Proceedings
of the Marine Safety Council

September-October 1992 Vol. 49, No. 5

Special issue on inland barge and towing industry

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DIST (SDL No. 130)
A: ac(2); ebfghijklmnopqrsuv(1).
B: nr(50); cefgipw(10); bklqshj(5); xdmou(2);vyz(1).
C: n(4); adek(3); blo(2); cfgijmpqrtuvwxyz(1).
D: ds(5); abcefghijklmnopqrtuvwyz(1).
E: kn(2). F: abcdehjkloqst(1).
List TCG-06.

Cover Photo

Barge tows band together on the lower Mississippi River.

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Special issue on inland barge industry

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Inland river barge and towing --

A standard 15-river barge tow. Photo by LT Chris Otto.

a unique industry

By RADM A. E. "Gene" Henn

Mention maritime commerce and eople immediately envision cargo ships rossing broad oceans, tankers working heir way along the coast or sleek cruise hips plying the waters of the Caribbean. There is another segment of the maritime ndustry, however, that is all too often verlooked -- the inland towing industry. Consisting of some 5,000 United States-flag vessels, the towboats operating on ur inland rivers command a vital ntegral role in moving America's ommerce.

Visualize the "standard" 15-barge ow. Each of the barges has the capacity carry 1,500 tons of general cargo, 2,500 bushels of grain, or 453,600 allons of petroleum or liquid chemical roduct. To move the amount of cargo ansported by a standard tow would quire a freight train two and three-arters-miles long or a convoy of trucks ending more than 34 miles.

It takes a special breed of mariner -- the riverman -- to navigate these quarter-mile-long tows along the winding 7,000 miles of inland waterways in the United States. Despite the fact that a large portion of the rivers are "pooled" by an intricate system of locks and dams, the riverman is constantly confronted with high water, low water, ice, shifting channels, shoaling, floating deadheads (empty barges) and a myriad of other obstacles.

The responsibilities of the riverman are huge, and the consequences of a navigational error on his part could prove catastrophic. Hundreds of communities line the rivers, often using them as their primary source of drinking water. More than 1,300 bridges provide important river crossings for our railroads and highways.

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Single package barge and towboat. *Photo courtesy of the Maritime Administration.*

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National wildlife refuges and designated wildlife areas along the rivers are home to many species of fish and wildlife, and are used by millions of migratory and resident birds.

Sport fishermen and recreational boaters enjoy the bounty and beauty of the rivers. Countless people -- from the Nebraska farmer to the Louisiana refinery operator -- depend upon the uninterrupted movement of commerce along the rivers.

An error in judgment by the riverman could result in a casualty with severe negative impact on any and all river industry.

Just as the Coast Guard is responsible for protecting life, property and the environment along the coasts and on the high seas, it is equally responsible for the same tasks on inland rivers. Through its extensive aids to navigation mission, the Coast Guard works to ensure that navigation channels are properly marked. Through its commercial vessel safety mission, the structural integrity of vessels and the qualifications of operators are maintained. Through its marine environmental protection mission, pollution threats are minimized.

It is fitting that this issue of Proceedings *be devoted to the inland barge and towing industry. The river industry is unique -- far different from its coastal cousin, the ocean shipping industry. The articles which follow will provide insights into those differences.*

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Oil runs downstream on North Platte River.

-- Open river spills --
strategies and tactics

By CAPT *Robert E. Luchun*

Preparedness

The passage of OPA 90 has institutional-ized contingency and response planning for all sectors of the oil industry. Inland spill response and response planning is a unique challenge to the river barge industry. It is similar to that of the coastal and ocean environments, but different enough to warrant its own niche.

OPA 90 has set the worst case scenario as the basis for planning activity and made resource identification a requirement. It seems only logical that the planner must now focus on strategies and tactics to be employed during response as part of the planning process.

Past approaches

Until recently, conventional wisdom and practice generally produced a plan based on prior operating and spill response experience. The plan addressed organization, command and control matters and contained a data base that could be used by a manager to respond to a spill or some other catastrophe.

One of the first steps of any response was for the responsible party and government officials to make a rapid assessment of the situation and quickly design a plan of action. Using this spill-specific plan, the manager would have the responders make the most direct and logical actions to combat the spill. This reactive approach is routinely successful in small spills, but during major events, it could significantly delay response actions. OPA 90 has compelled us to surrender our conventional wisdom and use a universally-applied planning approach.

Perceptions

How does one approach the concept of spill response strategy and tactics in the contingency or response planning process, and how much time should be spent on the subject?

In both the Ashland and *Exxon Valdez* spills, there was an almost instantaneous public demand made upon the responsible parties for explanations of what actions were being taken to combat the spills, collect the oil and protect threatened local resources. These spills were dramatically different situations, with problems

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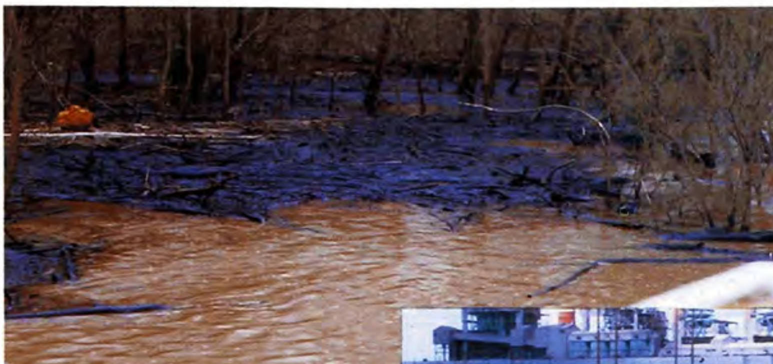
and solutions unique to their environments. Yet they shared an element -- perceptions of the inability of the senior corporate and government officials to quickly produce and articulate enact their plans of action. This inability height- interfered with their ability to deploy resources and combat the spills, particularly during the crucial first days of the response.

define the nature and extent of the clean-up operations that must take place. The vessel the requirements of a worst case discharge at sea, and in the coastal and near shore environments for all ports of call.

Facility operators have an easier planning task than vessel operators. The facility owner has a distinct advantage of being a resident of the port and has only one geographical



"The strategy must address the various facets of response created by the specific spill -- the location, physical environment and conditions . . ."

(Above) High water oil gathers among trees on the flood plain.

(Right) Workers clean up oil by hand in shallow habitat.

OPA 90 requirements

OPA 90 requires that all vessel and facility operators create response plans based on the worst case scenario. They must contain specific elements to facilitate response to a discharge of oil or hazardous material.

Section 4202 of the act requires that vessel and facility owners and operators identify a qualified individual with full authority to implement removal actions. The plan must also identify and ensure by contract, or by other approved means, the personnel and equipment necessary to remove a worst case discharge.

Domestic and foreign vessel owners and operators face a most complex task as scenario plans rely heavily on the use of site-specific knowledge to define the impacts of a discharge, the nature of the area, the resources at risk and the physical environment in which the discharge takes place. These factors will

location to deal with. He or she has access to all the historical and operational experience, as well as the local knowledge to draw upon in the planning process. This is a great advantage, since the fewer variables involved, the simpler the planning process can be.

Strategy and tactics

By definition, strategy is a game plan designed to produce a desired goal. The logical goal in any response operation is simply to gain control of the discharge, physically remove the discharged material, and mitigate and minimize injury to the environment.

The strategy must address the various facets of response created by the specific spill -- the location, physical environment and conditions, the type and quantity of discharge, and the natural resources that are effected and/or threat-

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MAN-MADE STRUCTURES INFLUENCE RESPONSE OPERATIONS

(Above) Barge is jammed against Old Lock and Dam 26, Alton, Illinois.

(Above) Concrete mattress is placed along bank of Mississippi River.

Dikes and islands dot Mississippi River.

(Above) Barge approaches Cairo (Illinois) highway bridge.

(Left) Barge and tow pass rock revetment.

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ened by the discharge. It must also take into account the limitations of the methods available to control and remove the discharge. A general strategy should be determined as the basis of response before a spill takes place. It would simply be refined to reflect actual conditions at the spill site. This will allow the spill manager or federal on-scene coordinator the latitude to make important decisions before the crisis gets critical and to focus all energy on managing the response.

By definition, tactics are the methods used to carry out the strategy to produce the desired result.

When considering options for responding to a river or fresh water spill, it is logical to draw upon ocean and coastal response experiences. It is a logical, but not necessarily the best approach. The goals are the same for river and coastal spills, but the strategy and tactics employed differ according to distinct differences in the operating environment.

Inland strategy

Using coastal spill strategies to respond to a major fresh water spill is not always appropriate. This point is illustrated by a generic comparison of the major response factors for ocean spill scenarios to those of an open river spill.

Coast Guard personnel work boom over the side of a small boat.

An open river is a navigable waterway that is improved with embankments and dikes. Its flow is not controlled by man-made structures, such as locks and dams or hydropower generating plants. It is alluvial in character with a significant velocity and flow rate. The flow varies according to the river's size and depth, and is influenced strongly by the natural processes of drainage and weather.

Time comparison

Coastal spills generally have limited windows of opportunity that allow the response manager time to employ certain response tools to

A barge is used as a vessel of opportunity in booming operations.

stall or prevent the landfall and stranding of oil. The use of dispersants, insitu burning, vessel-based skimming and even the destruction of the vessel to prevent oil from damaging the shore or coastline are common offshore tactics.

No such windows of opportunity exist in river environments where shore impact is inevitable and immediate. There is little time to start midstream physical recovery. The use of dispersants and chemicals is viewed as a threat to water supplies, and is generally dismissed as not effective in fresh water environments.

Oil slick mechanics

The physical spreading of oil on the ocean depends upon the amount and type of oil discharged, its viscosity, wind-driven currents, tidal influences and time. Although long-shore transport currents move oil along a shore, the tides are the major forces involved in stranding oil on a shoreline.

Variable ocean currents affect the recovery platform and the slick. The currents tend to move them at the same speed, which can be beneficial to recovery efforts. As a large oil slick spreads, it is broken apart by ocean surface and wind currents, and eventually forms windrows and isolated patches. Early in this spreading process, the slick contains enough oil in collectible thicknesses to warrant skimming.

In contrast, the spreading of oil on an open river is mainly affected by current, not wind and tide. Oil spread by river current rapidly breaks up into a web of windrows. The dynamics of river currents make vessel recovery methods less effective options. Skimmers and other vessel recovery systems can be used with varying degrees of success in large backwaters, still navigation pools and extremely low current flows. Navigational constraints, sinuous channels and varying river depths make the use of towed skimming barriers nearly impossible. However, skimming can be effective at shoreline and natural collection points.

Physical processes

Once oil is released into the environment, it undergoes the process of weathering. The mechanisms are the same in ocean and fresh water environments, but the rate of speed differs.

Evaporation is basically a function of the oil's composition, surrounding temperature, wind and time. Particularly highly volatile, refined oils can significantly vaporize in the first 24 hours. Under ideal situations, some crude oils can vaporize about 40 percent of volume.

Emulsification is the process of oil and water physically combining. It is caused by oil composition, water temperature, wax content, physical energy in the environment and time. The more turbulent the environment, the faster it takes place, making it very difficult for skimmers and pumps to be effective. For example, during the Ashland spill, the oil was subjected to flood level current, and passed over and through a lock and dam structure. The cold water and the significant mixing of oil into the water column greatly accelerated emulsification.

Dispersion into the water column is a process that is relatively the same in ocean and fresh water, although the chemistry is different.

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Floating debris compounds oil spill problems.

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The tumbling of the oil experienced in the Ashland spill resulted in an unusually high level of hydrocarbon components in the water column at a surprising depth of more than 18 feet. It was believed that the passage of the oil over the river control structures caused most of the dispersion.

Sinking is a direct result of weathering. Although some heavy refined products and crude oils are lighter than water, they can sink when mixed with sediment. Sometimes the oil becomes buoyant after this process and later reappears downstream.

It has been said that the Missouri River is too thick to drink and not thick enough to plow. It and other major rivers carry various suspended solid loads throughout the water column. When oil is introduced into the water column, it combines with the suspended sediment, accelerating the process of dispersion.

Tidal influences

Ocean tidal cycles and ranges are predictable and can augment specific clean-up activities, as in the *Exxon Valdez* shoreline washing operations. Oil refloated by tides can be targeted for collection by skimming vessels and boom.

There are no such cyclical tidal influences in the inland river environment, where the current remains near constant.

Debris

Floating debris and vegetation plagued the *Exxon Valdez* recovery operation. Seaweed, pop weed and plankton blooms mixed with floating oil, clogging skimmers. Oil-covered driftwood and jetsam on shorelines were targets for clean-up and, sometimes, removal. Along the south coast of Alaska, draglines and clamshell buckets were used to load waste onto hoppers and deck barges for disposal.

A similar and more severe problem exists in open river environments. Large floating logs, trees and collections of natural materials wash into rivers and amass at natural collection sites. The oil will flow downstream to the same locations where debris collects. Large debris can snare booms and cause them or anchor systems to fail. Floating debris also complicates oil skimming and suction operations. Debris can be a potential problem in coastal clean-ups, but it is always a problem in river response efforts.

Ice can be a real problem during cold weather responses. It acts much like other floating debris and can cause extremely hazardous working conditions.

Man-made structures

Locks and dams, bridges, wharves, piers and other man-made structures can influence response operation strategy and clean-up tactics.

Levees are large earthen walls constructed on the natural flood plain to prevent seasonal flood damage. The high walls are broad based and planted with grass to protect them from erosion. Levees are usually fenced off and not accessible to the public. There may be restrictions on the use of heavy equipment on or near them, which would require coordination of response activities with the local levee board.

Revetments are natural riverbanks that are armored with stone materials for stabilization, protection from the natural action of the river and erosion prevention. The slope of these banks vary and their masonry covering ranges from riprap to articulated concrete mattresses.

Ranging in size from that of a melon to a boulder, riprap is difficult to clean when covered with oil. Low pressure water can wash the oil back into the river, although downstream washing is tedious. It is best done from a vessel as working on a revetment can be difficult due to the sloping surface and lack of footing.

An articulated concrete mattress consists of concrete-reinforced slabs tied together into a blanket to cover a natural bank. Connected with reinforcing bars, the large mattress sections are held in place by their weight. Its smooth and uniform surface does not trap oil like riprap. Working from boats close to revetments can be hazardous, because of the possibility of stray rocks and other submerged objects in the vicinity.

Anchoring boom to a revetted bank can be difficult, but should be considered if an anchor point is available. Boat crews working near revetments must be skilled. When deploying boom near or at revetments, care should be taken to prevent damage from sharp edges on the masonry material.

Consisting of large piles of quarry stones that have been placed out from the shoreline, dikes are similar to the jetties seen in the coastal environment. The dikes extend out into the river to augment or redirect flow to prevent the deposit of suspended silt in the channel or crossing.

Sandbars form on Mississippi River north of Memphis Harbor.

hey may extend above water or be submerged. hey are usually constructed at right angles to e bank, some having "T-" or "L-shaped" ends. ilt and sand will collect behind them. Floating l may naturally collect in these areas.

Oil recovery operations in and around kes can be hazardous because they create eddy urrents and boils. Just as with riprap revet-ents, care must be taken in boom operations ear dikes.

Many of the large islands in the lower Mis-sippi River were formed by dikes. They also lter or control water flow into sloughs behind isting islands and oxbows. These areas can be tural pooling sites for floating oil during cer-ain river stages. When working near sandbars rmed by dikes, care should be taken as they ay be unstable and unable to support weights.

Sandbars

Sandbars form and disappear with rapid ver stage changes. Stranded oil can be physi-lly removed or flushed back into the river for erding to a collection point. Care must be taken not to drive oil into the substrate during recov-ery, nor to wash sand into the channel during clean-up and herding activities.

Newly exposed or formed sandbars can be unstable. Thorough site evaluations should be made before operations are conducted.

Natural collection sites

Oil will be transported downriver by cur-rent, adhering to the shoreline in an alternating pattern. It will be distributed much like river debris where there are slow currents, eddies and alternate water courses.

Prime sites for natural pooling are the up-river ends of sloughs and ox-bows, shorelines at bends where the river crosses, eroded cuts in the bank, seasonally flooded wetlands, eddy areas above or below a discharging tributary, outfall pools at industrial facili-ties, and behind dikes and sand islands. The best way to preidentify these sites is to conduct overflights by helicopter to spot debris deposited due to current. This should be done before a spill takes place, as part of the planning process.

Containment

Vessels of opportunity can assist in slow-ing or redirecting oil traveling downstream to create a window of opportunity for boom deploy-ment. If the oil is headed toward a barge fleet, the barges can be maneuvered and moored to form a physical barrier to alter river surface cur-

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Clean-up proceeds behind an island, a natural collection site.

It's a no current situation for this booming operation.

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rents and help collect oil. A vessel's wheel wash or waterspray can help herd oil into an otherwise inaccessible slack area along the bank.

The placement of booms is the most frustrating and time-critical activity in oil recovery operations. Booms do not work well in currents, and should never be positioned at right angles to a riverbank or completely across a major river. They must be angled to reduce current load and strain. The greater the current, the more acute the shoreline angle must be. Also, shoreline booming should be used in concert with containment booming to limit riverbank contamination.

Anchoring the river end of the boom requires the use of formed anchors with additional weight to hold the boom. Anchors should be buoyed to facilitate locating them for subsequent repositioning and recovery. They should be considered as expendable, and sufficient quantities should be on hand to allow for repositioning of anchor points. The operation is one of trial and error, and constant adjustments are needed to attain the right scope and weight combinations to reduce anchor system failure.

There are special anchors for differing boom applications. For example, disc anchors are designed to hold in high currents and to use with containment systems. A current practice is to use marine-type anchors that fit the holding ground requirements. Adding sacrificial anchors (poured concrete weights or blocks) in increments to the deployed marine anchor may help attain the necessary holding force. Anchoring operations in high current from small craft require skill, patience, luck and a [illegible] of the hazards involved.

Shore anchoring of boom requires much the same ingenuity, and trial and error approach. Available trees, or man-made or natural hard points should be used. Like fly fishing, [illegible] booming generally falls victim to terminal fixture failure. Shackles, chain pendants and wire rope all fail.

Diversionary and containment booming can be done on sandbars. Anchoring of booms to sandbars may require the use of buried anchors to provide needed force. Cross bars of treated posts with a chain or wire rope pendant can be buried in the bar or shoreline to provide a substantial anchor point. The use of a set of buried cross bars with their pendants joined can provide an adjustable hard point.

Any anchoring scheme should allow for a secondary system in the mooring arrangement. The loss of control of a boom or a pool of contained oil due to the absence of a backup system is embarrassing and expensive.

Boom tending in high current is a must, particularly when debris and ice are present. The selection of the boom type is also critical. The use of solid flotation on booms is necessary when there is a high probability of puncture damage.

Anchored booms, whether diversionary or containment, will have enormous strain and tension. Tension forces and strain created on the boom, midlines and mooring tackle will be very great. These forces can cause boom or tackle failure. Mechanical aids (portable winches and ratchet come-alongs) must be available to help adjust booms. This is necessary because the strains involved may exceed the strength of the workers on site.

Chafing gear, canvas or cloth wraps are a must to prevent boom damage. Caution must always be exercised when working around booms to prevent injury should a boom fail or get out of control during adjustment activities.

pill trajectories

Spill trajectory and movement monitoring needed in the management of coastal and off-ore spills for the spill manager to take defen-e booming actions, and stage clean-up re-urces and equipment to the best advantage.

The distribution and location of oil impact the determining factor in directing response ctions. There is always the chance that coastal ills will not reach shore until after a signifi-ant period of time. The location of impact and randing is dependent on weather, tide and cur-ent variables. There is an equal chance that the il will not behave as predicted. The spill man-

starts reaching pre-iously non-threatened areas.

