MARINE FIREFIGHTER TRAINING MANUAL

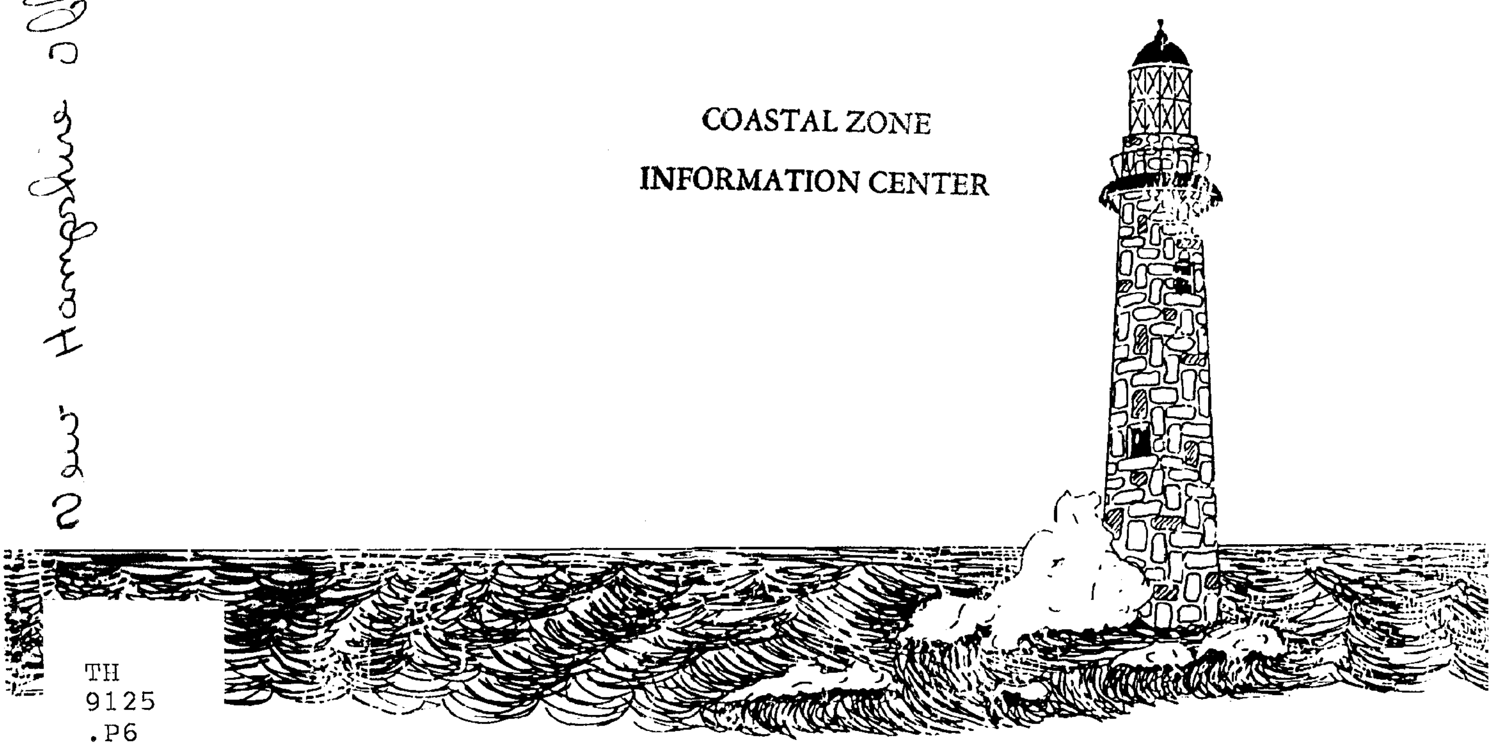
FOR

THE PORTSMOUTH HARBOR MARINE FIREFIGHTING

CONTINGENCY PLAN

MAY 1988

New Hampshire Office of State Planning



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CONTINGENCY PLAN

May 1988

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INTRODUCTION

Portsmouth Harbor Marine Firefighting Contingency Plan
Project Narrative

The Port of Portsmouth is the only ice-free, deepwater harbor between Boston, Massachusetts and Portland, Maine. As such, it is an active, year round 'working' port. The harbor's coastal area provides marine facilities and storage terminals, with land transportation networks for various inflammable and explosive commodities. Portsmouth Harbor is also a reknowned cultural and trade center for one of the fastest growing regions in the nation according to the 'New Hampshire Port Handbook'. Accordingly, specialized firefighting and incident response capabilities are requisites for protection of the harbor.

"The area is under the jurisdiction of two states and several municipalities as well as the federal government. Major facilities located within the port area are strategic defense munitions storage facilities, Pease AFB, Portsmouth Naval Ship Yard (PSNY), numerous oil terminal facilities, an LPG transfer and storage facility, break bulk and dry bulk cargo handling facilities. Tying this area together and making it accessible is a major highway and railway system. The potential impact of a major marine disaster in this area is evident." ('Piscataqua River Marine Disaster Plan-U.S.C.G.'Preface p.1)

The complexities of marine fire incidents for Portsmouth Harbor firefighting agencies are distinguishable from shorebased fire incidents in areas such as planning, operations and impact. Within these areas are factors of:

1. multi-jurisdictional coordination
2. marine circumstances
3. experience and training
4. fireground access
5. resource and equipment logistics
6. pollution and hazardous materials potential
7. impact on entire port community

Some of these factors are unique to Portsmouth Harbor and others are widely applied. For instance, marine and vessel problems which may initialize a marine fire incident or disaster plan include:

1. loss of steering or propulsion
2. grounding
3. collision
4. dragging anchor
5. marine terminal fire and/or explosion
6. cargo and bunkering operations

7. inherent cargo characteristics
8. fuel problems in machinery space
9. mooring failure
10. minor fire aboard

These problems apply to ports and harbors throughout the United States. However, port characteristics and capabilities affect the degree of seriousness of these problems.

Examples of Portsmouth port-specific characteristics are a channeled harbor, rapid currents, narrow lift bridges and abutting residential communities. Currently underway though, is a major dredging project which will improve access through lift bridges, and, provide for deeper, wider channels. The result will support safer, navigational access to the port and its facilities. Such port improvement should positively impact some of the problems listed by helping to prevent or minimize occurrence. Capability examples include management and coordination of municipal, state, federal and private agencies and resources. The marine firefighting forces and equipment may initially come from many jurisdictional contingents. Furthermore, groups may be supported by different mutual aid organizations depending on the particular agency in charge.

As previously noted, marine fire factors direct attention to pollution and hazardous materials considerations. Such consideration includes protection of New Hampshire's largest estuarine system. "The Great Bay estuarine system possesses an extreme vulnerability to oil spills due to the presence of many tank farms on the New Hampshire side of the Piscataqua River and the associated tanker and barge traffic."('Inventory of the Natural Resources of Great Bay Estuarine System V.1' by the New Hampshire Fish and Game Department with the Office of State Planning.p.8) The currents produced by the semi-diurnal transfer of water through the port are powerful, natural flushing processes. These currents have the potential to carry spills either further into inland waters of Little Bay, Great Bay and the numerous rivers of the ecosystem, or outbound into the ocean and possibly along the coastlines of New Hampshire and Maine. Recognizing such public concerns however, responsible agencies have taken an active role in development of marine, pollution, and hazardous materials plans.

Federal, state, local and private sector agencies have addressed these regional concerns, voluntarily and as tasked. The 'LPG Vessel Management Plan and LPG Emergency Contingency Plan'(p.i) "promulgates policies concerning Coast Guard actions concerning the transfer and discharge of LPG in the area of jurisdiction of the Captain of the Port, Portland, Maine." Sea-3, Inc. "As a major supplier of propane to the New England area" published 'Emergency Procedures' in which it "felt it imperative to publish this manual which designates the breakdown of responsibilities and actions to be taken in the event of an incident at the Newington Terminal."(Introduction)

A marine incident, with or without fire, may also qualify as a hazardous materials incident. If this is the case, then it is important to note that "hazardous material incidents differ from other emergency situations because of a wide diversity of factors and the pervasiveness of the potential threat to the population and the environment... in the case of vessel mishaps, aircraft accidents, agricultural chemicals and illegal dumping; incidents may occur in unpredictable areas and be relatively inaccessible by ground transportation." ('State of New Hampshire Hazardous Materials Incident Contingency Plan'p.8) For the Portsmouth Harbor marine firefighter, vehicle access is sometimes limited by narrow, wooden piers. Furthermore, physical difficulties of boarding vessels with equipment must be understood.

Other plans also address marine disaster response. For example, "five privately owned N.H. oil terminals on the Piscataqua River ...present unusual emergency spill containment and cleanup questions because of the high velocities achieved by he river during peak tidal conditions ...the New Hampshire Water Supply and Pollution Control Commission (WSPCC) has been experimenting with emergency booming techniques over the past several years. These efforts have suggested that it may be possible to establish emergency booming and clean-up procedures for the oil terminals on the Piscataqua River which should be able to contain and remove the majority of 'most probable' terminal spills without significant damage to the natural environment or property.' ('Emergency Oil Spill Containment and Removal Strategies for Piscataqua River Terminals'p.1) Statewide, the 'New Hampshire Oil and Hazardous Materials Pollution Contingency Plan' "was prepared for the purpose of controlling, undertaking cleanup operations or otherwise mitigating the effects of a spillage of oil or other hazardous material which is likely to reach the surface waters of groundwaters of the State either directly or indirectly"(p.1)

It is apparent from existing plans that the proximity of vessels, marine terminal facilities, residential areas, downtown business, recreational and fragile estuarial areas involves myriad considerations for Portsmouth Harbor. Among these considerations may be costs to the environment and economy. "The monetary value of Great Bay estuary is difficult to determine with absolute numbers...These values alone (no consideration has been given to estuarine worth based on existing recreational and commercial activities) indicate a resource value worth over two hundred million dollars annually to the State of New Hampshire. As more information becomes available on the complex interactions of an estuary, its value to society should become even more apparent." ('Inventory of the Natural Resources of Great Bay Estuarine System'V.1p.6-7) These 1981 inventory figures are assumed to be adjustable upwards for 1988.

Industries of tourism and trade make Portsmouth Harbor attractive for numerous reasons. If the physical beauty is marred even temporarily, so indeed might economic strengths. Additionally, "The Port of Portsmouth is New Hampshire's lifeline for waterborne trade to and from the world markets. This active Port plays an extremely important role in maintaining our healthy economic climate." (Governor John H. Sununu, 'The New Hampshire Port Handbook 1987-1988 by the Greater Portsmouth Chamber of Commerce in conjunction with the New Hampshire Port Authority.'p.5)

Various forms of Portsmouth Harbor marine protection exist evidenced through the aforementioned projects and emergency plans. However, there is a "consensus of opinion that something is still lacking which precludes the effective management of a marine firefighting disaster."(Project proposal: MFCP p.1) The purpose of this project is "to prepare a Marine Firefighting Contingency Plan (MFCP) which recommends actions to be taken for the protection of New Hampshire's Coastal Waterway of Portsmouth Harbor" (Project proposal: MFCP p.1) Accordingly, this project will address marine firefighting issues of inventory, fire hazards, operations, needs and municipal fire department training. The actual firefighting forces are comprised of volunteers and professionals, part and full-time. Those who have never been aboard a large vessel thusly lack familiarity with both transient and homeported vessels. This project will provide vessel familiarity to those who participate. Resultantly it may assist these firefighters who must respond to a fire which involves a vessel in Portsmouth Harbor.

Federal action regarding ports and shipping affects probabilities and minimization of marine incidents to varying degrees. "Among the provisions of the Ports and Waterways Safety Act of 1972 (PWSA) (33U.S.C.1221 et seq.) is an acknowledgement that increased supervision of port operations is necessary to prevent damage to structures in, on, or adjacent to the navigable waters of the U.S., and to reduce the possibility of vessel or cargo loss, or damage to life, property, and the marine environment "Marine Safety Manual Vol VI Chapter 8 Coast Guard Firefighting Activities P.8-1). The Port and Tanker Safety Act of 1978 (amendment to the 1972 PWSA) which includes standards for ship design and equipment, personnel and manning, lightering operations and a Marine Safety Information System continues to address federal concern with safety and protection of ports and waterways. Recognizing such concerns of and efforts by named in part private, municipal, state and federal agencies, this project will endeavor to further identify and address marine firefighting contingency planning and marine firefighting training for Portsmouth Harbor New Hampshire.

OVERVIEW

Manual and Trainee

This training manual is intended as an informative marine firefighting training guide for landbased firefighters with basic firefighting skills.

Trainees are assumed to have limited or no knowledge of:

- -vessels
- -crews
- -marine operations
- -terminal personnel and equipment
- -marine firefighting tactics and strategies
- -onboard safety systems
- -differences between shoreside and shipboard tactics

Trainees are volunteer or professional firefighters with varying levels of skill and experience.

This manual is not intended to supply the knowledge that is gained only through specialized education and many years of experience. The material in this manual is not all inclusive. It has been selected for introductory marine firefighting training.

Goals and Objectives
Discussion

The primary goal of the Portsmouth Harbor Marine Firefighting Contingency Plan is the protection of New Hampshire's coastal waterway of Portsmouth Harbor and the Portsmouth harbor area. This project was designed to develop components of the Marine Firefighting Contingency Plan to address the goal of Portsmouth Harbor protection. The development process includes using selected existing plans. Additionally, the process includes using existing resources and information relevant to marine firefighting. It is apparent the firefighting resources, including trained personnel, are vital to the protection of Portsmouth Harbor and relevant to marine firefighting. This is in part, why "Training" has been designated a project component.

Goals and objectives for programs of this nature are often derived from defined needs. The goals and objectives are then incorporated into a project proposal, design and developed in the most cost effective manner. This same approach was used for basic marine firefighting training for Portsmouth Harbor. Project objectives were viewed as mini-goals. Thusly considered, the objectives became targets of courses of action. The courses of action became project components. Combined, the overall approach was to develop a marine firefighting contingency plan working towards the primary goal, protection. There are many courses of action to take for the protection of Portsmouth Harbor. The most significant act of harbor protection is inherent in the initialization of this plan, concurrent with a marine firefighting training program.

There are already developed marine incident plans in place for Portsmouth Harbor. What differentiates the Portsmouth Harbor Marine Firefighting Contingency Plan from others is it is a multi-component project. It combines existing information. It emphasizes marine firefighting detail and hands-on protection of the harbor. It is based on agency input in determining fire hazards, roles, responsibilities, jurisdictions, needs and recommendations. The 'Portsmouth Harbor Marine Firefighting Contingency Plan' incorporates operating, planning and impact detail of several components of marine firefighting contingency planning. The components are necessary activities in order to delineate current and future detail. In brief, the project components are:

1. Inventory for marine firefighting
2. Fire hazard assessment relevant to marine firefighting
3. Needs/Recommendations Assessment for marine firefighting
4. Operation Manual
5. Training program for marine firefighting

This is not a reactionary project to a major event which occurred in Portsmouth harbor. This plan is special in this regard. Due to the infrequency and uncertainty of marine fire disasters, and, lack of education regarding the consequences, projects of this size and scope are often designed and implemented after the fact. This is a progressive project in its intent to minimize the negative impact of marine disasters should they occur through preparedness.

This specialized focus has resulted in unique attributes of the program:

-a State of New Hampshire effort to protect the harbor and area promulgated by the New Hampshire Port Authority and State Planning Office
-assistance and participation from the State of Maine
-involvement and assistance by several municipalities; two states; and, two branches of federal government, Department of Transportation and Department of Defense through the three agencies of USCG, Navy and Airforce.
-a training program available to municipal firefighters.
-firefighting contingency of volunteer and professional, part and full-time.
-delineation of marine firefighting jurisdiction, roles and responsibilities.
-discussion of fire hazards
-needs and recommendations
-heightened awareness of marine fire impact

As marine firefighting goals and objectives of the state(s) and port community mature, as the spirit of synergy grows, this plan can be refined. For now though, focus is upon the major goals and objectives - harbor protection and development of incident response capability to minimize and control incidents should they occur.

The assumption of a role and/or responsibility regarding any type of agency response to a marine fire incident is extremely serious. For all agencies, particularly the firefighting agencies, training and learning are an on-going process. They assist in carrying out roles and responsibilities. This basic marine firefighting training will not make you a professional marine firefighter. It is intended to make you a better firefighter. To assist you in understanding the circumstances of a marine fire event. To provide you with training. To help you assume your role and responsibility such that it is commensurate with your capability should you have to attempt marine fire combat. To instill knowledge and skill for the demands and consequences of marine fires.

Marine firefighting is unique. It presents complex situations. Accordingly, the objectives of the basic marine firefighting training program include:

-instill awareness that marine firefighting is unique. It requires specialized knowledge of vessels, ship's personnel, fire safety systems and more.
-firefighters will utilize their shorebased firefighting skills but tactics and strategies differ in marine environments. Structural fire tactics must be modified for shipboard fires.
-multi-jurisdiction operations require in-depth organization, planning, compatibility, communication.
-environmental considerations are of prime importance.
-in the event of disaster, there are grave consequences for adjacent facilities, residences, businesses and neighboring communities, states, and the environment.

The classroom course combined with the Vessel Orientation Program will provide essential basic information necessary to fulfill the duties of the firefighter's position. The success of extinguishment is contingent on early and positive action. The purpose of training is to make the firefighter more safe, and more capable in responding to marine fire incidents involving a vessel. Resultantly, the goal of harbor protection is underway.

The Need for Training

Lack of experience. Safety. Group operation. Strategy. Tactics. Skill. Practice. Key words of training.

"The best way to lessen the degree of an emergency is to always be prepared for it. When the emergency occurs, it may be too late to plan." (Dutton's)

Or train.

Your Goal: Train for marine firefighting.

- -learn life hazard dangers and appropriate courses of action for protection of life, vessel and environment.
- -familiarize yourself with the marine environment.
- -learn to use available fire suppression equipment and systems properly and effectively.
- -recognize and utilize available special resources.
- -practice.

Section One

MAJOR VESSEL TYPES

A ship is a relatively large floating vessel capable of self-sufficiently operating and maintaining itself in the ocean. The term usually applies to vessels over 500 tons. Boat is generally applied to smaller craft. Vessel design is based upon the purpose or purposes of the ship. The hull design distinguishes one type of vessel from another. This section lists some of the major vessel types and classes of vessel.

"Job Performance and Training

...all training has one ultimate goal: Improved performance on the job."

'Fire Simulation Instructor's Guide'

Major Vessel Types

A. Tankers. A vessel classified as a 'tanker' is, in essence, a ship dedicated to carrying liquid bulk commodities in tanks that are generally integral parts of the ship's hull. Often, for more viscous products, tanks are fitted with heating coils to facilitate pumping, especially in colder weather.

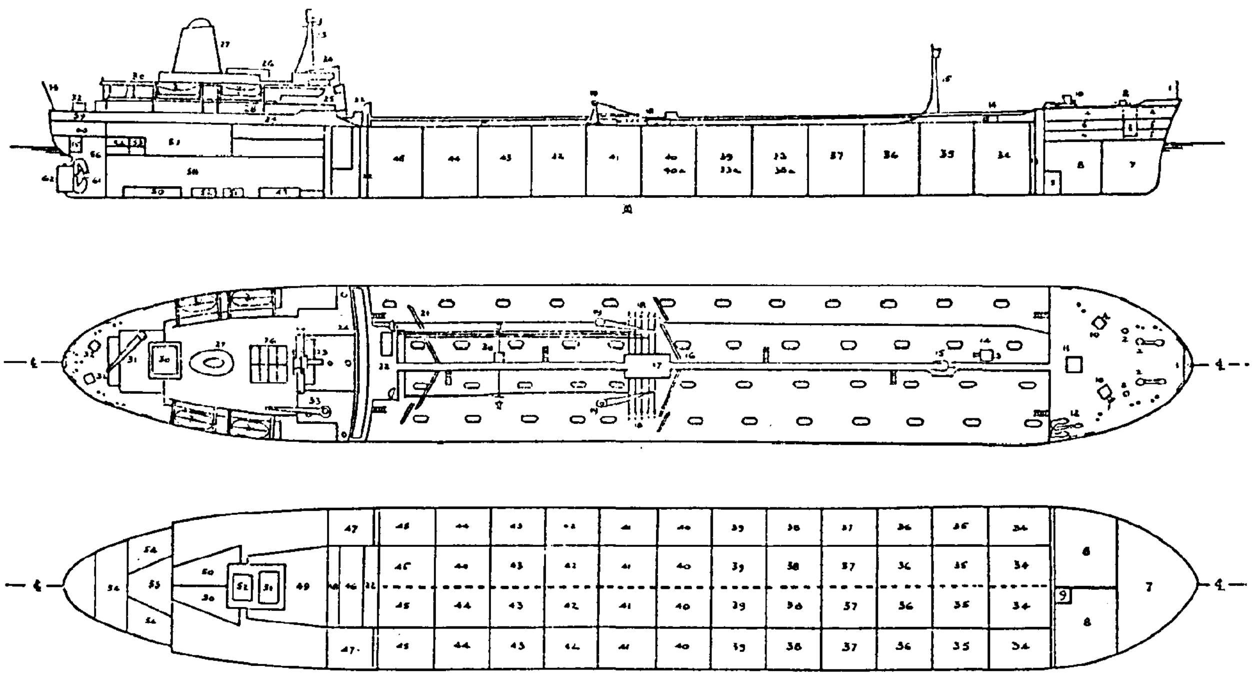
The majority of large vessels visiting Portsmouth Harbor are tankers or tank barges carrying flammable liquids. Fire protection for barges generally comes from the tugboats accompanying them. A ship's firefighting response is related to its automatic safety and detection systems, fixed suppression systems, and available crew onboard. Nowadays, crew sizes are being reduced to minimum levels on all vessel types and, when docked, crew members generally go ashore when possible.

Tanker Categories: (In Deadweight Tons)

1.	Small (Handy):	6K to 35K DWT
2.	Medium:	35K to 100K DWT
3.	Large:	100K to 160K DWT
4.	Very Large Crude Carriers (VLCC):	160K to 400K DWT
5.	Ultra Large Crude Carriers (ULCC):	over 400K DWT

6. Chemical Specialty Tankers: Often called 'drug store tankers' usually carry 30 or more separate cargos. These vessels have extensive specialized piping and pumping systems.
7. Liquefied Gas Carriers (pressurized, refrigerated or a combination of both): Sea-3, Inc. is a receiving facility for LPG (liquefied petroleum gas) tankers.

The Department of Transportation regulates shipment of hazardous materials on LPG vessels. For Portsmouth Harbor, the plan regulating vessel activity of the LPG tankers is promulgated by the Captain of the Port (COTP) Marine Safety Office in Portland, Maine. It is called the 'COTP LPG Vessel Management Plan.' A marine incident involving one of these carriers in Portsmouth Harbor will initialize the 'Captain of the Port LPG Emergency Contingency Plan'. (See tanker diagrams pages 2 and 3)



1. *Jackstaff*
2. *Warping capstans and cable lifters*
3. *Chain locker*
4. *Forecastle space*
5. *Forepeak storerooms*
6. *Cargo 'tweendecks*
7. *Forepeak (water ballast)*
8. *Fore Deep (oil bunkers)*
9. *Transfer pumproom*
10. *Tension winches, focs'lhead*
11. *Access to 'tweendecks*
12. *Spare bower anchor*
13. *Forward cofferdam*
14. *Foredeck tension winch*
15. *Foremast*
16. *Forward breakwater*
17. *Manifold platform*
18. *Pipeline manifold*
19. *5-ton pipeline cranes*
20. *Warping winch with extended spindles*
21. *After breakwater*
22. *Main cargo pumproom*
23. *Signal mast with aerial array and radar scanners*
24. *Navigating bridge*
25. *Master's and officers' accommodation*
26. *Engine room skylight*
27. *Funnel casing*
28. *Petty officers' accommodation, galley and crew messrooms*
29. *Crew accommodation*
30. *Swimming pool*
31. *Lifeboats*
32. *Poop tension winches*
33. *Ensign staff*
34. *No. 1 cargo tank—port, centre, starboard*
35. *No. 2 cargo tank—port, centre, starboard*
36. *No. 3 cargo tank—port, centre, starboard*
37. *No. 4 cargo tank—port, centre, starboard*
38. *No. 5 cargo tank—centre*

38a. *No. 5 permanent ballast tanks—port, starboard*

39. *No. 6 cargo tank—centre*

39a. *No. 6 permanent ballast tanks—port, starboard*

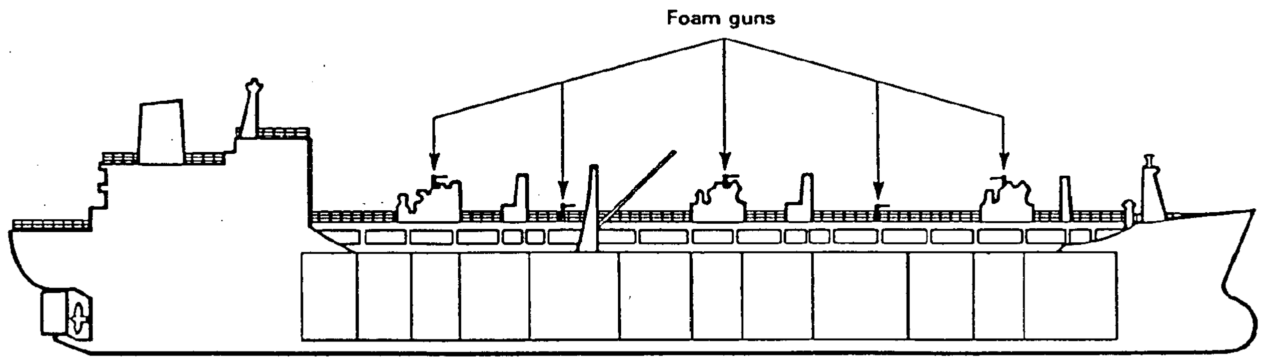
40. *No. 7 cargo tank—centre*

40a. *No. 7 permanent ballast tanks—port, starboard*

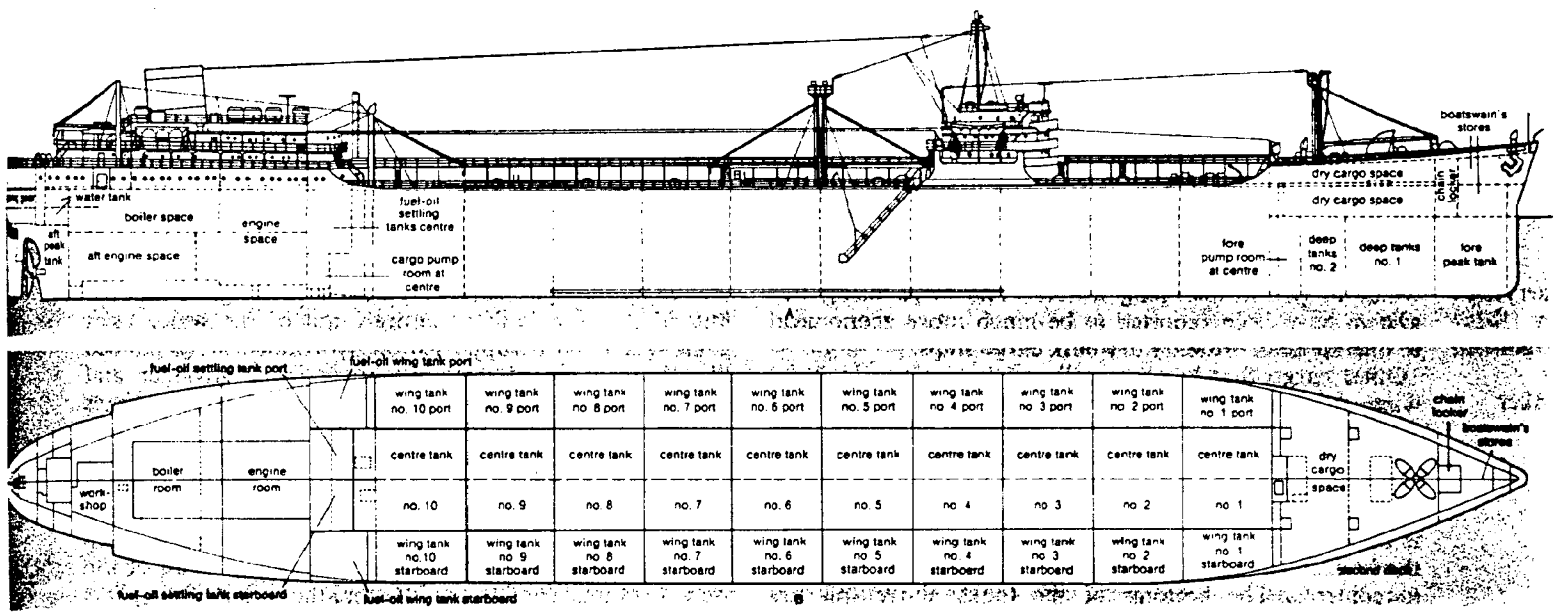
41. *No. 8 cargo tank—port, centre starboard*
42. *No. 9 cargo tank—port, centre, starboard*
43. *No. 10 cargo tank—port, centre, starboard*
44. *No. 11 cargo tank—port, centre, starboard*
45. *No. 12 cargo tank—port, centre, starboard*
46. *Bunker settling tanks*
47. *Side bunkers*
48. *Engine room cofferdam*
49. *Forward double bottom (fuel oil)*
50. *Aft double bottom (fuel oil)*
51. *Engine room water feed*
52. *Lubricating oil*
53. *Distilled water*
54. *Domestic fresh water*
56. *After peak (water ballast or fresh water)*
57. *Boiler room*
58. *Engine room*
59. *Rope store*
60. *Steering flat*
61. *Propeller*
62. *Rudder*

Source: Tanker Practice by G.A.B. King; Stanford Maritime LTD.1974

Typical 'Stemwinder' Foam Deck System



Older Type 'Midship House' Tanker



Below-deck arrangement of a typical tanker.
(A) Profile; (B) Plan view.
By courtesy of Newport News Shipbuilding and Dry Dock Co.

A. Tankers (continued)

9. Asphalt: Tankers and tank barges carrying asphalt call at the Newington terminals of Sprague and Fuel Storage. This product is normally maintained at temperatures in excess of 300 degrees F within the vessel. Consequently, any water introduced into a tank will immediately convert to steam. This rapid heating and expansion process can cause a tank to rupture or explode.

B. Dry Cargo Ships

1. Containership: Converted, Cellularized.: Containerships are equipped with a below deck grid of compartments accessed through main deck hatches upon which more containers are stored. The only containership presently engaged in regular Portsmouth trade calls at the New Hampshire Port Authority facility. This small 'feeder' vessel, the YANKEE CLIPPER is less than 300 feet long. (See diagram page 5)

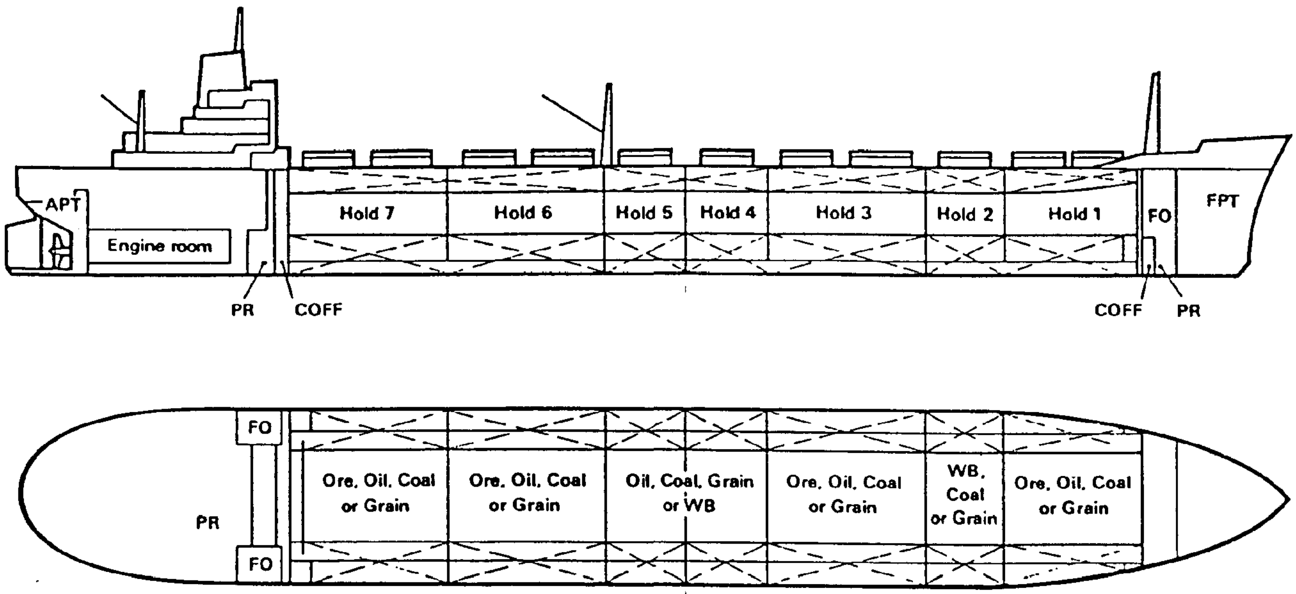
2. Dry Bulk Carrier: Presently salt, scrap steel, coal, and gypsum are dry bulk commodities handled in Portsmouth.

