craft Evaluation Report." The report covers an 11-year research and development effort by the Tacoma, Washington, Fire Department and MARAD which led to the development and successful demonstration of a high-speed multipurpose fireboat. The 70-foot harbor service craft, utilizing a surface-effect-ship design, operates on a cushion of air at speeds up to 30 knots. (See the April issue of this magazine, page 87, for a story on the new crafts.)

The report may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. The order numbers and prices are as follows: Executive Summary, PB85-2444747/AS, $9.95; Final Report, PB85-244739, $22.95. ⚓

Marine Safety Council Membership

Commodore Thomas T. Matteson

Commodore Thomas Tracy Matteson became Chief, Office of Boating, Public, and Consumer Affairs in Washington, DC, on 12 August 1985. Prior to this appointment, he was Chief of Staff of the Eighth Coast Guard District, New Orleans, Louisiana.

A native of Upper Sandusky, Ohio, Commodore Matteson was graduated from the Coast Guard Academy in New London, Connecticut, in 1957 with a bachelor of science degree. He received a master's degree in management science from the Naval Post Graduate School, Monterey, Calfornia, and is a 1977 graduate of the Air War College at Maxwell Air Force Base, Alabama.

His first assignment as a Coast Guard officer was aboard the cutter CASTLE ROCK, homeported in Boston, Massachusetts. He entered flight training in April 1961 at Naval Air Station Pensacola, Florida, and Naval Air Station Corpus Christi, Texas. From May 1962 to August 1963, he was assigned as training officer at Coast Guard Air Station Miami, Florida.

Commodore Matteson has served in a broad range of responsible staff positions including rescue coordination chief controller, Ninth Coast Guard District, Cleveland, Ohio (1965); assistant operations officer, Coast Guard Air Station Port Angeles, Washington (1968); division chief and executive officer, Aviation Training Center, Mobile, Alabama (1976); commanding officer, Coast Guard Air Station Borinquen, Puerto Rico (1979); assistant chief of the operations plan staff (1969-73); chief, aviation branch (1979-81); chief, officers personnel division, Headquarters (1981-82); and chief, operations division, Eighth Coast Guard District, New Orleans, Louisiana (1982-84).

Commodore Matteson's decorations include the Meritorious Service Medal with one gold star, the Coast Guard Commendation Medal with two gold stars, the Coast Guard Achievement Medal, the Meritorious Unit Award with one gold star, the Navy Expeditionary Medal, the National Defense Service Medal, and the Armed Forces Expeditionary Medal.

Commodore Matteson is married to the former Dorothy Ruth Johnston of Springfield, Massachusetts. They have two children, Juliet Marie and Jeffrey Cole.

Commodore Alan D. Breed

Commodore Alan D. Breed became the Coast Guard's Chief, Office of Readiness and Reserve, in Washington, DC, on 1 June 1985. Previously he served as Chief, Office of Boating, Public, and Consumer Affairs and was a member of the Marine Safety Council. Before moving to Washington, Commodore Breed was for 2 years Chief of Staff of the Seventh Coast Guard District, Miami, Florida. He was selected for that position while serving as Chief of Operations in the Seventh District, an assignment he assumed in 1981.

Since graduating from the Coast Guard Academy at New London, Connecticut, in 1955, Commodore Breed has been awarded the Defense Superior Service Medal, the Meritorious Service Medal with gold star, the Coast Guard Commendation Medal with two gold stars, the Coast Guard Achievement Medal, and several lesser decorations.

Commodore Breed has served in a variety of assignments including command of

the cutter JONQUIL, executive officer aboard the cutter MALLOW, and deck officer aboard the cutter NORTHWIND.

Commodore Breed served for 3 years as Commanding Officer of Coast Guard Support Center New York. Before that, he commanded the high endurance cutter GALLATIN for 2 years.