In contrast, we know which way the oil ill go in open river spills. It will naturally head wnstream, but the spill manager must know avel times and concentrations of oil in the ater column as it moves downriver. Projection nd tracking of the leading and trailing edges of e spill, and the degree of oil dispersed into the ater column were the major focus points of spill recasting efforts during the Ashland incident. ill projections, on-site observations and testing rmitted spill managers to recommend defen-ve actions to water and power plant operators the spill progressed downstream. These ac-ns prevented oil fouling of water intakes at inking water and power plants.

ill assessment

Remote sensing and aerial photography e played significant roles in all major spills. y can help locate oil in the vast areas gener- involved in coastal and ocean spills. Such ems were used effectively in the *Exxon* uez and Persian Gulf spills, for example.

These methods can be used in response to open river and fresh water spills, but may not be as effective due to technical limitations and the narrow widths of rivers. Overflight and video documentation from helicopters are effective assessment tools in river spills, particularly in remote areas, and should be used when possible.

Operational realities

River levels or stages can change dramatically quickly as a result of rain storms far from the spill sight. Although the rise and fall of rivers generally can be predicted based on known trends, predictions can be inaccurate. The rise and fall of a river can transport and strand oil deep into the flood plain, making it inaccessible to response efforts. We see that during spill situations when the river stage has fluctuated, the "oiling gives a bath tub ring effect to the shore."

The river is a high energy environment with dynamic forces that may easily exceed the operating and engineering limits of many containment and removal methods, which have been successful in ocean and near coastal responses. What has worked well in ocean environs may not perform well in open river situations.

Multijurisdictions

Spill managers must be aware that an inland spill on the Mississippi, Missouri or Ohio rivers will generate jurisdictional issues not generally present in coastal or ocean spills. They must be prepared to deal with issues requiring consensus by authorities in bordering states. For example, what may be an acceptable clean-up method in Illinois may not be in Missouri.

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Shoreside clean-up poses problems in a backwater.

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Similar problems arise in the areas of wildlife rescue, solid waste disposal and chemical use. The need to comply with dual standards can be very frustrating to spill managers, particularly during clean-up exercises.

The planning process must take into account the variances between states, and address the issues when strategies and tactics are being developed, and clean-up methods selected. Spill managers must be prepared to interact with several agencies on the same issue, and have developed tactics for each standard.

Planning process

Response plans cannot be designed in a vacuum. The process must include research, data collection and field work. Planners have to use the collective input of company personnel, along with contemporary management methods, such as total quality management and management by objective.

Tank farm and dock personnel, rivermen and pilots have experience-based opinions that can be extremely valuable. The planner should interview people outside the company who have operating experience in the area of the response operations. Such local knowledge is priceless.

Response plans

Response plans must be action-oriented and easy to use, with strategy and tactics presented clearly and concisely. The plan must be flexible enough to be used for minor or worst case discharge incidents. Maps, charts, matrixes, illustrations, decision trees, color coding, flow charts and check lists should be incorporated. They convey more information than the written word.

At minimum, the plan should address the following: response organization, chain of command, communications, response strategies and tactics, field operations, wildlife rescue, personnel requirements and inventories, notification procedures, charts for all preidentified booming and natural collection sites, and booming and clean-up techniques for each site. The plan must identify the resources at risk from a discharge.

Since the major rivers of the midwest are part of the Mississippi River flyway, the area is critically sensitive during the spring and fall bird migrations. Plan strategies must account for these periods of greater wildlife risk.

The plan must address the phased deployment of resources and establish priorities for action to be taken with limited resources at hand during the first hours of the response. It must facilitate the dispatching of personnel to field operations without delay, and it must establish a logistic system and procedures to support response needs and requirements that arise.

Spill response is expensive and failure to take the right action at the right time can be costly. For example, should the responders fail to place a secondary boom at the major collection site and the primary boom fails, the oil can escape and enter a critical habitat. The manager then must collect the oil with a labor intensive method, rather than the preferred mechanical method at the collection site. Costs will rise further if there is significant injury to the habitat.

"No two spills are alike."

Conclusions

No two spills are alike. Each has its own factors that limit the ability to employ tactics that have worked in the past. The world of [illegible] response operations differs enough from that of ocean and coastal operations to require its own set of strategies and tactics.

During the planning process, it will be rapidly discovered that pollution response strategy must be designed within the confines of the controlling factors and conditions where the response operations will take place. The presence of natural and man-made resources at risk, environmental factors and the availability of clean-up resources will dictate necessary strategies.

There is a real need and value to scenario-based planning and strategy identification. Whether required by OPA 90 or not, response planning is not only good business, it is the only way to do business.

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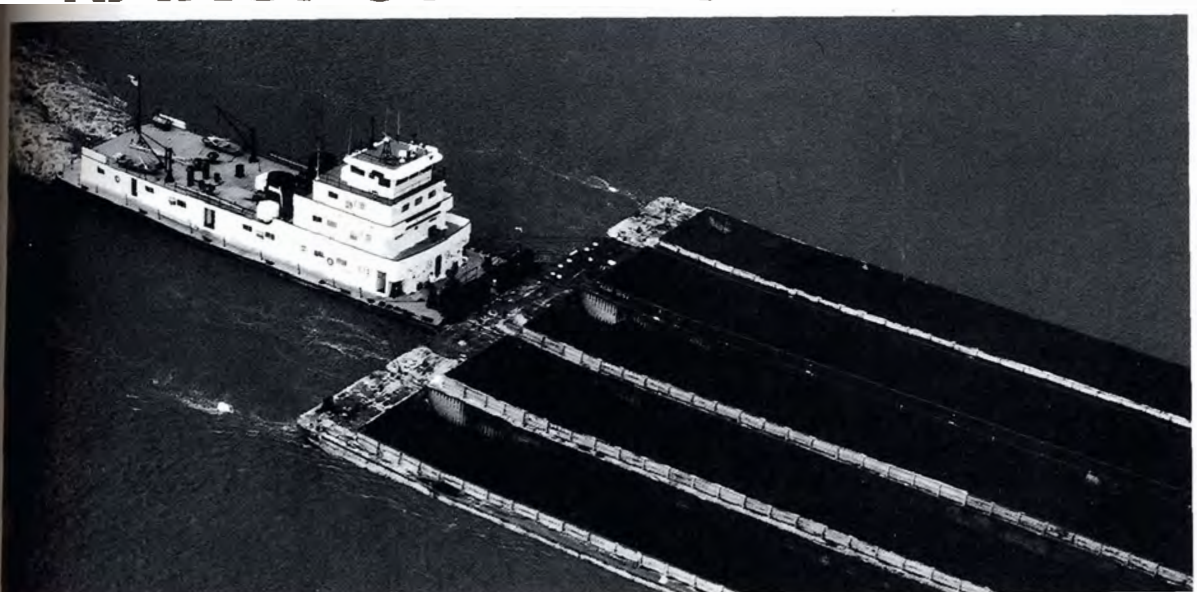
The shallow draft industry is a TRANSPORTATION GIANT



tug moves five coal hoppers up the Mississippi River.

By Ms. Penny L. Eastman

America today is a $5.7 trillion economy hich generates an incredible 3.6 trillion-ton iles of freight every year. Cargoes move by rious modes of transportation, ranging from r carriers to oil pipelines. One of the most pro-ctive, yet least recognized modes is shallow aft shipping. In 1990, a record-setting 621 illion short tons of freight moved by tug and rge on inland waterways.

From the earliest days of this nation, com-rce has moved on inland waterways. These tural highways were the paths of early explo-ion and trade. The same transportation sys-n serves America today with 23,875 miles of nmercially navigable inland waterways.

MARAD

The Maritime Administration (MARAD) is responsible for promoting maritime commerce on these inland waterways, as well as on the Great Lakes and the world's oceans. Maintaining close relations with all sectors of the inland waterways shipping industry, MARAD helps to solve problems and addresses issues of concern.

MARAD sponsors research and development projects to improve river operations and port planning. The agency coordinates its efforts with the Department of Agriculture, which ships large volumes of grain on barges, the Army Corps of Engineers, which maintains the waterways system, and the Coast Guard, which ensures safe navigation.

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MARAD also guarantees mortgages on inland waterway vessels. In the past year, Title XI mortgage guarantees were issued on 127 barges for $27.5 million.

Inland system

America's shallow draft carriers operate on navigable rivers, canals, and the Atlantic and Gulf intracoastal waterways. In general, waterways with depths of 12 feet or less are considered to be shallow draft, although the controlling depth for much of the system is nine feet.

The Mississippi River is the main artery for commercial navigation for the mid-continent. In 1990, it carried about 325 million tons of cargo, according to the Army Corps of Engineers. The Ohio River carried 221 million tons in the same period, and the Gulf Intracoastal Waterway carried almost 113 million tons. On the west coast, the Columbia/Snake river system carried approximately 25 million tons.

Typical barge cargoes are either raw materials that are feedstocks to industry, such as ore and coal, or bulky semi-finished products, such as iron and steel. In 1989, petroleum and petroleum products comprised 36 percent of the tonnage moved, while coal and lignite comprised 24 percent. Over 20 percent of the nation's coal moves by barge. Bulk agricultural commodities totaled 73 million tons, practically all of which was destined for export. In addition, containerized cargoes are carried by barge on both the Columbia/Snake and Mississippi river systems.

Conclusions

In spite of its significant contributions to the nation's commerce, there is little public awareness outside the river communities of the shallow draft industry. This can be attributed to the nature of its cargoes, the non-intrusive nature of the mode and the industry's impressive safety record.

> *"...the safest, most fuel efficient mode of surface transportation..."*

The industry

The shallow draft industry consists of approximately 800 towing companies, which operate 5,188 towboats and tugs, some 27,000 dry cargo barges and 4,043 liquid cargo barges, and employs around 176,000 people, according to the American Waterways Operators, the national association of the inland and coastal tug and barge industry.

While certainly not the size of typical oceangoing ships, inland barges are not small. A "jumbo" barge, now the industry standard, can carry 1,500 tons of cargo, equal to the capacity of 15 rail cars or 60 semi-trailer trucks.

An average barge can carry five times its own weight. In terms of fuel efficiency, studies have demonstrated that barge transportation ranks highest -- half again as efficient as rail and five times more efficient than truck transport.

The industry continues to serve the nation in innovative as well as old familiar ways. New applications are being found for barge technology as shippers discover the untapped potential of this transportation giant. To meet the country's new clean air standards, barge lines are carrying low sulfur coal greater distances to energy producers. In addition to the movement of traditional bulk commodities, every day more containers and manufactured goods can be seen on barges.

It remains the safest, most fuel efficient mode of surface transportation, and will do its part to move America into the 21st century.

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Old paddle wheeler evokes visions of "Old Man River" long ago. Photo courtesy of the American Waterways Operators.

The many faces of "Old Man River"

By LT Phil Miller, LT Jane Wong and CW02 Jon Burk

Think of the Mississippi River -- images of grand old gambling boats and Huck Finn lazily rafting downriver come to mind. Well, the gambling boats have gone and come again, while school boys are discouraged from rolling along with "Old Man River."

Nevertheless, the Mississippi keeps rolling on -- beautiful, demanding and unforgiving as ever. Generations of river operators have acquired a healthy respect for the myriad of moods and faces found day to day -- season to season -- on this mighty waterway.

An alluvial river, the Mississippi carries a lot of sedimentary matter, which in this case is sand. This sand spreads out as the river flows southwards, presenting a navigational challenge as the river is always changing. The channel actually moves, depending on the amount of water and deposited matter. This keeps the Coast Guard and Army Corps of Engineers hopping to maintain this water highway for river traffic.

Why is controlling the Mississippi so difficult? For one thing, there are no locks or dams on the more than 1,100 miles of river below St. Louis, Missouri, to manage the flow rates, which determine the amount of suspended matter carried which settle out and cause shoaling.

The upper Mississippi, north of Cairo, Ilinois, has notoriously fluctuating water levels, especially in the St. Louis Harbor, where the Illinois, Missouri and Mississippi rivers merge. The Missouri River, which descends from Montana, receives rain runoff from the midwest states, and the Illinois River, coming down from Lake Michigan, gets rain run off from the Illinois area.

Port of St. Louis

Small by some standards, the Port of St. Louis nevertheless hosts more than 100 million tons of cargo every year, including 57 percent of our nation's grain exports and 40 percent of our petroleum product. The floating monoliths that transport this cargo are often more than 1,100 feet long and 100 feet wide. The typical unit is five barges long and three wide pushed by a tug.

To accommodate this traffic, the Army Corps of Engineers attempts to maintain a channel that is 300 feet wide and nine feet deep. The Coast Guard attempts to keep the channel marked with buoys and river pilots attempt to guide their mammoth vessels. The word "attempt" reflects reality, as the Mississippi is an ever changing challenge.

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Low water

Continued from page 15

A severe shortage of rainfall in 1988 and 1989 caused the worst dry spell since the Dust Bowl. This crisis slowed the flow of commerce on the western rivers when restrictions were placed on river traffic to ensure safe navigation from Cairo, Illinois, through St. Louis Harbor.

Water flow dropped from a mean rate of 180,000 to less than 50,000 cubic feet per second. The channel depth decreased to less than nine feet and sandbars began to build.

The lowest river condition ever recorded on the St. Louis gauge was -6.2 feet on January 16, 1940. (A gauge of zero feet is the historical mark signaling the start of navigational difficulties for vessels on the river at St. Louis.) In 1988, the low water level was -3.2 feet, and in 1989, -5.2. It would not stretch the imagination to believe that a person could have walked from one bank to the other without getting a hair wet.

This was a challenging period for barge traffic management on the Mississippi. It set records for vessel/tow groundings and lost navigational buoys.

Drought conditions have eased off in the past few years, but low water is still no stranger to the Mississippi River. Everyone takes a deep breath each summer when low water sets in. Shoaling becomes more frequent, navigable channels narrow and groundings become more numerous. Tows grounding on the Mississippi River don't have the same impact as groundings on the coast, due to the sandy river bottom and flat vessel hulls. River groundings often result in no damage.

On the negative side, low water groundings often mean that the channel becomes blocked, holding up river traffic in both directions. In chronic trouble spots where multiple groundings have occurred, emergency dredging has been required to clear a channel before tows can proceed. This takes a day or two, resulting in a backup of as many as 10 tows (translating into some 150 barges).

Such delays are costly, not only in lost navigation time, but in other ways. The fixed costs of running a tow boat, including items like food and salaries, remain whether the boat is moving or not. Of much greater consequence, however, are the losses accrued by industries waiting for cargoes being barged. This is the direct result of today's common practice of shipments arriving "in time." This means that the factories don't stockpile inventories of supplies, but rather have them delivered just in time to be used in production. In more than one instance, a company has been threatened with shutting down and laying off employees when a tow was held up due to low water closing the river. An estimated average $36,000 revenue a day (operating costs, lost revenue and cargo delay costs) is lost by a tow due to low water delays.

Aerial view of low water in the Mississippi River

Trouble shooters

To minimize such down time, several organizations have focused on ways to avert trouble. This started after the drought of 1988, when record low gauge readings were set (Memphis hit minus 10.7 feet on July 10, 1988). Many barges were left high and dry. It drew the attention of the White House and the then vice president, George Bush, eyed the situation first hand.

One organization that is used early during low water is the Lower Mississippi River Committee established in 1988. This group is composed of tow boat company representatives who meet with the Coast Guard and Army Corps of Engineers to discuss problems and course [redacted] action to reduce the number of problem ar[redacted] along the river to keep river traffic movin[redacted]

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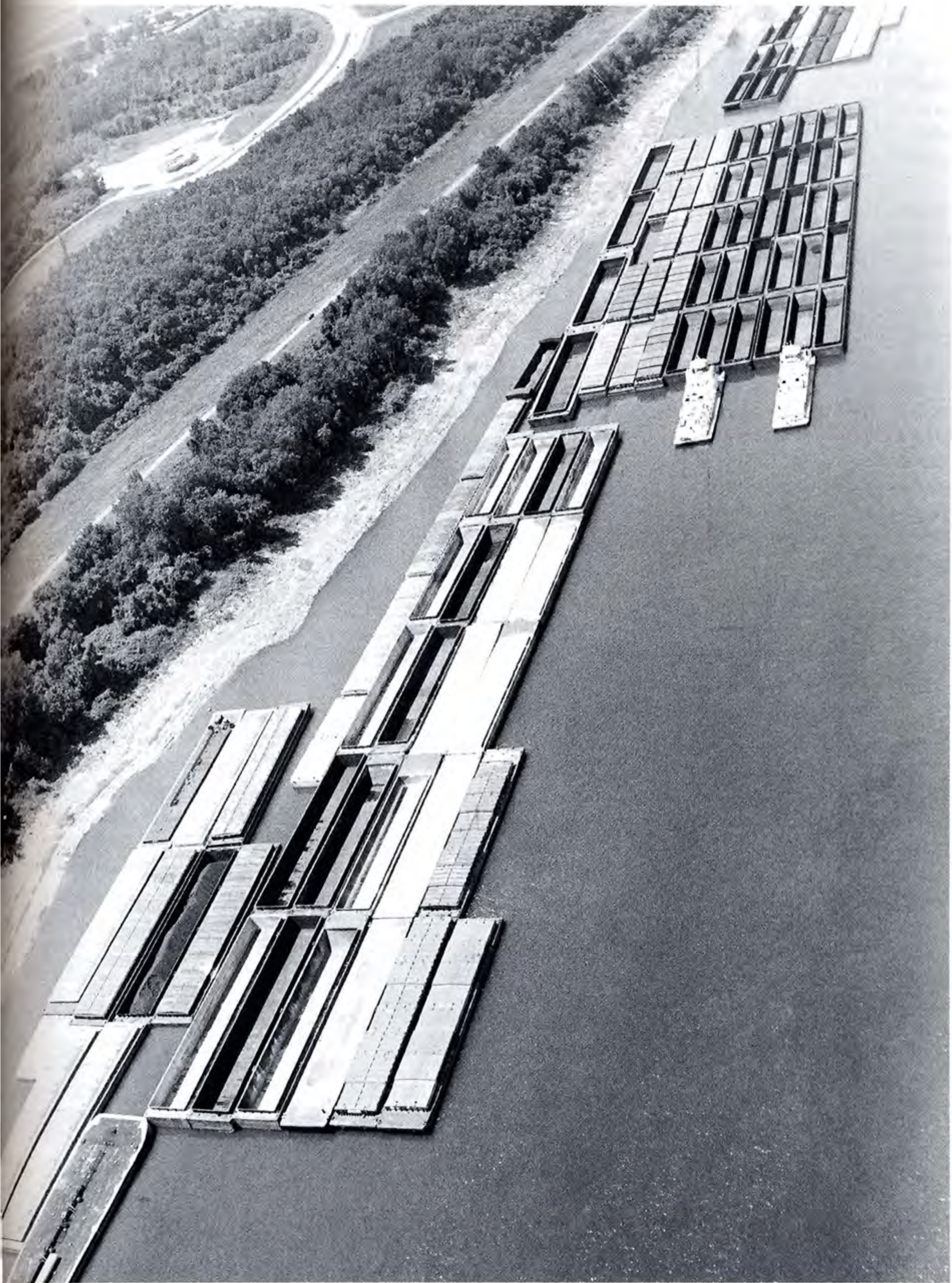

ams of barges idle at river's edge.

Continued from page 16

The committee's members are self-regulating in that they make decisions about reducing tow size (fewer barges or specialized tow arrangements) and imposing draft restrictions. This has proven to be effective in reducing the number of casualties during low water.

The Army Corps of Engineers conducts frequent surveys of the river when low water conditions set in. The Corps keeps the navigable channel dredged to a minimum of nine feet. Their surveys, along with those of industry and the Coast Guard, help determine potential trouble spots. Contract and Corps of Engineers' dredges can then clear the shoals or shallow areas which threaten to close the navigable channel. An example of a trouble spot addressed by the Corps is an area where several tows have grounded over a short time period. Each tow trying to work its barges off the bottom can actually change the bottom contours as wheel (propeller) wash sucks sand from one area and "blows" it to another, thus causing another shoal.