3. Ore/Bulk/Oil Carrier (OBO's) (See diagram page 5)

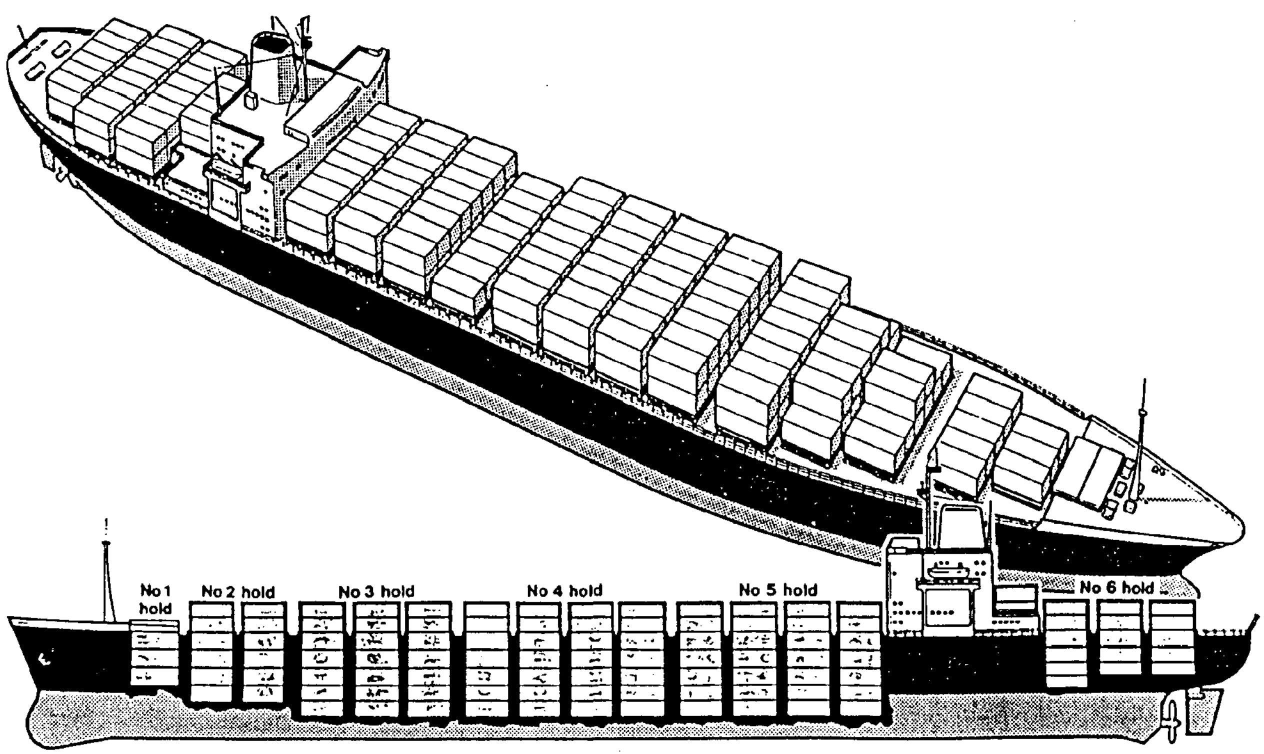
4. Break Bulk Carrier (See diagram page 6)

5. Roll on/Roll off(RORO): RORO vessels have angled stern ramps and/or side ramps that are extended onto a dock for efficient vehicle transfer. These may be compared to seagoing parking garages. To insure stability, fixed ballast is usually included along with water ballast to adjust load and stability. The engineering plants are commonly twin engines, a compact variety of diesel, arranged on either side of the ship so that the free space inbetween may be used for vehicle passage.

Bulk Carrier (Top) and Container Ship (Bottom)



A bulk carrier (OBO) showing lay-out of holds and compartments and a typical division of cargo.



A type of container ship showing the general arrangement of holds and container stowage.

(Both courtesy of Manual of Firemanship)

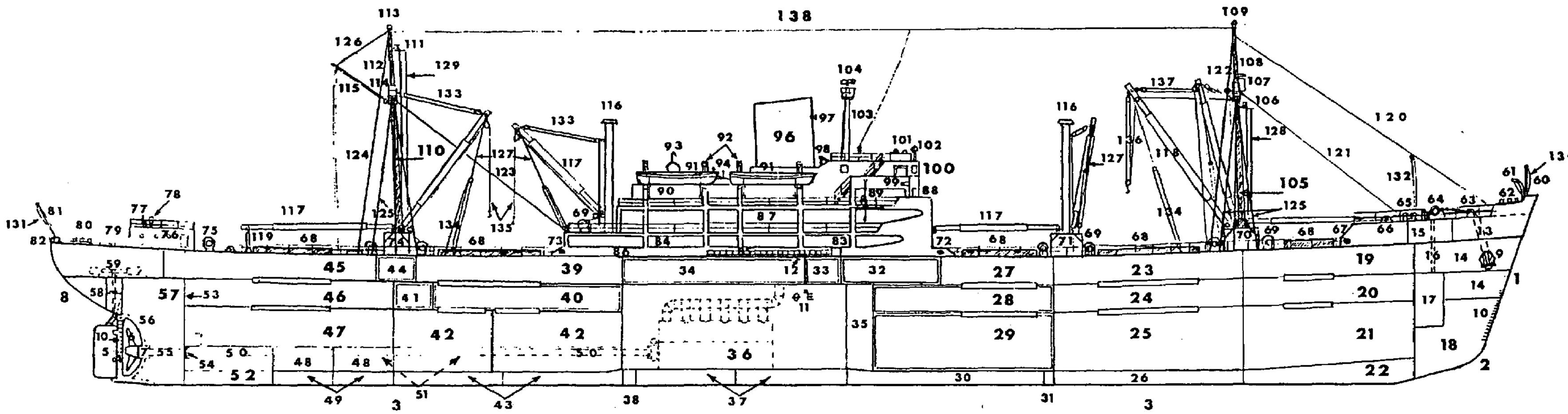


Fig. 1.—Cargo Vessel.

Hull.

1. Stem.
2. Forefoot.
3. Keel.
4. Rudder Post.
5. Rudder.
6. Propeller.
7. Propeller Boss.
8. Stern.
9. Anchor.
10. Draught Marks.
11. Load Line Markings.
12. Deck Line.

Hull Interior.

13. Hawse Pipe.
14. Deck Stores.
15. Windlass Machinery Room.
16. Spurling Pipe.
17. Chain Locker.
18. Fore Peak Tank.
19. No. 1 Upper 'Tween Deck.
20. No. 1 Lower 'Tween Deck.
21. No. 1 Lower Hold.
22. No. 1 Double Bottom Tank.
23. No. 2 Upper Tween Deck.
24. No. 2 Lower 'Tween Deck.
25. No. 2 Lower Hold.
26. No. 2 Double Bottom Tank.
27. No. 3 Upper 'Tween Deck.
28. No. 3 Lower 'Tween Deck, Refrig.
29. No. 3 Lower Hold, Refrig.
30. No. 3 Double Bottom Tank.
31. No. 3 Cofferdam.
32. Refrigeration Machinery Room.
33. CO_2 Fire Fighting Control Room.
34. Ship's Dry and Refrig. Store-rooms.
35. Cross Bunker Deep Tanks.
36. Engine-room (E.R.).
37. E.R. Double Bottom Tanks.
38. E.R. Cofferdam.
39. No. 4 Upper 'Tween Deck.
40. No. 4 Lower 'Tween Deck, Refrig.
41. No. 4 Locker, Refrig.
42. No. 4 Deep Tanks, For'd and Aft.
43. No. 4 Double Bottom Tanks.
44. Brine Control Room.
45. No. 5 Upper 'Tween Deck.
46. No. 5 Lower 'Tween Deck.
47. No. 5 Lower Hold.
48. No. 5 Deep Tanks.
49. No. 5 Double Bottom Tanks.
50. Propeller Shaft.
51. Propeller Shaft Tunnel.
52. Tunnel Recess.
53. Tunnel Escape Shaft.
54. Stern Gland.
55. Stern Shaft.
56. Stern Frame.
57. After Peak Tank.
58. Rudder Gland.
59. Steering Gear.

Forecastle Head.

60. Jack-staff.
61. Davit.
62. Warping Chocks.
63. Compressor.
64. Windlass.
65. Bitts or Bollards.
66. Panama Lead.

Main Deck.

67. Shoulder Fairlead.
68. Hatch Coamings.
69. Cargo Winches.
70. For'd Mast House.
71. Deck House.
72. For'd Waist Pipe.
73. After Waist Pipe.
74. After Mast House.
75. Mooring Winch.
76. After Deck House.
77. Auxiliary Steering Position.
78. After Steering Compass.
79. Bitts or Bollards.
80. Warping Chocks.
81. Ensign Staff.
82. Stern Light.

Bridge Superstructure.

83. Saloon and Galley.
84. Crews' Quarters.
85. Accommodation Ladder.
86. Bulwarks.
87. Officers' Accommodation.
88. Master's Quarters.
89. Sounding Machine and Boom.
90. Hospital and Dispensary.
91. Lifeboats.
92. Lifeboat Davits.
93. Sanitary Tank.
94. Engine-room Skylight.
95. Funnel Fiddley.
96. Funnel.
97. Whistle.
98. Galley Skylight.
99. Navigation Sidelight and Screen.
100. Navigating Bridge:
    Wheelhouse
    Chartroom
    Wireless or Radio Room.
101. Monkey Island:
    Gyro and Standard Compass.
102. Direction Finder (D.F.) Loop.
103. Radar Mast.
104. Radar Aerial.

Masts and Derricks.

105. Foremast.
106. Foremast Navigation Light.
107. Crow's-nest.
108. Fore Topmast.
109. Fore Truck.
110. Mainmast.
111. Mainmast Navigation Light.
112. Main Topmast.
113. Main Truck.
114. Derrick Outreaches.
115. Gaff.
116. Samson or King Posts.
117. Hatch Derricks.
118. Heavy Lift or "Jumbo" Derrick.
119. Derrick Crutches.

Standing Rigging

120. Fore Topmast Stay.
121. Forestay.
122. Fore Topmast Backstay.
123. Main Stay.
124. Main Topmast Backstay.
125. Shrouds.
126. Gaff Topping Lift.
127. Derrick Guy Pennants.
128. Foremast Lamp Guides.
129. Mainmast Lamp Guides.

Running Rigging.

130. Jack-staff Halliards.
131. Ensign Staff Halliards.
132. Anchor Light Halliards.
133. Derrick Topping Lifts.
134. Derrick Guy Falls.
135. Cargo Runners.
136. Heavy Lift Derrick Tackle.
137. Heavy Lift Derrick Topping Lift.
138. Wireless Aerial.

Source: The Boatswain's Manual

B. Dry Cargo Ships

6. Specialty Carriers

a. Heavy lift: Special cranes and booms designed to load/unload especially heavy cargoes of possibly hundreds of tons; locomotives, for example.

b. LASH Ships: A LASH (lighter-aboard-ship) vessel is designed to carry nearly any cargo in steel lighters or barges. The vessel's superstructure contains a large travelling crane supported by legs from each side of the ship. The crane tracks extend aft of the stern deck so that barges may be picked up from the deck and lowered directly into the water or vice versa, picked from the water and stowed aboard. LASH vessels can also carry containers.

C. Passenger Ships (See diagram Sec. 2 Page 4)

1. Car Ferry. This ship is built similarly to the RORO. However, the construction is designed for use in protected waters over a pre-determined and generally short route. Ships are sometimes double ended, with propellers and rudders at both ends, and, pilothouses at the top of both ends of the ship. The terminal generally has a specially designed slip enabling the ship to dock end first with limited maneuvering required for any condition of tide or current.

2. Cruise Ship or Ocean Going Liner

3. Day Cruisers. Presently operating day cruisers in Portsmouth Harbor and surrounding waterways include M/V THOMAS LAIGHTON, the M/V OCEANIC, and the M/V HERITAGE. These vessels were built for maneuverability and recreational passenger carrying. They have small crews and do not operate year round. The M/V THOMAS LAIGHTON is 90 feet long and can carry 350 passengers. The crew can assist with passenger disembarkation and should be familiar with vessel systems. However, fire protection of the vessel will probably rely heavily on the municipal firefighter.

4. Intracoastal cruisers

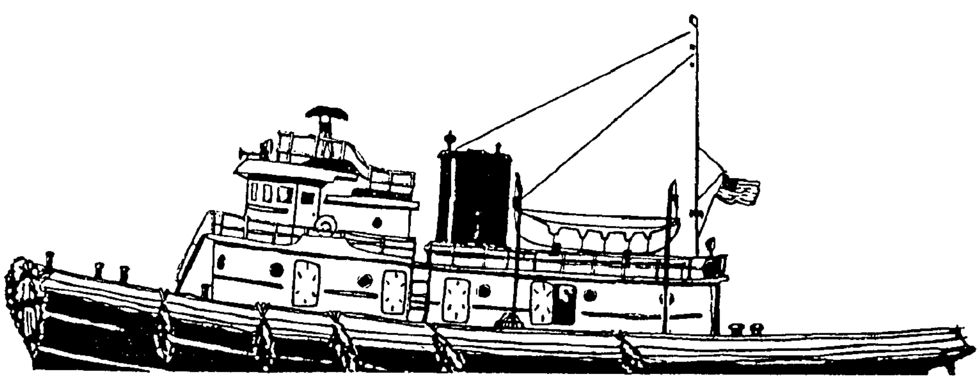
D. Military Vessels(DOD and DOT):

1. Combat Vessels
2. Aircraft carriers
3. Auxiliary Vessels
4. PNSY Vessels: Tugs and submarines (See also Special Resources Section).
5. USCG Cutters and small USCG craft: These vessels may assist with firefighting operations as available. They are not equipped nor designed for large firefighting missions.
6. Military Sealift(MSC) and US Navy vessels dock on occassion at Simplex Wire and Cable.

E. Tugboats and Towboats:

These vessels are small, powerful craft designed to perform many functions. They may be used to tow or push barges and large ships. They are invaluable in (un)berthing large ships.

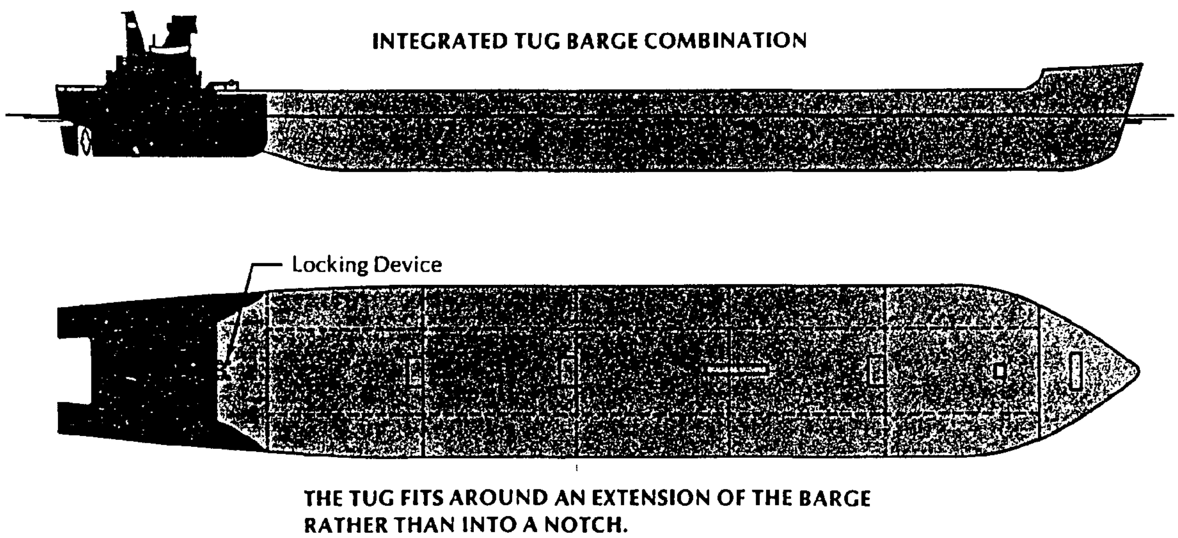
1. Harbor: Tugs NANCY MORAN, EUGENIA MORAN, E.F. MORAN JR., PNSY Tugs YTB-771 and YTL-602
2. Sea-going: Oceangoing tugs are generally used to transport barges along the coast and salvage. (See diagram below and page 9)



TUGBOATS	Length (Feet)	Breadth (Feet)	Draft (Feet)	Horsepower
	65-80	21-23	8	350-650
	90	24	10-11	800-1200
	95-105	25-30	12-14	1200-3500
	125-150	30-34	14-15	2000-4500

Standard dimensions and power of towboats and tugboats (including ocean-going tugs). (Courtesy American Waterways Operators, Inc.)

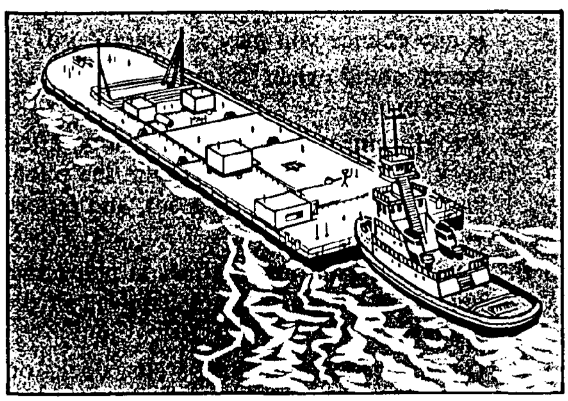
Tug and Barge Configurations



(Courtesy Maritime Administration)

A modern integrated Tug Barge system.

Notched Barge



Each year there is an increase in the amount of cargo moved along coastal waters by ocean-going tugboats and barges. (Courtesy American Waterways Operators, Inc.)

F. Barges:

On US inland and coastal waterways barges of the pushing or pulling type predominate. The push types employ a power push boat(tug) behind a line of barges. The pull type attaches a tow line to the barge. Self-propelled barges are rare visitors to Portsmouth Harbor. The November 1987 grounding on Cod Rock off New Castle involved a tug and tank barge that dragged anchor.

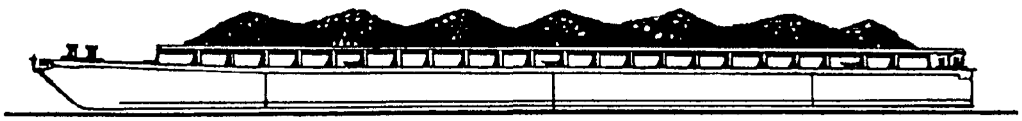
1. Inland
   - a.Deck
   - b.Single-Skin Tank
   - c.Double-Skin Tank
   - d.LPG
   - e.LFG
   - f.Open Hopper Cylindrical Tanks
   - g."Deck Over" or Enclosed Cylindrical Tanks
   - h.Hopper
   - i.Integrated Tug Barge: In 1987 the BULKFLEET PENNSYLVANIA regularly docked in Portsmouth. (See diagram page 9)
   - j.Notched Tug Barge (See diagram page 9)

2. Oceangoing (See diagrams page 11)
   - a.Deck
   - b.Single-Skin Tank
   - c.Double-Skin Tank
   - d.LPG
   - e.LFG
   - f."Deck Over" or Enclosed Cylindrical Tanks
   - g.Manned
   - i.Unmanned

G. Drilling Rigs

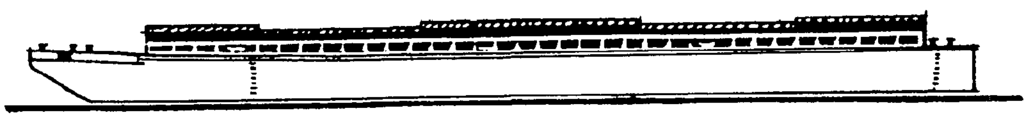
1.Submersible
2.Jack-ups
3.Semi-submersible
4.Platform
5.Drill ships
6.Drill barges

Barge Types



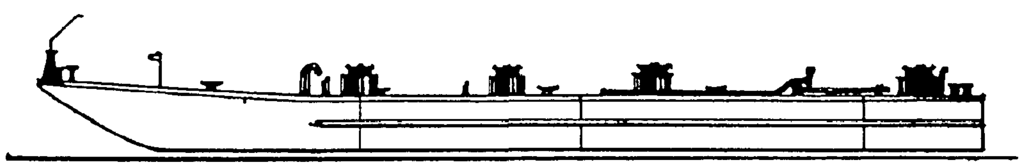
OPEN HOPPER BARGE

Length (Feet)	Breadth (Feet)	Draft (Feet)	Capacity (Tons)
179	26	9	1000
195	35	9	1500
290	50	9	3000



COVERED DRY CARGO BARGE

Length (Feet)	Breadth (Feet)	Draft (Feet)	Capacity (Tons)
175	26	9	1000
195	35	9	1500



LIQUID CARGO TANK BARGE

Length (Feet)	Breadth (Feet)	Draft (Feet)	Capacity (Tons)	Capacity (Gallons)
175	26	9	1000	302,000
195	35	9	1500	454,000
290	50	9	3000	907,000

Three common barge configurations. (Courtesy American Waterways Operators, Inc.)

H. Dry Docks

1.Floating

2.Graving

3.Marine railways

I. Off-Shore Supply Vessels

J. Fishing Boats/Ships, Lobster Boats: N. H. State Fish Pier

K. Cable Layers: The clipper type bow is adapted for handling deep-sea cable, and is fitted with large wheels or guides, which are fitted into the stem head and poop for that purpose. Cable layers dock at Simplex Wire and Cable.

L. Dredges

Section Two

VESSEL CONSTRUCTION

Ship design is largely based on experience, observation and theoretical analysis in order to meet requirements of strength for anticipated conditions of sea service. The vessel is constructed to be efficient and practical. Each piece of machinery, each bulkhead or onboard system is designed for a specific purpose. Whenever possible, inherent in the design is fire safety. This section lists key terminology to familiarize you with vessel construction. This knowledge is important not only to help understand how to combat fire aboard, but to help you remember salient points about the environment on which or in which you may be fighting fire.

> "Much can be learned from the study of past fire tragedies that occurred aboard merchant vessels. These fires took a terrible toll in human lives and in material. Of course, these losses are irreversible, but the tragedies can be utilized positively - to change regulations in order to prevent similar accidents, and as a learning tool."
>
> Marine Fire Prevention, Firefighting and Fire Safety
>
> Forward

Vessel Construction

General Considerations of Vessel Construction as it pertains to firefighting.

(Sources: Baker, Elijah III, "Introduction to Steel Shipbuilding,"
McGraw-Hill Book Company, Inc., N.Y., 1943

"Merchant Ship Construction"

"Ship Construction"

A. Basic Vessel Structure

1. Shell Plating

a. Materials

(1) Steel

(2) Aluminium

(3) Alloys

b. Welding

c. Riveting

d. Penetrations

(1) Above the Waterline

(a) Port Holes

(b) Lights

(c) Doors & Hatches

(2) Below the Waterline

(a) Sea Chests

(b) Keel Coolers

(c) Intakes and Discharges

(d) Shafts

2. Frames

a. Numbering

b. Distance

3. Decks

a. Weather Decks

(1) Freeing Ports or Fairleads

(2) Scuppers

(3) Camber

b. Internal Decks

4. Keels

a. Center Vertical Keel

b. Bilge Keel: These Keels are placed in the midship on most large vessels to reduce rolling when the vessel is underway. They appear as longitudinal fins which extend from the rounded portion of the hull where the bottom turns into the side of the vessel. They are designed to reduce rolling, but have little or no effect on the vessels stability. If the vessel becomes grounded, the bilge keel may reduce the apparent list of the vessel by digging into the bottom. An increase of list may rip the bilge keel from the hull, hole the hull or cause the vessel to assume the real list very rapidly, causing a rapid shift in free surface water. Firefighters should consider listing and grounded vessels with one bilge keel dug into the bottom as being in an unpredictable condition.

c. Flat Keel

5. Longitudinals

a. Hull

b. Deck

c. Stiffeners

6. Concealed Spaces

a. Double Bottoms

(1) Inner Bottom Plating

(2) Floors

(3) Rider Plates

b. Coffer Dams

c. Cable Raceways

d. Overheads

e. Lightening Holes: These are holes cut into structural members to reduce the weight of the member thus to "lighten" the member. They are permitted in any non-watertight Floor, longitudinal, frame or stringer. Lightening holes are frequently found floors and allow the free movement of air and water in double bottom vessels. Unless a frame or main vertical zone is a watertight boundary, it can be presumed to have lightening holes in the floor below plating, tank top or inner bottom. Therefore, firefighters should consider the possibility of flame, water and smoke travel through floors, frames and other structural members that are not watertight boundaries.

f. Limber Holes

7. Deck Beams

8. Transverse Bulkheads

a. Main Vertical Zones (See diagram Page 4.)

b. Fire Ratings

9. Super Structure

a. House

b. Poop Deck

c. Helicopter Deck

d. Forecastle

e. Stacks

f. Masts

g. Bulwark

10. Other Structures

a. Stanchions

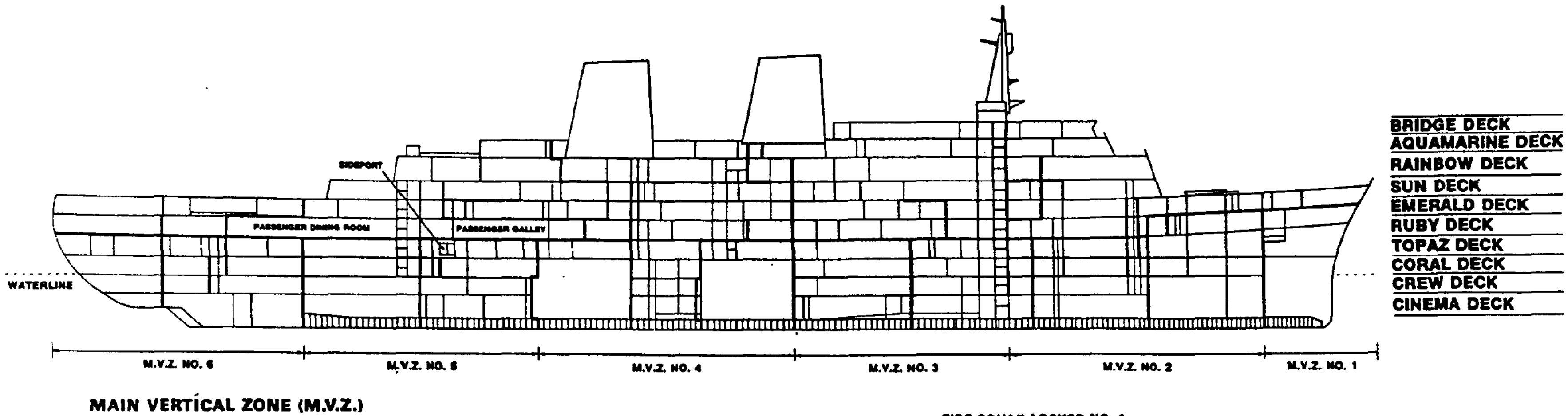
b. Flats

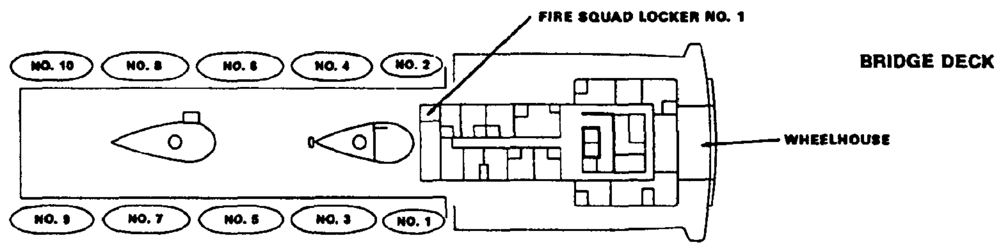
c. Pillars

d. Brackets

Passenger Vessel with 6 Main Vertical

Fire Retardant Zones



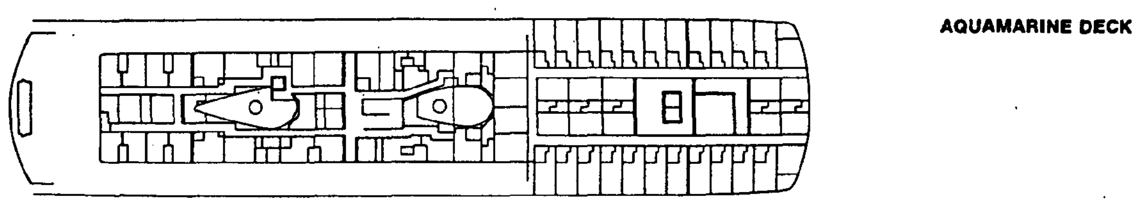


Passenger Vessel EMERALD SEAS

Length 622' Feet

Tons 24,458 Gross

People 1300



e. Gunwale

B. Accommodation Spaces (Living spaces)

1. Quarters
2. Berthing arrangements
3. Passageways
4. Ladders or Stairs
5. Construction Materials
6. Fire Loading
7. SOLAS Requirements

C. Doors and Hatches

1. General Size Considerations
2. Construction Materials
3. Non-watertight Doors (NWT)
4. Watertight Doors (WT)
   a. Components
      (1) Dogs
      (2) Gaskets
      (3) Knife Edge
      (4) Frame
      (5) Dog Wedge
   b. Individually Operated Dogs
   c. Control Wheel Operated Dogs
   d. Power Operated WT Doors
      (1) Hydraulic
      (2) Electric
      (3) Actuating
         (a) Remote

(b) Local

e. Airtight Doors (AT)

f. Passing Scuttles (PS)

g. Joiner Doors (JD)

h. Hatches (HTCH)

i. Escape Scuttles (ES)

j. Fire-Resistive(ing) (FR)

D. Holds

1. Arrangement

a. Single Deck Ship

b. 'Tween Deck Ship

c. Shelter Deck with 'Tween Deck

2. Construction

a. Insulated

b. Non-Insulated

c. Refrigerated

3. Covers

a. "Web Beam" and Hatch Cover

b. Weather Deck "Roller Path" Cover

c. 'Tween Deck "Hinged" Cover

d. "Accordion" Weather Deck Cover

e. "Single Pull" Weather Deck Cover

4. Access

a. Main Cargo Hatchway

b. Ladders

c. Mast Houses

d. Trimming Hatches

e. Ventilators

f. Bilges and Sounding Pipes

g. Manhole Covers

h. "Booby" Hatch

5. Numbering

6. Dunnage

E. Tanks

1. Cargo

a. Size

b. Arrangement

c. Access

d. Inert Gas Systems

2. Oil

a. Main Engine Fuel

(1) Settling Tank

(2) Day Tanks

(3) Gravity Tanks

b. Lubricating Oil

c. Generator Fuel

d. Waste Oil

3. Water

a. Water Ballast

b. Fresh Water

c. Feed Water

4. Sanitary

F. Decks

1. Arrangements

2. Obstructions

G. Onboard Pumps

1. Cargo

2. Fuel

3. Water

a. Firefighting

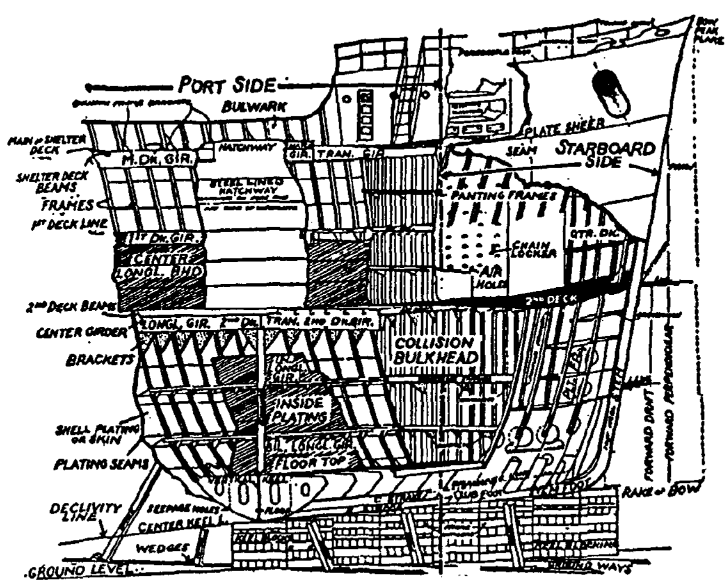
b. Bilge

c. Flooding

H. Machinery Spaces

I. Fore and Aft Peeks

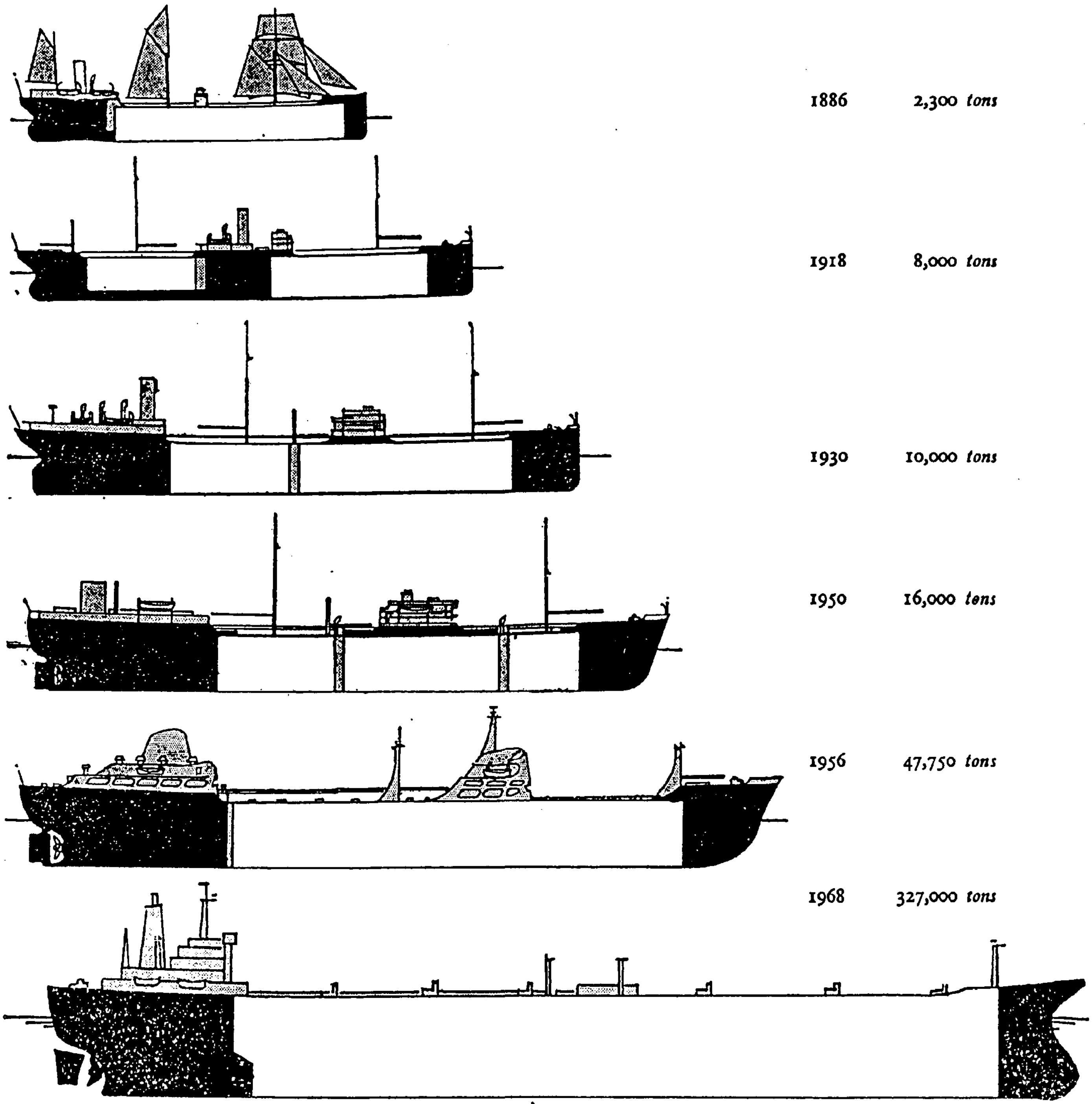
J. Watertight Integrity



(Courtesy Merchant Marine Officers Hnbk)

SKETCH OF FRAMING SECTION OF A BOW IN A CARGO VESSEL.