A native of Corning, New York, Commodore Breed holds a bachelor of science degree from the Coast Guard Academy and a master's degree in public administration from the University of Pittsburgh. He is also a 1976 graduate of the National War College.

The Commodore is married to the former Janet Phillips of Groton, Connecticut, who is a graduate of Simmons College, Boston, Massachusetts.

Captain Robert F. Ingraham

Captain Robert F. Ingraham became Executive Secretary of the Marine Safety Council of the United States Coast Guard in August of this year. Collaterally he will serve as Executive Director of the Towing Safety Advisory Committee.

Captain Ingraham was sworn in as a Coast Guard officer in August 1962 at Tampa, Florida, under the provisions of Public Law 80-219. (This law authorizes Coast Guard commissions to certain officers of the U.S. Merchant Marine.) Captain Ingraham wears the Atlantic Theatre, Pacific Theatre, World War II Victory and Korean Service ribbons from his Merchant Marine service.

Upon completion of the Coast Guard's General Service School at Yorktown, Viriginia, Captain Ingraham served aboard the cutter CHINCOTEAGUE for a year and a half. He was then assigned to Marine Inspection Office New Orleans, Louisiana, where he became very interested in the offshore mineral and oil industry and the inland towing industry. This later interest led to his being the first officer assigned to Marine Inspection Detachment, Baton Rouge, Louisiana. From March 1969 until June 1971, he served aboard the polar icebreaker WESTWIND which operated in both the Arctic and Antarctic regions as well as being twice involved in the opening of the St. Lawrence Seaway.

Captain Ingraham then began a 5-year tour with the Merchant Vessel Personnel Division at Coast Guard Headquarters. He has been Executive Officer, Marine Safety Office Hampton Roads, Virginia; Commanding Officer, Marine Safety Office Galveston, Texas; and, prior to his new assignment was Chief, Boating Safety Division, at Coast Guard Headquarters.

Captain Ingraham has twice been awarded the Coast Guard Commendation Medal and has been awarded the Coast Guard Achievement Medal. The unit he commanded was awarded the Coast Guard Meritorious Unit Commendation.

Captain Ingraham is married to the former Grace Hambric of Norfolk and Newport News, Virginia. They presently reside in Fairfax County, Virginia.

Captain Christopher M. Holland

Captain Christopher M. Holland, Executive Secretary of the Marine Safety Council, retired from the Coast Guard on 30 September 1985.

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

officer at the Coast Guard's recruit training center in Cape May, NJ, and as District Legal Officer for the Fifth and Fourteenth Coast Guard Districts.

Captain Holland and his wife, the former Julia A. Koontz, live in Vienna, Virginia. They have two sons, Christopher and Michael. ‡

Two Members of Tug Crew Recognized for Rescue

Two members of the crew of the tugboat MOBIL I have been presented Merchant Marine Distinguished Service Medals for heroic actions in rescuing a crane operator at Perth Amboy, NJ, on January 12, 1984.

Chief Mate Douglas Ruhl and Able Seaman Jose Alicea were commended by Acting Deputy Maritime Administrator Garrett E. Brown, Jr., U.S. Department of Transportation.

While the tug was in drydock undergoing repairs, a sudden power loss in a gantry crane caused the crane to topple forward into the water. The crane operator, inside the cab, landed in the water of the drydock. He managed to free himself and floated to the surface but was weighed down by several layers of wet winter clothing.