The Coast Guard's role is twofold:

(1) The Coast Guard monitors the condition of the river as it falls, through casualty reports, calls from industry personnel, the towboat rider program, by overflights and through Corps reports. These all help coordinate the different players to work toward a common end. If necessary, a safety zone may be established to restrict vessel movements.

(2) The Coast Guard sets buoys on the river to mark the navigable channel. Unlike those in deep water ports, these buoys are reset quite often as the navigable channel narrows or widens. They are an essential element in the safe navigation of today's large tows.

The National Weather Service also plays an important role in low water operations. At the onset of low water, the service provides long range forecasts of river stage information for all major Mississippi ports. Also, the Corps of Engineers gets involved in forecasting river stages to plan navigation maintenance.

Even with all of this effort Mother Nature sometimes works faster than the many organizations trying to keep the tows moving. If rapid drops in river stage occur, priorities change. When the so-called bottom falls out, shoaling can occur at an accelerated rate, causing an otherwise passable area to close. This doesn't mean there is no water there, just not enough to float a loaded barge and towboat through. An area which has to be dredged in anticipation of a problem may suddenly become a low priority as a result of the closure.

High water

High water conditions on the Mississippi River present a different set of problems, including bridge collisions. Seven bridges cross the St. Louis Harbor, four of which are within a 1.2 mile stretch of river. The combination of high water, increased currents and the close proximity of the

Barges give wide berth to sand buildup in low water.

bridges to each other can create a formidable obstacle course for mariners on the upper Mississippi River. Safe transit demands a high degree of skill, experience and knowledge of the river characteristics under high water conditions.

In the past, the most serious marine casualties have occurred when the St.Louis gauge was at or above 27 feet. (Flood stage is at 30 feet.) The Coast Guard usually designates a safety zone when the river reaches these heights. Tow operators, however, must be experienced to safely navigate the kamikaze course that the Mississippi lays out during high water seasons.

(2) On May 18, 1990, the *M/V Brenda* was proceeding through the harbor with 15 barges in tow when it collided with the same bridge. The water level was at 32.6 feet and rising. An assist tug was unavailable at the time, and the operator opted to proceed without it. After the collision, the barges broke loose and drifted. Two quickly sank and six sustained damage. Several adrift barges rammed moored barges. The harbor area was closed to commercial traffic until all adrift and sunken barges were located and marked to avoid damaging other vessels.

A maze of bridges confronts the pilot when passing through St. Louis Harbor.

Casualties

Two major marine casualties illustrate the effect of high water conditions in the St. Louis Harbor.

(1) What is considered the worst casualty in the history of the St. Louis Harbor occurred on April 2, 1983 when the gauge was 28 feet and rising. The *M/V City of Greenville* was proceeding south through the harbor with four tank barges in tow when it collided with the Poplar Street Bridge, rupturing at least one of the barges. More than 16,000 barrels of crude oil were released into the river and immediately ignited, producing flames which rose nearly 70 feet above the water, creating other fires. One barge sank and another collided with moored barges at a chemical loading dock. A large chemical pipeline was fractured, releasing approximately 100 pounds of monochlorobenzene into the river. The last barge was in flames as it collided with a grain barge loading terminal, igniting barges. Assisted by local firefighters, the Coast Guard cutters *Obion, Sumac* and *Cheyenne* battled the blaze for nearly eight hours until they could bring it under control.

Mariners who operate on the Mississippi River have a wealth of experience. Even so, the river can reach highs and lows that even the most experienced mariner has not witnessed. As a teacher, this river delights in presenting its students with new problems. Those who don't pass learn the answers painfully.

To ensure the safety of the public, property and the environment; restrictions, coordination between industry and the Coast Guard, and innovations such as simulator training for mariners have been pursued to soften the heavy blows that Old Man River can deal.

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A BARGE

is not just a barge

By LCDR Frank Paskewich

If you have ever crossed a bridge spanning the Mississippi River, you may have seen a towboat pushing one or more tank barges up or down the river. If you stopped your car to watch the towboat maneuver these massive structures in the swift current, you may have wondered just how sturdy and stable they are, and if they are capable of withstanding their operating environment.

You might be surprised to learn that these apparently simple box-like structures actually go through a rigorous plan-review process before going into service.

Requirements

The rules and regulations governing the carriage of flammable/combustible and hazardous liquid cargoes in bulk on tank barges are in 46 CFR subchapters D and O, respectively.

The list of cargoes which are considered flammable or combustible is found in 46 CFR table 30.25-1. The list of cargoes which are considered hazardous is in 46 CFR table 151.05.

The stability, structural and machinery requirements which a tank barge must meet depend upon their particular cargoes.

Typical flush-deck type III hulls with independent tank barge in the background.

Hull classifications

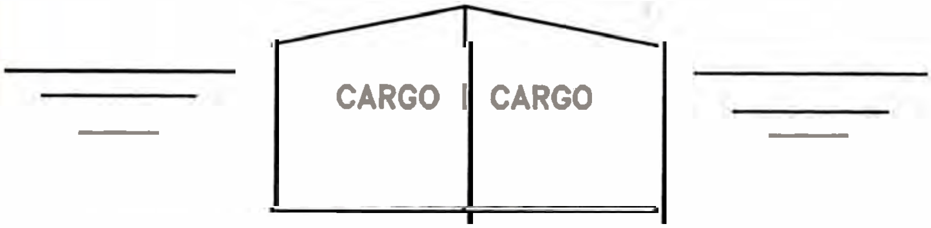
Barges carrying liquefied flammable gases or hazardous liquid cargoes are grouped into three types based on the hazards involved if some of the cargo is accidentally released. They are defined in 46 CFR 32.63-5 and 151.10-1.

A) Type I barge hulls are designed to carry products requiring the maximum measures to prevent the uncontrolled release of cargo to the waterways and/or atmosphere.

B) Type II barge hulls are designed to carry products requiring substantial measures to prevent release to the atmosphere, but whose uncontrolled release to the waterways does not constitute a long-lasting public or operating personnel hazard, though local, temporary pollution may occur.

C) Type III barge hulls are designed to carry products of sufficient hazard to require a moderate degree of

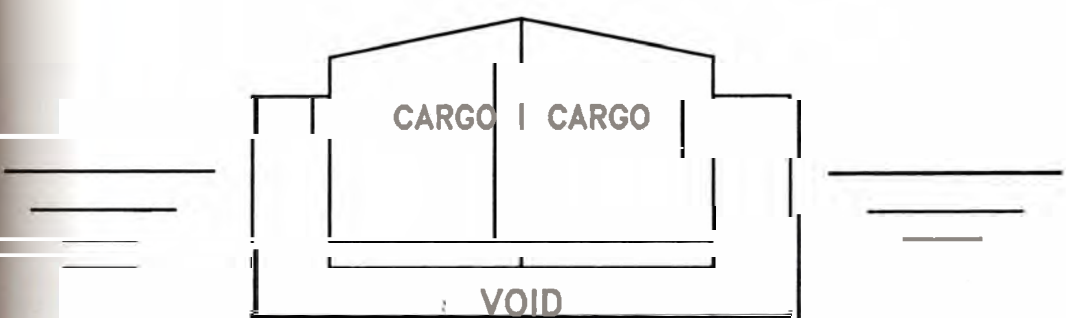
Three basic models



Single-skin tank barge (Type III hull)

1) **Single-skin tank barges** are the most basic design. Their cargo is separated from the water only by shell plating. This design is usually restricted to type III hazardous bulk liquid cargoes, such as caustic soda and hydrochloric acid. In addition, grade A and lower flammable and combustible bulk liquid cargoes, such as gasoline and fuel oil, which are carried on existing tank barges, may be carried in a type III hull.

With the implementation of OPA 90, barges constructed after June 30, 1990, which carry oil cargoes, must have double hulls. Existing barges carrying oil may continue to use single-skin hulls, but they must be phased out eventually, depending upon their construction dates. Most existing barges under 5,000 gross tons have until January 1, 2015.



Double-skin tank barge (Type I & II hull)

2) **Double-skin tank barges** have externally framed cargo tanks bounded on the sides and bottom with a void between the tanks and outer barge hull. This type can carry cargoes requiring types I and II hulls. Type I barges must have a wing tank width of four feet while type II hulls must have a wing tank width of three feet.

For types I and II hulls, cargo tanks must be located a minimum of 25 feet from the head log at the bow. While a specific height of double bottoms is not given, for the cargo tank not to be assumed damaged under the damage stability requirements, the height must be at least 15 inches. Whether or not a double bottom is required depends on the cargo carried.

Table 151.05 gives the type hull required for each hazardous cargo. Most liquefied flammable gases require a type II hull. Products such as ethylene oxide and phenol require type I. Cargoes such as vinyl chloride and acrylonitrile require type II. As cited, oil-carrying tank barges built after June 30, 1990, must have double hulls. While the implementing regulations for this have not yet been published, recommended standards for minimum wing-void width and double-bottom height have been published in Navigation and Vessel Inspection Circular (NVIC) No. 2-90. The double-bottom clearances given in the NVIC will usually be greater than those required for types I and II hulls.

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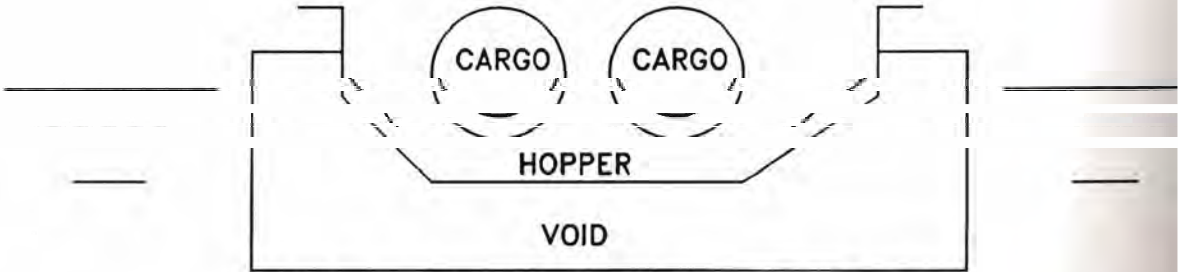

Independent tank barge (Type I & II hull)

Continued from page 21

3) **An independent tank barge** consists of an open hopper with one or more independent cargo tanks (usually cylindrical) mounted in the hopper space. The required wing tank width and cargo tank location from the head log are the same as given in section 2. This type design is most common in carriages of types I and II liquefied flammable gases or hazardous compressed gases. Such cargoes include butane, propane and chlorine.

Stability

Many people make the mistake of assuming that types I and II hulls are determined only by their wing tank widths. What they don't realize is that there are stringent stability standards differentiating hull types. The stability requirements for types I and II hulls carrying liquefied flammable gases are found in 46 CFR 172 subpart C. Subpart E gives the stability requirements for types I, II and III hulls carrying the hazardous cargoes listed in 46 CFR table 151.05.

The specific stability requirements are as follows:

A) Types I, II and III hulls carrying hazardous cargoes listed in table 151.05 must meet the transverse and longitudinal intact stability requirements in 46 CFR 172.090 and 172.095, respectively.

B) All types I and II hulls must meet these damage stability requirements:

1) Type I hull: assumed damage consists of a hole in the bottom of the side-shell plating anywhere on its hull, including the intersection of a transverse and longitudinal bulkhead. This means the barges must be able to survive flooding of four adjacent compartments if they [illegible] int. See 46 CFR 172.050(f) or 172.105 for details on the extent of assumed damage.

Typical flush-deck type III hull

2) Type II hull: assumed damage consists of a hole in the bottom or side-shell plating anywhere except on a transverse bulkhead. This type of barge must be able to survive the flooding of two compartments which share a common longitudinal bulkhead.

C) Inland barges carrying grade A and lower flammable and combustible liquids from table 30.25-1 do not have any stability requirements.

In general, a damaged barge is presumed to survive if it does not heel or trim beyond an angle at which the deck edge is fully submerged. See 46 CFR 172.050(e) and 172.110 for details on the required survival criteria. Types I and II hulls are designed so that the assumed extent of damage defined by the regulations will not penetrate into the cargo tanks.

Typical trunked type II barge.

Structure

A barge need not have very heavy steel plating to do the relatively simple job of keeping the water out. The ruggedness built into a barge is mostly to withstand the abuses encountered in day-to-day operation, such as contact with other barges, lock walls and the river bottom. Types I and II hulls have additional structural criteria to meet because of the more hazardous cargoes to be carried. The structural requirements are:

A) All barges must comply with the basic structural requirements of the American Bureau of Shipping. The bureau's rules determine hull dimensions from the direct application of proven formulas and have a built-in safety factor to survive everyday operations.

B) Types I and II hulls must be strong enough to survive a grounding condition without releasing cargo to the air and/or water. They must meet a grounding condition where the forward rake bulkhead of a fully-loaded barge is assumed to rest upon a pointed rock (pinnacle) at the water surface. The resulting hull bending stresses must not exceed specific stress levels, usually a percentage of the yield strength of the hull material.

C) All barges longer than 300 feet and all barges with types I or II hulls must have the trunk top and deck analyzed for resistance to buckling.

So the next time you drive over a bridge on the Mississippi River and see a group of tank barges being pushed around, you can let out a big sigh of relief. Rest assured that those barges were given a rigorous analysis by the Coast Guard before being put into service.

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Birth of a barge

. . . more than building a steel box

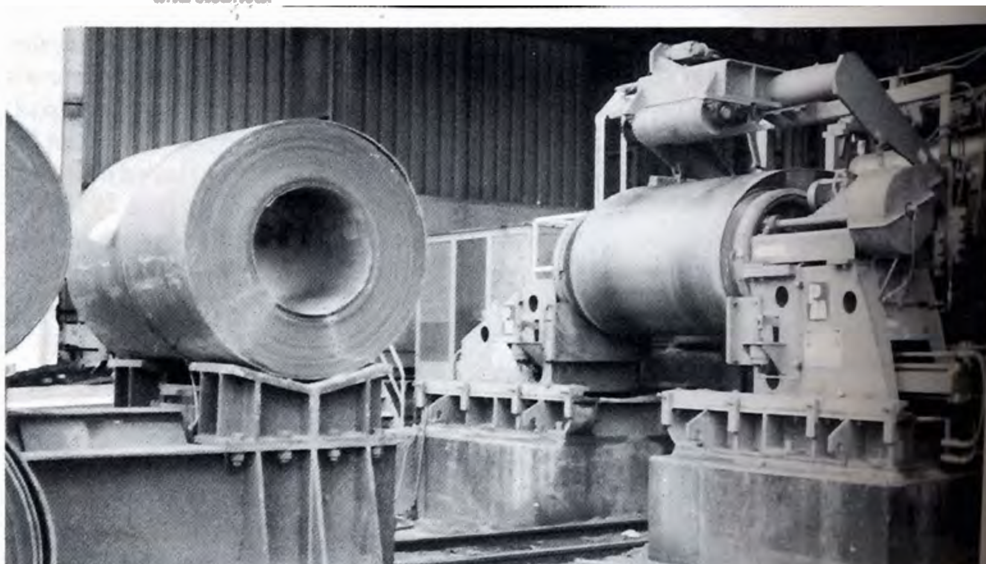
By LT Phil Miller

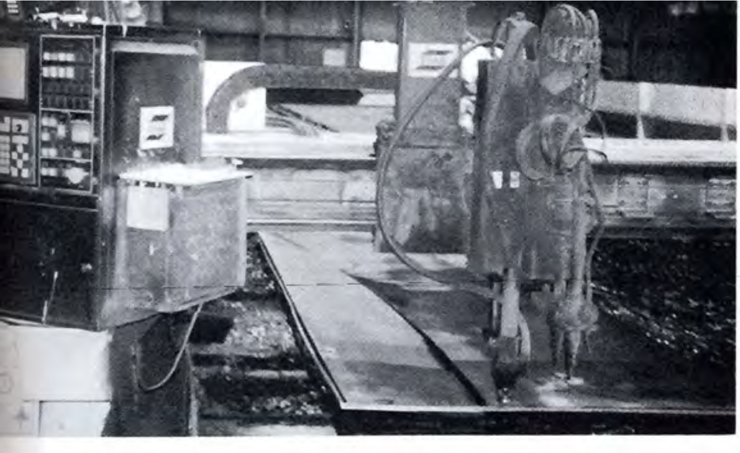
Until very recently, regulations concerning tank barge construction had not changed significantly. Now that double hulls have entered the picture, there's a lot more to constructing a tank barge than putting a steel box together with plumbing. We will soon see the day when the single-hulled barges will go the way of the steam-powered paddlewheeler.

The following is a pictorial journey of the construction of typical tank barges for inland waters. The plans for all such barges are approved by the Marine Safety Center in Washington, D.C., and, in the case of classed barges, the American Bureau of Shipping. The barges shown are from Caruthersville Shipyard, Caruthersville, Missouri. MSO Memphis conducts the inspections of the tank barges built there.

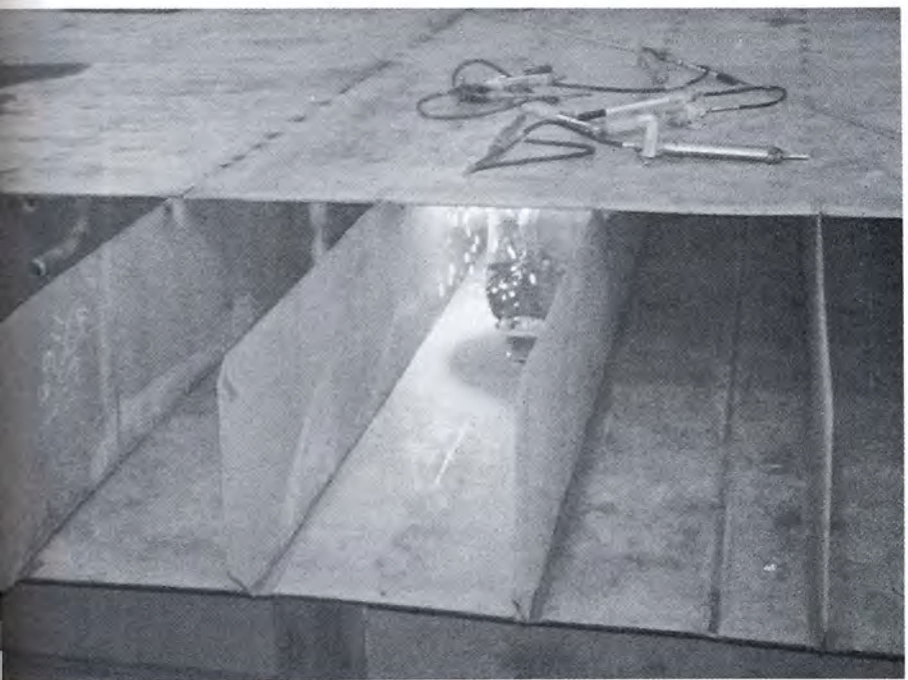
(Right) The "raw" materials, including steel coils, pipes and fittings, are assembled.

(Below) The coils are unrolled, cut to length and cleaned.



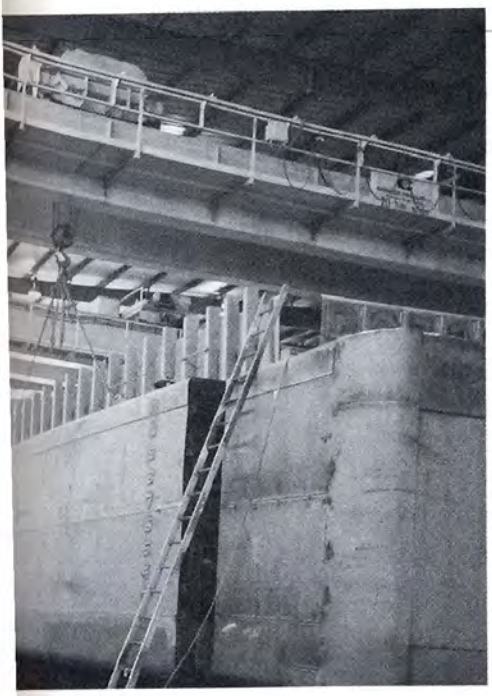


(Left) Steel shapes are cut by a computerized "plasma arc" system. The finished plates and shapes are beveled for welding.