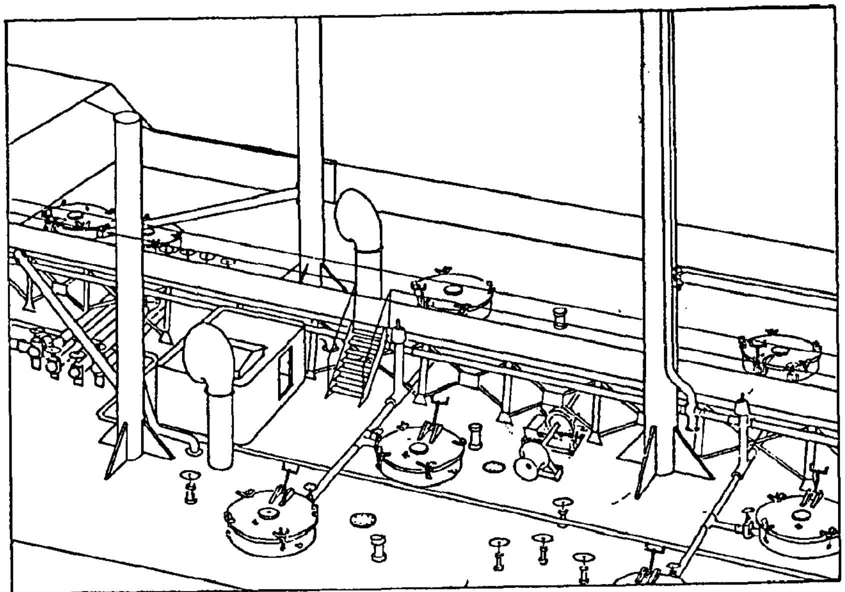
Tanker Development Over the Last 100 Years



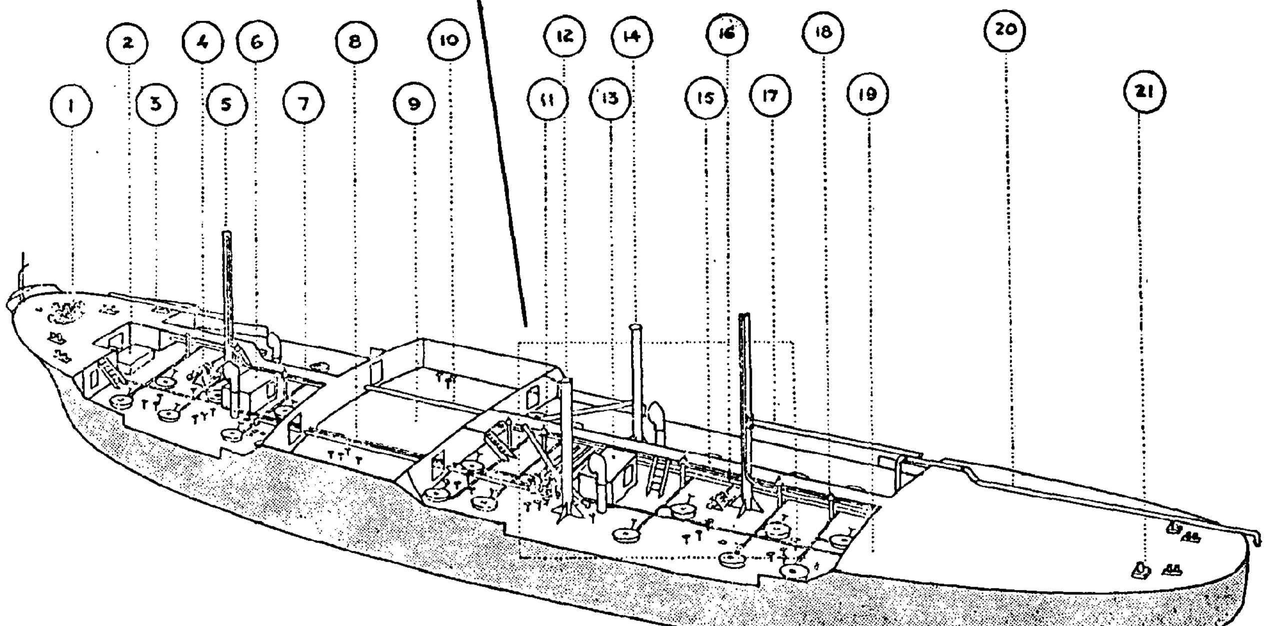
15

Source: Tanker Practice by G.A.B. King; Stanford Maritime 1974

Tanker Deck Nomenclature



showing tank lids, valves, cross-deck loading/discharge connections, pump-room top, ventilators, derricks, main-mast, after flying bridge, vapour lines, pressure/vacuum valves, bunker transfer line, ullage plugs, sighting ports, Butter-worth oppenings and after warping winch.

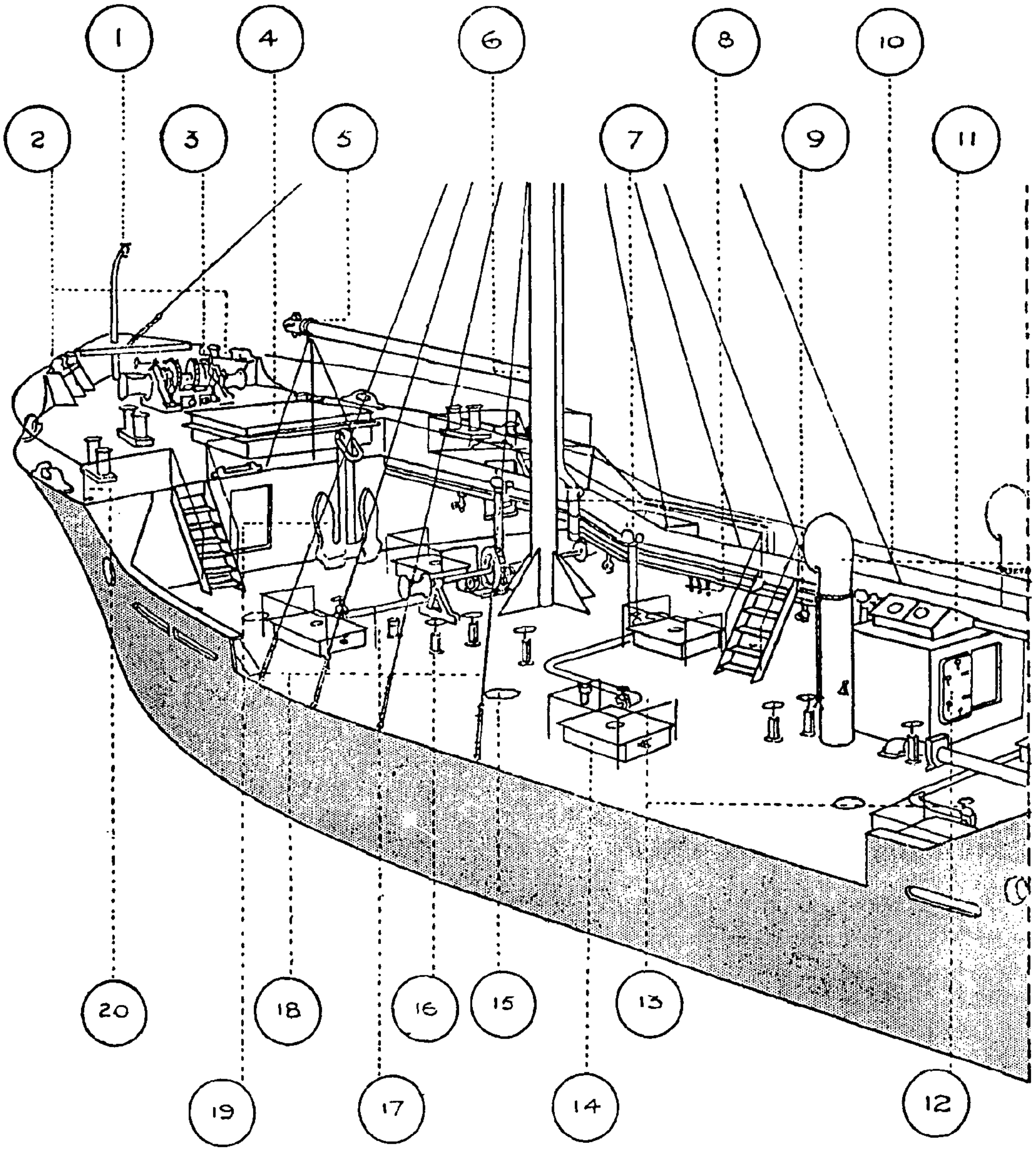


Product-carrying tanker of about 16,000 tons deadweight.

1. *Windlass*
2. *Fore hatch*
3. *Foremast derrick*
4. *Warping winch*
5. *Foremast*
6. *Forward cargo pumproom top*
7. *Forward flying bridge*
8. *Port overdeck load/discharge line and bunker line running between fore deep and cross bunker tanks*
9. *Centre-castle space (storerooms at sides)*
10. *Starboard overdeck load/discharge line*
11. *Cross-deck connections and gate valves*
12. *Port samson post with derrick*
13. *After cargo pumproom top*
14. *Starboard samson post with derrick*
15. *After flying bridge*
16. *Warping winch*
17. *Derrick on mainmast*
18. *Pressure/vacuum valve where No. 9 tank branch vapour line joins main gas line running to mast*
19. *Poop deck*
20. *Stern load/discharge line*
21. *Mooring capstans, both sides poop*

Source: Tanker Practice by G.A.B. King; Stanford Maritime Ltd. 1974

Tanker Deck Nomenclature



The fo'c'sle head and foredeck of a tanker, showing parts of the structure and the equipment to be inspected at the beginning of a voyage.

1. *Suez Canal projector davit and swivel*
2. *Fairleads, mooring chocks and rollers*
3. *Windlass—lubricating points, gears, clutch, piston rods and glands*
4. *Forehatch—securing bolts, butterflies, hinges and packing*
5. *Derrick crutches and clamps*
6. *Derrick heels and goosenecks (blocks, spans, topping-lift tackles, guys and runners)*
7. *Vapour lines and valve*
8. *Air salvage cocks on flying bridge and tank coamings (also pressure gauge cocks on tank lids)*
9. *Deck service line and hydrants*
10. *Ventilator cowls, stalks and damper flaps*
11. *Pumproom top and skylight (port glasses, packing and wing nuts*
12. *Watertight doors (packing and securing dogs)*
13. *Gas line valves at tank coamings*
14. *Tank lids (packing, tank bolts, butterflies, hinges and worm gear if fitted)*
15. *Butterworth cover plates (stud threads, nuts and jointing)*
16. *Tank valves (stalks, threads and "open-shut" indicators)*
17. *Ullage pipes, plugs and sighting ports (screw threads and jointing)*
18. *Rigging (wire, serving, earthing wires and bottle screws)*
19. *Spare bower anchor (flukes, shackle and securing brackets). Also stream anchor—not shown*
20. *Scuppers*

Not shown: Lifeboats, davits, falls and all lifesaving and fire-fighting gear.

(Courtesy Tanker Practice)

Section Three

PORTSMOUTH HARBOR MARINE ENVIRONMENT

The importance of the marine environment to the hands-on firefighter is found in strategy, tactics and particularly, personal safety. The marine environment is described in this section and the 'Project Narrative'.

"And the beauty and mystery of
the ships,
And the magic of the sea."

Longfellow
'My Lost Youth'

Portsmouth Harbor Marine Environment

Harbor and River

Portsmouth Harbor is at the mouth of the Piscataqua River. The many rivers and large bays that lie beyond the harbor exchange their water with the ocean twice each day. The volume of water transferred in this tidal process is very great in relation to the Piscataqua River's size. This is the primary cause of the river's tremendous currents.

The tidal currents of the Piscataqua River are among the strongest in North America. Ships that call on the port are usually regulated by these currents and the tides producing them. Docking and undocking are easier at the change of the tide, when the current temporarily stops and begins to reverse. This period of "slack water" is often a target docking/undocking time for the large vessels.

Tidal range, the change in the depth of the water between high and low tides, is normally around 8 feet. Deep draft vessels must often transit the river at the high tide so that proper clearance with the rocky bottom can be assured. The present 35 foot deep ship channel will soon be dredged wider at critical areas. This will help improve navigational safety while increasing the port's potential for productivity.

Offshore Firefighting

If the vessel on fire is anchored or hard aground, firefighters may be involved in an attempt to board the vessel out in the river. If this is the case, tactics will be limited. Generally, the limits will be established by the vessel's equipment, intact fixed systems, and whatever firefighters can bring. Fighting a fire in the river will probably be more difficult than fighting the same fire at the dock.

Offshore Firefighting (continued)

Ships, especially "light" ships with little or no cargo onboard, may have considerable "freeboard" (the height from the water to the main deck) to lift equipment. If hoisting equipment is not functioning or unavailable, firefighters may be further limited as to what may be brought onboard. If time permits, barges with cranes can be brought alongside or the USCG may provide helicopter assistance if appropriate. Watercraft that may be able to provide assistance are listed in the section concerning special resources.

Concerns associated with an offshore operation include:

- increased risk of falling in water
- current very strong-usually too strong to swim against
- cold water-hypothermia, especially in winter/spring
- access to vessel more difficult
- communication more difficult
- limitations of supporting resources
- limitations of medical treatment and transport
- possibility vessel will move or drag anchor

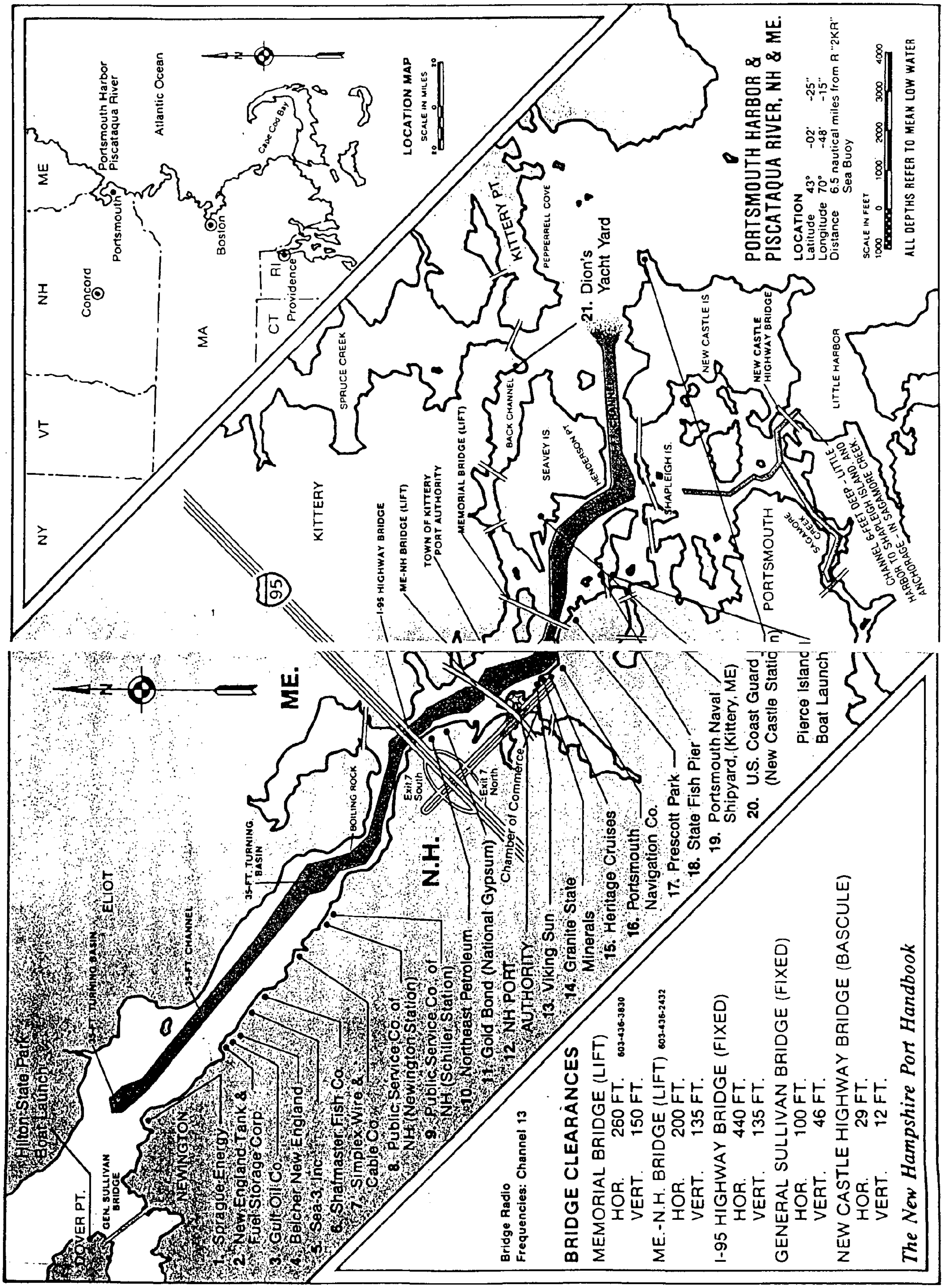
Vessel Fires at the Dock

All major commercial terminals for large vessels are located on the New Hampshire side of the harbor. Starting from the seaward end, some large facilities and their users or operators include:

- USCG Pier in New Castle
- Granite State Minerals Marginal Wharf in Portsmouth
- New Hampshire Port Authority Offshore Wharf in Portsmouth
- National Gypsum Co. Marginal Wharf (Shared) in Portsmouth
- Mobil Oil Co. Offshore Wharf(Owned by PSNH) in Portsmouth
- C. H. Sprague Offshore Wharf(Owned by PSNH) in Portsmouth
- Simplex Wire and Cable Co. Offshore Wharf in Newington
- Sea-3, Inc. Offshore Wharf (Shared) in Newington
- C. H. Sprague and Son Co. Offshore Wharf in Newington

The view of Portsmouth Harbor on the next page is taken from the 1987-1988 New Hampshire Port Handbook.

Portsmouth Harbor Marine Terminals



Marine Terminals. The marine terminals listed on page 2 vary in regard to firefighting considerations which include:

- dock construction
- dock combustibility
- vehicle access
- water availability
- hoisting capability
- proximity of combustibles
- proximity of populations

Concerns. Some concerns of offshore firefighting are also concerns of marine terminals. Many of the docks extend well out into the river. If a firefighter falls or lands in the water with full gear on, the consequences could be very serious. Others concerns include:

- strength of the dock to support vehicles
- combustibility of decking
- distance to nearest water supply
- maintenance of mooring lines
- fixed firefighting systems on dock

The Portsmouth C. H. Sprague and Son Co. dock (owned by Public Service of New Hampshire) has a dock firemain and is equipped with a sprinkler system. The Sea-3, Inc. dock has a 4" firemain to the berthing area and has two fixed monitors that operate off this main. Some docks have wood decks on steel pilings. Other docks are concrete on steel pilings. Some have cranes or hoists and some do not. All firefighters should be aware of each dock's capabilities and hazards.

Fire Control Berths

If fire occurs on a vessel transiting the harbor, and it is moveable, a decision may be made to dock the vessel at a berth that is available and condusive to fire control and support. According to the Pilots, it normally takes about an hour to tie-up a ship at any terminal on the river.

Section Four

COMMUNICATIONS

Landbased and marine based firefighting require orderly and planned communications operations. This section addresses the differentiating aspects between firefighting in the Port of Portsmouth and landbased firefighting of the harbor's municipal firefighters. This section identifies various communication systems, capabilities, limitations and logistical concerns.

"To my hated, but deeply respected, Enemy
FIRE
In whose Prevention, Detection and Swiftest
Extinction Much of my Life has been spent."

Frank Rushbrook
Fire Aboard Dedication

Communications

Radio Communications

Marine incident radio communications vary from those of typical structure fires both in kind and number of response agencies. A number of ongoing activities will be using radios. Such activites are:

- o Search and rescue
- o Movement of involved vessel(s)
- o Resource coordination
- o Fire control
- o Harbor traffic control
- o Pollution control
- o Hazardous materials control

Consequently, radio communication planning is necessary to minimize confusion and misinformation. Fireground communication considerations for planning should include:

- o The likelihood that many firefighting and emergency response agencies may be operating at the incident.
- o What common frequencies are available and what pre-assignments can be practically addressed?
- o What established, recognized radio procedures and call signs can be used by the participating agencies?
- o Limitations of portable radios onboard vessels

See Case Study: Fire Drills: Ship Shore Cooperation

Hardware. In addition to fire department radios, vessel, terminal facility, USCG and others may have radios. Some may have FM handheld portables that are very useful, particularly for large scale incidents. Others may have transportable or mobile units that can also be of great benefit. Uncoordinated, a number of problems might occur.

Radio Communications (continued)

Radio capability such as programmability, scanning, simplex, low/high wattage outputs, fixed channels and frequencies should be considered when determining who may most need special features. Features for handhelds to be used inside a large steel vessel include:

- o intrinsically safe or explosion proof
- o minimum 5 or 6 watt output capability
- o resistance to high humidity environments
- o capability to attach remote microphones
- o availability of charged spare batteries
- o capability to charge spare batteries

Shipboard fire incidents are often complex situations requiring hours and sometimes days to control. Resultantly, it is important to have spare handhelds and batteries as the hours wear on. Inadequate information and communications due to lack of radio equipment can be costly.

Presently, only Newington lists a marine radio in the inventory of municipal Portsmouth Harbor fire departments. Marine radios operate within the VHF-FM Maritime Mobile Frequencies 156-162 MHz band. They have dedicated channels corresponding to specified frequencies (see next page). Large vessels will generally have at least two marine radios. Mounted units will most often be located in the wheelhouse or the radio room. They are normally electrified by the ship's emergency circuit. Therefore, the radios would be operable by the ship's emergency generator(s) should the main generators fail. At least one radio is usually backed up by battery in case ship generated electrical power is unavailable.

Other agencies that may have marine radios should include:

- o USCG units
- o Portsmouth Pilots, Inc. (3 handheld portables)
- o Portsmouth Navigation Tugs (2 mobiles in each)
- o PNSY Tugboats YTB 711 & YLT 602
- o NHPA Director (1 handheld portable)

Radio Communications (continued)

Another type of radio is the single sideband radio (SSB). Large vessels will probably have one. It may not have battery backup since SSBs are usually more powerful radios. Some USCG cutters have SSBs. Also, landline telephone patch can be performed by marine operators for SSB traffic. This radio could be important if the vessel was inbound with fire onboard, and, was outside the 50 +/- mile marine radio range.

Frequencies. The municipal firefighters will probably use the VHF-FM frequencies normally used and designated per the 'Piscataqua River Marine Disaster Plan'.

o INITIAL TONE	154.190
o LOCAL GOVERNMENT	Various
o SEACOAST	154.190 (usually channel 1)
o FIREGROUND (FMARS)	154.280 (usually channel 2)

If the incident is large, many agencies may be toned during the initial 20-30 minutes. It should be anticipated that SEACOAST may be difficult to work during this period. LOCAL GOVERNMENT frequencies may not be clear if shared with local police who are heavily involved in traffic control and/or resident evacuation.

The most likely source for waterborne communications on SEACOAST and FIREGROUND are the PNSY tugs unless others are given a fire department radio. However, floating units will probably have marine radios. According to the ' USCG Piscataqua River Marine Disaster Plan', "the working radio frequency for all water based responding units will be 157.100 MHz, channel 22 FM".

Other important marine radio channels/frequencies include:

o CH 6	156.30	Safety
o CH 12	156.60	Vessel Traffic Management
o CH 13	156.65	Navigation
o CH 16	156.80	Calling; Distress
o CH 21	157.05	Government (USCG)
o CH 22	157.10	Government (USCG)
o CH 23	157.15	Government (USCG)
o CH 81	157.075	Government (USCG)
o CH 83	157.175	Government (USCG)

Radio Communications (continued)

These frequencies may be utilized if designated by the COTP. Their use for ship/ship or ship/shore traffic can be convenient since most vessels are able to monitor CH 16 and work another channel. In this manner, they can monitor "calls" from parties who do not know what channel is being "worked". If the USCG designated working channel (CHANNEL 22) became too crowded during a Portsmouth Harbor fire, the COTP might designate one of the other channels listed above to alleviate the situation.

Many large vessels and marine terminals have their own handheld FM portables. These radios will probably have preset frequencies which should not interfere with fire department frequencies. This provides for multiple dedicated working channels besides 154.280 (FIREGROUND). These radios may be intrinsically safe and are useful to safe operation in certain areas. An expanded list of marine radiotelephone channels is provided at the end of this section.

Concerns. The heavy steel construction of most large vessels will **inhibit interior transmission/reception** capabilities of most portable radios. Radio surveys will indicate the extent, if any, of limitations that may exist. If inside an accommodation area that is above the waterline and experiencing radio difficulty, find a room against the outside. Try the radio next to a porthole or window. The radio's capability should significantly improve.

There are two major disadvantages of the handheld radio. One is **public exposure** of the transmissions. The other is the susceptibility of the transmissions to interference, especially from more powerful units. Scanners have given everyone the ability to monitor almost anyone's conversation and **high wattage units** can blast through channels from dozens of miles away. An Incident Commander on the pier deciding the ship's fate with the Master on the bridge may need more privacy and less interference than handhelds may provide.

Microwave Telephone Communications

Cellular Telephone. Cellular telephones operate in the 800-900 MHz bands from repeater towers that provide coverage to specific geographical areas. Dover's tower would be used for Portsmouth Harbor communications. Some vessels may already have the phone onboard and be immediately accessible by either another cellular or landline-linked telephone.

SATCOM Telephone. Many larger vessels may also have Satellite Communications (SATCOM) onboard. This unit's voice circuit has extremely high integrity and reliability. With SATCOM, calls can be placed or received just like a landline telephone through the vessel's microwave satellite relay system. If the vessel is inbound and on fire, this unit will succeed where cellular may not, because it essentially has no limiting range. SATCOM is, however, very expensive to use with charges about $10 per minute for the voice circuit. When calling the vessel, it is possible to reverse the charges or charge the call to the vessel's owner or operator.

Intra-Vessel Fixed Communication Systems

Most large vessels have their own phone systems, intercoms, public address systems, and other vessel communication systems. It was previously mentioned that many ships have FM radios. If the ship has an FM radio, often the compatible "base" FM units are fixed in the wheelhouse, cargo office and/or engine room control station.

Sound Powered Phones. Large vessels, especially US Government vessels, will usually be fitted with sound powered phones (see photograph on next page). These phones are located throughout the vessel at critical locations such as the wheelhouse, engine room control station, emergency diesel generator room, cargo control room, bow lookout post and steering gear room.

Sound Powered Phone

(Text by MARITECH)

(Photo Courtesy Dept. of Transportation)

Sound powered telephones are a reliable means of communication within the vessel. They are not subject to the limitations of radios. They have advantages over runners in that simultaneous conversations by two or three parties can be conducted.

Sound powered telephones do not require an outside source of electricity as do ship's intercoms or "talkbacks" and public address systems. They make their own power supplies through two different methods.

To signal another station onboard, set the selector switch to the station number you are calling. Station numbers are listed on the index. Then crank the generator handle. Be sure to give at least three or four rapid cranks to activate a bell or buzzer by the magneto current. This cranking rings a bell or sounds the buzzer at the station being called.

Intra-Vessel Fixed Communication Systems (continued)

On the inside of the handset is a spring-loaded button which MUST BE DEPRESSED to either listen or talk. The speaker's voice activates a diaphragm in the mouthpiece which transmits the sound to the receiving station. Speech should be clear and forceful, particularly if loud background noise exists.

Electric Telephone. Most commercial vessels including tugs, have electric telephones. These will be much like landbased telephones with rotary or pushbutton operation. However, they depend on the vessel's electricity to operate. On larger ship's, they will probably be on the emergency circuit.

"Talkback" or Intercom. The master control for this unit is usually in the wheelhouse. The unit may function as follows. The master control unit can monitor selected stations on a one way basis. The master control station always receives unless a sub-station is deliberately monitored through the sub-station's speaker/microphone. The sub-station does not usually have the ability to call the master control unit. This system may also be connected to the vessel's emergency generator circuit like the telephones. These systems vary from vessel to vessel.

Public Address System. This system operates similarly to landbased systems. It might be useful for immediate notification of many people. A good example would be a decision to evacuate the vessel. It might also be prudent to establish some Universal Evacuation Signals and Procedures with the ship's whistle and general alarm bells for personnel onboard. The International Distress Signal for all vessels is "a continuous sounding of any fog apparatus" (i.e. ship's whistle).

Runners. As mentioned, a major vessel fire incident requires numerous agencies using large numbers of radios operating on common frequencies. One of the methods to minimize radio traffic is the use of "runners" or messengers as situations dictate. Messages and/or responses are walked back and forth between parties. Advantages and disadvantages of using runners should always be considered.

<u>Intra-Vessel Communication Systems</u> (continued)

Concerns. Communication equipment onboard seagoing vessels is subject to considerable abuse from daily routine. Most equipment is therefore extremely rugged and dependable as long as the unit and wire trunks remain intact.

Sound powered and battery operated units will be independent of the vessel's electrical supply. Loss of the vessel's generation capability does not necessarily become the loss of critical communication equipment. This will depend on the individual vessel. The wheelhouse need not be abandoned as a communications center because vessel-generated electricity is lost. Successful communications require flexibility and resourcefulness.