Seaman Alicea leaped into the water and pushed the crane operator to the fallen crane boom, and Chief Mate Ruhl helped Alicea lift the crane operator to safety. ‡

Recall Notice for Cylinders on Self-Contained Breathing Apparatus

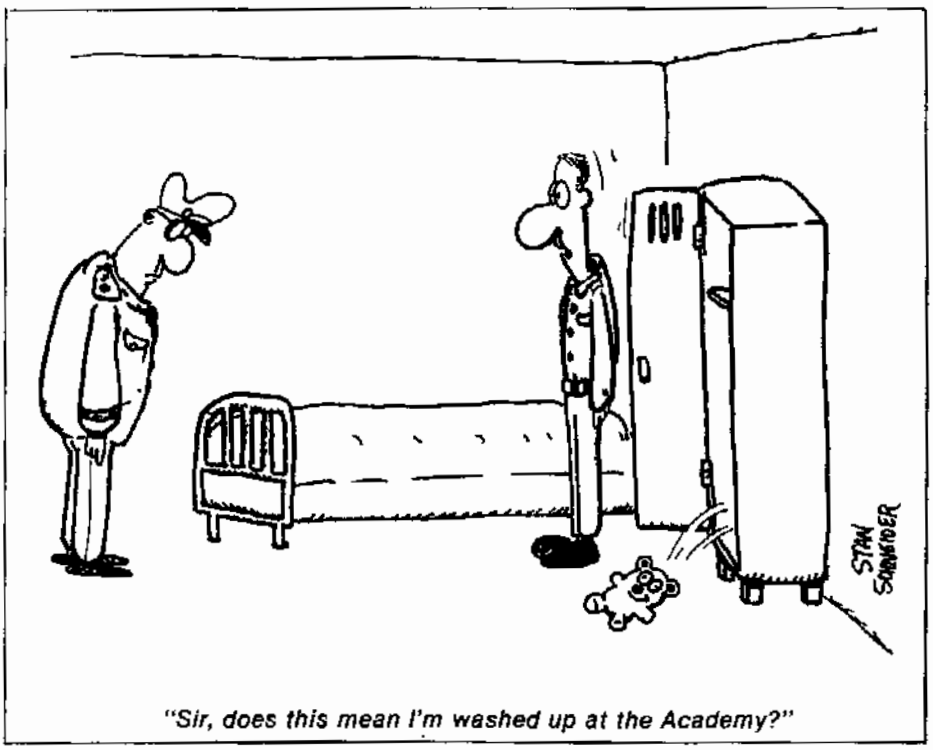
The Department of Transportation (DOT) has issued a recall notice for potentially dangerous cylinders used with self-contained breathing apparatus. DOT advises in Federal Register Document 85-16792, dated 16 July 1985, that serious injury or death could result from rupture of these cylinders.

The cylinders affected are high pressure composite aluminum, fiberglass filament wound, and are marked "DOT E-7235 4500."

The National Institute for Occupational Safety and Health (NIOSH) has also advised users of self-contained breathing apparatus that approval of such equipment terminates October 1, 1985, unless the cylinders are retrofitted.

The series of cylinders involved bear serial numbers WA 43160 through WA 50178 and WF 20321 through WF 21548. If any of these cylinders are found, the contents should be vented, and the cylinders should be returned to the manufacturer for replacement.

For more information, contact Arthur J. Mellen, Office of Hazardous Materials Regulation, Materials Transportation Bureau, 400 Seventh Street, SW, Washington, DC 20590; telephone (202) 755-4906. ‡



"Sir, does this mean I'm washed up at the Academy?"

Keynotes

Notice of Proposed Rulemaking

CGD 84-091	International Regulations for Preventing Collisions at Sea, 1972 COLREGS Demarcation Lines	19 September

The Coast Guard is proposing to update the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS) demarcation lines. The purpose of this update is to provide accurate and current location descriptions and to identify these lines as shown on nautical charts.

CGD 84-067	Oil and Hazardous Substance Discharge Reporting Requirements	20 September

The Coast Guard proposes to modify the procedures for reporting discharges of oil and hazardous substances as required by section 311 of the Federal Water Pollution Control Act, as amended (FWPCA), to revise or delete outdated language, and to clarify the criteria for direct payment from the Pollution Fund.