(Left) Welder is in tight quarters as he fabricates the double bottom between tank top and outer hull.

(Not shown) Wing voids comprised of hull plates and structural framing form outer and inner hulls for the barges' sides.



(Left) Wing voids are lifted and fitted into place for welding.

(Below) Rake ends are built up in their own jig. Side plate and frames are welded out on both sides, then lifted into place to be welded to the rake.

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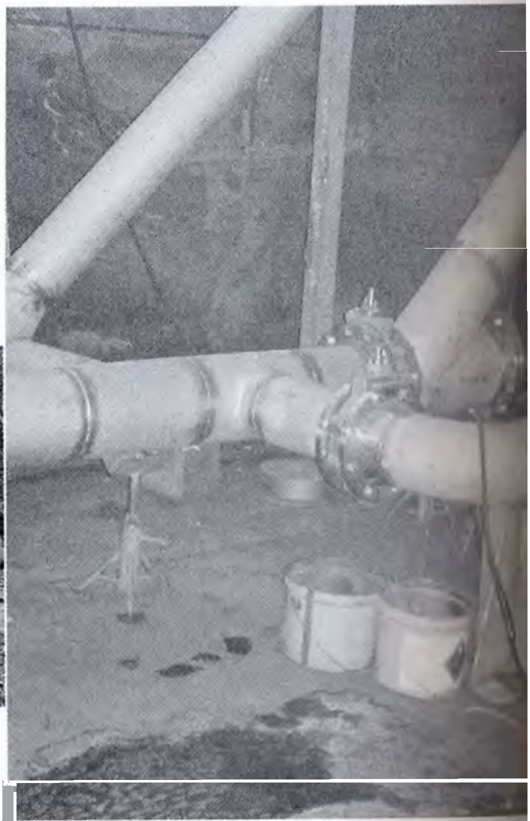
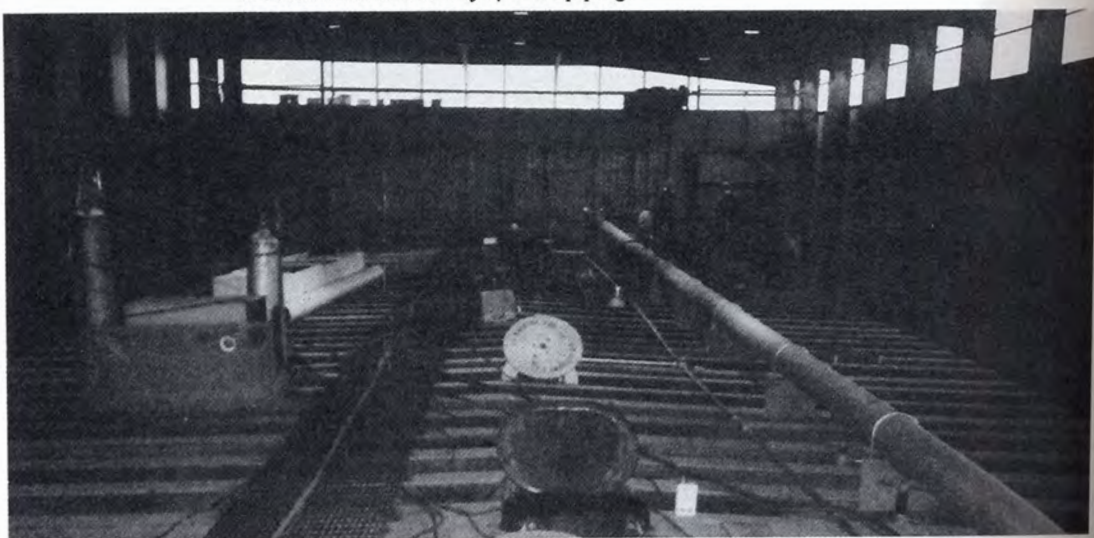
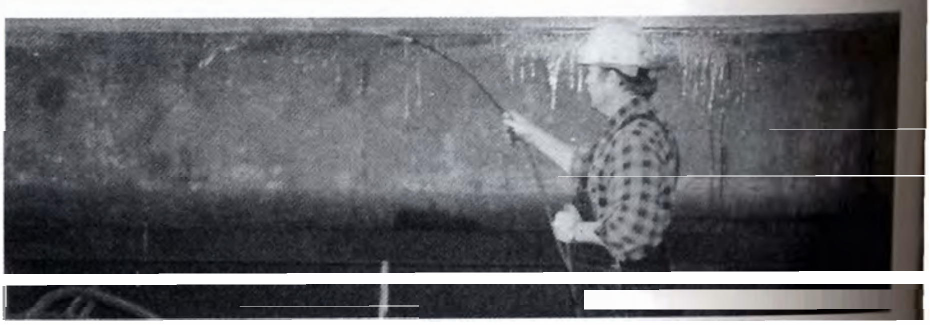


(Right) Piping installed in #1 cargo tank leads to cargo pump.

(Below) The cargo pump, along with the cargo manifold and containment, pump engine and fuel tank are the last installations to be made.

(Below) The cargo tank top and ullage hatches are installed immediately after the piping.





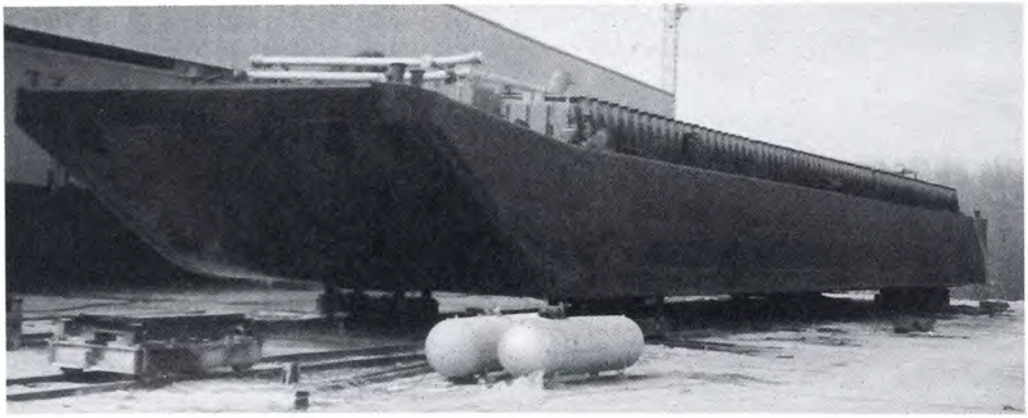
(Right) The hull is checked for leaks inside and outside the cargo tanks.

(Left) After all testing is completed, the barge is sand blasted and painted. Here a crew prepares to paint the voids.

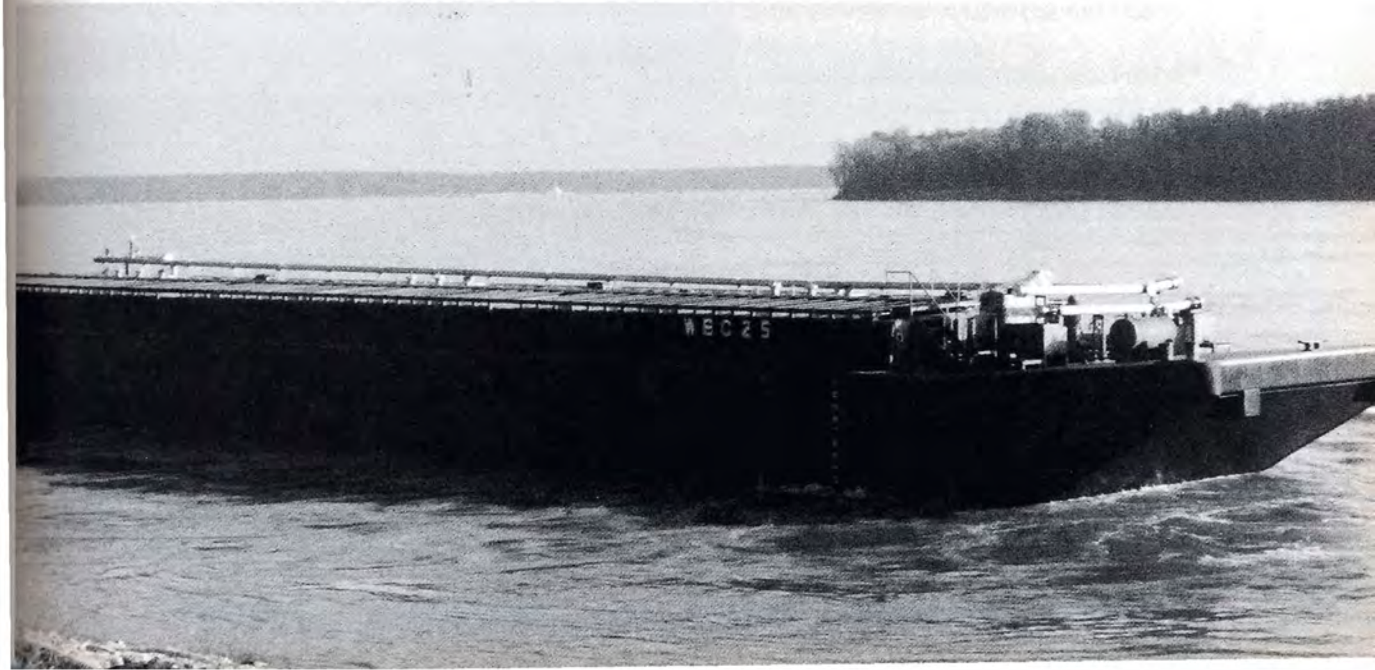
The photographs in this article were taken by LT Phil Miller, who was recently chief of the Inspection Department, MSO Memphis, 200 Jefferson Ave., Memphis, Tennessee 38103-2300.

Telephone: (901) 544-3941.

(Below) The completed barge is ready for launching.



(Below) Another barge is ready for service.



Abandoned barges pose serious problems

By CDR Timothy M. Keegan

Background

The Coast Guard responds to about 10,000 oil spills a year, with the Marine Safety Office (MSO) in New Orleans, Louisiana, handling more than 1,000 cases.

A growing number of abandoned barges are symptomatic of a general decline in the Gulf Coast oil exploration industry. The environmental problems left in the wake of the expansion and later contraction of this industry are just now being publicly recognized.

On April 19, 1992, an article published by the New Orleans ~~Times Picayune~~ discussed the problems posed by abandoned platforms. According to the article, the major oil companies are moving out of the Gulf Coast area and selling their leases to independents, who are suffering hard times and seeking relief through bankruptcy courts. This leaves the facilities without the management or financial backing required to properly close down their operations. This is typical of the problems associated with the abandoned barges, tanks and pits.

MSO responses

A couple of examples illustrate the problems. Recently, MSO New Orleans has responded to several oil spills from offshore facilities, pipelines and barges where there were no financially viable responsible parties. One such facility in Tante Phine Pass was in such disrepair that the oil was leaking out of the supersaturated soil. This response will cost the OPA 90 oil pollution fund well over a million dollars.

The MSO also responded to a spill from an old well head no longer operated by any company. It had shifted and wasn't properly shut in, which resulted in a leak.

Abandoned barge project

In the fall of 1989, the Abandoned Barge Project was undertaken as a cooperative effort by the Environmental Protection Agency (EPA) Region 6 Emergency Response Branch, the Eighth Coast Guard District, MSO New Orleans and the Coast Guard's Atlantic Area (now Gulf) Strike Team. The Louisiana Department of En-

These abandoned barges were found in the Empire area of Plaquemines Parish, Louisiana.

Two barges abandoned in Hero's Cut area of the Intracoastal Waterway.

(Left) T/B Natchez

(Below) T/B MK-450

vironmental Quality and the National Oceanographic Atmospheric Administration's scientific support coordinator also worked on the project.

The project was conceived when it became apparent that at least two abandoned barges, the *T/B Natchez* and *T/B MK-450* in the Hero's Cut area of the Intracoastal Waterway and two additional abandoned barges, the *T/B Ingalls No. 1* and *T/B Z-62* in the Empire area of Plaquemines Parish, all in Louisiana, were being used for the illegal disposal of hazardous wastes. In other cases, barges had been abandoned with oil or hazardous materials still on board.

In early 1989, MSO New Orleans began a series of helicopter and fixed-wing overflights of its area to determine how many abandoned vessels, tanks and waste oil pits were potentially sites for illegal hazardous waste disposal. Nearly 550 sites, consisting of 165 barges, 109 pits and 276 tanks were tentatively identified. Of these, a list of 31 priority targets was developed. Meetings between various project participants were held in the fall of 1990 to set objectives, the different agency roles, and to review an overall site safety plan, as well as finalize the necessary equipment list.

Due to limited resources, the project team decided to limit the initial survey to about 20 of the 31 priority targets. The criteria for selection was based on the accessibility and condition of the barge or tank (i.e., leaking or about to leak). The team ended up selecting 22 barges and tanks at 12 separate sites.

A work action plan was also developed which focused on personnel protection and safety in a chemical environment, personal protective equipment, respiratory protection, basic chemical data and air monitoring instruments.

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Field surveys

On November 6, 1990, project workers arrived at Empire in Plaquemines Parish to begin field operations. A baseline survey was conducted consisting of locating, visiting and photographing each of the sites, evaluating the condition of the barge or pit, air monitoring, gathering vessel identifications and documenting actual leaks.

Many of the barges identified by overflights were in remote locations accessible only by water. The Atlantic Strike Team provided a 32-foot Munson boat and crew for this purpose.

Using data gathered on barge identifications, MSO New Orleans conducted an extensive records search to identify the current or last known owners or operators. In nine cases, parties were identified and notified of their responsibility to mitigate the situation. Four out of the nine parties responded and agreed to remove the threats posed by their barges.

Sampling and analysis

Data gathered on vessel types and conditions was used to develop plans for the sampling and analysis phase of the operation. On March 11, 1991, a team began to take samplings of

This dilapidated barge was deserted in Adams Bay near the Empire area.

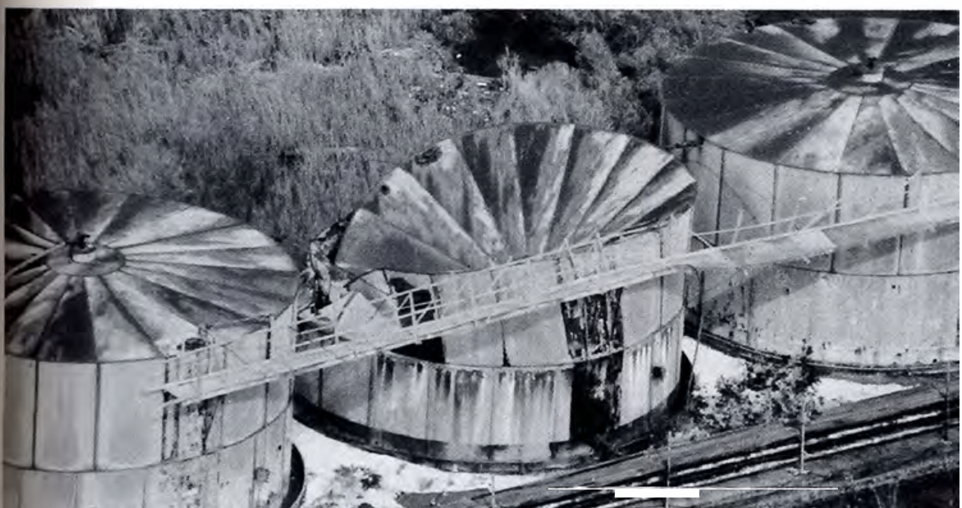
The surveys revealed that hazardous materials were stored in the barges in internal tanks, voids, day tanks, drums, holds and other containers. Storage tanks of between 20 and 1,000 barrels were fixed on land, aboard a floating barge and upon a grounded barge. Wastes could have been placed aboard the barges or storage tanks any time before or after abandonment.

When barges were found not suitable for further investigation, others were added to the priority list to maintain a data base of at least 20 barges with potential for further study. During the month, 26 barges were visited. Some which had been identified as potential pollution sources or candidates for illegal disposal receptacles were actually little more than shells with tanks and void spaces in direct contact with surrounding waters. Some of the barges on the priority list could not be located by ground search.

materials on the sites identified. By the end of the month, a total of 83 samples had been collected from 14 barges.

The samples went to the Coast Guard hangar at the Belle Chasse Naval Air Station, Belle Chasse, Louisiana, where an EPA technical assistance team screened them for hazard categorization and compatibility. The team then combined samples of like materials from the same barges. A total of 45 samples were sent to a laboratory for analysis by April 11, 1991.

Most of the material found in the 14 abandoned barges were waste oils and solvent-contaminated oils. The two Empire barges contained a mixture of hazardous wastes covered by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Eight barges contained mixtures of oil factions. Four did not contain regulated wastes.



These abandoned tanks are typical of many found in the Mississippi Delta.

Removal action

In early August 1991, on a visit to the Empire barge site, an oil-like sheen was observed coming from the vicinity of the *T/B Z-62*. MSO New Orleans requested EPA assistance in initiating a CERCLA-funded emergency removal action. An exemption from the one-year time [illegible] the $2 million ceiling requirement was requested from EPA. A removal action was begun on August 8 with an initial verbal ceiling of $100,000. Since the barges were located in a Coast Guard zone of response authority, MSO New Orleans assumed the duties of Federal On-Scene Coordinator.

As of May 15, 1992, the barges *T/B Ingalls No. 1* and *T/B Z-62* were off-loaded, destroyed for scrap metal and the contents destroyed at approved facilities. More than $1.87 million was spent in response contractor, salvage and waste disposal costs during the removal action. MSO New Orleans also spent a total of 4,464 work hours on the project, 3,354 hours of on-site time and 1,110 hours of administrative time.

Future removal actions will depend on individual sites presenting an imminent and substantial danger. Arrangements are being made for the removal of *T/B Natchez* and *T/B MK [illegible]0*. The contents have not yet been removed. Removal proposals are under evaluation, and the operation will cost more than $1 million.

Conclusions

Due to the sheer number of barges, tanks and pits which may be abandoned in the Mississippi Delta region, there is a significant problem. MSO New Orleans identified about 550 potential sites during overflights of a large portion of the coastal zone within its area of responsibility. Many of the barges are located in remote sites, accessible only by boat by individuals familiar with the waterways. The large expanses of water, swamps and marshes south of Baton Rouge, and the heavy barge traffic along the rivers and Gulf Intracoastal Waterway compound the problem.

Another conclusion is that abandoned barges are being used as illegal waste disposal sites. Thus, removing the barge contents without removing the barge itself does not eliminate the problem. While only the *T/B Ingalls No. 1* and *T/B Z-62* had CERCLA wastes on board, the presence of oil waste on other barges indicates that unknown individuals are using abandoned or unattended barges, tanks and waste pits to dispose of wastes.

Through conversations with fishermen and other individuals, the investigative team learned that when there is not a readily available method of disposing of used lubricants, fishermen and boat operators will dispose of them in

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abandoned or unattended barges, tanks, pits and other receptacles, rather than dump it overboard or pay for it to be disposed of properly. This is a problem of education and enforcement.

Another finding is that the only effective method of searching for abandoned barges is by using aircraft. Helicopters and small fixed-wing aircraft can cover large amounts of territory in a reasonable amount of time and identify potentially abandoned barges which may be invisible to someone on the ground. Once the potential targets have been identified, a ground survey is essential to gather information on hull integrity and barge owner identification.

This type of response goes well beyond the normal scope of business for a marine safety office. These are long-term projects requiring dedicated multi-agency teams with personnel who are extensively trained in hazardous materials response, personal protection and safety, sampling operations and other areas.

The downturn in the oil industry has caused major oil companies to sell off their assets, bringing about changes in ownership of barges, tanks and pits. Many of the new owners were small independent operators who lacked the ability of the larger oil companies to absorb the financial shock of further downturns in the industry. Consequently, it is becoming more difficult to locate responsible parties from whom to recover costs. The oil pollution fund has had to be used more frequently in response to oil spills.