Marine VHF Frequencies

Channel Designator	Use	Ship TX MHz	Coast TX MHz
6	Safety (IS)	156.300	-
7	Commercial	156.350	X
8	Commercial (IS)	156.400	-
9	Commercial	156.450	X
10	Commercial	156.500	X
11	Vessel Traffic Mgmt.	156.550	X
12	Vessel Traffic Mgmt.	156.600	X
13	Navigation	156.650	X
14	Vessel Traffic Mgmt.	156.700	X
15	Envior.(CS)	-------	156.750
16	Calling;Distress	156.800	X
17	State Cont.	156.850	X
18	Commercial	156.900	X
19	Commercial	156.950	X
20	Port Oper.	157.000	161.600
24	Pub.Corres.	157.200	161.800
25	Pub.Corres.	157.250	161.850
26	Pub.Corres.	157.300	161.900
27	Pub.Corres.	157.350	161.950
28	Pub.Corres.	157.400	162.000
65	Port Oper.	156.275	X
66	Port. Oper.	156.325	X
67	Commercial	156.375	X
68	Non-Commercial	156.425	X
69	Non-Commercial(SC,CS)	156.475	X
70	Non-Commercial(IS)	156.525	-
71	Non-Commercial(SC,CS)	156.575	X
72	Non-Commercial(IS)	156.625	-
73	Port.Oper.	156.675	X
74	Port.Oper.	156.725	X
77	Commercial(IS)	156.875	-
78	Non-Commercial(CS,SC)	156.925	X
79	Commercial	156.975	X
80	Commercial	157.025	X
84	Pub.Corres.	157.225	161.825
85	Pub.Corres.	157.275	161.875
86	Pub.Corres.	157.325	161.925
87	Pub.Corres.	157.375	161.975
88	Commercial	157.425	-

Source: 'NHWSPCC Oil Pollution Control Training Manual' granted permission by Motorola Corporation.

Section Five

FIXED FIREFIGHTING SYSTEMS

Fixed firefighting systems protect the vessel from fire onboard. They are designed and installed as part of the vessel's construction plan. Therefore, it is expected that a crew be knowledgeable and trained in system use to protect their vessel. However, there may be various situations when a landbased firefighter should assist with or operate a fixed system. This is the importance in learning about fixed systems.

"Training is everything. The peach was once a bitter almond; cauliflower is nothing but cabbage with a college education."

Mark Twain

Vessel Fixed Fire Systems

In general, tugs and barges operating in Portsmouth Harbor have relatively minimal firefighting equipment compared to ships. Tugs often have a firemain supplied by a small general service pump. The two Portsmouth Naval Shipyard tugs, however, have enhanced firefighting capabilities. Most barges will have only portable or semi-portable extinguishers. They do not usually have fixed systems.

Ships are normally fitted with considerable firefighting systems and equipment. This is particularly necessary for the control and extinguishment of shipboard fires while at sea. Among this equipment are fixed and fire-related systems. These can prove as valuable to the fire department in port, as to the vessel's crew at sea. Some of these systems include:

- fire alarm and detection systems
- fire main systems
- sprinkler and water spray systems
- fixed CO_2, halon, or foam systems
- steam smothering systems
- deck foam or deck dry chemical systems
- twinned agent systems
- inert gas system (IGS)

Fixed vessel fire extinguishing systems are one of many factors that differentiate marine firefighting from most local shoreside structure firefighting. The objectives though, are basically the same; to extinguish the fire while minimizing risk of injury to personnel, and minimizing damage to the structure and its contents. Whether it takes 4 hours or 4 days, the goals are to:

1. Prevent injury to personnel
2. Control the fire
3. Extinguish the fire
4. Minimize the damage

Although vessel fixed system extinguishment may take longer to accomplish, fire suppression may be more safe, simple, and less costly when compared to direct fire combat attack with handlines and portable dewatering equipment.

Common concerns regarding vessels' fixed fire systems:

- o system integrity due to environmental exposures- salt water, high moisture, impact damage, etc.
- o system integrity due to insufficient system maintenance
- o system incompatibility with shoreside equipment including fittings, thread types, thread sizes, etc.
- o lack of knowledgeable personnel to operate system properly

Fire Alarm and Detection Systems

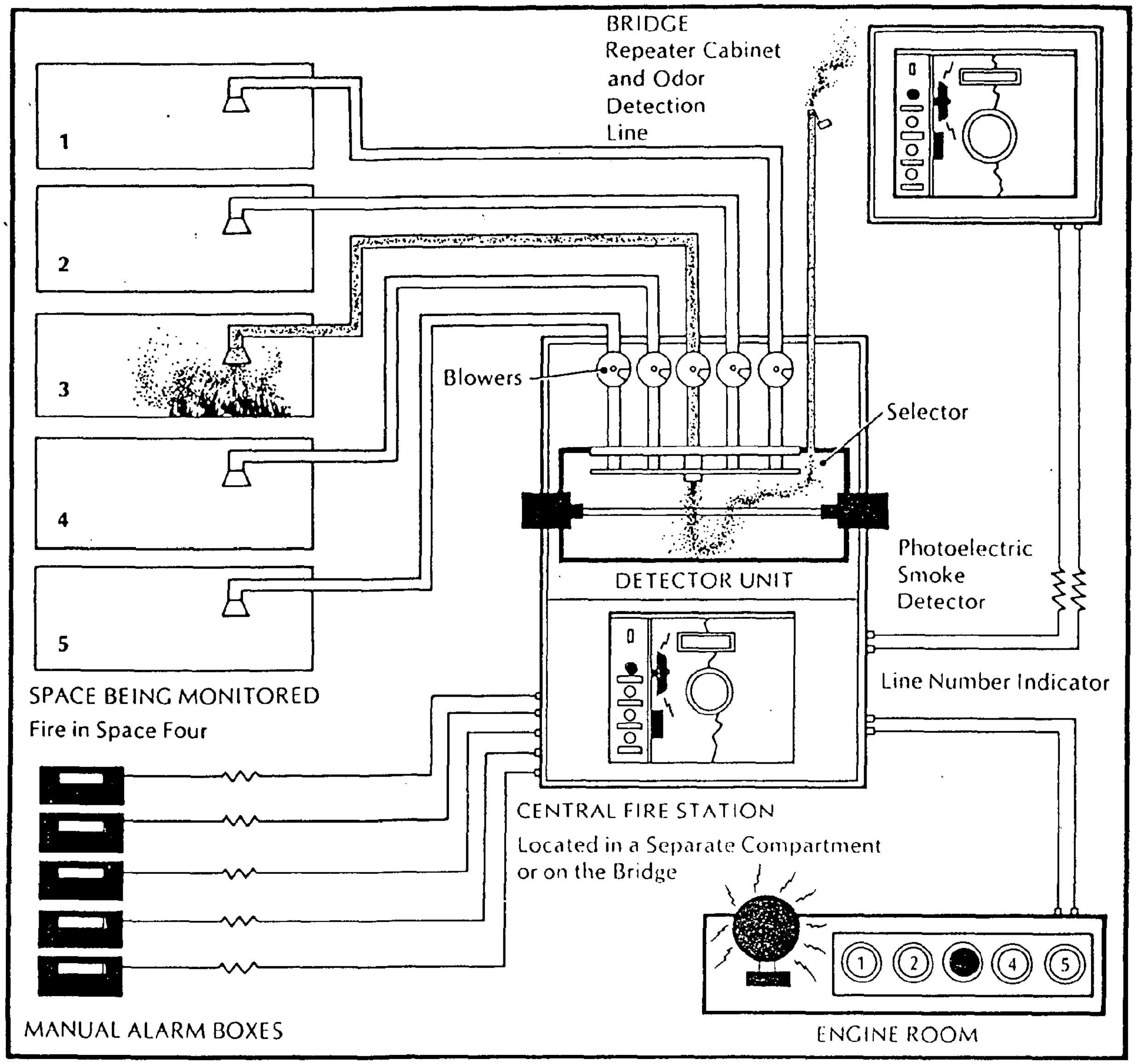
Fire alarm and detection systems are usually similar to the shorebased counterparts. Some examples include:

- o smoke detectors
- o heat detectors
- o vapor detectors
- o flame detectors
- o manual pull stations
- o light and bell/buzzer signals

A smoke detector system not common on vessels visiting the port and probably unfamiliar to many Portsmouth Harbor firefighters, is the Air Sampling Smoke Detection System illustrated on the next page. This system uses a central photoelectric cell to automatically detect smoke in a particular space by drawing it to a sampling cabinet normally located in the wheelhouse. The sampling tubes may also serve as part of the fixed CO_2 manifold. The unit will probably provide little help in monitoring fire progress since smoke will rapidly permeate many areas. It may however, provide an easy method to sample a compartment for toxic atmospheres or monitor its inerting progress.

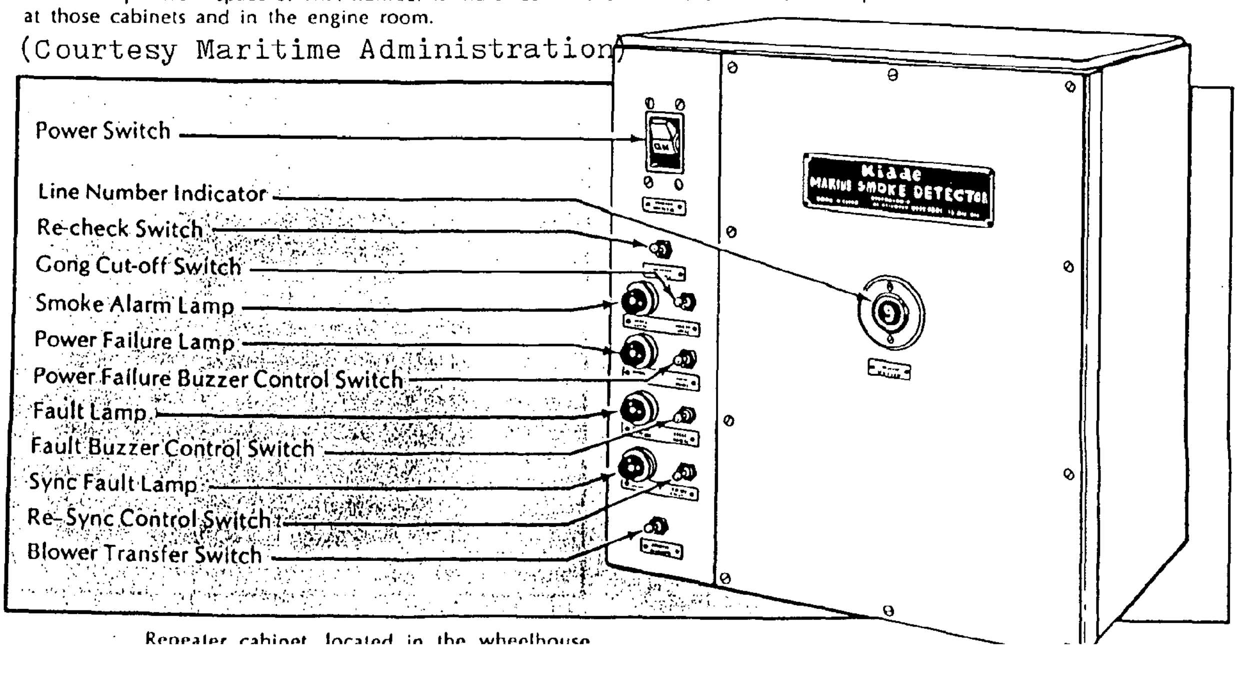
Heat detectors may be used to assess fire spread, especially in areas that may be obscurred by smoke and difficult to visually monitor. Vessel accommodation areas often present this problem as the confined passageways tend to contain the smoke and heat. Locating and tracking the fire can become a major problem as experienced with fire onboard the passenger ship SCANDINAVIAN SEA in Port Canaveral, Florida in 1984.

Air Sampling Smoke Detection System



Simplified schematic drawing of the automatic smoke-sampling system. The apparatus has detected smoke in an air sample from space 3. That number is indicated on the main cabinet and the repeater cabinet. The alarm is sounded at those cabinets and in the engine room.

(Courtesy Maritime Administration)



Repeater cabinet located in the wheelhouse

Firemain Systems

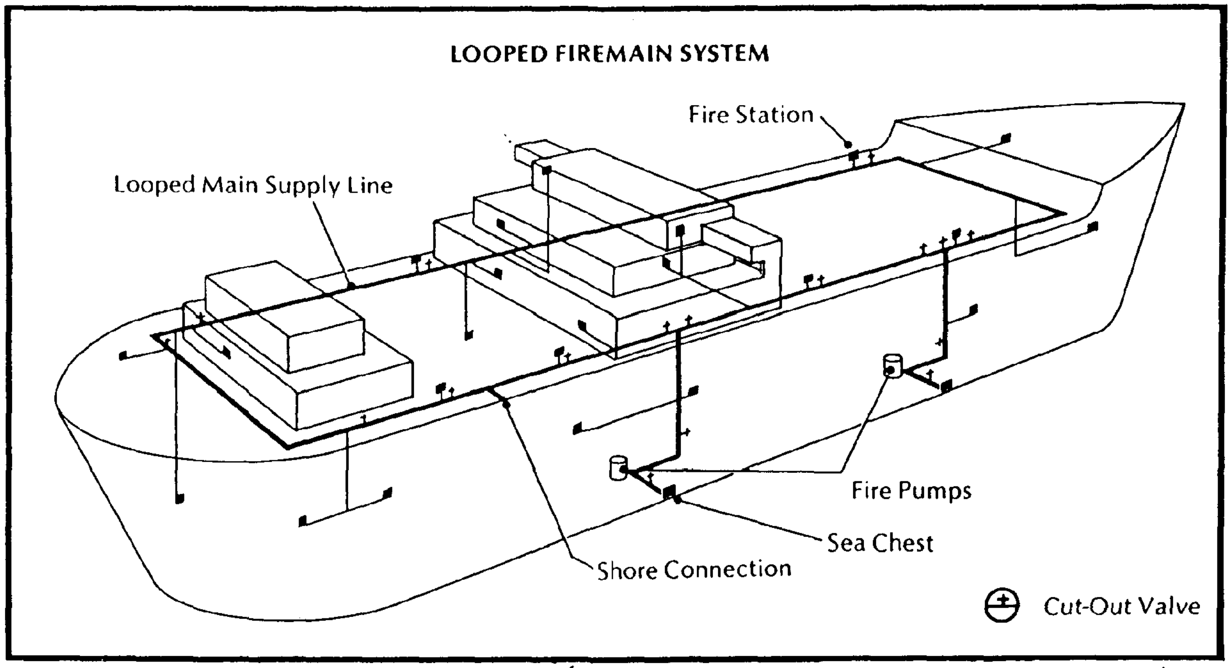
A vessel's firemain system is the one fixed system normally aboard all ships though other extinguishing systems may also be installed. There are various reasons for these additional systems such as dangerous cargo requirements. The ship's firemain system consists of fire pumps, firemains, hydrants, hoses, nozzles and related equipment which is usually capable of furnishing at least two strong hose streams anywhere onboard. The firemain may also provide water for special onboard fire systems. The system has many similarities to a building's wet standpipe system.

Single or 'Dead End' Main System. Tankers will usually have this system (see illustration on next page). It consists of a single pipe that runs the length of the vessel, normally on the main deck's centerline. On ships with fixed deck foam systems, it may be paralleled by a separate foam main. If the fire main is damaged, it may be possible to crossover to the foam main to deliver water beyond the break. CAUTION: THIS CANNOT BE DONE AT THE SAME TIME FOAM IS BEING DELIVERED OR FOAM WILL BE DILUTED.

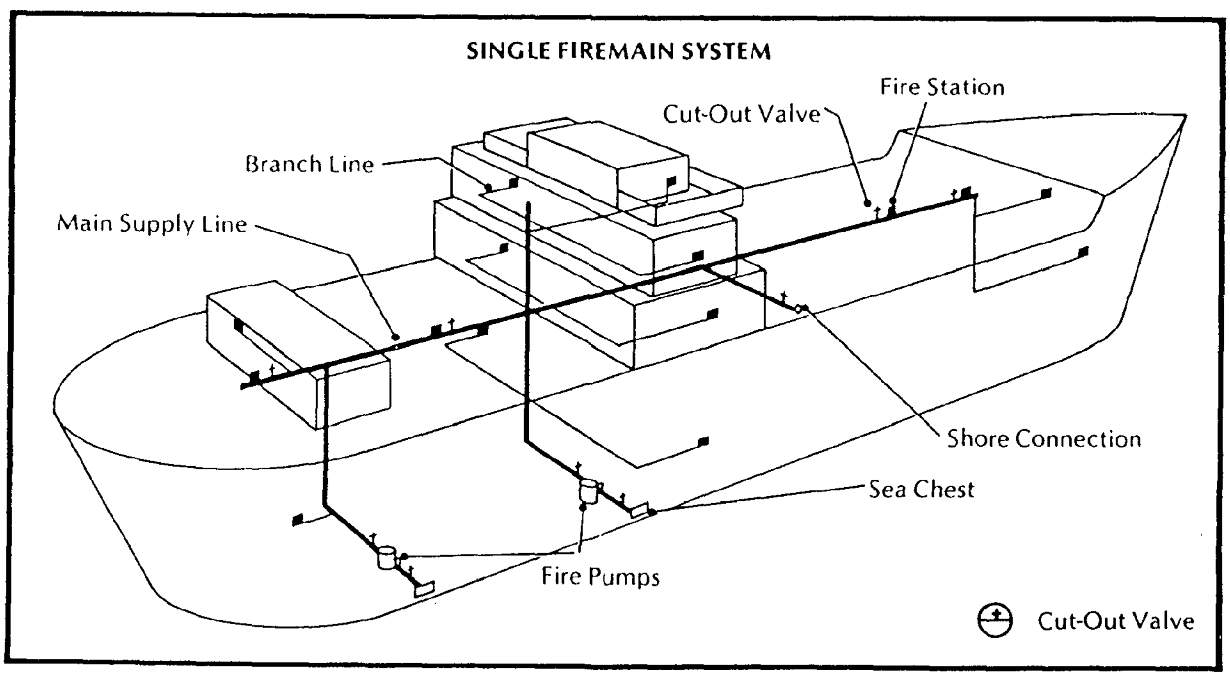
Horizontal or Closed Loop System. Many vessels that are not tankers will have firemains configured as a looped system (see illustration on next page). This system is preferred over the single main since it is generally flexible enough to bypass a break with isolation valves and crossover piping.

Fire Pumps. The vessel's fire pumps have an adequate supply of water available in the Piscataqua River. Their numbers, sizes, and prime movers vary from vessel to vessel. Sometimes other pumps, such as sanitary or bilge, augment dedicated fire pumps. Generally, at least one fire pump should be operable through a separate onboard emergency system. The fire pump relief valves are set relatively low, usually around 125 psi. Care must be exercised if the line is pressurized by an external source. Over pressurization might open the relief valve. This is a problem as many relief valves exhaust directly into the bilge of the engine room or other machinery spaces. This potential flooding problem can be avoided by securing the ship's pumps once the external source (i.e. fire engine) begins pumping into the system.

Vessel Firemain Systems



Typical horizontal loop fire-main system. (Courtesy Maritime Administration)



Typical single main system. (Courtesy Maritime Administration)

Firemain Concerns:

1. **Incompatibility** between shipboard and shoreside threads may require use of the International Shore Connection(s) (see below). On U.S. Government vessels there is a likelihood that the 2 1/2 inch connections are compatible.

2. The systems are not designed to operate under the higher pressures that can be produced by a pumper. **Avoid pressures** in excess of 150 PSI. Consider the age of the vessel, lack of system maintenance and possible system deterioration.

3. Insure there are **no open valves** or damaged piping if a pumper is about to pressurize. If pressure was lost during firefighting efforts, the hydrants may still be open.

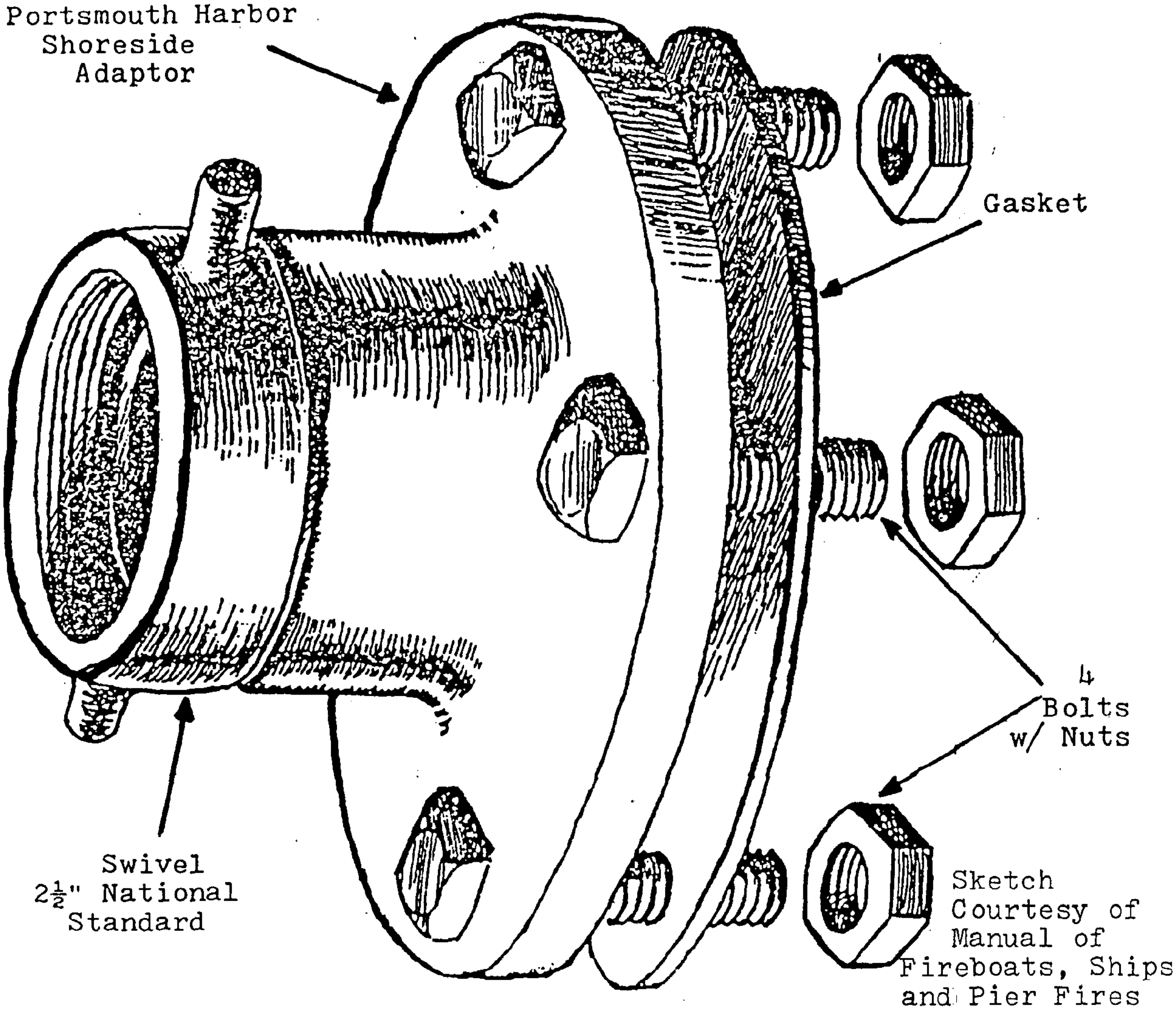
4. Determine where the ship's fire pump **relief valves exhaust** (see 'Fire Pumps" on previous page).

5. Use fresh water if possible when pumping to vessel as salt water is a **superior electrical conductor** and 440V DC equipment is not uncommon aboard large vessels. Shock hazards are evident.

Fire Stations. Fire stations usually consist of a hydrant regulated by a gate type valve, and required hose and nozzles. There may also be special equipment such as an extinguisher, fire axe or low pressure bayonet-type fog applicator.

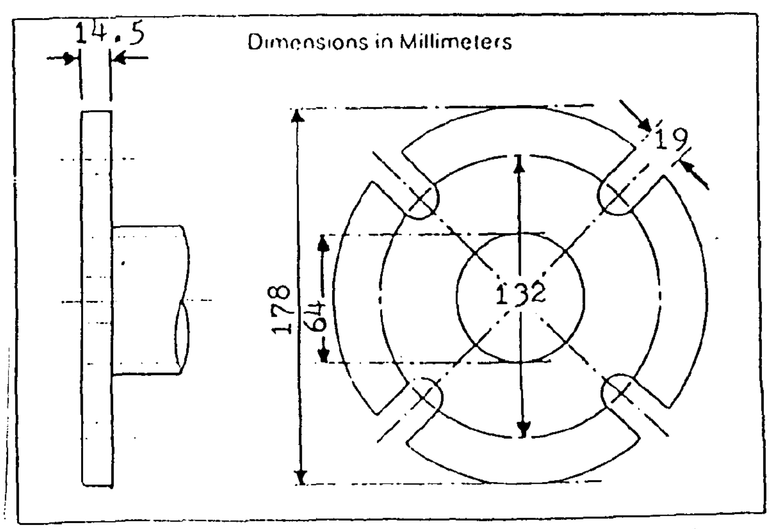
International Shore Connection. Vessels which visit the major Portsmouth Harbor terminals should have at least one fire main adaptor called the "International Shore Connection" (see next 2 pages for illustrations). It is a universal maritime coupling or connector. The ISC accepts vessel's threads or coupling and presents a flange to mate with the fire department's reverse adaptor or connection. These connectors are necessary if the ship's hydrants' threads do not match the 2 1/2 inch National Standard thread which is currently being used by the Portsmouth area's municipal fire departments.

INTERNATIONAL SHORE CONNECTION

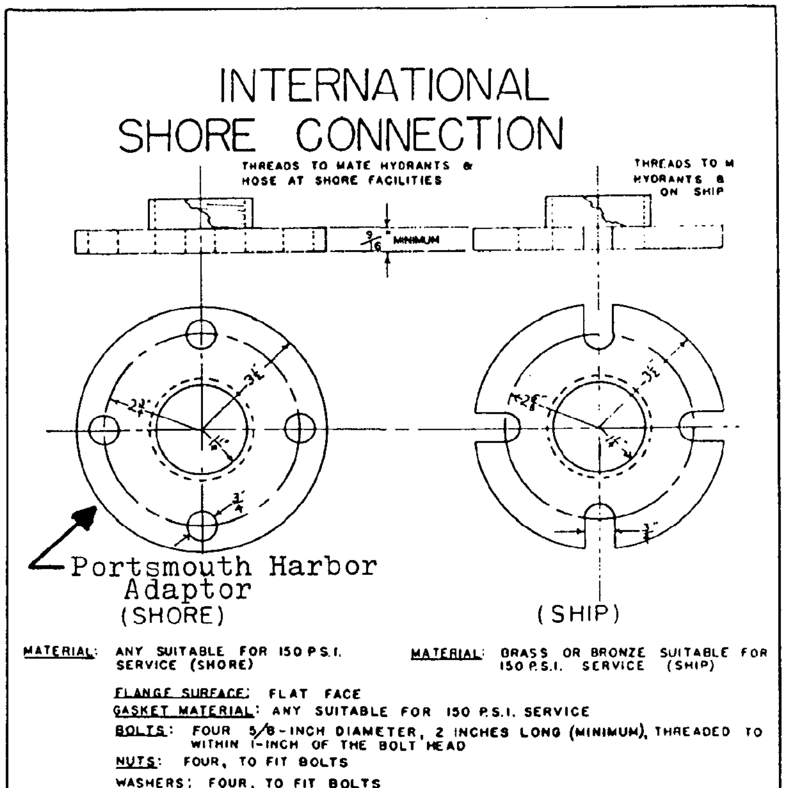


Ship's Connections
Mounted in Rack on
Passageway Bulkhead

International Specifications



International Shore Connections Specifications in Inches



(Courtesy Dept. of Transportation)

Water Sprinkler Systems

Water sprinkler systems are primarily found on passenger ships, ferries, and RO/RO (Roll-on/Roll-off) vessels. Due to the SOLAS requirements which promote the use of noncombustible materials rather than the reliance upon sprinklers, few merchant vessels in Portsmouth Harbor will have them fitted. If installed, their design is similar to land based systems. Generally they are divided into two categories:

1. **Automatic or Wet Pipe.** These systems usually have fusible links with the system charged by a pressure tank of fresh water that serves as the initial water source. The secondary supply comes from automatic pumps drawing sea water.

2. **Manual or Deluge.** These sprinklers have open heads with the system dry until water is delivered through the firemain by the ship's fire pumps. Since this is a manual system, location of control valves to the system must be determined to apply the water.

Sprinkler System Concerns:

1. **Stability.** Any system releasing water within the vessel effects the vessel's stability, especially if it results in significant free surface (see 'Stability' section). A large deluge system is able to pump at least 500 GPM into the vessel. Deluge systems used for long periods of time may produce water accumulations at over 100 long tons per hour.

2. **Reliability.** Salt water transferred within a vessel often causes premature deterioration of all water systems that are not dedicated fresh water systems. Scale, rust and other solid materials are frequently large enough to clog sprinkler heads and other parts of water systems. Periodic testing and flushing must be routine system preventive maintenance.

Water Spray Systems

Water spray systems are similar in design to sprinkler systems. They differ primarily in the final delivery heads. The heads are spray nozzles installed to aim water spray directly at the area or equipment to be protected. Spray system concerns are also similar to sprinklers (see above).

Fixed Foam Systems

Fixed foam systems are usually designed to extinguish flammable liquid fires in machinery spaces and boiler rooms. Bilge and inaccessible areas of motor ship engine rooms, steamship boiler rooms, tanker pumprooms, etc. may be protected by foam that is produced either mechanically or chemically. Chemical foam will generally be rare and on older vessels.

Operation. The activation and control of the system is usually a manual task performed by the ship's Engineers. The controls are required to be located outside the space to be protected. The foam is distributed through fixed perforated pipes or individual nozzles that bank the foam off bulkheads or deflectors.

Foams and Proportioners. Low expansion foams gently cover the flammable liquid with a blanket to effectively suppress vapors at the liquid's surface. High expansion foams provide vapor suppression by filling the entire volume of the protected space. There are various proportioning devices for producing mechanical foam for fixed systems. One of the most common is the balanced pressure proportioner. It regulates the pumped concentrate as it leaves the tank by a diaphragm control valve.

Fixed Foam System Concerns:

1. **Dilution.** Once the system has been activitated, water will mix with concentrate until the concentrate is depleted from the tank. If not shut down at that time, water alone will continue to be dispersed. A low expansion foam blanket will then become diluted and ineffective in minutes.

2. **Electrical Shock Hazard.** Low expansion foam is relatively wet. This makes it a superior electrical conductor compared to high expansion foam which contains little water.

3. **Visibility Limitations.** High expansion limits visibility.

4. **Shelf Life.** Some foams will have more limited shelf lives than others. If the system is not properly maintained and foam not periodically tested, the foam may be suspect.

Steam Smothering Systems

Steam smothering systems have not been installed on U.S ships since the mid 1960s. Resultantly, they are not common aboard most merchant ships that operate today. Spaces often protected are dry cargo holds, pumprooms, bunker tanks and paint lockers. Steam is normally generated by the main or auxiliary boilers. It must have pressure of at least 100 psi to be effective. The boiler should be able to produce at least one pound of steam per hour for each 12 cubic feet of volume protected. Steam is not considered very effective for various reasons. **It is NOT ADVISABLE to use steam on cargo that water should not be applied to. DO NOT use steam if explosives are in the cargo** **(see pg 14).**

Carbon Dioxide (CO2) Fixed Systems

CO2 systems are one of the more common fixed shipboard systems installed for the protection of enclosed spaces. These systems have some operational procedures which are similar to steam smothering, halon and dry chemical systems. CO2 systems are used throughout vessels protecting areas such as:

- Engine Rooms
- Cargo Spaces
- Pump Rooms
- Generator Rooms
- Electrical Rooms
- Storerooms and Lockers
- Galley Ranges and Hoods

Marine CO2 Storage. CO2 is generally stored in two different types of containment. Most vessels carry liquid CO2 at room temperature in large 100 lb.(of CO2) bottles at about 750-850 PSI. The second, and rarer containment, utilizes a large single 300 +/- PSI storage tank and maintains the liquid at about zero degrees farenheit. When released, the storage pressure acts as the propellent for the liquid as it becomes the heavier-than-air gas that displaces the oxygen in the involved compartment.

Marine System Types. There are three basic system types:
1. Total Flooding Main System (with manual release only)
2. Independent Flooding System (automatic and/or manual release)
3. Localized Application System(automatic and/or manual release)

The total flooding system is used for larger spaces like cargo holds, engine rooms and pumprooms. These larger spaces are usually supplied by a main bank of high pressure bottles or a low pressure tank of CO2. Supply may be shared by a multiple number of large spaces onboard. This system is usually operable from at least one remote station and the CO2 storage site. It must be manually released. This will pressure activate an audible warning alarm in the space for 20 seconds prior to system discharge to the space. It will also pressure activate automatic shutdowns for mechanical ventilation to the space.

<u>CO2 Marine System Types</u> **(continued)**

The independent flooding systems have dedicated bottles for each protected space. Thus, supply cannot be shared. Spaces protected by less than 300 pounds of CO_2 differ from larger spaces in that they may not be fitted with a warning alarm. Independent flooding systems may be automatically released by heat detectors and/or manually released at the control station. The control station is usually located in the vicinity of the space.

The localized application systems are generally installed to specifically protect rotating machinery such as generators and pumps. CO_2 is directly applied to the protected equipment through directional nozzles. Most of these systems are manually activated and may not sound a warning alarm prior to discharge.