CGD 81-030	Vital Systems Automation	23 September

The Coast Guard proposes to add regulations for automated vital systems on commercial vessels, including MODUs, to the Marine Engineering Regulations contained in various subchapters of Title 46 of the Code of Federal Regulations, Shipping. The Federal Register citation for this proposal is 50 FR 38608.

Notice of Public Hearing and Extension of Comment Period

CGD 80-113	Lifesaving Equipment; Improved Standards for the Stability of Inflatable Liferafts	9 September

The Coast Guard will hold a public hearing on the above subject on Wednesday, 11 December 1985 from 9:30 a.m. to 12 noon in Washington, DC. Written comments will be received no later than 10 January 1986. This NPRM was published on 11 January 1985 (50 FR 1558).

Extension of Comment Period

CGD 84-060	Licensing of Pilots; Manning of Vessels — Pilots	23 September

The Coast Guard has extended the comment period for this NPRM to 22 December 1985.

Notice of Meeting

CGD 85-064	Towing Safety Advisory Committee; Meeting	16 September

The Coast Guard's Towing Safety Advisory Committee met on 10 October 1985 at Coast Guard Headquarters. A list of agenda items was published in the Federal Register on 16 September 1985 (50 FR 37612).

This notice contains a listing of Coast Guard approvals terminated between 1 February 1984 and 31 January 1985. These terminated approvals were for safety equipment and materials required by regulation to be used on certain merchant vessels and recreational boats, and also in Outer Continental Shelf activities.

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 9:00 a.m. and 4:00 p.m. Monday through Friday. Comments are available for inspection or copying during those hours.

New Publications

From the Coast Guard's Office of Research and Development

In the effort to balance environmental and safety goals, the U.S. Army Corps of Engineers seeks to provide only the minimal river dredging needed for safe navigation. In recent years, industry and government have been uncertain whether the dredging permitted was adequate; some sections of the Upper Mississippi River do not meet the modern engineering criteria developed after the original channels were in place.

In a cooperative effort funded by the Corps' Waterway Experiment Station in Vicksburg, Mississippi, the Coast Guard's Office of Research and Development and the Office of Marine Environment and Systems did an experimental study on the Maneuvering Simulator at Coast Guard Headquarters in Washington, DC. The controlling scenario was a condition of relatively high flow in low water conditions in a winding river section near Wabasha, Minnesota. Active professional river pilots made repeated runs through the area in alternative simulated channel widths and depths. Both subjective and objective data were analyzed. The simulation was judged to be realistic and accurate enough to support the study objectives.

The study concluded that a significant improvement in operating safety could be achieved by maintaining a minimum 400-foot channel width in bends, even with no change to the criterion for mimimum depth, 11 feet. No change in authorization would be needed for such a change in maintenance-dredging policy. Increasing width but not depth would provide the safety benefit with minimal additional dredging, but it would not contribute to towboat operational efficiency. Increasing both depth and width would allow faster speeds as well as safer navigation, but at a cost of substantially greater dredging. Changing dredged depth without widening the channel would provide no safety benefit in the river sections studied.

Conduct of this study added to the capabilities of the Coast Guard Maneuvering Simulator and the nearly identical simulator at the Waterway Experiment Station. Simulators have been shown to be efficient and effective devices for harbor and waterway design studies and studies of the practical controllability of vessels, as well as efficient trainers.

The reports which document the study are available through the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. Please give all pertinent information when ordering the following:

"River Tow Needs for Maneuvering Room on the Upper Mississippi River," Report No. CG-D-24-84, Accession No. ADA154686 (brief project summary).

"Effects of Alternate Channel Configurations on Navigation in the Upper Mississippi River," Report No. CG-D-16-84, Accession No. ADA150155.

"Model Tests and Computer Simulations of a 15-Barge Tow for the Upper Mississippi River," Report No. CG-D-10-84, Accession No. ADA146511.

Dutton's Navigation and Piloting

A seventeenth edition of **Dutton's Navigation and Piloting** has been published, and readers will find this revision as informative

continued next page

and useful as previous editions. It has been completely updated, rewritten, and reorganized, resulting in a smoother flow of subject matter to make related topics comprehensible.