In-ground oil pits pose an immediate threat of release into sensitive marsh and wetlands.

Further, investigative activities need to focus on more than abandoned barges. Tanks and in-ground oil pits appear to pose as great a potential threat. In addition, there are a number of fishing and other vessels that are moored out of the way that are either abandoned or have been unattended for a long period of time as a result of industrial setbacks. While the barges pose an increasing threat of release as their hulls deteriorate, the waste oil pits pose a more immediate threat of release whenever the tide and/or rainfall causes them to overflow. These pits are located in sensitive marsh and wetland environments where an oil spill would cause significant environmental damage.

MSO New Orleans has gained much insight into the real nature of the problem through the abandoned barge program. Unfortunately, there doesn't appear to be an easy solution. The MSO will continue to respond to oil spills from abandoned barges, vessels and facilities, while working with industry and the state to develop an overall plan of action to resolve the majority of cases before they [illegible] response problems.

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Barges take BIG GULP

This hopper barge was filled with 200,000 gallons of water in three hours for "Operation Big Gulp."

By LCDR W. David Eley

In January 1988, on a shore of the Monongahela River just north of Pittsburgh, Pennsylvania, a four-million-gallon Ashland Oil Company storage tank filled with #2 diesel oil collapsed and lost all its contents. Fortunately, most of the oil was contained by dikes surrounding the tank, but more than 700,000 gallons entered the river.

The ice-covered river made clean-up efforts difficult, often impossible. Water intakes to several cities had to be shut down for several days while the oil plume passed and finally dissipated.

After the Ashland spill, tank barges and water buffalo tank trucks were used to supply fresh water to communities along the Monongahela and Ohio rivers where the water supply was contaminated. These efforts proved futile.

Oil and chemical cargo residues made cleaning the tank barges difficult and time consuming. State and local environmental quality agencies were justifiably concerned that these residues could also pollute water treatment plants, further complicating a serious problem.

Water buffaloes had their own shortcoming. They could supply clean water, but not enough to meet the huge demands of local water treatment facilities.

Both contamination and volume issues had to be resolved to develop an effective emergency water supply program.

"Big Gulp"

A solution is at hand, according to MSO Pittsburgh. Why not fill hopper barges with uncontaminated water from a point upstream of an oil spill, then move them downstream through the polluted water to the treatment plant?

Hopper barges carry cargoes, such as sand, gravel and coal, which do not have the contamination problems of oil. Furthermore, one of these barges can carry 200,000 gallons of water, 40 times that of a water buffalo tank truck.

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What sounded good in theory needed to be tested in reality. Late in October 1991, personnel from the Coast Guard and Consolidation Coal Company set out to either validate the concept or prove Murphy's law. A hopper barge was filled with 200,000 gallons of water at Point State Park on the Allegheny River and taken five miles down the Ohio River to Westview Water Authority, Pittsburgh's second largest water treatment plant.

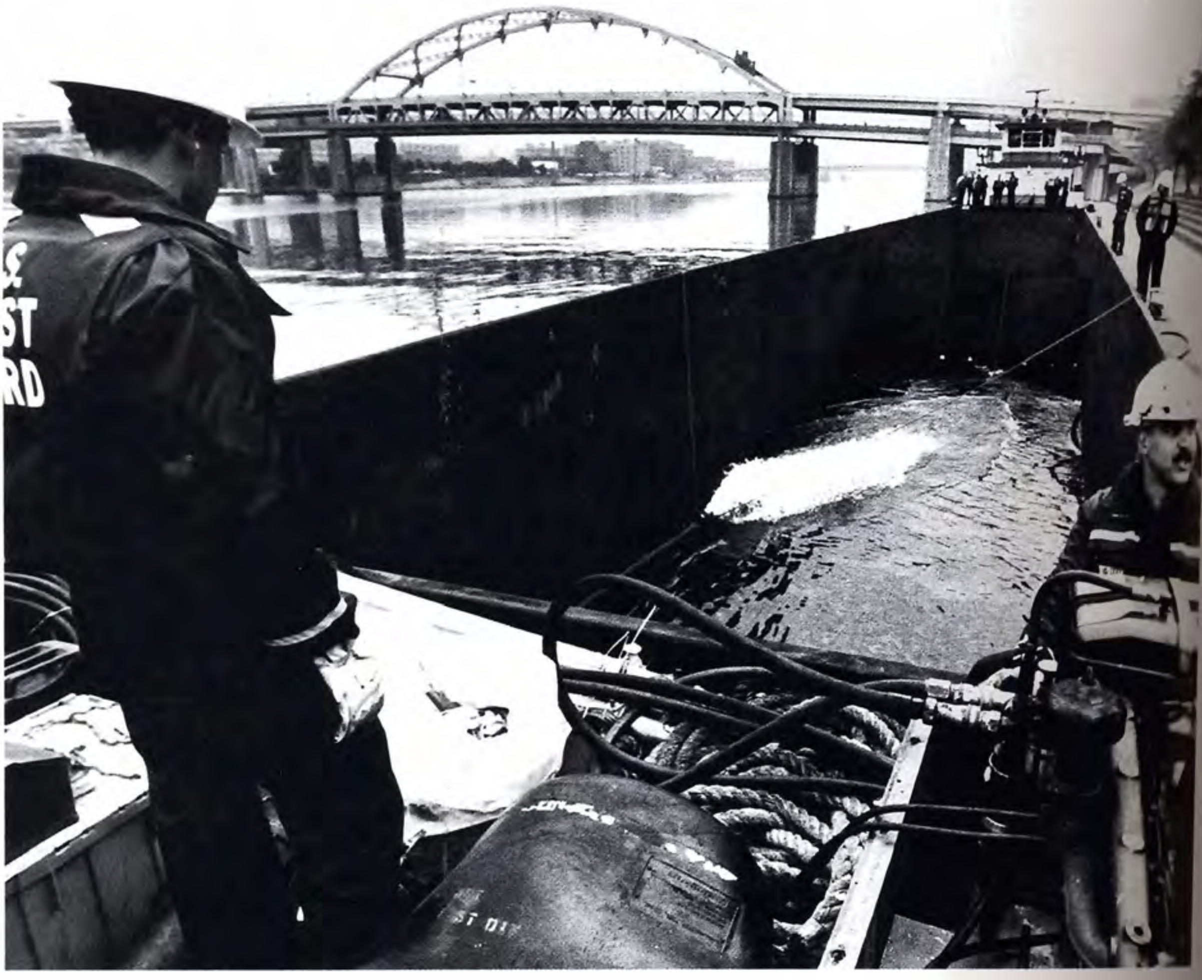
With few problems, the entire evolution, nicknamed "Operation Big Gulp," was completed in six hours. It was estimated that ten "water barges" a day, augmenting available well water, could effectively bypass the treatment plant's river intake and provide adequate emergency water to the 200,000 customers of the facility.

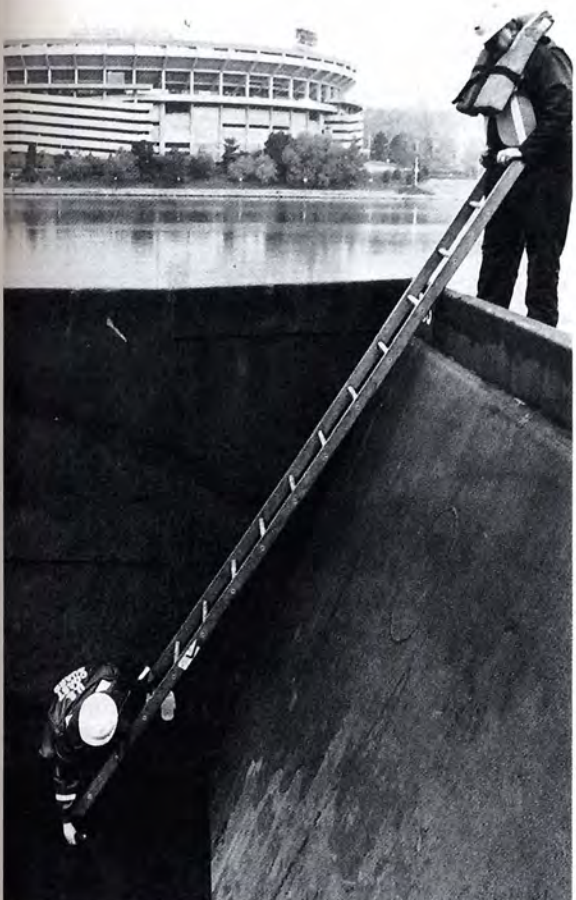
Potential pitfalls

Two potential pitfalls were identified which could wreak havoc with the water transportation scheme. The first was barge stability. It was not known how an open hopper barge would perform under tow with a cargo of water. There was concern that the unrestricted movement of water (free surface effect) in the barge would cause it to submarine, roll over or otherwise behave in a dangerous way.

To counteract any possible free surface effect, a temporary six-foot swash bulkhead was welded into place. This precaution proved to be unnecessary. Once the barge was filled and underway, the water remained as calm and steady as a small pond at dawn. It was concluded that as long as an operator doesn't "cowboy around," there shouldn't be any problem pushing four or five water-filled barges.

Atlantic Strike Team members pump 3,000 gallons of water per minute to fill hopper barge at Point State Park in Pittsburgh.





...r the barge is cleansed of coal dust, the Coast Guard conducts water quality tests to ensure against pollutants.

The other potential problem was that the barges could not be filled fast enough to meet consumption demands. To address this issue, the newly-formed Coast Guard Atlantic Strike Team brought two special pumps. The same type used to lighter the *Exxon Valdez*, the pumps could deliver 3,000 gallons of water per minute. They worked well, although the Coast Guard identified a number of pumps available locally and commercially, which could do as well or better.

It was estimated that the total cost of supplying two million gallons of treatable water per day by hopper barge would be around $4,000, a small price to pay for emergency drinking water during a hazardous substance spill.

Broad application

Among Coast Guard officers at MSO Pittsburgh, it is generally believed that "Operation Big Gulp" has viable applications anywhere along any river where communities face water intake contamination threats. Water pumped from the barges bypasses the shut down intakes and goes right into treatment plant holding tanks.

Advance planning is extremely important for such an operation. When an emergency occurs is not the time to start thinking about moving water by barge. Firstly, people involved in such an effort should be confident that it can be successful. Secondly, a firm should be identified that could have boats, barges and other necessary equipment available. And the ground-work should be laid ahead of time for meeting spill emergencies.

Exceptions

While this method of transporting emergency water is feasible where the right set of circumstances exists, it is not for everyone. First, the water treatment plants involved must draw the water into holding tanks before it goes into the treatment facilities. Pittsburgh's other major water treatment plant does not use holding tanks, but draws directly from the river. Its large capacity pumps are so big, they could not be controlled without burning out to handle the small amounts of water provided by the barges.

Also, the city of Pittsburgh itself is too large and its water consumption is too great to effectively take advantage of water barges. The plant used in the test only serves about 200,000 users, and the water only augments that drawn from local wells. There are, however, many smaller communities that could benefit greatly by the barge delivery method.

Overall success

"Operation Big Gulp," though not feasible everywhere, proved to be successful in general. Most of the water authorities in the Pittsburgh area were impressed with the operation's outcome. One water treatment plant owner whose plant was shut down for about 10 hours during the Ashland spill, said, "I would have killed for that kind of water during the emergency."

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The case of the "sparking" box

By LTJG Christopher J. Woodley

On its last three cargo transfers, the DM 973, a double-bottom, double-sided, unmanned tank barge, had carried benzene, the last load being discharged on May 4, 1989, in Natrium, West Virginia.

On the morning of May 6, the DM 973 was moored on the Ohio River in East Liverpool, Ohio. Before taking on a cargo of styrene, the barge's three adjacent centerline cargo tanks were to be cleaned of benzene residue by an independent mobile tank cleaning company.

Existing pollution prevention regulations only required facilities transferring oil to have an operations manual. Benzene is not considered an oil, thus there was no mobile facility operations manual in effect at that time.

Events leading to calamity

A worker from the tank cleaning company arrived that morning to prepare for the cleaning. He opened the hatches and ullages on each cargo tank access trunk, and removed the flame screens. He also opened the cargo piping valves to drain the piping systems of any residual benzene.

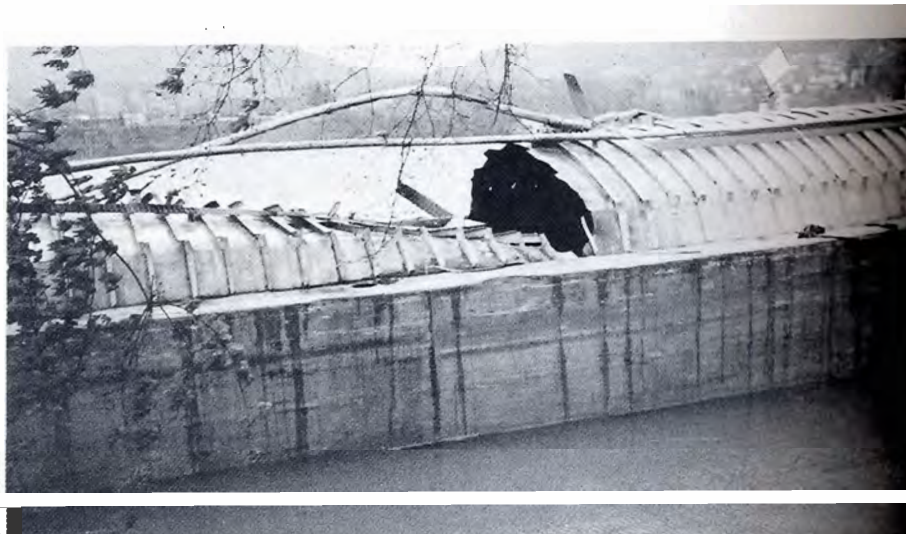
There were approximately 20 gallons of benzene left in the number two and three tanks, and 600 gallons in number one. The weather was overcast with winds up to five miles per hour.

Beginning at the box end of the barge, the worker moved from tank to tank, first stripping number three of residue with a jet of high velocity hot water, then on to tank number two. The cleaning company foreman arrived shortly thereafter and helped pump the mixture of water and benzene from tank number three into a shoreside vacuum truck, using a ten-foot cleaning wand.

When they finished pumping tank number three, they vented it using a two-horsepower, 120-volt electric blower, which was connected to a shore electrical outlet through a series of 100-foot extension cords and receptacle boxes. The extension cords ran across the deck of the barge past the number one cargo tank and up to the shore. The worker later recalled that the **receptacle box next to tank number one had been "sparking" the day before.**

The two men were about to pump off tank number two through an access hatch at the forward end of the tank, when the cleaning company owner arrived to check on the work. He was on-scene a very short time when vapors in the number one tank ignited and exploded.

The force of the explosion and the resultant pressure wave created a domino effect. The transverse bulkhead between each of the three tanks collapsed and sent the top of cargo tank number three flying 150 feet astern of the barge. A fire ensued.



The tank barge DM 973 as it appeared after the explosion collapsed all three transverse bulkheads between the cargo tanks.

The worker escaped to shore, and the other two men were thrown into the river. A fisherman rescued the foreman, but the owner could not be found. Police recovered his body the following day from the river.

This receptacle may have been the ignition source.

The cause?

A thorough investigation (#MC89002345) could not deter mine the exact source of the ignition. Possible sources included the use of a non-explosion proof motor on the blower; the use of extension cords, receptacles and plugs not designed for operation in a hazardous atmosphere; or static electricity building up in the hoses during cleaning and pumping operations.

While these were recognized as possible sources, the receptacle box that had been seen sparking the day before was considered the most probable ignition source.

Whatever the source, the Coast Guard investigation turned up "no evidence of actionable misconduct, inattention to duty, negligence or willful violation of the law," by the tank cleaning company. To the best of the investigator's knowledge, all appropriate regulations were followed without exception, and still one man was killed and two others injured.

Regulations vs common sense

Several conclusions can be drawn from this casualty. In particular, there is an excellent point to be made concerning common sense and regulations. The problem with the little red regulation books is that they communicate only a certain kind of information. Regulations state facts, procedures and conditions that must be met. But they don't always lend themselves to creating a holistic understanding of the action being regulated.

REGULATORY UPDATE

The pollution prevention regulations (33 CFR parts 154, 155 and 156) were amended on September 4, 1990. The amendments expanded the applicability to include facilities which are capable of transferring oil or hazardous materials in bulk, to or from a vessel with a capacity of more than 250 barrels. Today, a tank cleaning facility handling hazardous materials is required to comply with the above regulations. They are also required to be inspected by the Coast Guard and to possess an updated operations manual which details safety precautions.

This is where common sense and experience come into play. Even if the sparking receptacle was not the source of ignition, common sense dictates it should never have been used anywhere near a barge containing highly flammable benzene vapors. Someone should have had the presence to remove it from their equipment inventory immediately.

It is erroneous to think that simply following regulations will always keep people out of danger. Naturally, regulations should be followed, but company owners and employees should be constantly alert to safety issues in their workplace that are not necessarily spelled out in the regulations. Not only should they understand what is being regulated and why, they should also be able to spot trouble before it happens and report it.

Before going out on a barge boarding or facility inspection, talk to the tankerman or facility manager for a while. A little bit of education up front smooths out a lot of trouble down the road.

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An interior view of the Dubuque Casino Belle.

*** Casino riverboats *** need more than dice and dealers

By CDR Chip Boothe

A dilemma

Necessity is the mother of invention! This old adage certainly applies to the burgeoning casino river-boat industry begun in April 1991. Because the first vessels of this class were to operate from ports within Iowa on the Mississippi River, some 1,500 miles from the nearest major shipbuilding port, the owners demanded that their designers and engineers provide for local drydocking and repair services. Upper Mississippi River shipyard drydocks were designed and equipped to handle only moderate-size vessels.

The dilemma facing the designers was that each owner wanted a unique vessel. One particular owner, Robert Kehl, an entrepreneur and restaurateur from Dubuque, Iowa, wanted his gambling casino riverboat to be the largest passenger vessel on the Mississippi, Missouri, Ohio and Illinois rivers, and their tributaries (known as the Western Rivers). How could such an enormous vessel be drydocked locally?

The solution was to adapt the integrated tug/barge combination design. This included a 96' by 50' towing unit married to a 241' x 50' barge certified for 2,000 passengers under 46 CFR subchapter H. This design combination met the owner's general requirements -- indeed the *Dubuque Casino Belle* was the largest passenger vessel on the Western Rivers.

Inspection issues

The key issue facing the Coast Guard was that of ensuring passenger safety, while facilitating commerce to the maximum extent. Subchapter H did not adequately address the design of this vessel type, or its unique service and conditions of operation. The regulations did not anticipate a passenger tug/barge combination of this complexity, size and integrated design.

While the Coast Guard addressed the inspection of integrated tug/barge combinations in NVIC 2-81, it also did not anticipate a vessel of this design to be used exclusively on rivers.

The vessels are coupled using wires similar to a conventional tug/barge combination, except that the passenger barge is notched on the stern to allow close mating of the towing unit. The combination is controlled from a pilothouse on the forward half of the barge. The maneuverability is further enhanced by a bow thruster installed on the barge.

The towing unit has no pilothouse, but, if separated from the barge, it may be maneuvered by attaching a control module on the uppermost open deck. The person in charge of navigation would use a joy stick control on an umbilical to the module.

Gateway Clipper Fleet's Majestic has the authentic look of the old steam-powered, paddle wheel ships, but it is actually a towboat and barge configuration. The paddle wheel facade on each side of the vessel hides where the towboat (aft) and barge (forward) actually meet. The captain pilots the passenger ship from the superstructure on the upper deck of the barge.

There were a number of inspection issues that had to be resolved, including passenger egress, lifesaving equipment, structural fire protection, fire fighting and bilge system requirements. Perhaps the most significant issue to be resolved was whether both vessels required inspection.