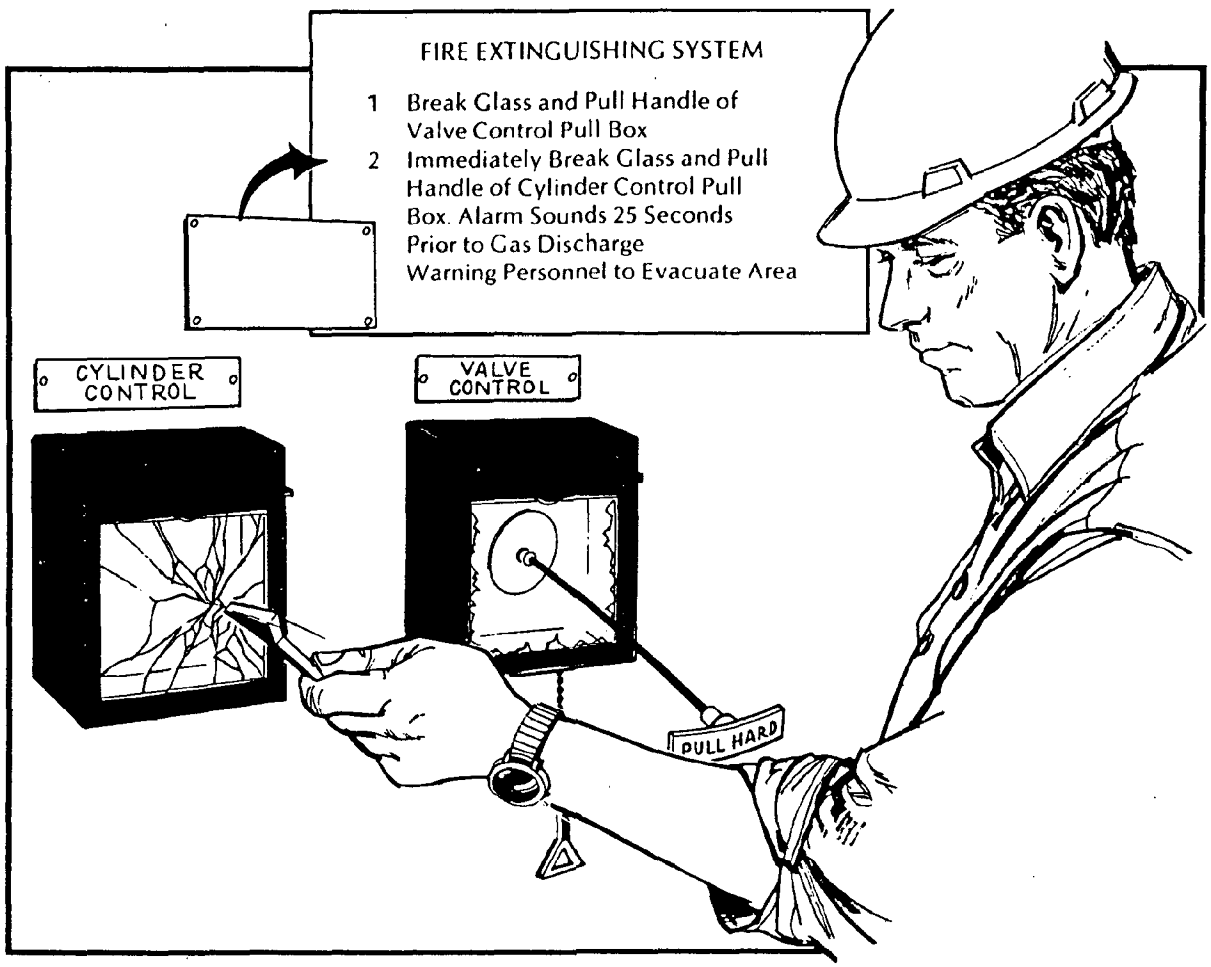
Fixed CO2 Operation. Insure all personnel are evacuated from the space prior to system discharge. Secure ventilation. Seal the space tight. Except for one small damper or hatch, all openings to the space should be closed, secured or plugged. This sole opening will allow the displaced air (oxygen) to escape and avoid overpressurizing the space. This 'vent' should be immediately closed once the system has discharged its initial application of the gas. If possible, stop all fans in advance, prior to system activation to allow them time to stop rotating.

Fixed CO2 Release. As with fixed foam systems, the Engineers will probably be the most knowledgeable personnel, the Chief Engineer being most familiar. Independent systems are usually a simple "Break Glass-Pull Handle" control box located just outside the space. Total systems are usually two separate control boxes (see illustration next page). The handles are normally pulled out in sequential order so that the directional valve (pull first) opens the piping to the involved space and the cylinder control valve (pull second) activates the system.

BE CERTAIN:

1. **PERSONNEL ARE EVACUATED.**
2. **THE SPACE IS SEALED AND VENTILATION OFF.**
3. **THE CONTROL HANDLES ARE SEQUENTIALLY PULLED**

CO2 Total Flooding Fixed System Control Station



The pull cables used to activate the total-flooding CO_2 system. The cables must be pulled in the proper order (valve control first) as noted in the posted instructions. (Courtesy Maritime Administration)

CO2 Application Amounts. To be certain of extinguishment, it is important to note that no concentration of CO2 can be considered excessive. A 100% concentration is not practical, but an 80% concentration should be obtainable and allow a reasonable safety margin to insure extinguishment. The initial application should be large enough to bring the CO2 concentration level up to at least 60%. The rule of thumb to obtain a 60% level is:

1. Calculate total cubic feet of space.
2. Divide this volume by 9.
3. Apply this number (in pounds of CO2) to space.

Volume of Space/9 = # Lbs. CO2 for Initial Application

CO2 Application Monitoring and Maintenance. Once CO2 is applied, a marine chemist should monitor the compartment until additional applications achieve a level of 80%. This high gas concentration of 80% or better should be maintained for at least 48 hours before opening the space. In addition to CO2, temperature and O2 readings should also be obtained by the chemist. Gas sampling tubes and, thermometers or thermocouples can be lowered down sounding tubes, through vents, stuffing tubes and drilled or cut holes. Readings should be taken throughout the operation at time intervals of approximately 15 minutes.

CO2 Fixed System Strategies. Different strategies exist regarding the initialization of a CO2 fixed system, as well as many other fixed systems. Some suggest that releasing the CO2 system is a last resort and that it should not be used until all other attempts at fire extinguishment have failed. Others suggest that CO2 fixed systems should be activated as soon as it becomes evident that a direct, 'quick attack' will not succeed. Ultimately, the decision will be made by the Incident Commander on a case by case basis. Some important points to consider are:

- early release avoids immediately committing personnel
- early release, before space gets superhot, may allow system to function more efficiently
- early release may buy time to allow personnel and resources to be assembled for a coordinated direct attack
- once released, is life hazard to unprotected people in space
- once released, there may be no immediate backups
- once released, the space may become difficult to monitor

Smothering Strategies in General. Smothering or suffocating a fire by application of CO2, foam, steam or sealing the space tight, can be a very effective strategy in almost all cases. Extinguishment of certain materials, however, SHOULD NOT be attempted by smothering. Always try to determine that the material or products on fire do not produce their own oxygen when burning. Celluloid is such a material. Also, smothering is not recommended for fires involving explosives, nitrates or sulfates. These three groups should be flooded with water as rapidly as possible.

Fixed CO2 System Concerns:

1. Ship's personnel tasked with firefighting aboard their vessel may have **already discharged the system.** If applied incorrectly or if the space was not properly sealed, the system may be of little further use to the fire department unless additional CO2 or other inerting agents are shortly available for application.

2. CO2 is a **life hazard** to personnel. It is a non-toxic, odorless, colorless gas that is fatal when inhaled in large concentrations of more than 15%-20% by volume.

3. Precautions must be taken if personnel are to occupy the CO2 manifold/storage area during system operation. If bottle couplings or **pipe joints leak**, the situation could be extremely hazardous to unprotected personnel.

4. Precautions must be taken to insure that firefighters working in a space protected by an **armed CO2 system** are aware of this fact. This is particularly important in larger spaces when SCBA is not being used. Additionally, precautionary measures must be in place to insure the system is not activated while people are in the space.

5. Once activated, **enough** CO2 or other inerting gas, must be available to maintain the space inert. It is possible that enough extra gas may be aboard the vessel itself. If this is not the case, bulk CO2 may be difficult for Portsmouth Harbor firefighters to readily obtain from regional suppliers. Also, logistical problems transfering a bulk supply to the vessel may present some difficulty.

6. Note **smothering** strategies information on previous page.

7. CO2 may not easily penetrate and **distribute** to all areas of a tightly packed hold or to spaces that are blocked off by cargo.

8. If the compartment is **opened prematurely**, the possibility exists that gas will be lost, fire may re-ignite and the entire process may have to begin again.

Fixed Halon Systems

On many newer vessels, marine halon systems are being installed in lieu of CO_2 systems. These two systems share some aspects of design, storage (see diagram next page), application/operation, controls, shutdowns, warnings, and strategies. The inherent qualities and system delivery aspects of halon make it the preferred agent for compartments containing high value equipment like computers and sophisticated electronics. Almost all vessels operating in Portsmouth Harbor with halon systems, will be using Halon 1301 agent. The engine space onboard the commercial tour vessel M/V THOMAS LAIGHTON is equipped with such a system.

Differences Between Halon and CO2 Fixed Systems Include:

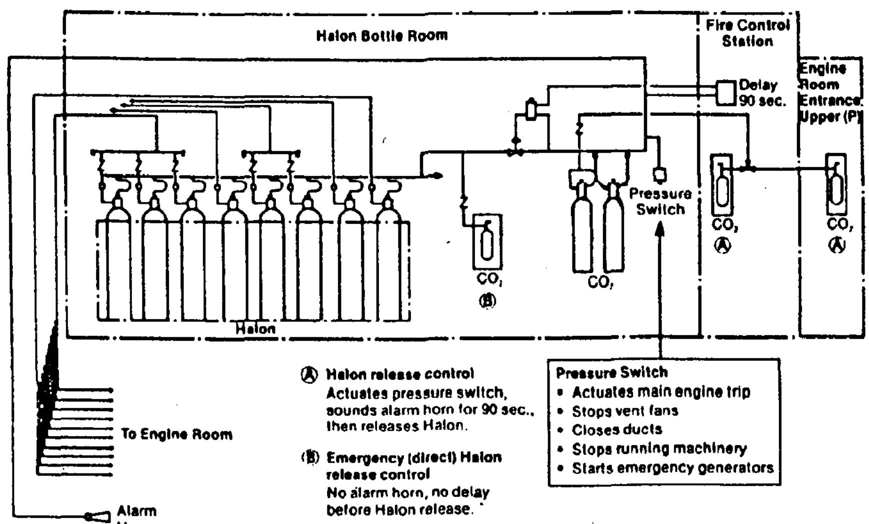
1. The primary strategy of a CO_2 system focuses on inerting and smothering the fire within a tightly sealed compartment over a long period of time. Halon is different in that it extinguishes the fire by **chemically interrupting** the combustion process. In this respect, halon is more like dry chemical. Incident Command may choose to combine tactics of both systems by immediately following halon application with application of an available inerting agent to the space. Automatic alarm and ventilation shutdowns are basically the same.

2. Halon is a more **expensive** extinguishing agent than CO_2. It may become **toxic** if exposed to flames and extreme heat, with toxicity increasing as a function of exposure time. The longer it takes the halon to extinguish the fire, the more volume of toxic material may be produced.

3. Halon is **delivered** at an extremely **rapid rate**. These systems are designed to immediately overwhelm the fire and are usually applied in less than 10 seconds. The diameters of manifold hoses and pipes are therefore much larger than CO_2 systems.

4. Halon **concentrations** necessary for extinguishment in a space are only a fraction of those needed for CO_2 systems. A 6%-8% concentration is normally sufficient for most materials.

Halon Piping Diagram for Engine Room



(Courtesy Chevron Shipping Safety Bulletin)

Note: Pressure switch automatically shuts down the main engine and various equipment while starting the emergency generators.

Dry Chemical Fixed Systems

Vessels fitted with dry chemical fixed systems will probably have them protecting galley cooking areas. These areas, the range, range hood and associated ducting are susceptible to fire due to the grease and oils used or produced by cooking. Systems vary, and may be combined with a water spray in the hood and/or ductwork which may also serve a routine maintenance washdown function. Systems may be activated automatically by fusible links, thermostats and other detection devices. Manual releases should also be available. If activating manually, DO NOT SHUT DOWN THE EXHAUST FANS as they will help suck the dry chemical into the ductwork where the most serious fire threat exists.

LPG vessels discharging at Sea-3, Inc. in Newington generally have extensive fixed dry chemical systems for cargo-related areas, particularly at cargo hose connection manifolds. These systems may include fixed monitors or individual stations with attached handhose for localized application. Before activating a handhose unit, PULL ALL THE HOSE OUT of its container if not on a reel. Otherwise, a kink may result and reduce or block discharge of the agent.

In addition to the dry chemical systems, these LPG ships may also have open deck water spray systems (see page 9). These could be used to help disperse leaking vapors or, for fire, to help protect and cool exposures from the intense radiant heat that could result. Some water spray systems may be activated automatically by local detectors or sensors.

Twinned Agent Systems

Twinned agent systems are unusual for merchant vessels. They are more likely to be found onboard military vessels at PNSY or visiting military vessels such as the USS JOHN KING. Generally, the systems contain bottles or tanks that supply two different agents through separate chambers of a double-chambered handhose. Usually a PKP type dry chemical is used in conjunction with an AFFF type foam. The dry chemical is applied first for quick knockdown, and then followed by the foam for vapor coverage.

Fixed Deck Monitors

Most liquid bulk ships that call at Portsmouth will have fixed monitors on deck for foam/water application over the cargo areas of the main deck. As mentioned on the previous page, LPG ships may have dry chemical monitors that protect the cargo manifold areas at about midships.

Tankers normally have two separate mains on deck. One is the fire main and the other is the foam main. Usually, the monitors have the capability of distributing water or foam by individual valved connections to each main. Sometimes, the monitors are connected only to the foam main. In this case, the foam system must be lined up to deliver either foam or water to the monitors unless a crossover is opened between the two mains. In no case though, should the foam main interfere with the fire main.

Deck monitors are similar to those on landbased apparatus. They are usually designed for application patterns to overlap from one monitor station to the next. Tankers by design, usually have their decks enclosed by a metal "fishplate" for containment

Fixed Deck Monitors (continued)

of cargo spills. This rim is generally 6"-10" high around the entire cargo area of the main deck. The more "even" the ship is with respect to list and trim, the more volume of liquid will be contained on deck (assuming the scupper plugs are in place). The main disadvantage of the fishplate in firefighting is that it contains burning liquid that might otherwise go over the side and into the water. The advantages are that it will contain the foam blanket, reduce pollution and minimize the exposure hazard of burning liquid on the water to other vessels and structures.

Inert Gas Systems

The design intent of a ship's inert gas system (IGS) is fire prevention rather than fire extinguishment. There are two common types of systems: (1) independent inert gas generators systems and (2) flue gas systems. Essentially, they both accomplish the same result: a reduced oxygen atmosphere in tanks carrying bulk liquid hydrocarbon products. Whether the tanks are almost full or empty, an IG system reduces the normal 21% oxygen (in air) content to 5% and below. If used properly, a system will help prevent explosion and/or fire that might otherwise have occurred.

In Portsmouth, tankships that have IGS will probably be fitted with the gas generator type. This type may be more useful if an incident has involved the vessel and large amounts of gas are required for either continued fire prevention or possibly fire suppression. The gas, which is primarily nitrogen and carbon dioxide by volume, may be utilized to inert a space and achieve similar results as with CO2. However, slower gas delivery rates and generation unreliability are some of its disadvantages compared to a fixed fire extinguishing system like CO2.

Concerns. Inert gas produced onboard poses many of the same risks as those discussed for CO2. It will be a **life hazard** to unprotected personnel who enter enclosed spaces that may contain the gas due to leaks, ruptures. etc. Be especially careful with any space over cargo tanks, the inert gas room and, if onboard, the vapor compressor room for vapor balance/recovery systems.

More detailed information is available in Chapter 9, ' Fixed Fire-Extinguishing Systems' of the Marine Fire Prevention, Firefighting and Fire Safety copy distributed PRIDE '87 by MSO Portland.

FIXED FIREFIGHTING SYSTEMS

TECHNICAL SUMMARY

References: NFPA Standard 12

Fire Protection Handbook 13, Chapter 3, 4 & 15

Texas A & M

A. CARBON DIOXIDE

1. Properties

   a. Inert, non-conducting, non-corrosive, and at atmospheric temperature and pressure is a dry vapor.

   b. Solid at atmospheric pressure at -110°F.

   c. Cannot exist as a liquid below 75 psia.

   d. Vapor only above 87.5°F.

   e. Controls body's breathing cycle; normal exhaled air is four percent carbon dioxide; at nine percent, unconsciousness will occur and at 20 percent death occurs in 20-30 minutes.

2. Extinguishing Characteristics

   a. Smothers by lowering oxygen below 16 percent.

   b. Slight cooling, about one-tenth that of water.

   c. Most effective when released as a liquid and expanded to vapor at nozzle.

   d. Heavier than air (specific gravity is 1.5), which helps smother fire.

   e. Must reach a local concentration of about 30-40 percent to be effective.

   f. Essential that ventilation be secured.

   g. Will dissipate and allow reflash.

   h. Ineffective against materials having own oxygen or reactive metals, i.e., cellulous nitrate, sodium, etc.

   i. Effective on B and C fires; will suppress but not extinguish a deep seated fire.

3. Storage

a. Low pressure systems less common on ships; 0°F, 100 psi, requires refrigeration; 1800 psi piping systems store one pound of carbon dioxide for each pound of metal.

b. High pressure systems are the most common; 70°F pressure if 850 psi; piping rated at 5000 psi; stores about one pound of carbon dioxide for each two pounds of metal.

c. Maximum storage temperature for a high pressure system is 130°F, which is about 2500 psi; frangible discs and relief valves set at 2600-3000 psi.

d. High pressure systems are only filled to about two-thirds of bottle volume capacity; thus, 1.4 times as much carbon dioxide as required must be carried. For the same installation, a high pressure system must store 1.4 pounds for every pound in a low pressure system.

4. Types of Systems

a. Cargo Systems -- for dry cargo holds on a sealed limited access space.

(1) Controlled carbon dioxide release over a long period of time (days); controls and suppresses fire until vessel reaches port; seldom extinguishes fire.

(2) Amount of carbon dioxide to be released specified in individual vessel operating manual.

b. Total Flooding Systems

(1) Specified quantity release (usually a volume factor of one pound of carbon dioxide for every 30 cubic feet) within two minutes.

(2) Carbon dioxide must be stored outside space unless system is less than 300 pounds and automatic release is provided.

(3) Remote release is required to be conveniently located to escape route.

(4) Manual pull must require less than 40 pounds of force and 14 inches movement.

(5) Two distinct operations are required to minimize inadvertent release, usually a cylinder valve and a direction valve.

(6) Twenty-second time delay and audible alarms are required on systems of 300 pounds or above.

(7) Two pilot valves required for systems of three or more cylinders.

(8) Bottle must be stored upright to assure liquid discharge.

(9) Automatic ventilation shutdown is required.

(10) Cylinder must be hydrostatically tested every 12 years if unused and every five years if recharging is required.

B. STEAM

1. Obsolete; systems still exist only on older vessels. It is not permitted for firefighting on vessels constructed after January 1, 1962.

2. Personnel hazard; no warning; scalds.

3. Since there is no vaporization, steam offers little cooling and relies only on smothering effects.

4. The extensive steam smothering piping system caused numerous maintenance problems and reduced the reliability of the system.

C. HALON

References: NFPA Standard 12A

Fire Protection Handbook 13, Chapters 4, 5, and 15

1. General Information

a. Extinguishes by disrupting the chain reaction, but there is some oxygen displacement.

b. Acceptable systems are a gas; however, original systems used liquid carbon tetrachloride, which was found to be too toxic.

c. Only presently approved Halon agent is 1301.

d. Primarily used for Class B and C fires.

e. Space can be flooded with Halon to extinguish fire, yet personnel can survive.

f. Halon 1301 affects vision and coordination during exposure to 7 to 10 percent concentrations; however, it decomposes to very toxic materials when exposed to 900°F; therefore, spaces should be evacuated as rapidly as possible; decomposition products have acrid smell at very low concentrations and therefore provide a warning.

g. Halon normally is stored as a liquid at 70 psi and 70°F; the maximum temperature is 130°F.

h. Vapor has a specific gravity of five.

i. Normally extinguishing concentrations are in the five to seven percent range.

j. Discharged within 10 seconds in total flooding systems.

2. Types

a. Vary as to chemical composition.

b. Numbers indicate number of atoms in chemical composition in following order: carbon, fluorine, chlorine, bromine, and iodine. Example: 1301 is $CBrF_3$; or bromotrifluoromethane.

(1) Bromine increases fire extinguishment.

(2) Fluorine increases inertness and stability.

(3) Halon is more costly than carbon dioxide; however, due to the greater effectiveness and systems costs, life costs of carbon dioxide and Halon are about equal.

D. WATER SPRAY SYSTEMS

References: NVIC 6-72
NFPA Standard 15
46 CFR 34.25

1. May be used in dry cargo compartments, lamp and paint lockers, pumprooms, and special deck tank protection for gas carriers.

2. Single valve or control operation required.

3. No real distinction between spray and sprinkler systems.

4. Application of 1.12 gpm/ft^2 required for sprinklers.

5. Cargo deck tanks require 0.25 gmp/ft^2 for exposure protection, <u>not</u> fire suppression.

6. Greatest problem is inability to test and maintenance of the systems.

Section Six

RELEVANT VESSEL SYSTEMS

A ship's self-sufficiency depends on the operation and maintenance of specially designed onboard vessel systems. Some of these systems such as fixed extinguishing systems, are directly related to fire combat operations. Others, such as ventilation or emergency power are indirectly related and relevant. Familiarity with and knowledge of these relevant systems can improve firefighting strategy, tactics and safety performance.

"What makes men good is held by some to be nature, by others habit or training, by others instruction."

Aristotle

Relevant Vessel Systems

A ship is designed to be self-sufficient. Sea-going vessels are stored with supplies, fuel and water to be self-sustaining for long periods of time. A vessel at sea does not have access to an electrical utility like Public Service New Hampshire nor the municipal water supply. It does not need to. It is its own fire department, police department, fuel supplier, food supplier, building maintenance and engineering plant, and, damage and flood control unit. The ship is also self-supporting in that it carries equipment to be anchored or moored to a dock.

A ship's self-sufficiency depends on operation and maintenance of specially designed onboard vessel systems. Some of the regularly used systems may relate directly and/or indirectly to fire aboard. These systems include:

- Fixed Ventilation Systems
- Electrical Generation Systems
- Fuel Supply Systems
- Fixed Dewatering Systems
- Mooring Equipment and Systems
- Anchoring Equipment
- Water Supply Systems (see Fixed Systems-Firemains)
- Fixed Fire Extinguishing Systems (see Fixed Systems)

Pilots and the USCG MSO may be available to provide consulting assistance along with vessel personnel regarding these systems. However, some general knowledge for firefighting personnel will enhance the firefighter's ability to operate the systems if the task falls to them. The following information used in conjunction with classroom training and the Vessel Orientation Program (VOP) is useful in this regard.

Ventilation Systems

Power ventilation systems are similar to systems in large facilities having air ducts, fans, fan motors, motor controls, manual and automatic dampers. Passive ventilation systems rely on forward movement of the vessel to create a flow of air through spaces not usually occupied by personnel such as lockers, storerooms, etc. They are manually controlled systems that utilize directional funnels, hatches, manual dampers and compartment accesses such as doors.

Air ducts are used for heating, ventilation and air conditioning. They may interfere with fire control if unchecked.

1. They can feed air (oxygen) to support combustion.
2. They allow heated gases and fire to travel to other areas of the vessel.

Any moving equipment, like fire dampers or hatch covers, should be suspected of 'freezing' due to:

- o the corrosive salt water environment
- o inadequate lubrication and maintenance
- o lack of use or periodic inspection

If this is the case, the ducts or hatches may have to be secured by some alternate means such as tarps, gasket material or any non-combustible material that can plug the opening.

Power ventilation systems may be positive pressure systems, negative pressure systems or a combination of both. Depending on the space to be ventilated, the system may be an intake blower which forces air into the space, an exhaust fan which pulls air from the space, or a fan that does both while exchanging some recirculated air with air outside the space. Emergency blower stops may be located in the wheelhouse, Engineer's accommodations, and the cargo control station. Most crews will immediately know to secure the ventilation to burning spaces. When attacking the fire, ventilation efforts will require good coordination.

See Case Study:'Fire and Explosions Onboard the Panamanian Passenger Ship EMERALD SEAS in the Atlantic Ocean near Little Stirrup Cay, Bahamas-July 1986.'

Electrical Generation Systems

Ships produce both AC and DC power and usually have multiple generators for daily operational requirements.

Steamships usually have turbogenerators that rely on the boilers to produce steam for the turbines. If the boilers are shutdown due to fire, generator power is lost. Some steamships may also have a diesel generator which functions independent of the ship's boilers.

All ships will have at least one emergency diesel generator that will be located in a different area from the other generating units. This is usually a small generator that will support only minimal lighting, ventilation and operating systems through the vessel's 'emergency power circuit'.

Most ships' emergency 'diesels' are automatic starting units that use battery, air or hydraulic starting mechanisms. If the 'mains' fail, the emergency diesel generator(s) will normally come on line as soon as the operating speed is reached in less than 30 seconds. **CAUTION: If the unit is not properly maintained, the possibility exists that the starting pressures or electrical current may not be sufficient to start the unit.** Lack of use and inattention can cause problems with any machinery, and the emergency diesel generator is no exception.

Fuel Supply Systems

Except for the submarines at PNSY, most vessels will use liquid petroleum products for fuel. Generally, this will be Marine Diesel Oil (MDO), Intermediate 180/380, Bunker C and Gasoline for small vessels.

Bunker C is very viscous at ambient temperatures and is heated prior to being transferred. This is the case when pumped to the ship from a barge, transferred within the ship or prior to being burned usually in the ship's boilers. Fires caused by the overheating of bunker C are not uncommon.

Fuel Supply Systems (continued)

Fuel systems are located throughout machinery spaces and often contain preheated fuels under pressure. The abundance of hot surfaces in machinery spaces provides many potential ignition sources for a ruptured or leaking fuel line.

These hot surfaces and those produced during a machinery space fire threaten re-ignition of fuel fires. Always observe precautions for the possibility of flashback or reflash.

Hot or overheated bearings in fuel pumps can quickly become a problem. This is also the case with tanker cargo pumps. Overheated bearings have caused a number of shipboard fires.

See Case Study: CHEVRON NAGASKI:1985 Pumproom Fire

Fixed Dewatering Systems

Fixed dewatering pumps are usually electrically driven, and therefore depend on ship's power for operation. Some may be steam reciprocating and others may be driven by an independent diesel engine.

Some dewatering pumps may also double as fire pumps.

It may be possible to run dewatering pumps off the vessel's emergency generating circuit. This may be impractical while simultaneously running a fire pump due to the limited electrical output from the emergency system.

Dewatering pumps usually draw water from the lowest areas in the vessel, including engine and pumproom bilges, cargo holds and low lockers and storage areas.

Drains of various sizes are fitted in most spaces to gravity feed water overboard from spaces above the waterline or to bilge areas. These drains or 'scuppers' are usually small diameters in the accommodation spaces and larger in cargo areas. Removal of plumbing fixtures at the deck may also act as drainage.

Mooring Equipment and Systems

Mooring equipment is used to keep the vessel at the dock, and for docking and undocking operations. It mainly consists of the lines or ropes that attach to the dock or shore, and the mooring winches that maintain the tension on the lines.

Lines may be fiber or wire (steel). Wire lines have fire safety advantages over the fiber lines. Fiber ropes may possibly melt or burn. The more popular fiber lines are synthetic materials including:

- Polypropylene
- Polyethylene
- Polyester
- Nylon
- Dacron

Nylon is very elastic and may stretch 25%-30% of its length. Dacron is less elastic and may stretch about 10% of its length. The 'polys' vary inbetween. Wire rope has very little elasticity, less than 3%-5%.

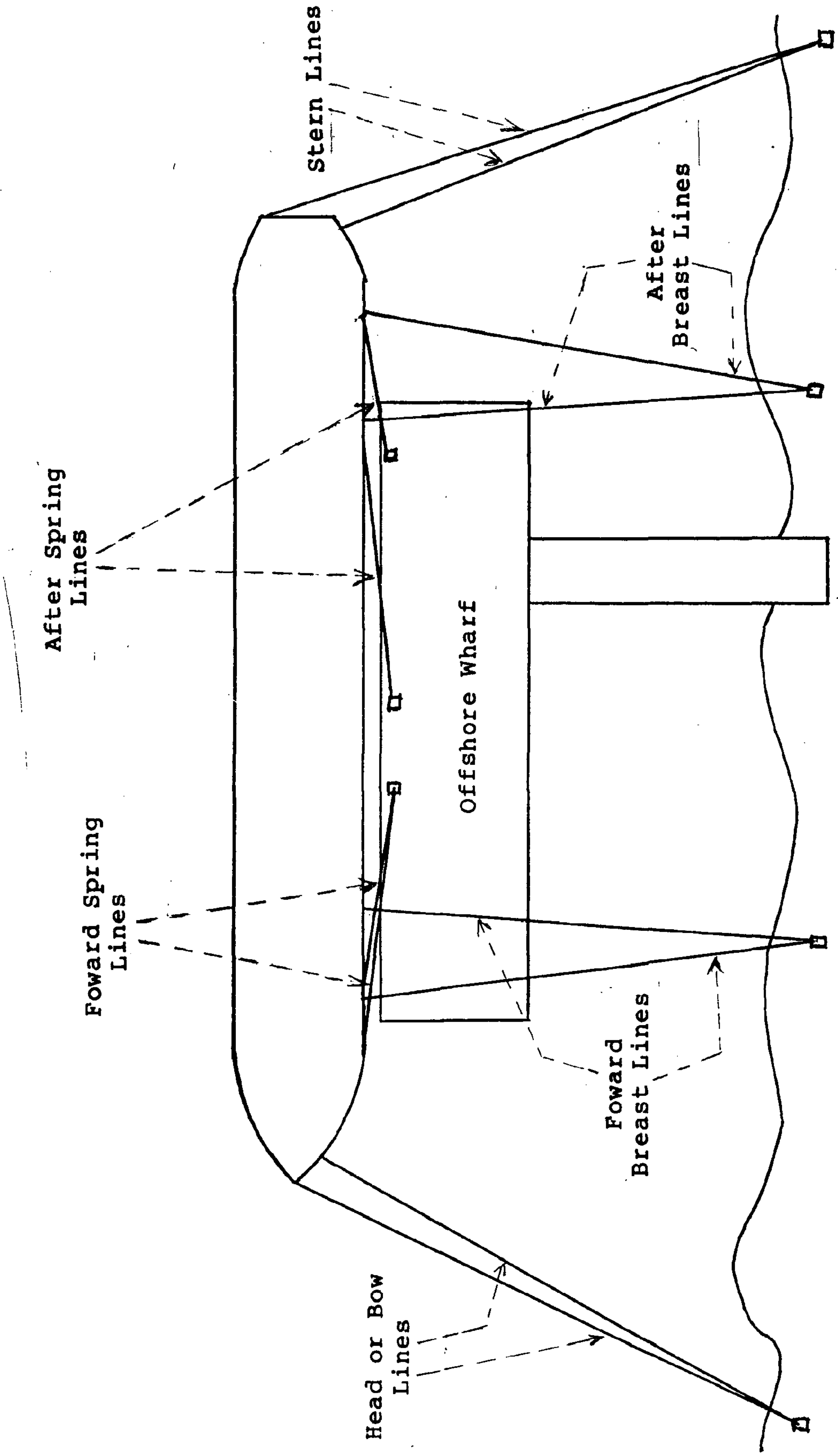
Wire ropes that become too tight may fail and part. When they do there is usually not much 'whipping effect'. Fiber lines that have stretched considerably before parting will often 'whip back' and may hurt someone or cause damage.

Mooring winches may be manual or automatic tensioning. As the tide drops, the vessel drops and the slack must be taken up. A rising tide normally requires the lines to be slacked. Automatic tensioning winches will adjust automatically by gauging the amount of stress on the line and taking it in or paying it out.