The larger print and page sizes allow for quick subject access and easier reading. The use of illustrations is extensive: they are uniformly well-conceived, facilitating rapid comprehension in many cases. This edition also has more emphasis on electronic aids to navigation, while still providing an in-depth coverage of the more traditional/fundamental forms of navigation and navigational aids that has made **Dutton's** an important reference guide for the professional and amateur mariner alike. The most evident change to this edition is the new NOAA/NOS Chart No. 1, Nautical Charts Symbols and Abbreviations, which covers over 50 pages of appendix material.

This edition has been authored by Elbert S. Maloney, boating enthusiast and author of the last edition of **Dutton's**. He is also Chief, Department of Education, for the U.S. Coast Guard Auxiliary.

This edition of **Dutton's** is available from the U.S. Naval Institute Press, Annapolis, MD 21402, Attention: Marketing. The cost is $32.95.

New Publications from IMO

"Code of Safe Practice for Solid Bulk Cargoes (Supplement 1985)" contains amendments as adopted by the Maritime Safety Committee at its 50th Session in November 1984. The publication includes a new appendix F to the Code; the deletion of emergency information in existing schedules in appendix B; revised MFAG table number entries, and new emergency schedule numbers (EmS) in appendix B; and a new entry in appendix C to the Code. Sales number is 25485.10.E and the price is £2.00. The "IMO/ILO Guidelines for Packing Cargo in Freight Containers or Vehicles" is intended as a short guide to the essentials of safe packing for use by those responsible for the packing and securing of cargo in freight containers or vehicles and by those whose task it is to train people to pack those units. Such training is essential if safety standards are to be maintained. Sales number is 28485.11E and the price is £2.50. More information on these publications can be obtained from the International Maritime Organization, Publications Section, 4 Albert Embankment, London SE1 7SR England. *(Printed with permission from the* ***IMO News****, No. 2, 1985.)*

Equipment Lists

"Equipment Lists: Items Approved, Certified or Accepted Under Marine Inspection and Navigation Laws" has been published by the Department of Transportation. This manual includes a listing of various items of lifesaving, firefighting, pollution abatement, and miscellaneous equipment used aboard vessels. For each type of item, the name and address of the manufacturer and the complete model identification are provided.

The manual consists of four separate lists: approved and certified instruments, machines, and equipment; manufacturers having submitted affidavits covering valves, fittings, and flanges; acceptable hydraulic components; and formerly approved instruments that are no longer manufactured but may still be used. A list of marine inspection offices with mailing addresses located in each Coast Guard District is included.

The 212-page "Equipment Lists" is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Ask for stock number 050-012-00212-6. The price is $6.00. All orders must be prepaid by check or charge.

Sloshing Study from MARAD

The Maritime Administration has published a technical report on "Further Studies on Liquid Sloshing."

MARAD said the research objectives of the studies, conducted at Texas A & M University under MARAD's university research program, were to investigate certain aspects of liquid sloshing under so-called combined excitations (pitch or roll combined with heave, surge, or sway) and to provide information useful to ship designers in minimizing problems related to sloshing in moving containers.

Sloshing is a safety concern in shipping, especially in large oil tankers and liquefied natural gas carriers because of their large tank sizes. Severe sloshing can cause structural damage in such oceangoing vessels.

Copies of the study may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The order number is PB85-198695/AS, and the price is $20.50. *(Reprinted with permission from* ***Traffic World****, July 1, 1985.)* ‡

Readers are encouraged to submit material for "New Publications." Our address for submissions appears inside the front cover.

Acetone

If you have used paint remover or nail polish remover and could not avoid that strong, distinctive odor, chances are that you have been exposed to this month's chemical, acetone. The chemical is usually in the form of a clear, colorless liquid and is easily recognizable by its strong, sweet, and fruity odor.