Ultimately, it was decided that only the passenger barge would require inspection. The unique towing unit would be examined as an uninspected vessel, since there was no precedent new NVICs and policy letters have been drafted to refine the inspection requirements for this unique vessel design.

Manning issues

inspection status of a vessel differ somewhat from those involved in deciding manning and licensing requirements for the crew. Under current statutes and regulations, tonnage is a principal determining factor for a vessel's inspection category. Tonnage is also the criteria used for setting deck officer license thresholds, but it is not the exclusive factor used for determining vessel manning requirements.

The determination of a minimum safe crew complement, including license requirements, must take into consideration the total operating requirements of the vessel.

Unique conditions

Tonnage is a particularly significant factor in determining manning when it accurately reflects the physical size of the vessel, or, in this case, the tug/barge combination. From the perspective of the vessel's navigator, this is especially managed as a single unit. navigated and

The following conditions were considered most relevant for this vessel design:

A) the person in charge of navigation maintains control from a fixed steering station on the barge;

B) the barge itself has a thruster to allow the combination to be maneuvered more easily as a single unit;

C) the galley for all passenger food preparation is located on the tow boat;

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D) at any one time, the employees and crew for the barge may be distributed throughout the barge and tow boat;

E) due to the barge service electrical generators being on the tow boat, and the permanent nature of the electrical connections between the barge and this particular tow boat, the barge could not be operated as intended without the tow boat or one with similar power generation and food preparation capacity; and

F) the impression given to other traffic on the river is that the combination is a single unit.

Manning determinations are unique for each vessel. By policy, we can establish generic manning scales by vessel type and common factors that should be considered by the Officer in Charge, Marine Inspection (OCMI), but ultimately the OCMI must assess the unique conditions and local circumstances affecting the individual vessel in determining the final manning level. The tug/barge combination design has also been used on two other large operational passenger vessels and is being incorporated in new casino vessel construction.

Often technology and innovation go beyond issues addressed by current rules or guidance. The Vessel Manning Branch of the Merchant Vessel Personnel Division, Office of Marine Safety, Security and Environmental Protection tracks the exceptions, studies the implications of each decision or policy to ensure they are considered in future manning guidelines.

The largest passenger vessel on the Western Rivers, the Dubuque Casino Belle is similar in size and design to this medium-sized ocean liner.

It is evident that the person in charge of navigation in this case is responsible not for operating an independent tow boat pushing a conventional barge, but for ostensibly navigating a single large vessel.

Passenger safety, vessel navigation and operational requirements would best be met by master/mate license holders. To ensure the person in charge of navigation was appropriately qualified for the size of this vessel, the scope of the required license is based on the aggregate tonnage for the tug/barge combination.

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Introducing . . .
A partner in safety

By LCDR Roger M. Dent

The Towing Safety Advisory Committee (TSAC) is a vigilant watchdog and the Coast Guard's right arm ensuring safety of the vital transportation industry on our inland waterways

Established by Congress in 1980, TSAC advises the secretary of transportation on matters relating to shallow-draft inland and coastal waterway navigation and towing safety. The committee is sponsored by RADM A. E. "Gene" Henn, chief of the Office of Marine Safety, Security and Environmental Protection.

Mr. Royal Joslin, vice president of eastern operations of MARITRANS GP Inc., is the chairman of the 16-member TSAC, which meets two or three times a year at Coast Guard headquarters in Washington, D.C. The executive director is CDR Robert Letourneau, chief of the Engineering Branch of the Marine Technical and Hazardous Materials Division, Office of Marine Safety, Security and Environmental Protection.

As directed by Congress, the members of TSAC break down as follows:

1. **seven from the barge and towing industry, reflecting a regional geographic balance;**
2. **one from the offshore mineral and oil supply vessel industry; and**
3. **two from each of the following:**
   a. **port districts, authorities, or terminal operators;**
   b. **maritime labor;**
   c. **shippers and**
   d. **the general public.**

In addition, the Army Corps of Engineers and the Maritime Administration each have an observer. Membership is for two years, with half the members being appointed in the fall of each year. Applications for membership are solicited in the late winter and early spring by a notice in the *Federal Register*.

TSAC advises the Coast Guard in the form of formal recommendations. Since its inception, the committee has produced more than 90 recommendations. Typical matters covered by these recommendations include:

A. use of emergency towing releases,
B. OPA 90 implementation details,
C. barge inspection requirements, and
D. inland licensing and manning aspects.

The most recent recommendation delivered on June 17, 1992, consisted of a 54-page study conducted by TSAC for the Coast Guard. The study will be used to evaluate the adequacy of navigation equipment and systems, including sonar, and also evaluate the use of computer simulator courses for training, under the requirements of Oil Pollution Act of 1990. The Coast Guard requested this study in March 1992, less than four months before it was completed. This is an excellent example of the quick feedback provided by TSAC and other advisory committees to the Coast Guard.

All in all, TSAC is a capable and active advisory group working hand in hand with the other advisory committees sponsored by RADM Henn.

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T Q M improves cargo program

By LT Hung M. Nguyen

In the spirit of total quality management (TQM), a philosophy of pursuing continuous improvement in every process through the combined efforts of all members of the organization, the Coast Guard Marine Safety Center in Washington, D.C., continues to find ways to serve customers better.

Recently, the center's Cargo Division reduced the time it takes to update a Certificate of Inspection for an inland chemical barge by having the list of permissible cargoes readily available to the Officer in Charge, Marine Inspection (OCMI) on the Marine Safety Information System (MSIS). This new practice reduces the paperwork involved and leads to a quicker response to the needs of the chemical barge industry, as well as the Coast Guard.

Background

The Marine Safety Center is responsible for reviewing inland chemical barges for compliance with 46 CFR part 151. Before this new practice, for an owner or operator to get a list of permissible cargoes for a barge, he or she had to provide the center with information on the barge's cargo containment system, electrical system and maximum allowable cargo density.

The Cargo Division compared this information with barge data on file, and then generated a list of cargoes which the barge is qualified to carry. This list was forwarded as part of the plan review information sheet to the submitter and the local OCMI.

The owner or operator then took this list to the OCMI in whose zone the barge operates and requested cargoes on the list to be placed on the barges Certificate of Inspection.

After verifying that the barge's characteristics matched those shown on the plan review information sheet, the OCMI entered the MSIS, a nationwide data base of Coast Guard-certified vessels, and updated the barge's Certificate of Inspection.

If there were any discrepancies between the information in the plan review information sheet and the barge's actual characteristics found by the OCMI, the barge's owner or operator had to return to the Marine Safety Center to resolve the problem.

In the *Proceedings* August-September 1991 issue, an article entitled, "Cargo lists for chemical carriers," described the benefits to the Coast Guard and the marine industry resulting from a computer data base program designed by the Cargo Division, which creates a list of permissible cargoes for inland chemical barges.

Previously, this list was compiled by hand, which took a tremendous amount of time.

Recent development

The Cargo Division recently developed and carried out a new method of delivering the list of permissible cargoes directly to the OCMI via the MSIS.

Instead of having to retype the chemical codes for cargoes approved for the barge to carry, the OCMI can now quickly mark in MSIS the owner's desired authorized cargoes as they will appear in the Certificate of Inspection.

Future development

In the near future, a vapor control system column will be added to the MSIS so that the OCMI can endorse those chemicals approved by the Marine Safety Center for use with the vapor control system.

Conclusion

The list of permissible cargoes for inland chemical barges is now available to the OCMI via the MSIS, benefiting both the Coast Guard and the marine industry. The OCMIs do not have to spend as much time updating a Certificate of Inspection for an inland chemical barge and the paperwork is vastly reduced.

Through such innovative thinking incorporating the TQM approach, the Marine Safety Center can now respond even more quickly and efficiently to the needs of the marine industry.

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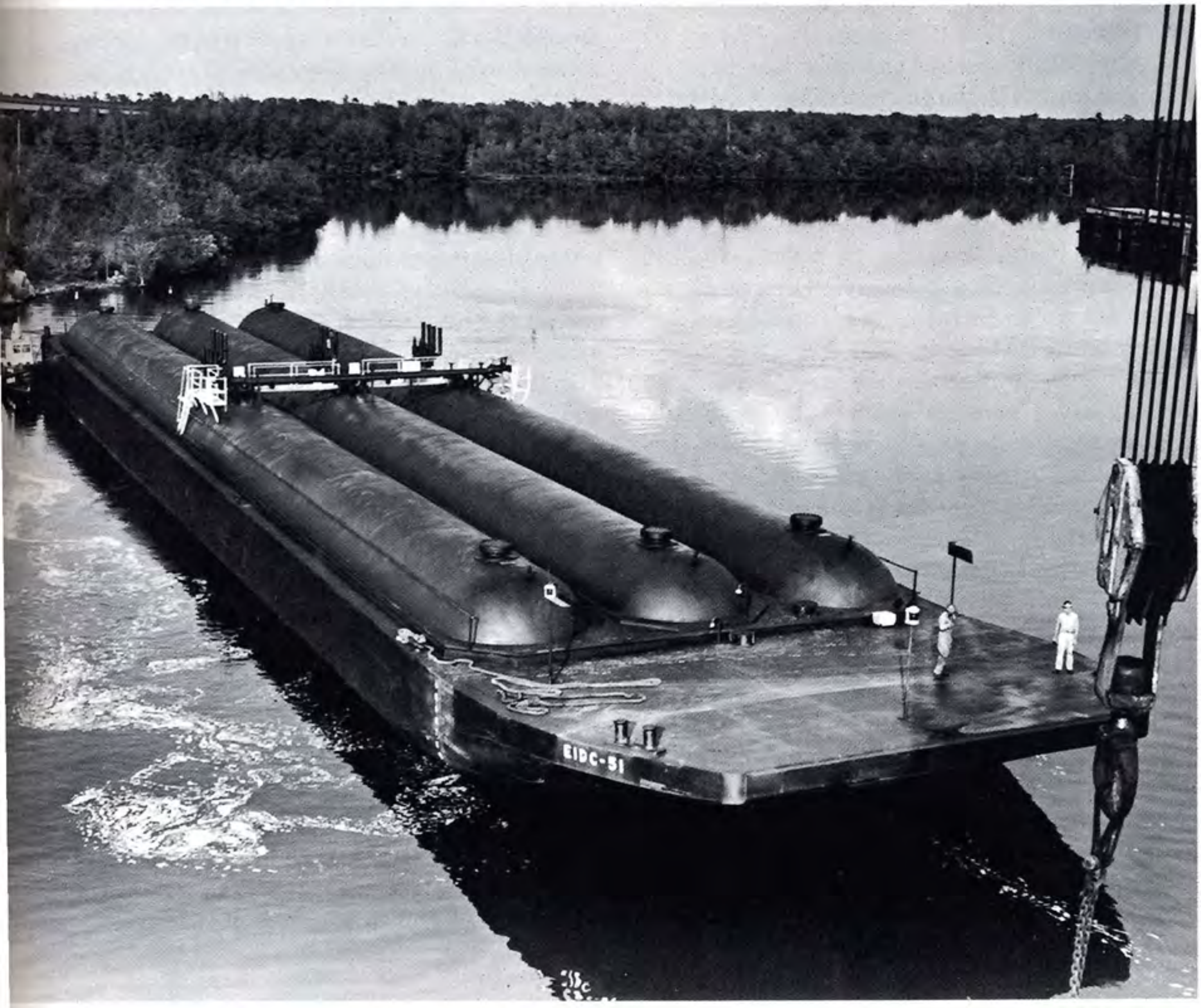
iquefied flammable gas barge EIDC-51 is delivered for inland service.



Chemical of the month

3/C Eric C. Riepe

Allyl alcohol

Allyl alcohol is a colorless liquid and has an easily detectable, pungent mustard-like odor. It is commonly referred to as 2-propenol in trade, and may also be called vinyl carbinol, 2-propen-1-ol or propenyl alcohol.

The chemical has many applications, including use as a fungicide and a herbicide. It is also used in the production of allyl esters, and as monomers and prepolymers in manufacturing resins and plastics. Its single largest use is in opticle resins. It is also used as an organic corrosion inhibitor, a use which is not widely recognized.

Hazards

Allyl alcohol poses numerous threats to humans as well as to the environment. As with most alcohols, it has a much higher boiling point than its respective hydrocarbon. However, it does boil at a relatively low temperature (96.9°C) in regards to transport. It is classified as a grade C flammable liquid.

One shouldn't be fooled by its threshold limit values, for those values are a measure of direct contact with the chemical. For instance, absorption may be altered while driving in a vehicle by being "sprayed" rather than "soaked." The latter case would be of particular concern in fungicide and herbicide applications.

Extremely dangerous to humans, allyl alcohol attacks the eyes, skin, respiratory system and lungs. Locally, liquid and vapor are highly irritating to the eyes and the respiratory system. Systemically, local muscle spasms occur at the sites of absorption. This happens especially when liquid is "splashed" on the skin, resulting in a "deep bone ache," if not removed promptly. Pulmonary edema, liver and kidney damage, diarrhea, delirium, convulsions and death have been observed in laboratory animals (but have not been reported in man).

A person exposed to allyl alcohol vapor should be removed to fresh air. If breathing stops, artificial respiration should be administered. If breathing is difficult, oxygen should be given. If even minor skin or eye contact occurs, immediately flood affected areas gently with water for at least 15 minutes. Remove contaminated clothing and shoes immediately. Individuals assisting exposure victims should not handle contaminated clothing unless wearing appropriate protective apparel. Wash the clothes and destroy the shoes. If it is swallowed and the victim is conscious, have him or her drink water or milk and induce vomiting. Medical help should be requested and the victim should rest and be closely observed for 24 to 48 hours. (The effects may be delayed.)

The chemical is also a water pollution hazard. Its aquatic toxicity is 10 ppm in freshwater and 2.5 ppm in salt water. This is noteworthy, because herbicides are often used near fresh water. It is harmful to aquatic life in very low concentrations and may be dangerous if it enters water intakes. If this should occur, local health and wildlife specialists, as well as nearby water intake operators should be notified.

In a spill or a leak, rubber gloves, facial and protective clothing and respirators should be worn. Ignition sources should be secured and the spill should be flushed with a minimum of water, and recovered if possible. Unprotected individuals are to stay upwind of the contaminated area. If a spill occurs, call the National Response Center at 1-800-424-8802. Fire procedures call for CO_2, dry chemical or alcohol foam as extinguishers. Fire-exposed tanks should be cooled with water spray.

Shipping

Allyl alcohol is shipped in commercial grades of about 98 percent purity.

Applicable Coast Guard bulk regulations are found in subchapter O of 46 CFR. It is included in group 15 of the compatibility chart, part 150, and should also be isolated from strong oxidizers. The IMO considers it a pollution category B. The Environmental Protection Agency regulations also list it as a category B pollutant.

Allyl alcohol

Chemical name:	Allyl alcohol
Formula:	C_3H_6O
Synonyms:	2-Propenol, 2-propen-1-ol, propenyl alcohol, vinyl carbinol
Physical description:	Colorless liquid with a pungent mustard odor
Physical properties:	
Boiling point :	206°F (96.9°C)
Freezing point:	-200°F (-129°C)
Vapor pressure:	17 mm Hg @ 20°C (68°F) 1.8 psia @ 46°C (115°F)
Threshold limit value:	
Time weighted average:	2 ppm (4.8mg/m^3) /skin
Short-term exposure limit:	4 ppm (9.5mg/m^3) /skin
Flammability limits in air:	
Lower flammability limit:	2.5% by volume
Upper flammability limit:	18% by volume
Combustion properties:	
Flashpoint:	72°F, TCC
Autoignition temperature:	713°F
Densities:	
Vapor (air=1):	2.0
Specific gravity :	0.85
Identifiers:	
CHRIS code:	ALA
Cargo compatibility group:	15 (Substituted allyls)
CAS registry number:	107-18-6
U.N. number:	1098
U.N. class:	6.1, Poisons
NFPA:	
Health hazard:	3
Flammability:	3
Reactivity:	1

Eric C. Riepe was a third class cadet at the Coast Guard Academy when this article was written as a special chemistry project for LCDR Thomas Chuba.

This article was reviewed by the Hazardous Materials Branch of the Marine Technical and Hazardous Materials Division of the Coast Guard's Office of Marine Safety, Security and Environmental Protection. Telephone: (202) 267-1577.

The following items are examples of questions included in the third assistant engineer through chief engineer examinations and the third mate through master examinations.

Engineer

1. Waterside grooving is usually very hard to locate in a boiler tube before leakage occurs, because ________.

A. detection and confirmation of this type corrosion requires lab examination
B. it occurs only on interior surfaces of desuperheater tubes
C. it usually occurs in the tube bends near the water drum
D. it occurs in narrow bands along the top of horizontal floor tubes exposed to the products of combustion

2. When there is a fire in a large electric motor, normally the first step is to ________.

A. secure the electric supply
B. ventilate area to remove smoke
C. start the fire pump and lead out hose
D. apply foam

3. On a diesel engine equipped with an isochronous hydraulic governor, an increase in load will cause the engine speed to ________.

A. decrease only
B. increase only
C. decrease slightly then return to original speed
D. increase slightly then return to original speed

4. You should replace a burner front refractory when the slag accumulation causes ___.

A. burner flame patterns to be distorted
B. radial cracking around burner cones
C. flame scanners to sense false signals from glowing brickwork
D. overheating of the burner atomizer tips

5. If a "high" drum water level condition should arise in an automated system at half speed, accompanying the alarm annunciation and illumination, the ________.

A. main feedwater stop valve will automatically close
B. main feed pump recirculating line will automatically open
C. surface blow valve will automatically open to lower the level
D. throttle will be automatically prevented from opening any further

6. The air bladder clutch used with some reverse reduction gear drives consists of ________.

A. twin-disk clutch plates
B. jaw-type clutch plates
C. multi-plate friction plates with sliding collars
D. two independent clutches

7. A hole should be made in a sagging tube in a water-tube boiler before that tube is plugged to prevent a ________.

A. pressure build up
B. quick burnout
C. complete sagging failure
D. crack failure

8. When securing a centrifugal distillate pump, what should you do first?

A. Stop the pump.
B. Close pressure gauge valves.
C. Close pump discharge valves.
D. Close suction line valve to the pump.

9. In an electromagnetic coupling, torque to the driven shaft is limited by the ________.

A. overload trip
B. coupling pullout value
C. staybolt strength
D. shear-off coupling

Deck

1. You are off the coast of South Africa when a seaman is injured. What indicator should be used in a request for medical advice from a South African station?

A. DH MEDICO.
B. XXX RADIOMEDICAL.
C. MEDRAD.
D. PORT HEALTH.

2. Retrograde motion is the ______

A. movement of the points of intersection of the planes of the ecliptic and the equator
B. apparent westerly motion of a planet with respect to stars
C. movement of a superior planet in its orbit about the sun
D. movement of the celestial north pole in an elliptical pattern in space

3. Which of the following would give the best radar echo?

A. The beam of a three-masted sailing vessel with all sails set.
B. A 110-foot fishing vessel with a radar reflector in its rigging.
C. A 300-foot tanker, bow on.
D. A 600-foot freighter, beam on.

4. A holder of a license as Operator of Uninspected Towing Vessels may navigate a towing vessel each day for a period not to exceed ______.

A. six hours
B. 12 hours
C. 18 hours
D. 24 hours

5. A great circle crosses the equator at 157°W. It will also cross the equator at what other longitude?

A. 157°E.
B. 57°E.
C. 23°E.
D. 57°W.

6. You are on an ice-reinforced vessel about to enter pack ice. You should ______

A. enter the pack on the windward side where there is a well defined ice edge
B. trim to an even keel or slightly down by the bow to take maximum benefit of the ice reinforcement
C. take maximum advantage of coastal leads caused by offshore winds
D. look for areas of rotten ice and enter perpendicular to the ice edge

7. Under the IALA-A Buoyage System, a green spar buoy with a triangular topmark would indicate that the buoy ______

A. should be left to port when heading out to sea
B. may be left close aboard on either side
C. is on the north side of a point of interest
D. is marking the preferred channel

8. The name and home port of a documented vessel is ______.

A. not required to be marked on the vessel
B. required to be marked on both bows and on the keel
C. required to be marked on the stern with the vessel name marked on both bows
D. required to be marked on the keel, stern and both bows

9. An air mass that has moved down from Canada would most likely have the symbols______

A. mPk
B. cPk
C. cTk
D. cTw

Answers

Engineer

1-C, 2-A, 3-C, 4-A, 5-D, 6-D, 7-A, 8-C, 9-B.