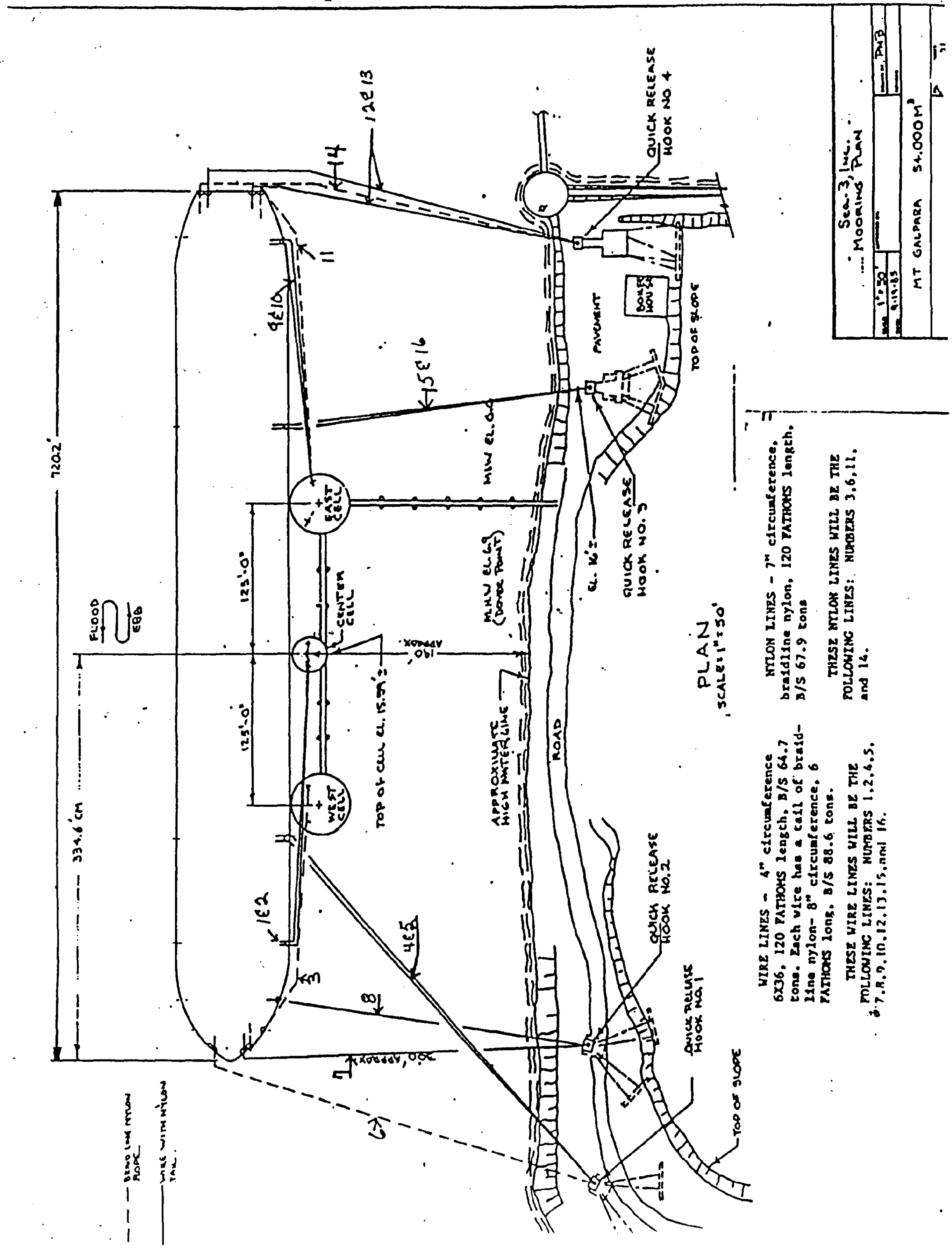
As the vessel unloads its cargo (most vessels discharge cargo in Portsmouth), the ship rises out of the water requiring the lines be slacked. If this occurs with a rising or incoming tide and the lines are manually adjusted, the one person that usually is tasked with 'tending' the lines will be very busy.

If large amounts of accumulated firefighting water are being pumped off and none is being introduced into the vessel, the effect may be similar to the offloading of cargo and should be carefully monitored.

Basic Mooring Line Terminology



LPG Ship Mooring Arrangement

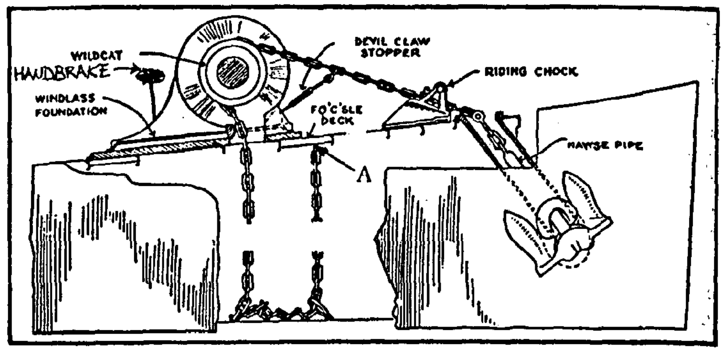


Basic Line Terminology

Page 6 is a diagram indicating mooring line terminology for firefighting purposes. Page 7 is an actual Sea-3, Inc. "Required Mooring Plan" arrangement in the USCG COTP Portland, Maine 'LPG Vessel Management Plan and LPG Emergency Plan'.

Anchoring Equipment

Starboard Anchor and Windlass



(Courtesy of Merchant Marine Officers Handbook)

Most vessels have two anchors, one on each side of the bow. Prior to a vessel's arrival at Portsmouth, the safety mechanisms that secure the anchors will be released. These may be hooks or chains that insure the anchors will not loosen from their stored positions while at sea.

While in the harbor, the anchors are capable of being released in seconds. The wildcat will probably be disengaged from the anchor windlass to allow for emergency release of the anchors. If this is needed, **the steps to drop the anchor are** basically:

1. The vessel should be stopped or have very little speed.
2. **The "riding pawl' ("chain stopper") must be raised** so the chain can run freely.
3. **The brake must be released.** This is usually a large handwheel that is turned counter-clockwise to release.
4. **Tighten the brake** when sufficient 'shots' of chain have been released. Otherwise serious consequences may result.

CAUTION: EYE PROTECTION SHOULD BE WORN DUE TO THE RUST, SCALE AND OTHER MATERIAL THAT WILL FLY OFF THE CHAIN AS IT EXITS THE CHAIN LOCKER AND GOES OVER THE WILDCAT.

Engaging and lifting an anchor requires power to the anchor windlass and an experienced person who is familiar with anchors.

Section Seven

STABILITY and DEWATERING

The intent of this section is to provide a basic understanding of vessel stability and dewatering to Portsmouth Harbor fire personnel who must comprehend and base decisions upon expert advice that should be available during an incident. Though stability is built into a vessel, the vessel's stability may become precarious. This may be due to the introduction of large amounts of water among several reasons. It is important that landbased firefighters understand the principles of stability and need for dewatering in order to practice prudent strategy and tactics.

"Great is truth. Fire cannot burn, nor water drown it."

Alexandre Dumas the Elder
The Count of Monte Cristo

Vessel Stability

Concepts and Definitions

Vessel Stability and Equilibrium. Stability is the tendency of a floating vessel to return to an upright position when inclined from the vertical by an external force. If the vessel returns to or remains at rest after being acted upon, it is either in stable or neutral equilibrium. If it continues to move unchecked in reaction to the external force, it is in unstable equilibrium. An unstable vessel therefore, is one that after being inclined, continues to incline, possibly until it capsizes. Throughout an incident, it is desireable to maintain vessel stability and minimize list.

Initial Stability. The ability of the vessel to initially resist heeling from the upright position is determined by its initial stability. The vessel's initial stability characteristics hold true only for relatively small angles of inclination. At larger angles, defined as those over 10 degrees, the ability of the vessel to resist inclining moments is determined by its overall stability characteristics.

Unquestionably, expert advice should be obtained anytime the stability of the vessel is in doubt. A complete list of consulting resources, including those for vessel stability, should be compiled and maintained. The vessel's crew, who should be most familiar with the vessel's stability situation, may not always be available or able to provide adequate situation assessment (see 'Stability Information').

Center of Gravity. The concept of center of gravity, whether for a vessel or other mobile equipment such as an aerial ladder or snorkel, is essentially the same. In essence, the weight of the particular piece of equipment is considered to be concentrated at that point. As an aerial ladder is raised, the unit's center of gravity rises and is counteracted by the inherent weight of the vehicle and its supporting outriggers. Similarly, a vessel's center of gravity also rises as weight is placed higher in the vessel. It differs in that it is unable to provide external support mechanisms (i.e. outriggers) due to the water around it.

Vessels, will therefore suffer a loss of stability as water utilized in firefighting is accumulated above the original center of gravity. This is particularly significant in regard to vessels with large superstructures like passenger ships and car carriers. The higher the weight, the more detrimental the effect. If this vulnerability is not properly understood and controlled, the consequences may severely impact all firefighting efforts. It is an integral part of overall strategy.

Free Surface Effect. Free surface, for firefighting considerations, is the tendency of liquid within a compartment to remain level as the vessel is transversely inclined or heeled providing the compartment is : (1) intact, (2) partially full, and (3) allowing the liquid to move unimpeded from side to side. The free surface effect of loose water anywhere in the vessel will impair stability by raising the center of gravity in an apparent or virtual sense.

Combined Effects. The strongest threat to vessel stability from water-induced firefighting efforts is encountered when the water is (1) confined high in the vessel and (2) is free to travel significant distances across the beam. The consequences of these combined effects may be devastating. Unfortunately, they sometimes trigger other serious problems. Once the vessel begins to heel, this 'domino effect' may quickly compound an already aggrevated situation. These concerns will be addressed in the next section.

Vessel Draft Marks

Newport News Shipbuilding—Nixon

Typical and Efficient Modern, Double Plate, Semi-Balanced Rudder (on horn) in a Single Screw Ship.

Vessel Stability Concerns:

General. The most important concern regarding vessel stability is control of the vessel's list. The inability to maintain the vessel at a reasonable degree of transverse levelness will seriously impact all firefighting operations.

Firefighting Factors Affecting Stability. The introduction of large amounts of water into the vessel as a result of firefighting operations will probably be the most critical factor affecting vessel list. Other factors include:

- o intentional flooding of compartments
- o personnel/equipment movement through watertight doors

Stability Factors Affecting Firefighting. As a vessel's list increases, so do the concerns related to firefighting activities. As the vessel heels, poor footing on slippery decks can slow or stop fire combat teams. It may be difficult to apply and maintain a foam blanket. Other concerns include:

- o increased chance of flammable liquids spilling
- o possible closure problems with automatic fire doors
- o strain and possible failure of mooring lines
- o restriction and loss of vessel access/egress
- o damage or injury from loose objects shifting
- o problems with fixed dewatering drains and suctions
- o loss of vessel machinery due to excessive sustained list

Vessel Factors Affecting Initial Stability. The stability of the vessel is described as its ability to resist heeling from the upright position at small angles of inclination. This ability, which is a function of the vessel's GM, may diminish rapidly as the incident progresses and will depend on current vessel factors such as:

- o the free surface status of all liquids aboard
- o whether or not the hull is intact
- o if contacting ground, flatness of hull bottom
- o whether double bottoms are empty or full
- o if flooding, intactness of watertight boundaries

Instability Factors Affecting Overall Stability. As the vessel destabilizes and list increases to larger angles of inclination, other factors may aggravate the vessel's worsening condition. These include:

- o shifting of loose, bulk dry cargo such as grain or coal
- o flooding from unsecured hull openings like portholes
- o movement of unsecured cargo, machinery, stores, etc.

Instability Factors Affecting Underway Operations. The self-propelled movement of a destablized vessel within a confined waterway may be hampered by operational difficulties. If suffering a large list, trimmed by the bow, or drawing too tight a draft for the available water, operational concerns would include:

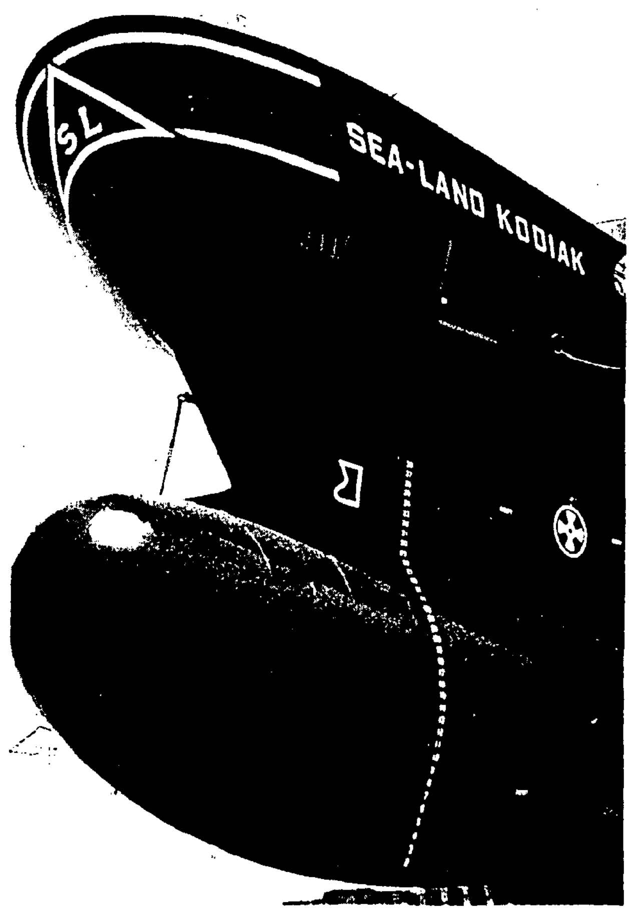
- o steering system may function improperly
- o vessel machinery may not function at large lists
- o loss of manuevering control due to proximity to bottom
- o if poor visibility, needed radar aid may be reduced
- o free surface may cause vessel to flop from side to side

External Factors Affecting Stability. If external factors are anticipated, then it is more likely that negative impacts will be lessened and positive impacts used to their full advantage. External factors would include:

- o adjacent structures such as piers and wharves
- o mooring lines if vessel is listing away from structure
- o range of tide may cause vessel to contact bottom
- o contour of bottom beneath vessel if contact ocurrs
- o bottom composition beneath vessel such as mud or rock
- o precipitation accumulations of snow or ice on high areas
- o sea state of surrounding water
- o action of passing vessels (wake, suction effect, etc.)
- o unusually intense high winds if significant 'sail' area

Bulbous Bow with Foward Draft Marks

(Notice painted symbols on bow indicating the bulbous bow and the bow thruster)



Basic Stability Information and Resources

Stability Resources. An Incident Commander with a basic understanding of stability , should be able to make decisions with appropriate consultation. A review of information gathered prior to the incident and during the incident are necessary to the best decision making. Information resources are divided into consulting personnel and documentation. Stability equipment resources are discussed under 'Dewatering'.

Consulting Personnel. Prior to an incident, a regional inventory of stability advisors should be compiled. The list of these agencies and individuals will include the USCG COTP and the Marine Safety Office (MSO) located in Portland, Maine. The COTP or representative wil be on-scene to provide assistance and stability advice. The COTP can also help access and coordinate various federal resources and agencies should additional expertise and/or equipment be necessary. Stability advice may also be obtained from other personnel including:

- o vessel's officers - Master, Chief Mate and Chief Engineer
- o vessel operator/owner representative such as Port Captain
- o Portsmouth Navigation Pilots
- o N.H. Port Authority Director
- o Portsmouth Naval Shipyard Staff
- o salvage masters
- o officers from other vessels
- o marine consultants
- o naval architects
- o maritime academies
- o marine firefighting schools

Documentation. It is prudent to maintain vessel information. This should include information on regularly and occassionally visiting vessels. Since it may be difficult to gather information during an incident, gather information as possible. General information and copies of vessel documents may be available from the owner or operator if you should need information during an incident. In an emergency though, some firms may be able to send information via facsimile. The preferred approach is to be familiar with the vessel's onboard documentation prior to an event. Documentation and other information which may be helpful with stability considerations include:

- o vessel trim and stability booklet or similar document
- o vessel tons per inch immersion factor (T.P.I.)
- o vessel general arrangement plan
- o vessel capacity plan
- o vessel fire control plan
- o vessel docking plan
- o vessel cargo plan
- o slide rule used to calculate trim and stress factors
- o computer or loadmaster used for stability calculations

Obtain Primary Stability Information. Basic stability data should be gathered during the initial stages of an incident. The methods or sources used to obtain the data often affect accuracy. Always endeavor to verify information.

Vessel Drafts. Most large vessels have draft marks as vertical scales on both sides of the hull at the bow and the stern. They are usually incremented in either feet or meters with the bottom of the number being the 'zero' line. Large ships and barges also have draft marks midships on both sides. All drafts should be visually read as soon as possible in order to establish a baseline for future reference. For various reasons, automatic draft gauges for obtaining draft readings remotely should be suspected as inaccurate. If possible avoid using an automatic reading as the primary source of draft information. Consider such readouts a good double check for visual hull observations.

Vessel List. The angle of transverse inclination is normally obtained aboard by reading the vessel's inclinometer. Most vessels have one in the wheelhouse on the bridge deck. Some vessels, particularly large ones, may have additional inclinometers at other locations including the: engine room control flat, cargo control room, Master's office, Chief Mate's office, Chief Engineer's office, or at a prominent centerline location on the main deck. Similar to the drafts, establish a baseline reading as soon as possible for monitoring purposes.

Vessel Status. Determine tank and cargo status. If cargo operations were in progress, the vessel may be considerably more vulnerable to stability problems. This is especially true of bulk carriers and even more so of liquid bulk carriers due to the free surface effect. The location and status of any flooded compartments within the vessel should also be ascertained at this point.

Available Depth of Water. Determine the minimum depth of water at the shallowest location beneath the vessel. Subtract the vessel's present deep draft from the water depth to obtain the vertical distance between the vessel and the bottom. Tidal changes should also be incorporated if applicable.

Type of Bottom Material. If the vessel contacts the bottom, the nature of the bottom can be a very critical factor. For example, the difference between a mud or rock bottom is extremely significant. Vessel aground considerations apply. As above, determine this as soon as possible and insure accuracy.

Secondary Stability Information: If vessel stability is in doubt, the initial assessment should be followed by another assessment to include other information such as:

- Openings in hull
- Water flow into vessel
- Vessel dewatering capacity
- Watertight capabilities within vessel
- Mooring lines status and operation
- Vessel's proximity to the bottom

Dewatering

Vessel Fixed Pumps. Vessels will usually have bilge pump capability for most machinery spaces and large compartments that are situated in the lower parts of the vessel. Some of these spaces may include:

- cargo holds
- main engine room
- boiler room
- shaft alley area
- cargo pumprooms
- thruster rooms
- forward machinery space

Vessel Drainage System. Drains located onboard most vessels are designed to gravity drain most spaces that are above the vessel's normal waterline through the hull into the sea. Spaces that are at or below the water line are often drained into the vessel's bilges. Whether they drain overboard or into the bilge, these drains (called "scuppers") are generally small in diameter making them vulnerable to blockage by debris that would almost certainly be present throughout the firefighting efforts. Swimming pools should have their own drain system. Also, in accommodation areas, removal of plumbing fixtures at the deck level may also assist in drainage.

Portable Pumps Brought Onboard. Dewatering arrangements should be made without delay. Moving portable pumps onboard will require hoisting equipment and numerous personnel to assist with positioning. Dewatering considerations should be automatic and must be addressed without delay if the fire is not quickly suppressed. Sources of portable pumps in addition to those of the municipal fire departments may include:

- USCG COTP
- Portsmouth Naval Shipyard
- pollution cleanup contractors
- industrial pump suppliers
- salvage companies
- USCG Strike Teams

Portable Pump Types. Pumps may be powered by a variety of methods including electricity, air, gasoline and water. Of all, the water eductor or ejector pump is probably one of the most efficient devices to position within the vessel. It works on the syphoning principle of a venturi and has no moving parts. These units are extremely lightweight and require no supervision once they are operational.

Cutting Holes. In areas of the superstructure, where the metal is relatively thin, it may be preferable to cut holes to allow water to run out. Do not violate the hull's integrity as a serious list may allow water to pour in the hole rather than out.

Stability Tactics

Vessel List. Generally, the prime stability concern of an Incident Commander is to minimize the vessel's list. Control of the list may be accomplished through a variety of tactics and will depend on the cause(s) of the list and the particular circumstances involved.

List Correction. If the list is due solely to the accumulation of water through firefighting efforts, then the preferred tactic for corrective action is to remove the water. Corrective measures are more complex for other list causing factors such as progressive flooding or large weight shifts.

The following outline is a sequence of actions to help limit and improve an impaired stability situation, and, the list that accompanys it:

(1) Determine and establish flooding boundaries.
(2) Remove water from partially flooded areas (remove free surface first).
(3) Remove water from solidly flooded areas.
(4) Transfer weight as appropriate (usually liquids).
(5) Add weight as appropriate (counterflooding).

Establishing Flooding Boundaries. Boundaries should be established to enclose the area subject to flooding. Vertical as well as lateral perimeters should be planned. Action should be swift and efficient.

Free Surface Reduction. There are two basic ways to reduce free surface: (1) completely fill the flooded compartment or (2) completely empty the flooded compartment. Filling may be a faster, more convenient approach but increases the vessel's weight, draft and possibly increases list. Emptying the compartment is much more desireable.

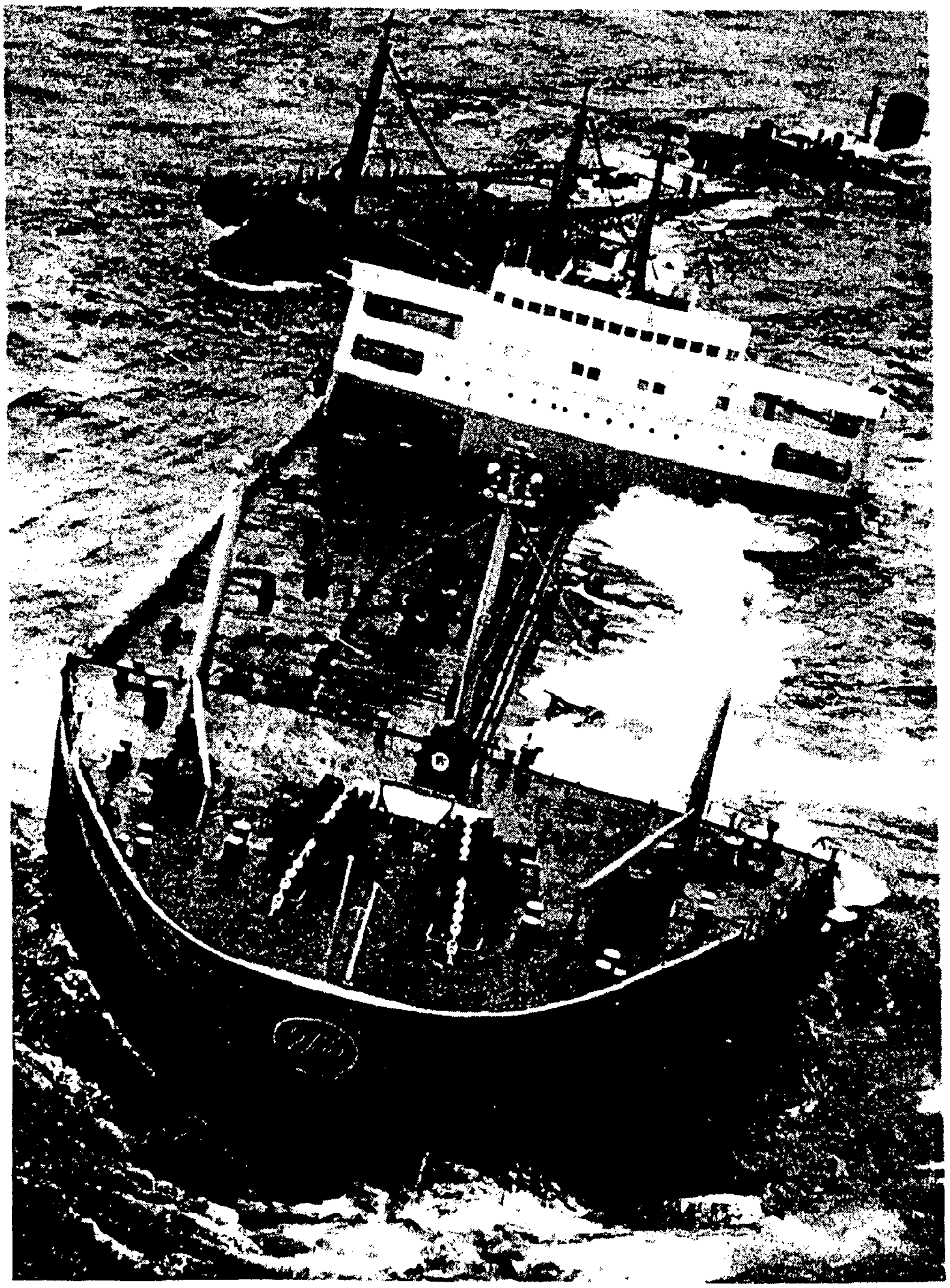
Weight Removal. Removal of liquid and solid weights from higher locations should lower the center of gravity, improve stability and help improve the list.

Weight Transfer. Weight transfer is normally accomplished with liquids since the movement of large amounts of solid objects will probably be impractical. Methods of transfer may include sluicing, pumping and gravitating.

Weight Addition. Similar to transfer, weight addition of liquids will usually be most practicable. This will probably be accomplished through counterflooding the compartment(s) with seawater. **NEVER counterflood if free surface is the cause of the list.** The result may be an even greater list to the opposite side. Always start with the lowest spaces available such as the double bottoms or low water tanks. The inherent free surface effect and the additional weight induced by counterflooding or counterballasting make it a "last resort".

Scuttling or Beaching. If it becomes apparent that the vessel is going to be lost due to capsizing or from the fire being too extensive to control, it may be necessary to sink or scuttle the vessel. Under these two circumstances, it may be necessary to sink the vessel at the pier by overall flooding. If time permits, and it is preferable, the vessel may be moved to a suitable beaching ground. There, it may be sunk awash without damage to the hull from a rocky bottom and where the vessel will not create an obstruction to normal shipping. However, the strong currents of the Piscataqua and the harbor's narrow lift bridges may significantly impact the risk of safely removing a large vessel from its berth. This decision will rest primarily with the COTP.

A Vessel Awash



The TORREY CANYON ran aground off Great Britain in 1967 due to a mistaken helm order.

Seven Stones Reef broke her in two, contributing to the environmental disaster.

Attempts to scuttle the vessel and her cargo of crude oil were relatively unsuccessful.

Dewatering Information

DEWATERING OSC-------------------NAME: ____________________
RADIO CHANNEL: ______________ CALL SIGN: ________ "DEWATERING" ____________
SHIP'S CREW LIAISON: ____________________

(REPORTS TO OPERATIONS)

(THE DEWATERING OSC SHOULD BE A MEMBER OF THE SHIP'S COMPLEMENT IF POSSIBLE. IF ASSIGNMENT AS OSC IS NOT FEASIBLE, A MEMBER OF THE CREW SHOULD BE ASSIGNED TO THE DEWATERING TEAM AS AN ADVISOR.)

NOTE: IF THE SITUATION APPEARS TO WARRANT A SUSTAINED FIRE ATTACK, DEWATERING OPERATIONS MUST START IMMEDIATELY!

(1) Establish Flooding Boundaries:
(a) PRIMARY (use fire zones)
Are Primary Flooding Boundaries Established------------------------------(YES/NO)

Are ALL Watertight Doors CLOSED---------(YES/NO)

(b) SECONDARY (within fire zones)

(2) Determine Water Intake Rate:
Use the following data:
1 1/2" fire hose = 175 U.S. gals. per min.
10,500 U.S. gals. per hour
0.7 tons per min.
41 tons per hour

2 1/2" fire hose = 300 U.S. gals per min.
18,000 U.S. gals. per hour
1.2 tons per min.
72 tons per hour

(a) CALCULATIONS:

IF "1N" = NUMBER OF 1 1/2" HOSES IN USE
AND "1T" = DURATION OF 1 1/2" USE IN MINS.
THEN 1N x 175 x 1T = TOTAL GALS. FROM 1 1/2" HOSES TO BE REMOVED

1 1/2" Total Gals. = __________

Total Tons = __________

IF "2N" = NUMBER OF 2 1/2" HOSES IN USE
AND "2T" = DURATION OF 2 1/2" USE IN MINS.
THEN 2N x 300 x 2T = TOTAL GALS. FROM 2 1/2" HOSES TO BE REMOVED

2 1/2" TOTAL GALS. = __________

Total Tons = __________

TOTAL FIREFIGHTING WATER
(1 1/2" + 2 1/2") TO BE REMOVED------________Gals.

-------________Tons

(3) Determine Amounts of Existing Water Onboard Prior to Firefighting Efforts:

(a) Passenger Vessel With Swimming Pools----(YES/NO)
(b) Number of Swimming Pools----------------________
(c) Capacity of Each Pool-------------#1________GAL
#2________GAL
#3________GAL
#4________GAL
(d) Capacity of Holding Tanks-----------________GAL
(e) Degree of Fullness of Holding Tanks---________

NOTES:
If involved ship is a passenger vessel with swimming pools, remove water from pools beginning with the highest first.

Obtain the capacity of the holding tanks and their degree of fullness.

If there is a sanitary drain available at the floor level, remove the fixture (toilet, shower, bidet) to allow the water to flow into the holding tanks which are well below the water line. The resultant shift of weight lowers the "CENTER OF GRAVITY".

REMEMBER: Freely moving ("FREE SURFACE") water in the vessel is dangerous to the stability of the ship and; therefore, dangerous to your fellow firefighters. It is the responsibility of the dewatering team to remove that water AS SOON AS POSSIBLE!

(4) Dewatering Filled Compartments:

(a) Are Any Compartments Completely Full----(YES/NO)

(b) Are Adjacent Compartments Full or Partially Full--------------------------(YES/NO)

(c) Is the Integrity of Adjacent Spaces' Bulkheads Endangered by the Filled Compartment--------------------------------(YES/NO)

(d) Will Bulkheads Collapse if Spaces are Dewatered Individually-----------------(YES/NO)

NOTE: "Pressure differentials between flooded and dry (dewatered) spaces must be anticipated and countered as required to prevent collapse of boundaries between the spaces. Changes in pressure can unseat patches. The weight added by salvage machinery and patching materials, especially large concrete patches, can affect stability. Gas hazards are possible in any dewatered space.

Entry into these spaces should be made only in accordance with prescribed safety precautions."

(5) Dewatering Equipment: The following equipment is immediately available in ______________________ :

Agency	Pumps	Cap	Phone

Section Eight

SPECIAL RESOURCES

Special resources are available and may be necessary for marine fire incident response. They range from paper documents to a flare gun with which to re-ignite a fire if appropriate. It is important that firefighting forces know what resources may assist them with combat and where these sources can be obtained. This section introduces the various special resources that should be studied.

"We need training because we do not get enough fire fighting experience and I don't only mean here in West Virginia, but in California, New York, the Midwest and Canada. Nobody gets enough fire fighting experience. Show me a guy who is loaded with fire fighting experience, and you show me an old man who is ready to retire."

'The Need for Training'
James F. Casey
'Proceedings-Annual West Virginia Fire School:11/68'

Special Resources

Unique attributes characterizing a marine fire involving a vessel include:

- o Lack of experience
- o Lack of familiarity
- o Access limitations to vessel
- o Movability of vessel
- o Potential amount of combustible material
- o HAZMAT/Pollution potential of incident
- o Special personnel and equipment hazards
- o Special resources

Municipal fire department pre-fire planning should address these characteristics. Vessel inventories would help Fire Chiefs assess these potential problems at the same time they increase vessel familiarity. Pre-fire plans may also address special resource issues and identify sources.

The maximum benefits from special resources are achieved through proper management and coordination of agencies. This identification and supply coordination is essential to the efficient management of the large marine fires. (Special personnel and organizational resources are addressed in the Operations Manual). Special resources include:

- o Special documents and information
- o Special firefighting equipment
- o Special support equipment and operations
- o Special craft and apparatus
- o Special fire extinguishing agents

Special Documents and Information

Vessel Inventory or Survey. A sample MARITECH vessel inventory has been provided each fire agency on the harbor. As possible, this information should be obtained for larger vessels. It will take vessel and fire department time to complete. However, once completed the agencies are more prepared to respond if fire occurs.

General Arrangement Plan. This plan shows the vessel layout including accommodation areas, machinery spaces, cargo tanks or holds and miscellaneous storerooms and spaces.

Vessel Fire Control Plan. Most self-propelled vessels more than 100 gross tons should have this plan. This is basically a general arangement plan of the vessel showing for each deck:

- o the various fire retardant bulkheads (see Sec. 2 page 4)
- o fire detection and manual alarm systems
- o fire extinguishing systems
- o fire doors, compartment ingress/egress
- o ventilation systems including dampers and remote stops

If possible, obtain a copy with the vessel inventory. It can be most helpful. Any number of reasons may make it difficult to obtain this plan during an incident. Fire control plans are required to be kept near the gangway in a watertight container.

Vessel Safety Plan. This plan illustrates the locations of safety equipment that may not be found on the Fire Control Plan. Example items are lifeboats, resuscitators and lifejackets.