Acetone is used in a number of everyday items such as paints, varnishes, lacquers, and smokeless gunpowder. These, as well as other acetone products, are produced mainly by large industries, placing the chemical in demand.

Acetone is essentially a molecule of a carbon atom double-bonded to an oxygen atom which in turn is bonded to two methyl (CH_3) functional groups (CH_3-C-CH_3). It was first observed in 1595 from the dry distillation of sugar of lead (lead acetate). Later it was manufactured by the dry distillation of calcium acetate obtained from wood distillate, neutralized by lime, and then allowed to dry. During and after World War I, uses for acetone increased. As a result, more effective means of manufacturing the chemical were developed. Acetone production in the United States was an estimated 1149 kilotons in 1975 and 1302 kilotons in 1980 according to data from Montedison, U.S.A., Inc.

In using the chemical so widely, we must be aware of the specific dangers and threats acetone may pose. Acetone is highly flammable, and when mixed with air, it can become explosive. Due to this danger, certain care must be taken in storing and transporting this chemical. The facilities in which acetone is stored must be well-ventilated and fire-retardant. A sprinkler system or some other firefighting device should be on the premises. Acetone should not be stored near acids or oxidizing materials.

Even though acetone is a highly volatile solvent, it is one of the least hazardous to personal health. The threshold limit value for acetone is 1000 ppm (parts per million), but short-duration exposures to concentrations above the threshold limit are, although not recommended, essentially harmless. High vapor concentrations well above that recognizable by smell will produce anesthetic effects such as headaches, drowsiness, and loss of coordination as well as irritant effects. These irritations are usually in the nose, throat, and eyes. Dryness and mild irritation to the skin (dermatitis) is another effect, but it occurs only after repeated and prolonged contact.

No protective equipment is needed for most uses of acetone, if proper ventilation is provided. Where high vapor concentrations are unavoidable, a breathing apparatus should be used. Protective clothing can be used to avoid prolonged contact with the skin. Goggles will protect the eyes from splashing. If exposure does occur, simple first aid steps to be taken:

Skin exposure: Remove the contaminated clothing; wash skin and dress with clean, dry clothing.

Eye exposure: Flush eyes immediately with water; see a physician if pain continues.

Ingestion: Induce vomiting; if the victim is conscious, call a physician.

Inhalation: Remove victim to fresh air immediately; give artificial respiration if breathing has stopped; call a physician.

The Department of Transportation classifies acetone as a flammable liquid. The U.S. Coast Guard regulates acetone as a Subchapter D, 46 CFR 30-40 and Annex B, 46 CFR 154a substance for shipping in bulk onboard tank vessels. It is regulated by the International Maritime Organization as a Chapter 7 (BCH Code)/18 (IBC Code) cargo; that is, it is a chemical to which the codes do not apply, and is assigned the Hazard Class of Flammable Liquid. Acetone is found in the International Dangerous Goods (IMDG) Code on page 3020.

William Kupchin was a Fourth-Class Cadet at the Coast Guard Academy when this article was written. It was written under the direction of LCDR Thomas J. Haas for a class on hazardous materials transportation.

Chemical name:	Acetone
Formula:	CH_3-CO-CH_3
Synonyms:	Dimethylketone 2-Propanone
Physical Properties:	
boiling point:	56°C (133°F)
freezing point:	-94°C (-137°F)
vapor pressure:	
20°C (68°F)	180 mm Hg
39.5°C (103°F)	400 mm Hg
Threshold Limit Values (TLV)	
time weighted average:	750 ppm; 1780 mg/m^3
short term exposure limit:	1000 ppm; 2375 mg/m^3
Flammability Limits in Air	
lower flammability limit:	2.15% vol.
upper flammability limit:	13% vol.
Combustion Properties	
flash point:	
open cup:	-18°C (0°F)
closed cup:	-9°C (15°F)
autoignition temperature:	560°C (1040°F)
Densities	
liquid (water=1):	0.8
vapor (air=1):	2.0
U.N. Number:	1090
CHRIS Code:	ACT
Cargo compatibility group:	18 (Ketones)