Deck

1-D, 2-B, 3-D, 4-B, 5-C, 6-D, 7-A, 8-C, 9-B.

If you have any questions concerning "Nautical Queries," please contact U.S. Coast Guard (G-MVP-5), 2100 Second St., S.W., Washington, D.C. 20593-0001. Telephone: (202) 267-2705.

Notice and request for comments

CGD 92-033, Special Service Great Lakes Limited Domestic Load Line (46 CFR parts 44/45) (May 29).

The Port of Milwaukee requested approval of a special service limited domestic load line for certain unmanned barges carrying nonhazardous cargoes. These barges are to operate between Chicago, Illinois and Milwaukee, Wisconsin. The Coast Guard has determined that the barges may be issued a special service limited domestic load line, to be implemented on a case-by-case basis, by vessel, subject to special operating and certification requirements. This notice is intended to advise members of the maritime community and to request public comment.

DATE: This notice was effective on May 29, 1992. Comments must have been received on or before June 29, 1992.

For further information, contact: LCDR Keith Dabney, Office of Marine Safety, Security and Environmental Protection, (G-MTH-3), room 1308, Coast Guard headquarters, 2100 Second Street, N.W., Washington, D.C. 20593-0001. Telephone: (202) 267-2988.

Final rule

CGD 89-104, Great Lakes pilotage rates (46 CFR part 401) RIN 2115-AD47 (June 5).

The Coast Guard amends the Great Lakes pilotage regulations by increasing the basic pilotage rates on an interim basis by 14 percent in District 1, 21 percent in District 2 and 10 percent in District 3. These adjustments are designed to increase revenues received by the pilot organizations so to increase pilot compensation, pending development of a permanent rate methodology.

DATE: This rule was effective on June 5, 1992.

For further information, contact: Mr. Scott Poyer, Project Manager, Office of Marine Safety, Security and Environmental Protection (G-MVP-7), Room 1210, Coast Guard headquarters. Telephone: (202) 267-6248.

Notice of proposed rulemaking

CGD 91-034, Vessel response plans (33 CFR part 155) RIN 2115-AD81 (June 19).

The Coast Guard proposes to establish regulations requiring response plans for certain vessels that carry oil in bulk as cargo, and additional requirements for each vessel operating in Prince William Sound, Alaska. These regulations are mandated by the Federal Water Pollution Control Act, as amended by the Oil Pollution Act of 1990 (OPA 90). The purpose of these requirements is to improve response capabilities and minimize the impact of oil spills from these vessels.

DATE: Comments must have been received by August 3, 1992.

The executive secretary maintains the public docket for this rulemaking. Comments will become part of this docket and will be available for inspection or copying at Coast Guard headquarters, Room 3406. For information on comments, call (202) 267-1477.

For further information, contact: LCDR Glenn Wiltshire, Project Manager, OPA 90 staff, (G-MS-1), (202) 267-6739. This telephone records messages 24-hours a day.

Notice of intent

CGD 92-032, South Florida oil spill research center (June 22).

The Coast Guard intends to establish a federally funded research and development center to address prevention, tracking and cleanup of oil discharges in the unique tropical and subtropical environment around South Florida.

The Coast Guard sought letters of interest with capabilities statements from interested parties. This is the second of three required notices.

DATE: Letters of interest with capabilities statements must have been received by July 28.

For further information, contact: Ms. B. Burke, Procurement Office (Code FP), U.S. Coast Guard Academy, 15 Mohegan Avenue, New London, Connecticut 09320-4195. Telephone: (203) 444-8242.

Final rule

CGD 92-038, Amendment to International Regulations for Preventing Collisions at Sea, 1972 (33 CFR part 81) (July 1).

On March 19, 1991, the President proclaimed the 1989 amendment to the Regulations of the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS), which entered into force for the United States on April 19, 1991. This rule publishes the President's proclamation and revises the text of the 72 COLREGS to include the 1989 amendment.

DATE: The amendment was effective on April 19, 1991.

For further information, contact: Mr. Jonathan Epstein, Office of Navigation Safety and Waterway Services (G-NSR-3), Coast Guard headquarters. Telephone: (202) 267-0352/7.

Proposed rule

CGD 91-202, Escort vessels for certain oil tankers, (33 CFR part 168) RIN 2115-AE10, (July 7).

The proposed regulations are designed to implement the provision of OPA 90 that requires the secretary to define the areas where two escort vessels would be required for single-hulled tankers over 5,000 gross tons (GT) transporting oil in bulk. Prince William Sound, Alaska, and Rosario Strait and Puget Sound, Washington (including those portions of the Strait of Juan de Fuca east of Port Angeles, Haro Strait and the Strait of Georgia subject to United States jurisdiction) are required to be included in the areas. This proposed rulemaking will implement OPA 90 only in these two statutorily required areas.

In addition to defining the areas where escort vessels are required, the proposed rules would provide for Coast Guard review of the capabilities of the escort vessels and a pre-escort conference between the master of the tanker, pilots employed and the operator of each of the escort vessels. This action should reduce the likelihood of groundings and collisions involving oil tankers and help protect the environment from large oil spills.

This rulemaking is limited to the requirements for escorts for single-hull tankers over 5,000 GT in the above two areas. The secretary is authorized under OPA 90 to require two escort vessels for similar tankers in other areas; and under the Ports and Waterways Safety Act of 1972, as amended by the Port and Tanker Safety Act of 1978, the secretary is authorized to require escorts for any type of vessel. Although any such additional action taken would be done under a separate rulemaking, the public is invited to nominate other areas around the country where the risk to the environment merits a two escort requirement for this type of tanker, or escorts in any number for any type of vessel carrying oil or other hazardous materials as cargo.

DATE: Comments must be received on or before September 8, 1992.

ADDRESS: Comments may be mailed to the executive secretary, Marine Safety Council (G-LRA/3406) (CGD 91-202), Coast Guard headquarters, or may be delivered to room 3406 between 8 a.m. and 3 p.m., Monday through Friday, except federal holidays. Telephone: (202) 267-1477. Comments on collection of information requirements must be mailed also to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th St., N.W., Washington, D.C. 20503, ATTN: Desk Officer, U.S. Coast Guard.

The executive secretary maintains the public docket for this rulemaking. Comments will become part of this docket and will be available for inspection or copying at room 3406, Coast Guard headquarters.

For further information, contact: Mr. Charles Vekert, project counsel, (202) 267-6220.

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Request for applicants

CGD 92-041, National Boating Safety Advisory Council; Applications for appointment (July 13).

The Coast Guard seeks applications for appointment to membership on the National Boating Safety Advisory Council, a 21-member federal committee that advises the Coast Guard on matters related to recreational boating safety. Members are drawn equally from state boating safety program officials, recreational boat and associated equipment manufacturers, national recreational boating organizations and the general public. Applicants are considered on the basis of their expertise, knowledge and experience in boating safety. To achieve the membership balance required by the Federal Advisory Committee Act, the Coast Guard especially seeks applications from minorities and women.

The council normally meets twice a year at a location selected by the Coast Guard. Attending members are provided travel expenses and per diem.

DATE: Applications should be received no later than September 14, 1992.

ADDRESS: Requests for application forms and completed forms should be sent to Commandant (G-NAB), Coast Guard headquarters. Telephone: (202) 267-0997.

For further information, contact: Mr. A. J. Marmo, executive director, National Boating Safety Advisory Council, room 1202, Coast Guard headquarters. Telephone: (202) 267-1077.

Final rule

CGD 86-0671, Programs for chemical drug and alcohol testing of commercial vessel personnel; delay of implementation dates (46 CFR part 16) RIN 2115-AD74 (July 14).

The Coast Guard announces a delay in the effective date of regulations governing drug testing, insofar as those regulations would require testing of persons on board U.S. vessels in waters that are subject to the jurisdiction of a foreign government. Under this final rule, employees must become subject to testing no later than January 2, 1995.

DATE: This rule was effective July 14, 1992.

For further information, contact: LCDR Mark Grossetti, project manager, Marine Investigation Division, Office of Marine Safety, Security and Environmental Protection. Telephone: (202) 267-1421.

Notice of proposed rulemaking

CGD 87-0941, Subdivision and damage stability of dry cargo vessels (46 CFR part 174) RIN 2115-AC87 (July 22).

The Coast Guard proposes regulations requiring new dry cargo ships of 500 gross tons or more, calculated in accordance with the International Convention on Tonnage Measurement of Ships, 1969, to meet a minimum standard of subdivision and damage stability. These proposed regulations will implement an international standard developed to ensure that ships can sustain limited damage without loss of that ship.

DATE: Comments must be received on or before September 8, 1992.

ADDRESS: Comments may be mailed to the Executive Secretary, Marine Safety Council (G-LRA/3406) (CGD 87-094), Coast Guard Headquarters, or may be delivered to room 3406 between 8 a.m. and 3 p.m., Monday through Friday, except federal holidays. For information about comments, telephone: (202) 267-1477.

The executive secretary maintains the public docket for this rulemaking. Comments will become part of this docket and will be available for inspection or copying at room 3406.

For further information, contact: LCDR Guy R. Nolan (G-MTH-3), room 1308, Office of Marine Safety, Security and Environmental Protection. Telephone: (202) 267-2988.

Final rule

CGD 92-007, Revised penalty provisions (33 CFR parts 95 and 151) RIN 2115-AE23 (July 27).

OPA 90 revised the statutory penalty provisions for operating a vessel while intoxicated; for violating the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978 (MARPOL

73/78); and for violating certain other statutory and regulatory provisions for the prevention of pollution from ships. Parallel citations contained in federal regulations are being updated to reflect the statutory changes. The revisions [illegible]tended to correct the text of the regulations by restating statutorily prescribed penalties.

DATE: The effective date was July 27, 1992.

For further information, contact: Mr. Charles T. Vekert, project manager, OPA 90 staff (G-MS-1), Coast Guard headquarters. Telephone: (202) 267-6220.

Interim rule with request for comments

CGD 88-079b, Commercial fishing industry [illegible] regulations (46 CFR part 28) RIN 2115-[illegible] (August 3).

The Coast Guard is amending the requirement, found in the final rule for commercial fishing industry vessels, to carry immersion suits for each individual on board undocumented commercial fishing industry vessels operating on coastal waters which are only seasonally cold; and documented commercial fishing industry vessels operating inside the boundary line on waters which are only seasonally cold.

Coastal waters that are seasonally cold are defined as the United States waters of the Great Lakes, except for Lake Superior; the coastal waters on the entire east coast of the United States; and the coastal waters on the west coast of the United States, south of Point Reyes, California.

The Coast Guard solicited proposals from the Commercial Fishing Industry Vessel Advisory Committee concerning the carriage of immersion suits on vessels operating in seasonally cold waters at its meeting in May 1992. The Coast Guard is drafting a NPRM incorporating the committee's proposals addressing the carriage of immersion suits on these vessels, to be published later this year.

DATE: The interim rule was effective August 3, 1992.

ADDRESS: Between the hours of 8 a.m. and 3 p.m. Monday through Friday, except holidays, comments and the final rule are available for inspection and copying at room 3406, Coast Guard headquarters. Telephone: (202) 267-1477.

For further information, contact: LCDR Tim Skuby, Office of Marine Safety, Security and Environmental Protection (G-MVI-4). Telephone: (202) 267-2307.

Office of Marine Safety, Security and Environmental Protection

ADVISORY COMMITTEE EXECUTIVE DIRECTORS

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Commercial Fishing Industry Vessel Advisory Committee (CFIVAC)

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National Offshore Safety Advisory Committee (NOSAC)

CDR Mike Ashdown	G-MVI-4	(202) 267-1094

Towing Safety Advisory Committee (TSAC)

CDR Bob Letourneau	G-MTH-2	(202) 267-2206

Can cargo tanks take the pressure?

By LT Greg Buie

The ability of the steel structure of an inland barge cargo tank to withstand the pressure loads created when a marine vapor control system is used is a primary safety concern of the Coast Guard.

Maximum design working pressure

Just like buildings, bridges and even automobile tires, cargo tanks on inland barges are designed to withstand a variety of loads. Automobile tires have a maximum recommended pressure printed on their side walls. This pressure, usually about 30 to 35 pounds-per-square-inch (psi), should not be exceeded, because it could result in premature uneven wear of the tire and possibly a severe blow-out.

Inland barge cargo tanks have a similar maximum safe pressure. Coast Guard regulations covering marine vapor control systems refer to this pressure as the maximum design working pressure. This maximum pressure is considerably less for most cargo tanks than for automobile tires - between one and three psi is typical for most inland tank barges.

Venting requirements

The marine vapor control regulations in 46 CFR part 39 have requirements that directly relate to the maximum design working pressure of a cargo tank. The tank venting system must be capable of discharging cargo vapor at 1.25 times the rate that cargo is entering the tank [46 CFR 39.20-11(a)(1)]. The venting system must ensure that the vapor space pressure does not exceed the maximum design working pressure of the tank or the operating pressure of a spill valve or rupture disk, if fitted to the tank.

Overfill requirements

The regulations also require that cargo tanks be protected in the event they are overfilled with liquid. A 1977 study conducted for the Coast Guard determined that, without protection, a cargo tank would catastrophically fail in less than one minute if it were accidentally overfilled at a normal loading rate.

Therefore, 46 CFR 39.20-9 requires a liquid overfill protective device for the tank, such as a spill valve. This valve must limit the maximum pressure at the tank top during liquid overfill, at the maximum loading rate for the tank, to not be more than the maximum design working pressure of the tank.

Structural adequacy

The Coast Guard uses the American Bureau of Shipping's (ABS's) Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways to determine the maximum design working pressure of inland barge cargo tanks. Similar to building codes for land structures, the 1980 rules are a body of engineering design formulas and codes used to ensure that inland tank barges are adequately designed for their intended service.

Under the 1980 rules, tank barges were presumed to have a maximum design working pressure of three psi. However, a certain class of barges with raised trunks experienced bulging and cracking when operated at or near three psi. [illegible] analysis revealed relatively high theoretical stresses in the trunk at this maximum design working pressure. Because of this, ABS modified the 1980 rules with change 3 that became effective on May 14,1990.

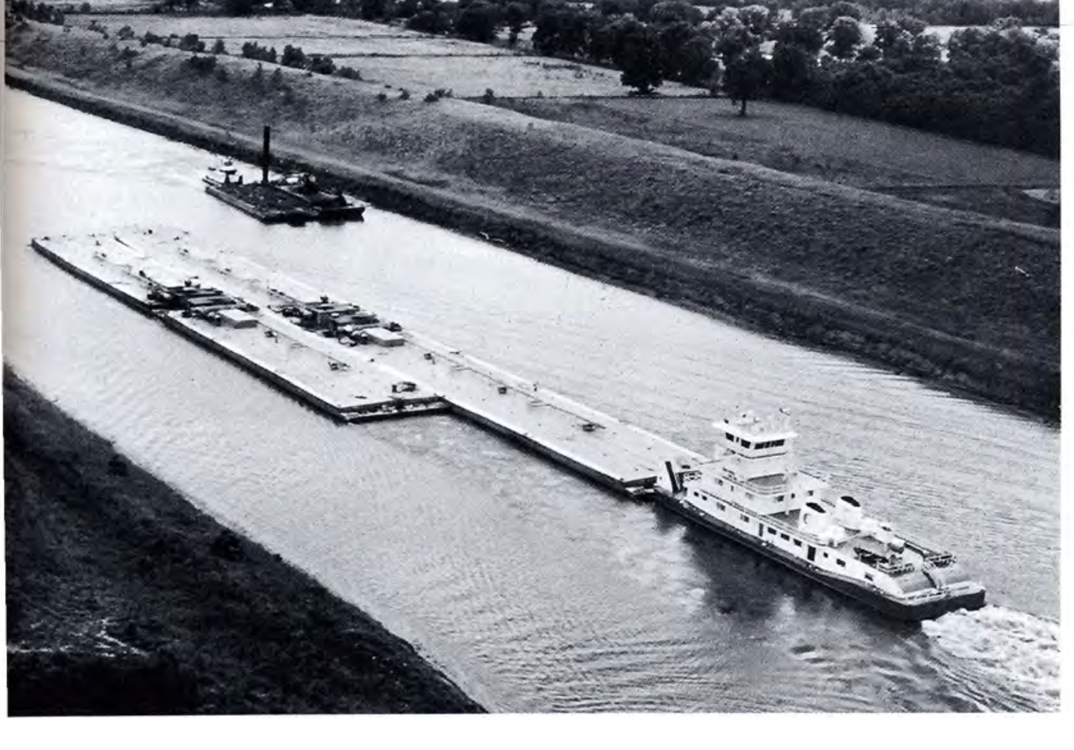
Basically, change 3 requires the use of trunk top and side stiffeners which are heavier and stronger than those previously accepted for a maximum design working pressure of three psi. Only trunks are affected by the change. Heavier stiffeners are not required for any other parts of the tank.

When the heavier trunk stiffeners are fitted, a maximum design working pressure of three psi is still presumed. Flush deck tank barges are not affected by change 3, because of their historic satisfactory service.

Change 3 permits easing of the requirements for heavier trunk stiffening if the maximum design working pressure is less than three psi. In this case, the designers need only address the structural adequacy of the trunk for the designated maximum design working pressure.

Occasionally, a maximum design working pressure of above three psi is desirable. Then the entire tank must be strengthened accordingly.

Continued on page 54



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Existing barges

The maximum design working pressure must be determined for tanks on existing barges being fitted with marine vapor control systems. Before change 3 went into effect, inland tank barges built under the provision of the ABS rules were presumed to have adequate structure for a maximum design working pressure of three psi.

Before the advent of marine vapor control, most inland tank barges were loaded with their cargo hatches open (open loading). Loading in this manner keeps tank pressures low, so trunk-top cracking was not widely seen. In states having mandatory vapor control, open loading is not permitted, and tank pressure becomes an item of concern. The potential for trunk top-bulging and cracking needs to be addressed through a judicious evaluation of the maximum design working pressures of existing barges.

The maximum design working pressure of an existing trunked inland barge must be established early in the design cycle of a retrofitted marine vapor control system. Most existing barges have needed trunk top strengthening for even relatively low pressure vapor control systems. Costly delays and unpleasant surprises can be avoided by firming up the designated maximum design working pressure of an existing barge in the early design stages of a retrofit project, so that strengthening, if needed, can be factored in at that time.

The Marine Safety Center has evaluated and approved numerous approaches to strengthening the trunks of existing barges. All of these approaches have required the addition of steel. The amount needed would depend on the original scantlings and the target maximum design working pressure. Acceptable designs have included the installation of longitudinal trusses inside the cargo tanks and flat bar reinforcement of deck beams.

A strengthening proposal should be developed with a firm maximum design working pressure target in mind, which should be communicated clearly to the Coast Guard. The Marine Safety Center evaluates strengthening proposals using the 1980 rules as modified by change 3 as the accepted design standard. Proposals that fall outside of the general scope of the rules, such as partial frame reinforcements, are reviewed by the center on a equivalent level of safety basis.

Summary

The structural adequacy of a cargo tank must be considered when designing a marine vapor control system. On trunked barges, the scantlings of the trunk are explicitly related to a maximum design working pressure of three psi or less. For a retrofitted system, the maximum design working pressure of an existing trunked barge must be determined through an analysis of the trunk using the requirements of change 3 early in the design process.

Existing flush deck barges, if originally built to the requirements of the ABS, are presumed by the Coast Guard to be acceptable for a maximum design working pressure up to and including three psi.