Vessel Trim and Stability Booklet. This booklet contains information that is needed regarding vessel stability. The booklet should be obtained as soon as possible along with the other documents. It is necessary for stability issues. Information usually included in the booklet is:

- o The vessel's Hydrostatic Curves (or Curves of Form)
- o The Hydrostatic Table -displacement, DWT, TPI, etc.
- o The Curve of Righting Levers (or Stability Curve)
- o Data of flooding effects on compartments singly/combined

Special Firefighting Equipment

The following list of equipment should be available to firefighters, particularly fire combat teams:

60 Minute Air Packs	Especially if fire is deep in large ship
60 Minute Spare Tanks	Large number of spares may be needed
4500# Cascade System	To recharge tanks at fireground site
4500# Air Compressor	To recharge tanks or cascade system
Special Water Nozzles	As appropriate
Lifevests/Floatcoats	Especially for FF open deck liquid fires
Intl. Shore Connection	See Section 5 - Fixed Systems Fire Main
Foam Eductors	If using foam for vapor suppression
Foam Pick-up Tubes	For local foam access and application
Foam Nozzles	For application of mechanical foam
Infrared Detectors	To see fire through dense smoke
Explosimeters	For detecting combustible atmospheres
Monitoring Equipment	Thermocouples, O_2 & CO_2 monitors, etc.

Special Support Equipment and Operations

Vessel fires may take several days to ultimately extinguish. Therefore, special support equipment should be available and in quantities beyond those normally needed. Some equipment and operations not normally used might include:

Spare Radio Batteries	Many spares needed if long duration
Battery Chargers	Sufficient to recharge spares
Special Portable Radios	High wattage, intrinsically safe, etc.
Copier Machine	For plans, instructions and other info
Cameo Computer	For plumes and HAZMAT information
Recording Equipment	For documentation (tape recorder, video)
Portable Pumps	For vessel dewatering-intrinsically safe
Water Eductors	For vessel dewatering
Diving Equipment	For survey or dewatering assistance
Oxy-Acetylene Torches	For dewatering assistance or other
Underwater Torches	For cutting holes (Isothermic Torch)

Special Support Equipment and Operations (continued)

Hoisting Equipment	To move equipment/personnel on/off ship
Cargo Handling Equipt.	For removing cargo from vessel
Mooring Equipment	To replace/enhance vessel equipment
Shoring/Patching Aids	For control of watertight integrity
Tarps and Sealing Aids	For control of space being smothered
CO2 Transfer Equipment	To aid bulk transfer (hose, couplings)
Remote Ignition Device	Ignition/re-ignition LPG (i.e.flare gun)
Portable Generators	Trailer-mounted 50 KW unit at PNSY
Portable Light Units	For outside nighttime or inside vessel
Light Strings	As above (may require explosion-proof)
Extra Extension Cords	For department electrical equip onboard
Smoke Ejectors & Fans	For ventilation--smoke/fumes/fresh air
Ejector and Fan Socks	To assist ventilation tactics
Forcible Entry Equipt.	Especially metal cutting FE saw
Spare Fuel for Equipt.	If incident of long duration
Hand Trucks or Dollies	For movement of heavy equip (pumps/gens)
Fork Lift Trucks	To move drums of agent/palletized equipt
Personnel Shelters	For rest/recovery, rain or cold weather
First Aid Stations	If large mass casualty or potential of
Canteen Trucks/Huts	For food/refreshments if long duration
Portable Heatrs/Lights	For above shelters in cold weather/night
Outhouses	For obvious reasons

Special Craft and Apparatus

Search and rescue (SAR) activity around the harbor may best be accomplished by the USCG SAR Unit stationed at New Castle. They have equipment and apparatus suitable to SAR. Their boats are staffed and away from their facility within two (2) minutes of notification. The 41s can exceed 25 knots (29 MPH) and may be on scene in a matter of minutes. Their boats may also provide limited firefighting capability for small fires. The USCG Cutter TAMAROA stationed in New Castle, may be the first large Coast Guard vessel one scene. Her personnel contingent is considerable and well trained. However, the USCG's responsibility is not to fight large shipboard fires.

Special Craft and Apparatus (continued)

Once notified of the incident, according to the 'Piscataqua River Marine Disaster Plan', the USCG Group Portland may take charge of the SAR operations. Depending on the scope of the incident, they may request additional watercraft from USCG Base South Portland including USCG cutters. USCG Group Portland may also request helicopter assistance as necessary. However, helicopters near the scene will produce excessive noise and may also produce VHF interference. This could be disruptive to local communications. USCG helicopters servicing this area will be responding from Air Station Cape Cod with about 45 minute response. They should be able to communicate on marine channels, especially distress/calling channel 16 (156.80 MHz) and channel 22 (157.10 MHz).

The local military bases at Portsmouth Naval Shipyard in Kittery and Pease Air Force Base in Newington-Portsmouth may provide specialty pieces of apparatus and watercraft. The inventory includes two tugboats with mounted firefighting monitors (YTB-771 & YTL-602) at PNSY and 3 crash trucks at PAFB. If available to assist, these units should respond quickly due to their close proximity. If off hours, the PNSY tugs require about 45 minutes to staff and warm up.

Special craft and apparatus would therefore include:

USCG SAR Boats	For SAR, FF and waterborne support
USCG Cutters	IC/OSC firefighting and water support
USCG Helicopters	For SAR, offdock personnel/equip support
Portsmouth Navigation	Tugs for various waterborne support
YTB-771 & YTL-602 PNSY	Firefighting tugboats-2000 GPM each
PNSY Barges and Boats	Offshore equipment/personnel transfer
Lines Boats	For assisting with mooring lines at pier
Private Boats	Waterborne support-SAR/traffic/pollution

Special Craft and Apparatus (continued)

Mobile Command Post	If Mobile On Scene IC Post-NH OEM/S.Port
SCBA Service Trucks	To recharge expended SCBA bottles/tanks
Foam and Crash Trucks	If large amounts of foam are required
Trailer-Mounted Equipt	Foam generators, elec. generators, etc.
School Buses and Vans	For person transfer to/from fireground
Flatbed/Pickup Trucks	Transfer equip & foam to/from fireground

Special Fire Extinguishing Agents

Here again, the local military units are good sources of supply. PAFB has four to five thousand gallons of AFFF and will probably loan out at least half of it if necessary. They must retain adequate supplies for the protection of the base. The USCG SAR Unit at New Castle, the TAMAROA, and PNSY each maintain supplies of AFFF totaling hundreds of gallons. Within the IEU Mutual Aid System, hundreds more could be mustered.

If the incident is of great magnitude, many thousands of gallons of foam may be needed. Catastrophic fires could require tens of thousands. Airbases and airports probably have the best stockpiles and may provide supplies. Regional airports include:

- Loring Air Force Base
- Manchester Airport
- Portland International Jetport
- Logan International Airport (Massport)
- All New York/New Jersey Airports

Another important source of large foam supplies is the foam manufacturer. There are few firms in the United States producing these products. Most offer 24 hour emergency service to deliver very large amounts of foam directly from their sites. PAFB has indicated that emergency shipments of items like foam, may be flown into the facility unless defense requirements conflict.

<u>Special Fire Extinguishing Agents</u> **(continued)**

Foam Types. Except for the 2000 gallons of fluroprotein foam stored at the Fuel Storage fixed unit, foams in the Seacoast area are mostly the AFFF type. AFFF has very quick knockdown power but may lose its vapor suppression control in a relatively short period of time compared to protein-based foams. For polar solvent Class B fires, AFFF may not be as effective. These products may require more specialized universal polar solvent, alcohol-resistant or alcohol-type foams.

Stabilizers. To prolong the effectiveness of the foam, firms offer a stabilizing agent to be mixed with the foam prior to application on the fireground. With stabilizer, vapor suppression can be extended many times that of unstabilized foam, depending on the foam and the product burning.

New Products. New water-applied fire extinguishing agents are being introduced and researched. One product, is a jelly-like agent. The PNSY Fire Department has purchased this product for their protection.

Bulk Carbon Dioxide. In the section on fixed systems, steps to seal and smother fire with CO2 were discussed. Possible time frames for proper inertion of a space may be days. It may be necessary to re-inert the space for reasons such as improper space sealing. It may be possible to use an alternate inerting agent other than CO2. If available, however, CO2 should be used in most cases because of its inherent firefighting qualities.

Bulk CO2 will normally be delivered in tanker trucks at about zero degrees farenheit under about 270 PSI. Transfer logistics require a very long single length of special hose, maybe hundreds of feet. Without this hose, or its equivalent, bulk transfer is not possible. Presently, no local inventories or emergency plans list such a hose.

Section Nine

STRATEGIC OPTIONS

The science or art of command as applied to the overall planning and conduct of large-scale combat operations. This section is a one page list of marine firefighting considerations that should be identified in the course of strategic planning. Section Twelve combines Strategy and, the art of deployment, Tactics.

"The St. Lawrence is water, and,
the Mississippi is muddy water;
but that, sir, is liquid history."

John Burns
'House of Commons'

Strategic Options

A. Offensive:

1. The firefighting resources are available to mount an attack with acceptable danger to personnel ------(AND)------------------ (YES/NO)

2. The vessel/structure/cargo has survivability ---------(AND)---------- (YES/NO)

3. There are NO explosive contents ---(AND)--- (YES/NO)

4. There is NO significant backdraft/flashover threat -----------(AND)-------------------- (YES/NO)

5. Dewatering is NOT a problem --------------- (YES/NO)

B. Defensive:

1. The resources are NOT available to attack or complete an attack. -------(OR)--------- (YES/NO)

2. The exposures present a greater potential hazard than the vessel fire -----(OR)------ (YES/NO)

3. The vessel is FULLY involved. ---(OR)------ (YES/NO)

4. There are EXPLOSIVE contents. ----(OR)----- (YES/NO)

5. There is a BACKDRAFT probability. ---(OR)-- (YES/NO)

6. The water/agent supply is NOT available to control or extinguish the fire. -------(OR)-------- (YES/NO)

7. The dewatering resources are NOT available to prevent dangerous instability. ------------ (YES/NO)

C. Offensive-Defensive:

You begin in an offensive posture until new information, hazards, injuries, equipment failures or other variables affect the approach.

D. Defensive-Offensive:

You contain, investigate, control and confine until the resources can be marshaled to sustain an attack.

Section Ten

TACTICAL OPTIONS

The technique or science of securing the objectives designated by strategy. This section is a list of tactical options that should be considered during response development. Tactics are combined with Strategy in Section Twelve.

"When it has leveled everything,
fire burns itself out, and so
does a lie."

Samuel Shellabarger
Lord Vanity

Tactical Options

A. Interior Attack:

1. Quick (Blitz) (Fast) Attack:
(The fire is small enough that it can be extinguished with a maximum effort with minimum risk over a minimum period of time) -------------------------------- (YES/NO)

2. Rescue Attack:
(There are victims in the fire zone who must be protected until removed by extinguishing or controlling the fire) ---------------------------- (YES/NO)

3. Task Attack:
(There is a specific short-term task in the fire's proximity that will significantly reduce the life hazard the fire may be creating (ie. fuel shut-off) -------------- (YES/NO)

4. Sustained Attack:
(Sufficient Manpower, Equipment, Watersupply, and Airsupply are available to mount a long term effort) ------- (YES/NO)

B. Exterior Attack:

1. Defend Exposures:

   a. The vessel is fully involved -(OR)---- (YES/NO)

   b. There no victims to be rescued -(OR)-- (YES/NO)

   c. The vessel is an internal explosive hazard --(OR)------------------------- (YES/NO)

   d. The involved spaces of the vessel are a backdraft/flashover hazard --(OR)----- (YES/NO)

   e. There are inadequate resources to protect exposures and attack fire ------------ (YES/NO)

2. Surround and Drown:

   a. The vessel is fully involved -(AND)--- (YES/NO)

   b. Sufficient dewatering equipment is NOT available --------(AND)--------------- (YES/NO)

   c. The fire MUST be put out ----(AND)---- (YES/NO)

   d. Pollution hazard is minimal ---(AND)-- (YES/NO)

   e. Sinking will not block waterway ------ (YES/NO)

3. Cool and Contain: (and allow to burn out)

   a. Agent is not available --(OR)---------

   b. It is manifestly unsafe to attempt entry into the fire area ------------------- (YES/NO)

   c. The only REASONABLE option is to cool and contain the fire --------------------- (YES/NO)

4. Cool and Apply Agent:

   a. The safest/ best agent to use on this fire is NOT water ----------(OR)----------- (YES/NO)

   b. The source of fuel can not be isolated from the fire -------------(OR)---------------- (YES/NO)

   c. The agent can be applied and the only approach remaining is to wait for the agent to extinguish /smother the fire --------------------- (YES/NO)

5. Artificial Reef Addition:

   It is entirely possible that the safest/best way to extinguish a fire is by sinking the vessel at an appropriate spot so it may serve some purpose.

Section Eleven

STRAT/TAC ACTIONS

This section lists salient strategic and tactical actions to pursue for the various locations of vessel fires. The different areas onboard the ship will require similar and different actions.

"Marine and aviation fires present special challenges to fire fighters. At such incidents, fire fighting operations can require the coordinated effort of every available fire fighter. While some departments minimize the possibility of such disasters, others plan, organize, and train to be ready for them."

Clinton Smoke,
Editor-in-Chief
'Fire Command:1/88'

Strat/Tac Actions

TASK OPTIONS:

A. ACCOMMODATION SPACE FIRES:

1. Rescue primary
2. Secure Power
3. Ventilate
   through portholes if necessary
   only when all resources ready
   cover against interior spread
4. Extinguish:
   Use Quick attack if possible
5. Flash-over potential HIGH
6. Check for extension
7. Extinguishers not usually effective
   (application techniques)
8. Overhaul thoroughly
   remove wall & ceiling pannels
9. DO NOT rely on watertight or fire
   resistive bulkheads to act
   as fire stop
10. Air & personnel critical

B. FIRES IN HOLDS:

1. Close ALL openings to hold
2. Batten down hatches
3. Use fixed system FIRST
4. Tighten down hatches
   (calk if needed)
5. If cargo is nitrates or sulfates
   use speed and water
6. Never use steam smothering if explosives
   are present
7. NEVER ENTER HOLD WITHOUT SCBA
8. Place charged hose lines on deck
9. If entry is made,
   use hose lines
10. Investigate adjoining holds
11. Cut holes only as needed and NOT
    in outer skin of vessel
12. Have plugs available for
    all holes cut
13. Cool skin of vessel
14. Close all side openings early
15. Standby while cargo is unloaded

C. ENGINE ROOM FIRES:

1. Rescue personnel
2. Used fixed system (CO2 or Halon)
3. Secure all non-essential engine room systems
4. Cool boundaries

IF AN ATTACK MUST BE MADE:

5. Establish vertical ventilation
6. Establish attack teams (3 deep)
7. Access and attack
8. Use foam and dry chemical on fuels
9. Check for extension
10. Divert critical systems to alternates, if possible

D. MACHINERY ROOM FIRES:

1. Rescue personnel
2. Enter from as low as possible
3. Secure all automatic controls
4. Secure all power to area
5. Cool boundaries
6. Establish vertical ventilation
7. Establish attack teams (3 deep)
8. Access and attack
9. Check for extension

E. ELECTRICAL ROOM FIRES:

1. Rescue personnel
2. Secure all power
3. Cool boundaries
4. Attack as a Class A fire
5. Check for extension

F. PETROLEUM TANKER FIRES:

1. DECK FIRES:
   a. Rescue Personnel
   b. Attack from upwind (still use SCBA)
   c. Maneuver ship if necessary
   d. Secure source of fuel on deck
   e. Secure ALL pumping
   f. Use fixed foam monitors, if available
   g. Use foam hand lines as second choice and backup
   h. Cool crews with water
   i. Close ullage hatches, PV valves, vents, manholes, sounding manifolds and fuel lines
   j. NEVER APPLY WATER ON TOP OF FOAM THAT IS ON THE DECK
   k. Cool surrounding deck and structures with water
   l. Replenish foam blanket as needed
   m. Attack burning pressure leaks with dry chemical then blanket with water fog or foam ONLY IF YOU MUST EXTINGUISH

2. TANK FIRES:
   a. Rescue personnel
   b. Energize inert gas system
   c. Maneuver ship to bring wind and seas to best advantage of firefighting
   d. Status of tanks on fire:
      (a) Loaded
      (b) Partially loaded
      (c) Empty
      (d) Inert
      (e) Gas free
   e. Secure all tank vents
   f. When fighting tank fires, consider the following:
      (1) Attempt to apply extinguishing agent(s) directly on burning fuel through a hole, vent line, rupture, ullage cover, or manhole
      (2) If unable to get extinguishing agent on burning liquid, attempt to:
         (a) Cool tank with water
         (b) Inject foam through vents
         (c) Press up the tank with fuel or water
         (d) Extinguish fire by injecting inert gas
         (e) Defuel the tank
         (f) A combination of the above recommendations

      (3) Prevent fire from spreading to surrounding tanks by the following or any combination of the following:
         (a) Cooling down with water
         (b) If ruptured but not burning, cover with foam (Do not put water on cargo that has been covered with foam)
         (c) Press-up with fuel or water
         (d) Inerting
         (e) Maneuvering ship
         (f) After fire has been extinguished, cool down surrounding tanks, deck, and cargo long enough to prevent a flash.

NOTE: The above actions may take several hours or days.

G. CHEMICAL TANKER FIRES:

1. Rescue personnel
2. Shut down cargo pumps
3. Shut down all power to area
4. Attack from up-wind
5. Attack with Universal foam AND dry chemical
6. Keep adjacent tanks cool
7. Used fixed systems if available
8. Be prepared to evacuate one-half mile down-wind
9. Protect all teams with hose lines
10. Use SCBA

H. FIRES IN FORE AND AFTER PEAKS

1. Rescue personnel
2. Shut down all power to area
3. Contain in vertical zone
4. Attack from below if possible
5. Consider piping in smothering agent
6. Consider high-expansion foam
7. Try almost anything before sending teams down a "chimney" into a fire

Section Twelve

COMMAND AND CONTROL

The following one page guideline will assist in preparing pre-fire plans. It is important that all items are discussed in advance by agencies that may be participating in marine fire incidents under pre-fire conditions. It is apparent that such issues may be difficult to discuss during an incident.

"We went through fire
and through water."

Psalms LXVI,12

Command and Control

COMMAND AND CONTROL PROBLEMS

A. Incident Command System

B. Unified Command

C. Jurisdictional Boundaries

D. Resource Management

   1. Manpower

   2. Airpacks

   3. Procurement

   4. Staging

   5. MOU

E. Communications

   1. Radio

      a. Hull Penetration

      b. Channel Assignment

      c. UHF - VHF - Marine - SSB

   2. Language/Translators

   3. RTO

F. Freelancing

G. Personnel Accountability

   1. Victims

   2. Fire/rescue

H. Drills

Section Thirteen

FIRE COMBAT TEAMS

This section contains a list of tasks of the fire combat teams.

"The charmed water burnt alway
A still and awful red."

Samuel Coleridge
'Rhyme of the Ancient Mariner'

Fire Combat Teams

FIRE COMBAT:

The Combat Officer and the people in the combat division are responsible for making direct and/or indirect attacks on the fire.
The Fire Officer, Fire Attack Officer or Fire Combat Officer reports to the Incident Commander unless the position of Operations Officer is established.

FIRE OFFICER-----------------NAME: ____________________________________
RADIO CHANNEL: _____________ CALL SIGN: ______ "COMBAT" _______________
CREW REPRESENTATIVE: ____

```
                               +-------+
                               | FIRE  |
 +-----------------------------+COMBAT|-----------------------------+
 |                 +-----------+---+--+---------------+             |
 |                 |               |                  |             |
 |                 |               |                  |             |
 |                 |               |                  |             |
 |                 |               |                  |             |
 #1                #2              #3                 #4            #5
SECTOR            SECTOR          SECTOR             SECTOR        SECTOR
```

#1 SECTOR		#2 SECTOR		#3 SECTOR		#4 SECTOR		#5 SECTOR
______	name	______	name	______	name	______	name	______
_Y/N__	radio	_Y/N__	radio	_Y/N__	radio	_Y/N__	radio	_Y/N__
______	call	______	call	______	call	______	call	______
______	freq	______	freq	______	freq	______	freq	______
_Y/N__	map	_Y/N__	map	_Y/N__	map	_Y/N__	map	_Y/N__
______	loc	______	loc	______	loc	______	loc	______
______	guide	______	guide	______	guide	______	guide	______
______	task	______	task	______	task	______	task	______

A FIRE COMBAT OFFICER DIRECTLY CONTROLS ONLY FIVE SECTORS.

(1) Responsibilities of Fire Combat Division:

(a) Find the Seat of the Fire:------------------ ________

(b) Determine the Extent and Size of the Fire:--- ________

(c) Deploy Hand lines:
Attack:--------------------------------------- ________
Use "Fire and manuver":----------------------- ________
Cover (back-up):------------------------------ ________

(d) Determine Resources Necessary to Attack:

Personnel:
Primary Attack Group:------------------ ________
Secondary Attack Group:---------------- ________
Back-Up Group:------------------------- ________
Spare Air Bottles:------------------------- ________
Gal. Per Min. Needed:---------------------- ________

(e) Defensive Situations:
Confine:------------------------------------ ________
Use Exterior Attack:------------------------ ________
Cool Bulkheads:----------------------------- ________
Retreat If Necessary:----------------------- ________

(f) Deploy Master Streams If Necessary:---------- ________

(g) Request Other Agents Where Needed:----------- ________

(h) Mount Interior Attack on Seat of the Fire:--- ________

(i) Reinforce Key Positions:--------------------- ________

(j) Attack Fires From Below If Possible:--------- ________

(k) Extend Hose Lines UP Stairs:----------------- ________

(l) Extend Hose Lines UP Ladders:---------------- ________

(m) Attack Fire's Concealed Spaces:-------------- ________

(n) Gain Control of Vertical Passages Before
Advancing Above the Fire Deck/Floor:--------- ________

(o) Check Firefighting Water Temperature;
It Should Be Warm/Hot Coming Off Fire:------- ________

(p) Establish Fire Safe Areas;
For Staging:---------------------------------- ________
For Victims:---------------------------------- ________

(2) Hints for Combat Division:

(a) Do not try to smother explosives in a hold! Use total flooding with water

(b) Back teams up. Have two back up teams for each team sent in. Plan on teams expending air bottles in 15 minutes. During a sustained attack, maintain contact with the fire by rotating teams into the fire scene on a scheduled basis. Do not wait for them to come out before the replacement goes in. Too much can happen while they are away.

Section Fourteen

FIREFIGHTING PLATFORMS

This section contains inventory requirements that are helpful to use in conjunction with the inventory agencies completed. It is important to know the firefighting resources of vessels that may assist during an incident.

"A little fire is quickly trodden out,
Which being suffered, rivers cannot quench."

William Shakespeare
"King Henry VI, Part 3
Act IV, Scene VIII

Firefighting Platforms

POTENTIAL WATERBORNE FIREFIGHTING PLATFORMS

How many times do we get asked or ask ourselves "What If" questions? Most of the time the response is phrased in terms of a solution that employs tools or resources to accomplish a task which will solve the problem. The person, company or agency who has the tools and knows how to use them can accomplish even the most difficult tasks. Conversely, if you know how to use a tool but haven't got one, the task becomes much more difficult and may be impossible.

Ports, rivers, waterways and coastal areas solve daily problems involving the effective allocation of resources or tools. Minor emergencies are mitigated by the quick application of resources. The larger problems frequently give us enough time to form an opinion, find a solution, locate the resource(s) and negotiate contracts.

Fire allows very little spare time. Fire Departments, Captains of the Port, Port Authorities and Coast Guard Stations must be prepared to respond with effective resources to the call for help from a vessel on fire.

In the marine environment, the emergency planner, on-scene coordinator or incident commander is frequently faced with the problem of effectively deploying the resources that are available. Actually, this is a six stage problem.

First, the resources should be identified.

Second, the information should be documented.

Third, detailed performance capability information should be readily accessible.

Fourth, the information about the potential resources should be current and up-to-date.

Fifth, all decision making levels of the Incident Command System (ICS) should have at their disposal the same data on each possible resource.

Sixth, the information should be in a format that is relatively easy to acquire, distribute and access.

Preparing for marine fires requires that agencies look at the floating resources that may be at their disposal. Many ports and waterways in the United States are not fortunate enough to have fireboats assigned to service in their area and must rely on other sources for platforms to get to the fire.

These potential firefighting platforms (PFP's) are not dedicated fireboats but tugs, work boats, military and service vessels that may have been equipped with some firefighting capability at some point in their existence. They ply the waters all over the world and very few records exist of their abilities.

Also not included in this discussion, are the "vessels of opportunity" (VO's) which must be equipped with portable or shoreside firefighting equipment and were never intended to have onboard systems. The VO is a more complicated topic and requires a separate detailed discussion at another time.

Presented here is a possible system that can be used by agencies that may be called on to respond to a vessel fire in their area of responsibility. It is based around a "Data Sheet" that may be prepared for identified PFP's that operate in any area and may be able to respond if needed. The data sheet may be modified to meet local needs.

POTENTIAL FIREFIGHTING PLATFORM DATA SHEET

NAME OF VESSEL: ______________________ CALL SIGN: ______

1. L.O. - (Length Overall) .... ________FT
2. Draft - (Depth of keel) .... ________FT
3. Speed - (on normal seas) .... ________KTS
4. Location: a. Normal(berth): ______________________
   b. Operating Area: ______________________
   c. Time to get underway: .... ________MINS
5. Fuel: a. Type: ______________________
   b. Consumption rate(pumping): .... ________GAL/HR
   c. On station time(pumping): .... ________HRS
   d. Cruising range: .... ________MILES
6. Maximum safe seas: .... ________FT
7. Tow Capacity(in bollard pull tons) .... ________BPT
   a. Size line carried: .... ________INCHES
   b. Safe working load of tow line: .... ________TONS
   c. Length tow line: .... ________FT
8. Crew: a. Size(normal operations)(#): .... ________PERS
   b. Protective clothing: .... (Y/N)
   c. Protective Breathing Equipment: .... (Y/N)
   d. Breathing air refilling system aboard: ... (Y/N)
9. Passenger capacity(Firefighters)(#): .... ________PERS
10. Pump: a. Type(centrifugal)(pressure)(2Stage)(volume)(jet)
   b. Flow (Rated gallons per min.): .... ________GPM
   c. Fuel Type (for on-scene refueling): ________
   d. Salvage pumping ability: .... (Y/N)
11. Fire hose connections: .... (Y/N)
   a. Type: ______________________
   b. Size: .... (1 1/2") .. (2 1/2")
   c. Number: .... ________ .. ________
   d. Thread: .... ________ .. ________
12. Monitors: .... (Y/N)
   a. Type: ______________________
   b. Size: .... ______ .... ______ ... ______
   c. Number: .... ______ .... ______ ... ______
   d. Gpm of each: ..... ______ .... ______ ... ______
   e. Range (Reach): .... (no wind condition)
      (1) Without Foam: . ______ .... ______ ... ______
      (2) With foam: ... ______ .... ______ ... ______
   f. Foam: .... (Y/N)
      (1) Type Foam: ______________________
      (2) Capacity of vessel: .... ________GALS
      (3) Foam duration of supply: ...... ________MINS
13. Communications Data:
   a. Radio: .... (RDF)(SSB)(UHF)(VHF)(CB)
      (1) Vessel Name: ______________________
      (2) Call sign: ______________________
      (3) CHAN/FREQ: ______________________
      (4) Watts power: .... ______WATTS
      (5) Number of radios: .... ________
   b. Phone Data:
      (1) 9 to 5 contact; Name: ______________________
      Phone Number: .... (_____) ______-________
      (2) 24 hr. Contact; Name: ______________________
      Phone Number: .... (_____) ______-________
      (3) Cellular phone (on-board) .... (Y/N)
      Phone Number: .... (_____) ______-________
14. M.O.U. EXISTS: .... (Y/N)

15. PREPARED BY: ______________________ DATE: ________

The fields of the data sheet are defined as follows:

POTENTIAL FIREFIGHTING PLATFORM DATA SHEET

NAME OF VESSEL: ______________________________

This is the top line of the form and should allow for easy identification of the resource by the name painted on the bow or stern.

1. L.O. - (Length Overall) .... ________FT

What is the length of the vessel? This may affect the deployment of this vessel in tight spaces.

2. Draft - (Depth of keel) .... ________FT

How much water does the vessel draw? This may limit the areas in which the vessel may be utilized.

3. Speed - (on normal seas) .... _______KTS

How fast can an incident commander expect this vessel to navigate the distance from where it is to where he needs it?

4. Location: a. Normal(berth): ______________________

Where is the vessel normally docked?

b. Operating Area: ______________________

If not at berth, where will the vessel normally operate?

c. Time to get underway: .... ________MINS

Once requested, how long will it take the vessel to start moving in the direction of the emergency?

5. Fuel: a. Type: ______________________________

If on-scene resupply is required, what type of fuel will be required?

b. Consumption rate(pumping): .... ______GAL/HR

Once on-scene, how fast will the vessel consume fuel?

c. On station time(pumping): .... _________HRS

How long will the vessel be able to remain on station at it's normal fuel consumption rate?

d. Cruising range: .... _______MILES

What is the maximum round trip distance the vessel can safely travel without refueling?

6. Maximum safe seas: .... __________FT

At what sea conditions is it unsafe for this vessel to operate?

7. Tow Capacity(in bollard pull tons) .... _________BPT

If an emergency movement of the fire vessel is needed, is this vessel capable of providing a tow? If so, at what force can it be expected to pull? A "0" in this blank would indicate that the vessel is unable to tow.

a. Size line carried: .... ______INCHES

What is the diameter in inches of the tow line normally carried by this vessel?

b. Safe working load of tow line: .... ________TONS

What is the rated towing capacity of the line carried by this vessel?

c. Length tow line: .... __________FT

How many feet of towing line does the vessel normally carry? A "0" in this blank would indicate that the vessel normally carries no tow line.

8. Crew: a. Size(normal operations)(#): .... ________PERS

How many people normally comprise the crew?

b. Protective clothing: .... (Y/N)

Will the exposed (on deck) crew be equipped with NFPA approved protective clothing?

c. Protective Breathing Equipment: .... (Y/N)

Is the vessel equipped with USCG or NFPA approved protective breathing apparatus (Self Contained or Line Breathing Units) for all crew members?

d. Breathing air refilling system aboard: ... (Y/N)

Is the vessel capable of filling Self Contained Breathing Apparatus or SCUBA cylinders while on scene?

9. Passenger capacity(Firefighters)(#): .... ________PERS

How many firefighters, with full protective gear is this vessel capable of carrying? If transportation to the burning vessel becomes necessary.

10. Fire Pump:.. (Y/N)

Is the vessel equipped with a fire pump? This may be portable or fixed.

a. Type(centrifugal)(pressure)(2Stage)(volume)(jet)

What type of pump is on the vessel? This information will help the incident commander determine other applications the vessel may have as a pumping platform for super monitors.

b. Flow(Rated gallons per min.): ..... ________GPM

What is the rated flow of the pump(s) onboard the vessel?

c. Fuel Type(for on-scene refueling):. ____________

What type of fuel will be required to refuel the pumps on scene? Enter none if these pumps are fueled by the vessel's main fuel system or they are electrically powered.

d. Salvage pumping ability: .... (Y/N)

Does the vessel have the ability to conduct dewatering operations? If so, detailed information should be included in another data collection system which includes the dewatering resources in your area.

11. Fire hose connections: .... (Y/N)

Does the vessel have fire hose connections available for use in fighting a fire external to itself? These would be primarily on deck or topside and pump water from the "sea chest" or suction inlet box.

a. Type: ____

Are these connections gated, pressure governed, foam equipped, swivel, strained etc. and at what pressure do they flow?

b. Size: .... (1 1/2") .. (2 1/2")

What is the diameter of these connections? Most hose connections in the U.S. have been standardized at these two diameters. Circle the appropriate diameter and/or write variations in the dotted lines.

c. Number: .... ________ .. ________

How many hose connections of each diameter are available for use off the vessel? A "0" would indicate that fitted hose connections are not available for use off the vessel.

d. Thread: .... ________ .. ________

Are these fire hose connections pipe thread, "Storz", snap-lock, "surelock," standard fire thread, national fire thread, national standard thread or a foreign thread that requires some type of adaptor? Once you have this information, you will be able to determine if you have the necessary adaptors. Don't expect them to have, keep, buy or maintain these adaptors.

12. Monitors: .... **(Y/N)**

Is this vessel equipped with fire monitors that can be employed to fight fire?

a. Type: ________________________________

Are these fire monitors hand trained, electrically trained, portable, fixed, 360 degree, remotely or internally gated, straight stream, fixed fog or adjustable pattern.

b. Size: .... ______ .... ______ ... ______

What is the diameter of each of these monitors?

c. Number: .... ______ .... ______ ... ______

How many monitors of each size does this vessel carry?

d. Gpm of each: ..... ______ .... ______ ... ______

What is the rated flow of each monitor?

e. Range (Reach): .... **(no wind condition)**

Range in defined here as the distance out from closest gunwale of the originating vessel to the center of the beaten zone of the stream. When the monitor is set on straight stream and when the elevation angle of the monitor is set for maximum range or approximately 32 degrees from the horizontal. Since this measurement is derived under ideal weather conditions, planners and tacticians must be very sensitive to wind conditions.

(1) Without Foam: .______ .... ______ ... ______

What is the range of each monitor using water as the extinguishing agent?

(2) With foam: ... ______ .... ______ ... ______

What is the range of each monitor using finished foam as the extinguishing agent?

f. Foam: .... (Y/N)

Does this vessel carry firefighting foam?