Correction

Our October issue incorrectly stated that the "Chemical of the Month," creosote, could be found in Title 46, Subchapter D, parts 30 to 40 of the Code of Federal Regulations. Rather, creosote is found in Title 46, Subchapter O, parts 150 to 154 of the Code of Federal Regulations. Our thanks to the readers who alerted us to the error so promptly.

"Chemical of the Month" Note

"Chemical of the Month" will not be published for the next several issues due to the upcoming sabbatical of LCDR Thomas Haas, chemistry instructor at the Coast Guard Academy. LCDR Jerzy Kichner, also a chemistry instructor at the Academy, will be assuming LCDR Haas' duties as **Proceedings** coordinator for this column after a sufficient time for transition.

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. The main difference between a circuit containing low voltage protection and low voltage release is that the former contains

A. a magnetic operating coil.
B. normally open line contacts.
C. thermal-overload protection.
D. a momentary-contact start button.

Reference: Hubert, Preventive Maintenance of Electrical Equipment

2. In reversing any two-stroke cycle direct reversing engine, prior to admitting starting air for the new direction of rotation, you must

A. line up for restarting with light diesel oil.
B. change the fuel injection cam positions.
C. change the intake and exhaust valve cam positions.
D. do all of the above.

Reference: Harrington, Marine Engineering

3. While inspecting an open water drum, you observe silt-like deposits on the waterside. This condition would be caused by

A. contamination of boiler water with fuel oil.

B. insufficient bottom or surface blows.
C. failure to properly dry out the boiler when opened.
D. a high chloride concentration in the boiled water.

Reference: U.S. Navy, Naval Ships Bureau of Ships Technical Manual 9510

4. Which of the following is true concerning the use of fire-resistant fluids in a hydraulic system?

A. Deterioration of paints, seals, metals, and electrical insulation may occur.
B. Fluid viscosity always increases as a normal result of its use.
C. Decreased wear rates of components is an advantage of its use.
D. Only chemically active filters may be utilized.

Reference: Gunther, Lubrication

5. If you set off the emergency generator room CO_2 system and the remote pneumatically actuated ventilation shut-down switch failed to move, you should next

A. shut down the emergency generator room ventilation fan from the main switchboard.
B. manually move the switch actuator to the operated position.
C. disconnect the CO_2 piping to check for blockage.
D. unscrew the pressure operated switch housing and manually operate the switch.

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

DECK

1. What size block shell should be used with a 4" manila line?

A. 8"
B. 12"
C. 16"
D. 24"

Reference: Merchant Marine Officer's Handbook

2. Which of the following steps is NOT generally taken when gas-freeing a tank?

A. Washing the tank interiors with sea water.
B. Application of degreasing solvents.
C. Removal of sludge and corrosion products.
D. Fresh air ventilation.

Reference: CG-174

3. High pressure areas are areas where the air is

A. dense.
B. light.
C. humid.
D. moving rapidly.

Reference: Donn, Meteorology

4. What publication should be consulted to find information about ship repair facilities available in Cadiz, Spain?

A. World Port Index
B. Coast Pilot
C. Nautical Index
D. Sailing Directions

Reference: Dutton's Navigation and Piloting

5. When a back sight of the sun is observed using a sextant,

I. the observer faces away from the sun and observes the altitude.
II. what appears in the horizon glass to be the lower limb is in fact the upper limb of the sun.

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

Reference: American Practical Navigator

ANSWERS

ENGINEERING
1-B;2-B;3-B;4-A;5-B
DECK
1-B;2-B;3-A;4-A;5-C

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. ⚓

U.S. Department
of Transportation

**United States
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