Most existing trunked inland barges need to have their trunks strengthened when marine vapor control systems are retrofitted. There are numerous acceptable ways to strengthen a barge once the target maximum design working pressure is established.

Some of these structural issues have caused delay, controversy and needless expense. After reviewing numerous proposals, the Cargo Division of the Marine Safety Center has established standard design and plan review criteria. Owners, operators and designers are strongly encouraged to contact this division in the early stages of their vapor control projects to ensure that they have a complete understanding of the tank structure requirements.

Towboat and barge photos accompanying this article are courtesy of the American Waterways Operators.

LT Greg Buie is a staff naval architect and marine engineer with the Cargo Division of the Marine Safety Center, 400 7th Street, S.W., Washington, D.C. 20590.

Telephone: (202) 366-6441.

Vapor recovery systems -- how they are regulated

By LTJG Robert E. Bailey, Jr.

An estimated 56 million metric tons of volatile organic compounds are emitted every year in the United States, according to studies conducted in 1988 by the National Academy of Science Marine Board. These horrifying statistics coupled with increasing environmental consciousness drove California, Louisiana, New Jersey and Texas to enforce federal and state air quality standards upon their marine industries by the early 1990s.

The first federal legislation requiring states to meet National Ambient Air Quality Standards was the Clean Air Act Amendment of 1970, issued by the Environmental Protection Agency. On July 23, 1990, the Coast Guard implemented vapor recovery system regulations for tank barges to reduce the pollution hazards of cargo transfer operations.

The American Bureau of Shipping (ABS) and the Coast Guard issued rules and regulations requiring United States vessels to meet specific criteria outlined in "ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways" and 46 CFR parts 30 and 39. Collectively, these requirements identify accepted cargo capacities, design pressures, construction materials, overfill and spillage, and transfer operation plans. The purpose is to reduce the potential for structural failures, spillage of liquid cargoes and hazardous working environments.

Structural failures

Flow rate calculations, approved transfer operations and venting systems are required to reduce chances of structural failure. Accurate flow rates prevent excess accumulation of pressure. Tankermen use a transfer operations guide to interpret cargo configuration data, and valve opening and closing sequences. Venting apparatus on each cargo tank and vapor control piping system allows excess pressure to dissipate.

Spillage

New requirements reduce the potential for spillage while transferring liquid cargoes. In addition, revised oil and vapor transfer procedures give tankermen and dockmen step-by-step instructions, along with precautionary measures and a list of key personnel to notify in emergency.

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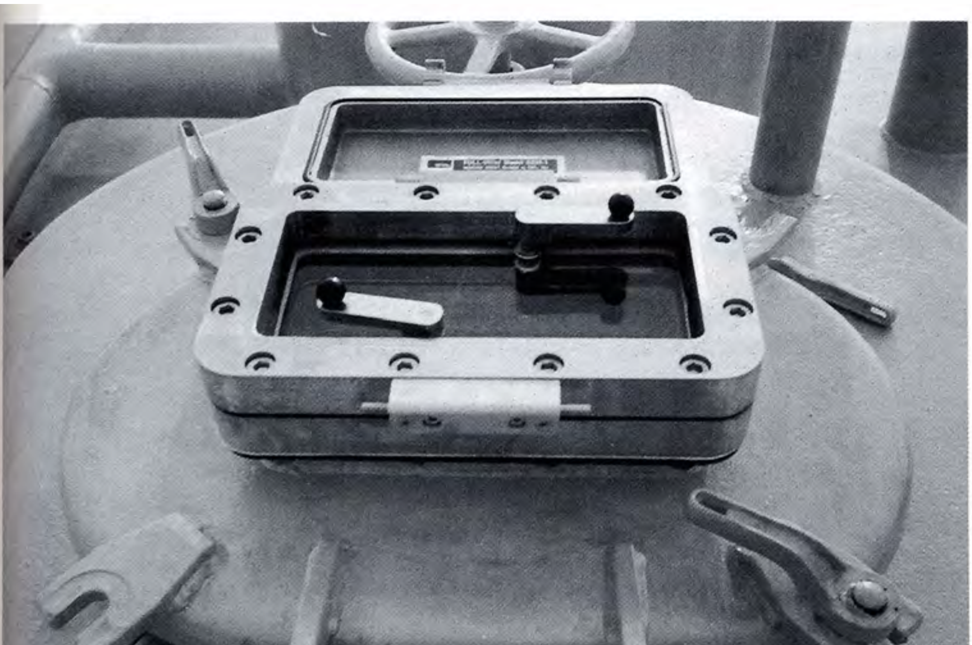

Closed gauging sight glass satisfies requirements of 46 CFR part 39.

Continued from page 55

Vapor system approval

Presently, the Coast Guard approves vapor recovery systems for barges that transfer crude oil, benzene and gasoline blends. Owners and operators who wish to have other cargoes authorized for transfer using an approved vapor recovery system may submit requests to the Coast Guard.

Exposures

Before vapor recovery systems were put in place, the potential for exposure to toxic materials was high for tankermen. Now, it is hoped that the exposure to hazardous vapors is minimized by prohibiting tankermen from keeping tank tops open while loading or unloading liquid cargoes. The closed vapor recovery system sends the hazardous vapors to a shoreside facility without exposing personnel.

VAPOR RECOVERY SYSTEM INSTALLATION REQUIREMENTS

NECESSARY COMPONENTS

A) Piping and manifold arrangement
B) Cargo gauging system
C) Liquid overfill protection
D) Vapor overpressure and vacuum protection

PIPING AND MANIFOLD ARRANGEMENT

Each piping system must:

1. be permanently installed;
2. be located as closely as possible to loading manifold;
3. keep incompatible vapors separate;
4. have a means to eliminate liquid condensate;
5. have continuous electrical bonding to the hull;
6. not interfere with proper operation of cargo tank venting system;
7. have the last meter painted red-yellow-red, marked with the word "VAPOR" two inches high; and
8. have a flange with permanently attached half-inch stud at the top midway between bolt holes.

CARGO GAUGING SYSTEM

A . In the absence of an overfill protection alarm system, a vessel must have a stick gauge that:

1. visually indicates the cargo tank level when it is within 1.0 meters of the tank top,
2. has the maximum liquid level permitted at even keel conditions permanently marked, and
3. is visible from all cargo control areas.

B Avessel must have a closed-tank gauging system, such as a sight glass and gauge tree, that:

1. allows the operator to determine the full range of liquid levels, and
2. indicates the level where cargo transfer is controlled.

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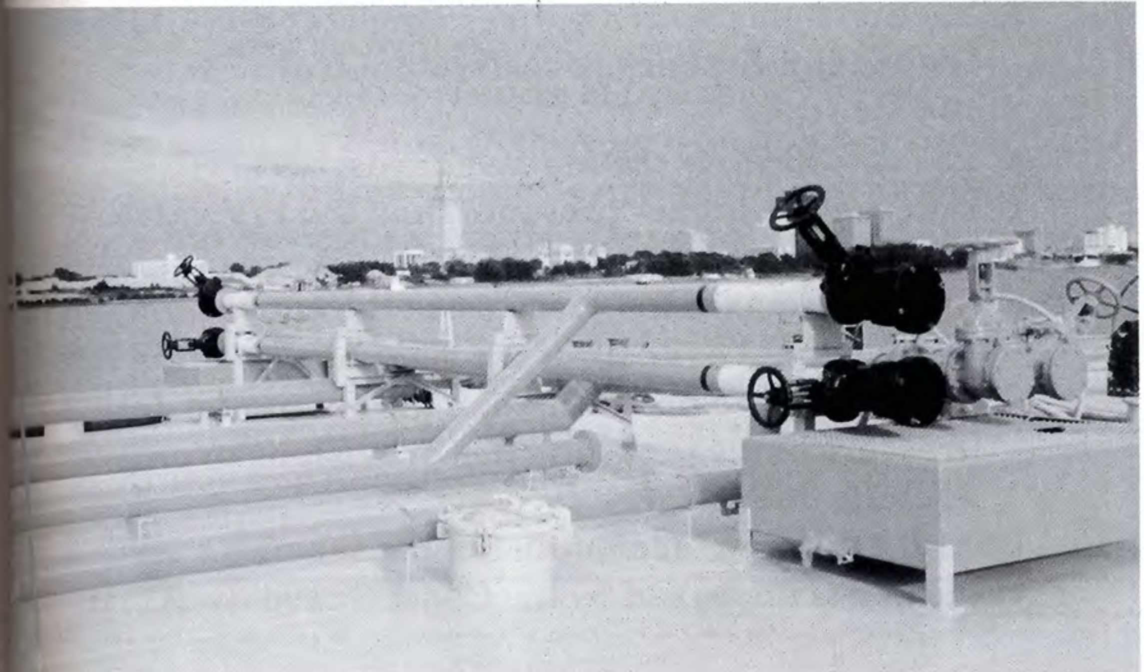
gauging system "stick gauge," on the left, provides visual indication of the last ...er of cargo level from the tank top. The cargo manifold is shown at right.



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LIQUID OVERFILL PROTECTION

Each barge cargo tank must have one of the following:

1. High level tank overfill shutdown system that:
   a. is intrinsically safe;
   b. is powered by one of three sources:
      1) self-contained power supply,
      2) vessel generators, or
      3) shoreside facility via a shore-tie cable with an explosion-proof plug,
   c. is independent of the cargo gauging device;
   d. is actuated by an alarm and automatic shutdown system at the facility overfill control panel;
   e. is capable of being checked at the tank before each loading;
   f. has at least one overfill sensor switch with normally closed contacts per cargo tank;
   g. has interconnecting cable that meets 46 CFR 111.105-15(b); and
   h. has male plug with a 5-wire connector body, labeled "connector for barge overflow control system."
2. Spill valve that:
   a. meets spill valve testing standards;
   b. relieves at a higher pressure than the P/V valve settings; and
   c. limits the maximum pressure at the cargo tank top during liquid overfill, at the maximum loading rate for the tank, to not more than the maximum design pressure of the tank, and has provisions to prevent opening due to cargo sloshing.
3. Rupture disk that accomplishes the same as a spill valve and is approved by the Coast Guard (G-MTH).

The last one meter of piping is properly color coded: Red-Yellow-Red with "vapor" in two-inch high letters.

VAPOR OVERPRESSURE AND VACUUM PROTECTION

A. The cargo tank venting system must:

1. be capable of discharging cargo vapor at 1.25 times the maximum transfer rate so the pressure in the vapor space of each tank connected to the vapor collection system does not exceed:
   a. maximum design pressure for the tank, and
   b. the pressure at which the spill valve or rupture disk operates;
2. not relieve at a pressure of less than 1.0 PSI;
3. prevent a vacuum in the cargo tank vapor space that exceeds the maximum design vacuum for any tank; and
4. not relieve at a vacuum of less than .5 PSI below atmospheric pressure.

B. Each pressure vacuum valve must:

1. be tested in accordance with accepted standards; and
2. must have a means to check that the device operates freely and does not remain in the open position, if installed after July 23, 1991.

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Conclusion

The success of the vapor recovery system will depend upon industry and environmental agencies working together toward a common goal --

to create an economical, safe, compatible and effective system that will lower toxic emissions to protect our environment.

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Cargo tank venting system shows "bullet-" type pressure vacuum valve.

Teamwork makes quick work of styrene spill clean-up

By CAPT Christopher T. Desmond and LT W. Mike Pittman

At the same time that people all over the country were taking a halftime break from watching the Super Bowl, a far less joyful event was unfolding on the busy Gulf Intracoastal Waterway near Morgan City, Louisiana. On that January 26, 1992, a rock-filled barge under tow struck another towed barge loaded with styrene. Both barges began to sink.

The narrow waterway was blocked immediately, but more threatening was the release of more than 87,000 gallons of liquid styrene monomer into the water. A crewman from one of the lead vessels was surveying the damage and quickly became overcome by toxic fumes. He was hospitalized for two days.

About 15 miles of the Gulf Intracoastal Waterway was closed for eight days to allow environmental clean-up and removal of the damaged barges. During this time, more than 300 tows were backed up at considerable cost to the marine transportation industry.

The accident

The collision took place just west of a 90-degree intersection of the Gulf Intracoastal Waterway with the Wax Lake Outlet. This outlet was dredged as a drainage ditch by the Army Corps of Engineers in the 1930s to relieve flooding on the Lower Atchafalaya River.

The Wax Lake Outlet provides a straight flow of water south to the Gulf of Mexico from the Atchafalaya basin. It feeds Wax Lake, an important winter waterfowl habitat. During high water conditions, which usually occur in late winter and spring, the current flow through the outlet runs faster than normal. This can cause a tricky crossing of the intersection by tows.

The motor vessel *Scaup* was westbound towing three barges on the Gulf Intracoastal Waterway, in high water conditions with current running about one and one half miles-per-hour. After crossing the Wax Lake Outlet intersection,

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More than 300 tows were backed up on the Gulf Intracoastal Waterway due to the styrene spill.

M/V Scaup lost control of its tow, including a rock-filled barge.

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the operator lost control of his tow and began to veer towards an eastbound tow pushed by the *M/V Delasalle*. Both vessels reversed engines to try to avoid a collision. At 6:05 p.m., about ten minutes after agreeing by radio to a port-to-port passage, *Scaup*'s lead barge loaded with rocks [illegible] the styrene barge pushed by *Delasalle*.

Scaup's lead barge, *RM 732*, was severely holed and sank as the bow rake flooded with water and styrene. The rock cargo was also contaminated with styrene. *Delasalle*'s double-skinned tank barge, *NMS 1905*, sank after sustaining a huge hole in the bow rake and the number one port wing void. The number one port cargo tank was ruptured near the main deck level.

Because of the current flow, the low density of liquid styrene and high location of the hole, almost all of the styrene was probably lost from the tank within an hour. There was partial downflooding in every wing void on the barge, and with water came styrene.

A total of six vessels within a four-mile area of the accident were instructed by the vessel traffic system in Morgan City to push their tows into the bank and evacuate the area.

Hazardous material

A colorless, combustible liquid, styrene monomer does not mix with and weighs less than water. It smells like the resin used in fiberglass work. The monomer is shipped in bulk with an inhibitor to prevent polymerization, which, in turn, imparts a yellowish green color. The relatively low flash point of 88°F raises explosion potential, ruling out the use of vacuum trucks for clean-up during the initial stages of this spill. (Vacuum trucks would present an ignition source in a potentially explosive atmosphere.)

Styrene monomer cannot be detected in the muddy waters of the Gulf Intracoastal Waterway, except in large pockets. Once it polymerizes (changes chemically), however, it is easi-

M/V Delasalle pushed the styrene barge.

Lightering operations remove styrene-contaminated rocks from barge RM 732.

ly spotted even in small quantities as a white, [illegible] stringy plastic floating on top. Upon complete polymerization, styrene becomes inert, similar to a styrofoam cup. In this case, polymerization was much slower than usual, because inclement weather impeded inhibitor burn-off.

The threshold limit value (TLV) for styrene is 50 ppm. Its vapors irritate eyes and mucous membranes. There can be significant absorption through the skin from direct exposure, and contact for more than five minutes can cause swelling and blistering.

Clean-up

In most locations, resources, such as crews and equipment, are readily available to respond to oil spills. Such resources are not as available for hazardous material spills, because personal protective equipment and specialized training is mandatory. Clean-up operations are slower and more cumbersome than with oil. Toxicity and flammability are of continuous concern in hazardous material spills, thus air monitoring must be conducted quickly.

Critical issues must be addressed during the early stages of a hazardous chemical spill response. What are the immediate hazards for individuals on-scene? Should evacuation of the surrounding area be considered? What is the appropriate response? Should the product be contained? Should response be delayed until the chemical dissipates? What level of personal protection is necessary?

In this case, National Marine Inc., the owner of tank barge *NMA 1905*, immediately assumed clean-up responsibility and hired LARCO Environmental Services Co., a clean-up contractor from Lake Charles, Louisiana. The federal on-scene coordinator requested assistance from the Gulf Strike Team, the Public Information Assist team and the regional response team's scientific support coordinator. The latter mobilized a team of specialists. All of these people arrived on-scene within a few hours after the accident.

The strike team's chemically trained and outfitted crew made significant initial assessments. Air sampling dictated level B protective equipment for everyone on-scene. This includes full splash gear and self-contained breathing apparatus with face masks. This requirement was gradually downgraded during the next week, except for many clean-up workers exposed to heavy concentrations of styrene and vapor spikes at collection points.

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Coast Guard Gulf Strike Team takes styrene and air samples.

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The damaged barges required lightering, temporary repairs and removal. This task was greatly complicated by styrene contamination. Lightering crews had to be outfitted with protective equipment, and the disposal of the contaminated rock cargo had to be done very carefully. The Riedel-Peterson Company, a specialist in this work, was called in to perform the operation.

A safe, expedient clean-up required air monitoring and product removal plans by the responsible party. A public health service specialist advised the federal on-scene coordinator on personnel hazards and necessary protective measures. Technical experts on the scientific support coordinator's team produced excellent visual displays of the impacted area, as well as timely advice on the environmental effects of styrene and efficient clean-up measures.

Seemingly overnight, a small city of people and equipment mobilized at a public boat launch ramp area close to the spill site. Command posts, emergency response vehicles, a crane, dumpsters, storage tanks, decontamination stations and pumps were staged along with many other logistic support items, including water, food and toilets.

LARCO employed more than 100 individuals, plus 16 subcontractors to tackle the problem. There were 47 watercraft assembled, including work boats, skimmers, air boats, tugs, barges and a spud barge. They deployed more than 21,000 feet of containment boom and recovered all visible product.

For the most part, winds and currents kept the styrene near the south bank. Deflection boom was effectively used to trap styrene in the waterway, to be removed by skimmer and vacuum truck. Forty-eight-inch barrier boom was deployed across the waterway four miles west of the spill. Several small bayous required booming and manual recovery. The best way to recover product on such shallow and narrow waterways is to rake by hand using nets.

Unplanned spill complications always present unique challenges to clean-up crews, and this one was no exception. The oil-friendly belts on the skimmers were rapidly melted by styrene. This problem was solved by spreading peat moss over the styrene. This then became a necessary part of the clean-up process, enabling the skimmers to be used.

Vacuum trucks could not be deployed to the remote spill site without tugs and barges. Quickly locating and hiring necessary vessels was an extra burden on National Marine. Also, styrene trapped between barges pushed into the bank posed more clean-up problems and delays.

Fortunately, there was no severe environmental damage. A steady westerly current flow kept styrene from going down Wax Lake Outlet to the waterfowl habitat. The destruction on Blue Bayou of about 200 mostly small catfish was the worst damage.

However, representatives of agencies with environmental responsibility, such as the U.S. Fish and Wildlife Service and the Louisiana Department of Environmental Quality, were not permitted on-scene after the spill without protective gear until human health threats abated.

> *Complete product clean-up and the reopening of the waterway in minimum time was the result of well coordinated teamwork.*

(Left) Vacuum truck crew picks up styrene (white) and peat moss (brown).

(Left) Skimmer and crew work inside defection boom.

All photographs accompanying this article are by CWO2 Jerome Snyder.

Conclusion

A report of violation has been initiated against the responsible party for the discharge of a reportable quantity of a hazardous substance, as required by the Comprehensive Environmental Response Compensation and Liability Act. Suspension and revocation proceedings against the license of the *Scaup*'s operator for negligence are in progress. An advisory notice to mariners discouraging meeting situations at the Wax Lake Outlet intersection during high water conditions has been published.

The intersection is being evaluated for other waterways management actions by the Coast Guard. The southern region of American Waterways Operators has established a 24-hour notification and update hotline for its members.

The recovery of styrene was estimated at approximately 16,000 gallons (18.3% of the total), with most of the chemical evaporating.

National Marine's hiring of one primary contractor over all subcontractors was particularly effective. It eliminated confusion and conflict, and provided a single point of contact for problem resolution.

The Gulf Intracoastal Waterway reopened to restricted one-way traffic on February 3, 1992. and to two-way traffic the next day.

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