(1) Type Foam: ________________________________

What type of normally carried onboard: Protein, AFFF, ATC, ARC, Fluoroprotein, High Expansion, Universal etc. What is the manufactures recommended mixing percentage for this type of foam?

(2) Capacity of vessel: .... ________GALS

How much foam concentrate does this vessel normally carry?

(3) Foam duration of supply: ...... ________MINS

If the foam is metered into the application system at the manufacture's recommended solution concentration, percentage or rate, and flowed on the fire at the NFPA recommended application rate, how long will the vessels on-board foam supply last?

13. Communications Data:

a. Radio: .... (RDF) (SSB) (UHF) (VHF) (CB)

What type of radio is available onboard the vessel: single side band, ultra high frequency, very high frequency or marine band, citizen's band, AM, etc.? Is the vessel equipped with a radio direction finder?

(1) Vessel Name: ______________________________

When calling the vessel on the radio what is the documented (legal) name should you use to refer to it?

(2) Call sign: ________________________________

What is the FCC approved call number or sign for this vessel?

(3) CHAN/FREQ: ______________________________

What channels or frequencies can the radios onboard the vessel access?

(4) Watts power: .... ______ WATTS

How many Watts of power does this vessel's radio(s) produce? This will help to determine the radio transmission range of the vessel.

(5) Number of radios: .... ___________

How many radios does the vessel normally carry?

b. Phone Data:

If a phone request or authorization is necessary to obtain the services of this vessel, who is authorized to dispatch or assign this vessel?

(1) 9 to 5 contact; Name: ____________________

Who is the person with dispatch authority to call during business hours?

Phone Number: .... (_____) _____-__________

What is the number of the business phone where this person can be reached?

(2) 24 hr. Contact; Name: ____________________

If the request is made after normal business hours or if the primary authority can not be reached, who has the authority to dispatch the vessel?

Phone Number: .... (_____) _____-__________

What is the phone number of the person who can dispatch the vessel after normal business hours?

(3) Cellular phone (on-board) .... (Y/N)

Is the vessel equipped with a cellular phone?

Phone Number: .... (_____) _____-__________

What is the cellular phone number?

14. M.O.U. EXISTS: .... (Y/N)

A memorandum of understanding (MOU) exists that clarifies the deployment of this vessel for emergency firefighting duties? This MOU may include but is not limited to: the hazards of marine firefighting, response priorities, compensation, range of operation, command relationships and resupply requirements.

15. PREPARED BY: ______________________ **DATE:** __________

Who prepared this data sheet and when was it prepared or rechecked?

Although some of this information may seem to be obvious to "Old Salts" it should be remembered that shipboard fires frequently turn into multi-agency responses and many of the other agencies may be less familiar with nautical procedures and terminology than professional marine interests.

This form was designed to be limited to one page to provide a quick data entry, collection, transmission and retrieval system. The author is working on a Basic language computer program to compliment this form. Obviously, some items had to be left out to keep the form to one page.

Many of groups are involved in regular inspection, survey and information collection along the waterfront. Although this is only a part of the data needed for emergency planning, it is an item that is too frequently ignored. Any one of the emergency preparedness agents could share in the preparation, reproduction, verification and dissemination of this essential knowledge.

All resource data to any plan should be updated on a regular basis. An annual analysis schedule may fulfill some area needs while more congested or transient locales may require more frequent review.

Agencies are invited to use this form or modify if to suit their specific needs. The agency may want to summarize the information on the sheets or attach all of them to the resources section. But, collect the information and make it an annex to your plan.

If, after collecting the information on this sheet, you have a stack of sheets with a bunch of no's, none's, and 0's you quite probably have a potential problem. You may not have the readily accessible resources available to combat a vessel fire away from a pier or a pier side fire from the waterside.

This information should then be documented, summarized and presented to the appropriate officials for the action they may deem suitable. Regulations, Port Tariffs and licensing rules have been known to require fire monitors on vessels plying their trade in a waterway.

However, don't sit quietly and tell no one of the potential problem(s), successful emergency planning results from identifying resource shortfalls and developing mitigating plans to correct them or strategies to compensate for identified deficiencies.

Section Fifteen

CASE STUDIES

History repeats itself. The purpose of case study is to confront the possibilities. It is to learn.

"O Captain! my Captain!
Our fearful trip is done!"

Walt Whitman
'O Captain! My Captain!'

Case Study: CHEVRON NAGASKI 1985 Pumproom Fire: Courtesy of Chevron Shipping Safety Bulletin September 1985

Example: Bearing failure fire

Situation:
- -cargo hoses connected and crude oil washing was in progress using the cargo pump
- -visual warnings of black smoke from the starboard pumproom exhaust vent
- -automatic cargo pump shutdown when the high temperature sensor on the pump casing activated the thermal trip
- -sounding of general alarm

Strategy:
- -seal all spaces
- -close off ventilation
- -activate foam system
- -cool down

Tactics:
- -form emergency squads
- -man the foam room
- -stop pumproom ventilation
- -close accommodation doors
- -secure cargo valves
- -establish communications
- -flood the pumproom with the fixed foam system
- -start the engine room fire pump
- -switch off exhaust fans
- -cool the bulkhead
- -vessel directs water stream at slop tank to cool down

Outcome: Fire UNDER CONTROL and EXTINGUISHED within 15 MINUTES after General Alarm had sounded.

Cause: BEARING FAILURE which probably displaced the pump shaft position allowing leakage of crude oil from the aft mechanical seal. The resulting oil spray was directed toward the engine room/pumproom bulkhead, and the gas produced by this spray was ignited by the hot surfaces of the forward bearing housing.

Pumproom Fire

The CHEVRON NAGASAKI recently suffered a pumproom fire just after completing her last lightering to the CHEVRON FRANKFURT. The cargo hoses were still connected and crude oil washing was in progress on the CHEVRON NAGASAKI using the No. 1 cargo pump.

At 12:48 local time, black smoke was seen coming from the starboard pumproom exhaust vent and the General Alarm was sounded. At this time No. 1 cargo pump shut down when the high temperature sensor on the pump casing activated the thermal trip.

Emergency Squads quickly formed, the foam room was manned, pumproom ventilation was stopped, accommodation doors were closed and cargo valves were secured. Communications were established with the FRANKFURT. After a quick assessment of the situation, the Master ordered flooding of the pumproom with the fixed foam system. This was accomplished within two minutes of sounding the General Alarm.

In the engine room, the fire pump was started, all exhaust fans were switched off and the engine room personnel began to cool the paint blistered bulkhead between the engine room and pumproom. The fire was under control and extinguished within 15 minutes after the General Alarm had sounded.

Meanwhile, onboard the CHEVRON FRANKFURT the General Alarm was sounded and all available fire fighting equipment was rigged and made ready for use. A water stream was directed at the NAGASAKI's starboard slop tank as a precautionary step to cool the tank top, if needed.

Investigation later revealed that the cause of the fire was the failure of the foreward bearing on No. 1 MCP (main cargo pump) which probably displaced the pump shaft position allowing leakage of crude oil from the aft mechanical seal. The resulting oil spray was directed toward the engine room/pumproom bulkhead, and the gas produced by this spray was ignited by the hot

Source: Chevron Shipping: Safety Bulletin Sept. '85

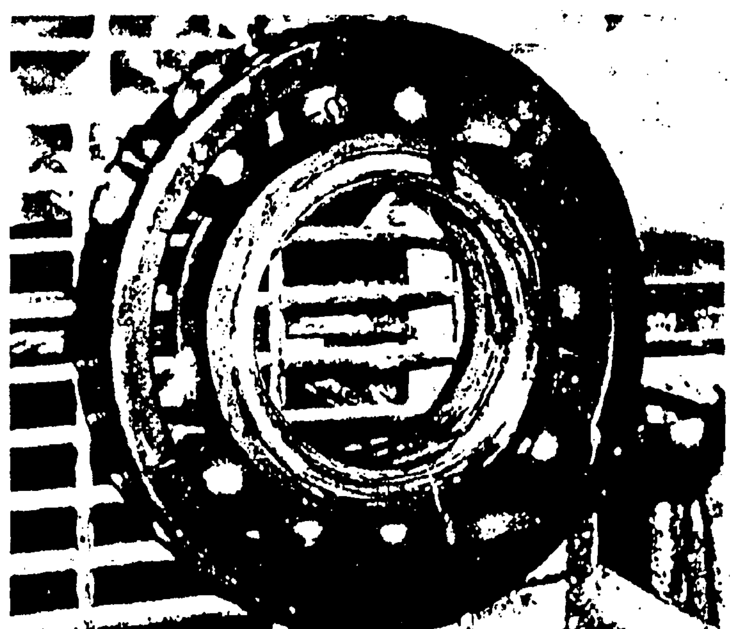
surfaces of the forward bearing housing.

Fortunately, there were no personnel injuries and structural damage was minimal. In this case, the prompt action of all vessel officers and crew prevented a dangerous situation from deteriorating into a major fire. Our congratulations to the officers and crew of the CHEVRON NAGASAKI.

The officers and crew of the CHEVRON FRANKFURT are also to be commended for their rapid response.

Scorched paint on engine room/pumproom bulkhead and ventilating trunking.

Check Your Bearings



[T]he failure of the cargo pump bearing on the [C]HEVRON NAGASAKI indicates a need for regular [i]nspections of cargo pump bearings. They are prone [t]o suffer attack by rust due to their relatively long [p]eriod of inactivity and remote location. Regular [i]nspections of the bearings and their sumps and [fr]equent oil changes will help prevent an accident [s]imilar to that on the CHEVRON NAGASAKI.

Case Study:	EMERALD SEAS-Fire and Explosions Onboard the Panamanian Passenger Ship EMERALD SEAS July 1986
Example:	Ventilation
Situation:	-anchoring -visual warnings of thick, black smoke coming out of an engine department storeroom -two explosions and fire
Strategy:	-passenger life hazard -attempt to extinguish -cool down
Tactics:	-fire extinguisher -early application of water -stop ventilation motors -dry chemical -CO2 fire extinguishers
Outcome:	-evacuation -personnel treated for smoke inhalation and injuries -vessel damage -the use of smoke detectors adapted with a device which, when activated, would have automatically stopped the ventilation system motors, would have prevented the ventilation system from spreading the smoke.
Cause:	-ignition by an undetermined source of acetylene leaking from a cylinder, caused an acetylene-fueled fire resulting in subsequent explosions.

TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract About 0910 on July 30, 1986, the EMERALD SEAS, a Panamanian registered, 622-foot, 24,458-gross ton, passenger ship with 1,296 people aboard, was anchoring less than a mile offshore of Little Stirrup Cay, Bahamas, when a crewmember saw thick, black smoke coming out of an engine department storeroom. The storeroom contained acetylene, oxygen, and argon cylinders, and plumbing parts. When the storeroom door was opened, more smoke poured out, so crewmembers retreated behind a watertight door. Shortly thereafter, there were two explosions and a fire. While passengers were assembled at their assigned lifeboats, the crew fought the fire. By 1005 the fire had been extinguished. U.S. Coast Guard helicopters evacuated 15 passengers and 2 crewmembers, who were taken to hospitals in Miami and treated for smoke inhalation and injuries. The ship arrived in Miami with the remaining passengers and crewmembers on July 31. Damage repair costs were estimated to be about $300,000. The ship was returned to service on August 1, 1986.

The National Transportation Safety Board determines that the probable cause of the fire and explosions in the engine department storeroom of the EMERALD SEAS was the ignition by an undetermined source of acetylene leaking from a cylinder, which caused an acetylene-fueled fire resulting in subsequent explosions.

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EXECUTIVE SUMMARY

About 0910 on July 30, 1986, the EMERALD SEAS, a Panamanian registered, 622-foot, 24,458-gross ton, passenger ship with 1,296 people aboard, was anchoring less than a mile offshore of Little Stirrup Cay, Bahamas, when a crewmember saw thick, black smoke coming out of an engine department storeroom. The storeroom contained acetylene, oxygen, and argon cylinders, and plumbing parts. When the storeroom door was opened, more smoke poured out, so crewmembers retreated behind a watertight door. Shortly thereafter, there were two explosions and a fire. While passengers were assembled at their assigned lifeboats, the crew fought the fire. By 1005 the fire had been extinguished. U.S. Coast Guard helicopters evacuated 15 passengers and 2 crewmembers, who were taken to hospitals in Miami and treated for smoke inhalation and injuries. The ship arrived in Miami with the remaining passengers and crewmembers on July 31. Damage repair costs were estimated to be about $300,000. The ship was returned to service on August 1, 1986.

The safety issues discussed in this report include:

1. Stowage of dangerous materials as ships stores.

2. Means to ensure the automatic shutdown of ventilation systems during a fire.

3. Prevention of injuries from lifeboat winch hand crank handles when lifeboat is being lowered or when power is applied.

4. Crewmembers in charge of lifeboats being provided with a list of passengers assigned to each lifeboat.

Recommendations concerning these issues were made to the U.S. Coast Guard and to Admiral Cruises, Inc. The National Transportation Safety Board recommended that the U.S. Coast Guard propose that the International Maritime Organization's (IMO) 1974 International Convention for the Safety of Life at Sea (SOLAS 74) be amended to require regulations for the stowage of dangerous materials as ships stores and to require the use of smoke detectors to shut down ventilation systems automatically. Also, the Safety Board recommended that Admiral Cruises, Inc., provide a positive method to prevent the hand crank from turning when the electric motor is energized or the lifeboat is being lowered, and to provide crewmembers in charge of lifeboats with lists of passengers assigned to the lifeboats.

The National Transportation Safety Board determines that the probable cause of the fire and explosions in the engine department storeroom of the EMERALD SEAS was the ignition by an undetermined source of acetylene leaking from a cylinder, which caused an acetylene-fueled fire resulting in subsequent explosions.

Case Study: Fire Drills: Ship-Shore Cooperation: Courtesy of Chevron Shipping Safety Bulletin August 1985

Example: Communications

Situation: Fire drill enacting explosion onboard the VLCC. Fire is out of control. Unberth vesssel. Communications failure.

Strategy:

-pilot dispatches tugs

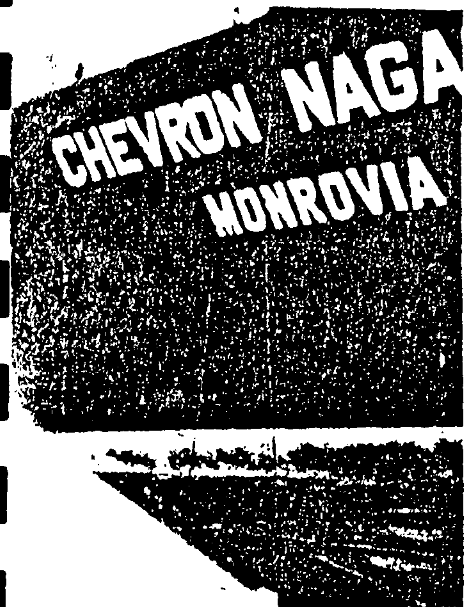
-pilot again attempts to contact the vessel on channels 16, 13 and 10. No response.

Tactics:

-pilot contacts terminal shift operator to trip the mooring hooks to unberth the vessel.

Outcome: In the future, the terminal's portable radio will be moved from the Cargo Control Room to the Bridge during an emergency. The Communications Officer will monitor all working VHF channels. With SATCOM on the bridge, the Radio Officer will be stationed on the bridge during such emergencies as backup.

Cause: The Pilot was unable to contact the vessel by VHF while the master was on the bridge wing.



Incorrectly rigged fire wire. See page 6.

Fire Drills

Ship-Shore Cooperation

A Company VLCC recently participated in a joint fire drill at Borco Terminal #10, Freeport. The drill was a great success, but as expected there were several weaknesses which required corrective action.

Here is the scenario used:

"An explosion has occurred onboard the VLCC at the manifold area while discharging. Fire engulfed the area and spread up the chicksan arms — the fire is out of control. It is necessary to unberth the vessel."

This is what happened:

At 09.34 hours the emergency signal on the platform is activated and the Head Operator informs pumphouse personnel there is a fire drill. The Terminal Shift Supervisor contacts the Pilot on VHF and requests tug assistance to make ready to unberth the vessel. The vessel trips the cargo pump and contacts the jetty by VHF to confirm that the cargo operation is shut down.

The vessel sounds the General Alarm at 09.35. The jetty firepump is activated, and the Pilot dispatches two tugs to pick-up and make fast to the vessel's fire wires.

During the next five minutes: The jetty fire monitor and elevated fire monitor are directed at the vessel's manifold area. The Dock Operator orders launches to get underway with back-up personnel. One vessel monitor is activated and directed on the manifold. The Port Authority is informed that a fire drill is in progress. The vessel's Emergency Squad #1 approaches the manifold from leeward making ready to fight the fire with portable foam equipment.

At 09.42 the first tug is on station and is instructed by the Pilot to make fast to the fire wire. The vessel's Standby Squad swings out the starboard lifeboat and Emergency Squad #2 provides backup to Squad #1.

At 09.43 launches are positioned to evacuate jetty personnel. The Pilot initially tries to contact the vessel by VHF, but is unsuccessful.

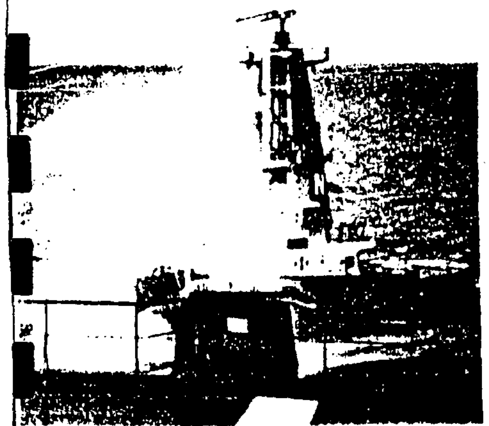
During the next three minutes: The gangway is removed from the vessel and stowed on the jetty. Jetty personnel are standing by the mooring hooks. The vessel Master

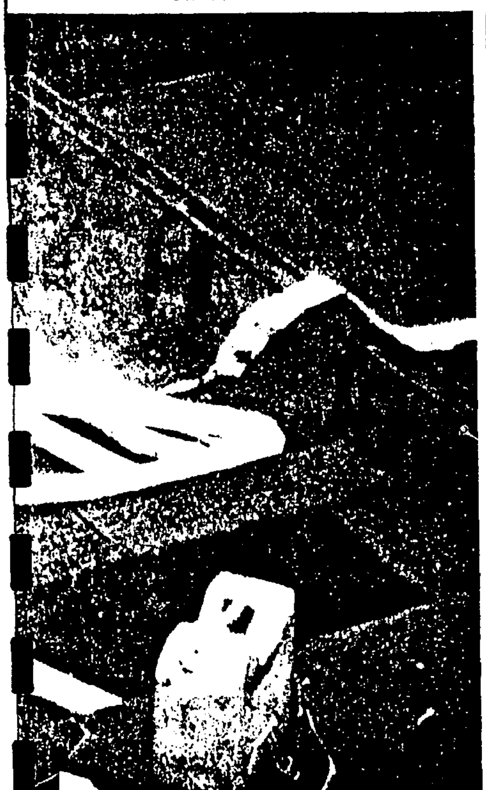
monitors the tugs and directs the firefighting operation from the starboard bridge wing.

At 09.47 the Pilot again attempts to contact the vessel on channels 16, 13 and 10. No response. The tug with the Pilot arrives along side the vessel amidship and activates its fire pumps.

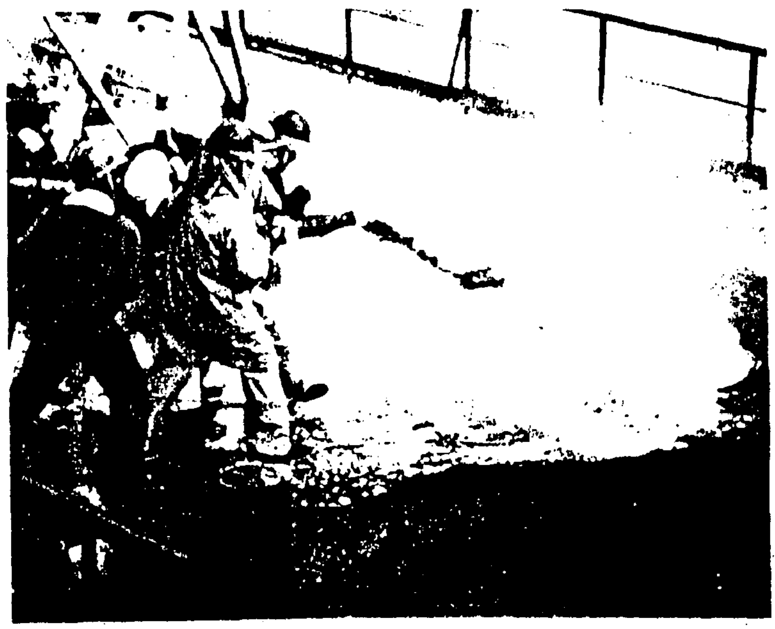
The Pilot contacts the terminal Shift Operator at 09.49 and instructs him to trip the mooring hooks to unberth the vessel.

Source: Chevron Shipping: Safety Bulletin Aug.'85





"several valuable lessons were learned..."



At 09.54 the drill is declared complete.

That same day separate critique sessions were conducted onboard the vessel and at the terminal.

These were the primary deficiencies and corrective actions noted by vessel personnel:

1. The vessel fire wires were inadequately rigged. The forward wire was flaked out on deck as required by Borco, but did not have sufficient length over the side to be handled from the tug. The aft wire was flaked on deck with the bight of the wire near the water, but the eye was lashed at the coaming. (Borco is modifying its requirements to conform to the standard Chevron practice as indicated on page 6 of this Safety Bulletin.)
2. The Pilot was unable to contact the vessel by VHF while the Master was on the bridge wing. In the future, the terminal's portable radio will be moved from the Cargo Control Room to the Bridge during an emergency and the Communications Officer will monitor all working VHF channels. With the availability of Satcom on the bridge, the Radio Officer will be stationed on the bridge during such emergencies to provide a backup to assure a good flow of communications.
3. Squad #1 could have been injured by approaching the fire from leeward. In the future, wind direction will be considered when deploying a hose team.
4. The Squad was unable to produce sufficient finished foam because the fire hose became entangled beneath a hydraulic piping guard and restricted water flow to the nozzle. To prevent this from happening in the future, all fire hose will be laid out in such a manner as to prevent it from becoming kinked.

From our point of view, this drill was a total success. Cooperation between the vessel and the terminal was exceptional and several valuable lessons were learned by vessel personnel.

Please discuss this fire drill at your next Safety Committee meeting and let us have your comments in your next Safety Meeting Minutes.

APPENDIX

GLOSSARY

abaft: A term used to describe the relative position of an object which is farther aft than another.
abeam: At right angles to the keel.
accommodation ladder: A stairway hung alongside the vessel for boarding and disembarking.
aft: Toward, at or near the stern or rear of a vessel.
aftermost: Nearest the stern.
afterpart: Ship's hull, aft of midships section.
afterpeak: The compartment in the narrow part of the stern, aft of the last watertight bulkhead.
ahead: The direction forward of the bow.
amidships: At or near the midship section of the ship.
anchor ball: As soon as the anchor is "let go" a black ball 2 feet in diameter is hoisted on the forestay to indicate the vessel is at anchor.
astern: The direction abaft the stern.
athwart: Same as abeam.
athwartships: Across the ship at right angle to the center line
ballast: Any weight (usually sea water) used to control the draft of a vessel or to improve the stability of a vessel.
barrel: 42 U.S. gallons; 34.973 Imperial Gallons
beam: The extreme width of the ship.
between ('tween) decks: Cargo space between the lower hold and main deck, divided by bulkheads which are usually watertight and fire resistant.
bilge: Generally space in the lower part of the ship's hold where waste water collects and in which bilge suctions are placed for pumping out.
bitt: A post, usually in pairs, around which mooring or other lines may be made fast.
boat deck: A deck on which lifeboats and auxiliary boats are kept.
bollard: A single or double cast steel post secured to a pier and used for mooring vessels.
bow: The front end of the vessel.
bow stopper: An appliance on the forepart of the windlass, over which the anchor cable runs. It is designed to secure the cable when the windlass brake is slackened off.
bridge, navigating or flying: The uppermost deck from which the ship is navigated.
bulkhead: A vertical partition corresponding to the wall of a room extending athwartships or fore and aft with the length of the ship.
chain locker: A compartment in the forward portion of a ship, usually near the hawse pipes in which anchor chain is stowed.
chartroom: A small room adjacent to the pilot house in which charts and navigating instruments are located.
chock: A heavy saddle of wood or metal through which ropes or hawsers may be led.
cofferdam: A small space left open between two bulkheads as an air space, to protect another bulkhead from heat, fire hazard or collision.

GLOSSARY

crew: Vessel personnel. (see diagram page 4)
davit: A crane arm used in handling small boats, stores, gear, anchor, etc.
deadweight: The total weight of the vessel including cargo, fuel, stores, passengers, etc.
fathom: Six linear feet
forecastle (fo'c'sle): The upper deck forward of the foremast and included in the bow area.
freeboard: The vertical distance between water line and main deck.
froth: European word for firefighting foam.
gangway: The opening in the bulwarks of a vessel through which persons come onboard or disembark.
halogenated extinguishing agents: Halon;made up of carbon and one or more of the halogen elements: flourine, chlorine, bromine and iodine
hatchways: Openings in the deck giving access to holds, bunker spaces and storerooms.
hawse hole: A hole in the bow through which a cable or chain passes.
high-expansion foam: A foam that expands in ratios of over 100:1 when mixed with water; it is designed for fires in confined spaces.
hold: The cargo space of a ship's hull.
LNG (liquified natural gas): A natural gas, a hydrocarbon of fossil fuel, consisting mainly of methane stored as a liquid and vaporized and burned as gas.
LPG (liquefied petroleum gas): Any one of several petroleum products such as "butuane" or "propane" stored under pressure as a liquid and vaporized and burned as gas.
monitor(sentinel): a large stream nozzle, normally found on tankers, fixed in various locations above the maine deck. They are operated by gear-driven wheels or handles and have a 360 arc. Can deliver a stream of water or foam onto a deck type fire.
port side: The left side of a ship, looking forward.
scupper: Any opening or tube leading from the waterway through the ship's side, to carry water from the deck.
shot: Also known as shackle, represents 15 fathoms. Designated by a mark (usually painted white) close to a shackle to indicate the length of anchor line let out.
starboard: The right side of a ship, looking forward.
superstructure, ship: That portion of a ship located above the main deck.
winch: A hoisting or pulling machine fitted with a horizontal single or double drum.
windlass: An apparatus in which horizontal or vertical drums or gypsies and wildcats are operated by means of a steam engine or motor for the purpose of handling heavy amnchor chains, hawsers, etc.

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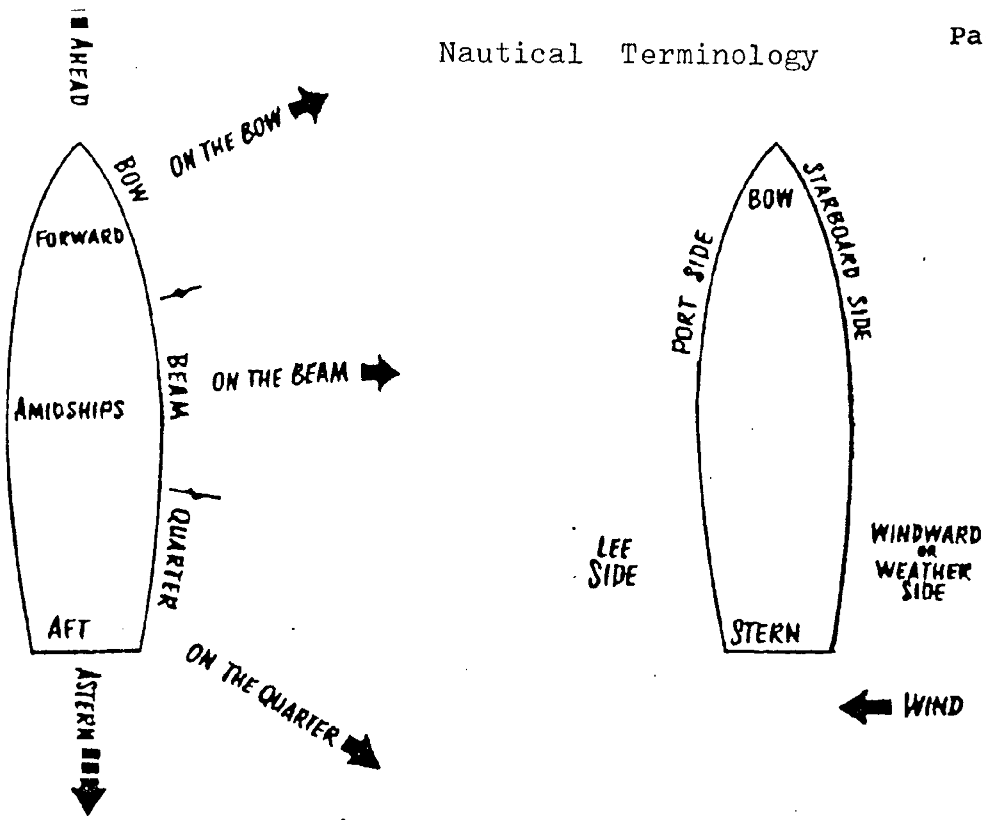
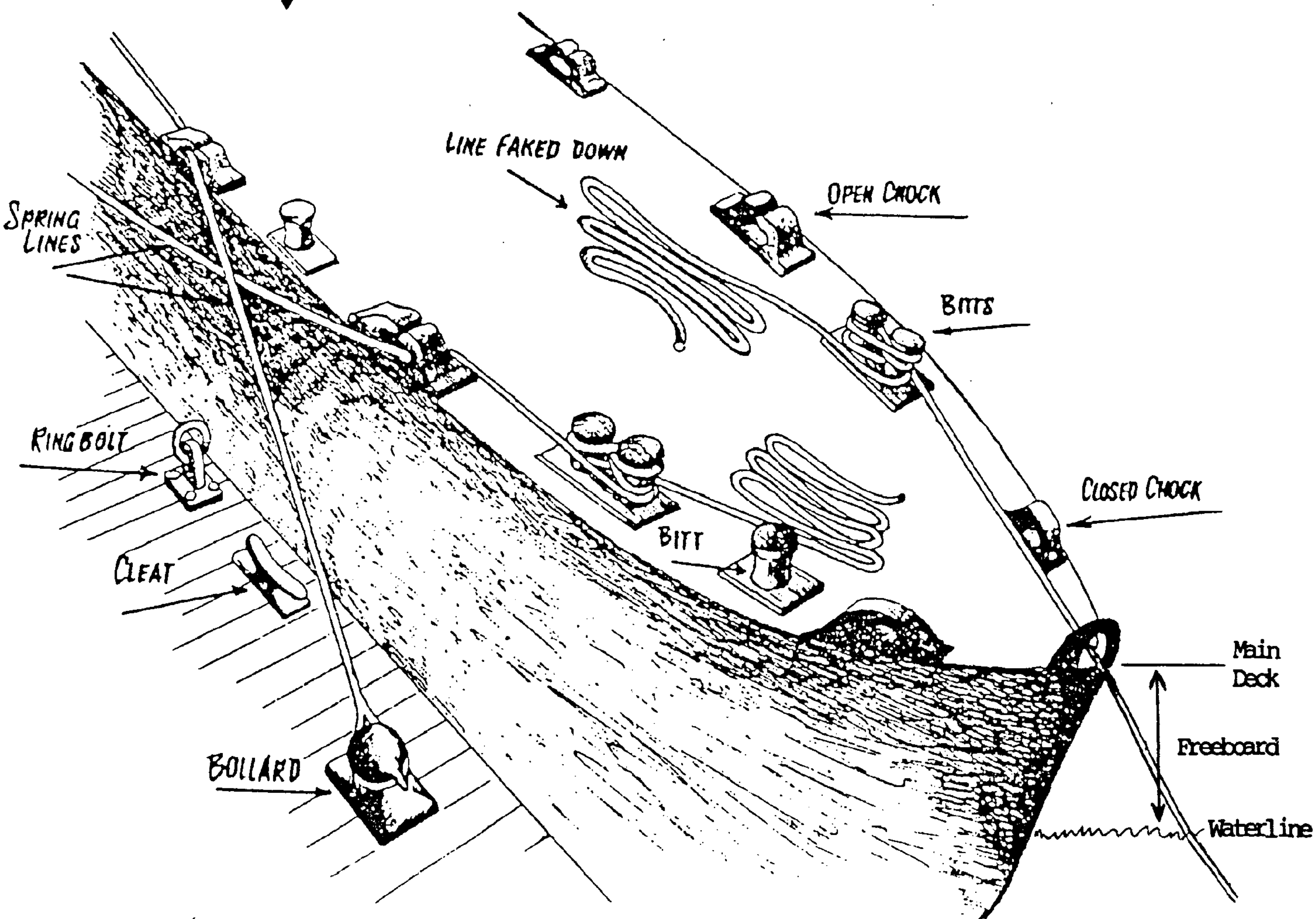
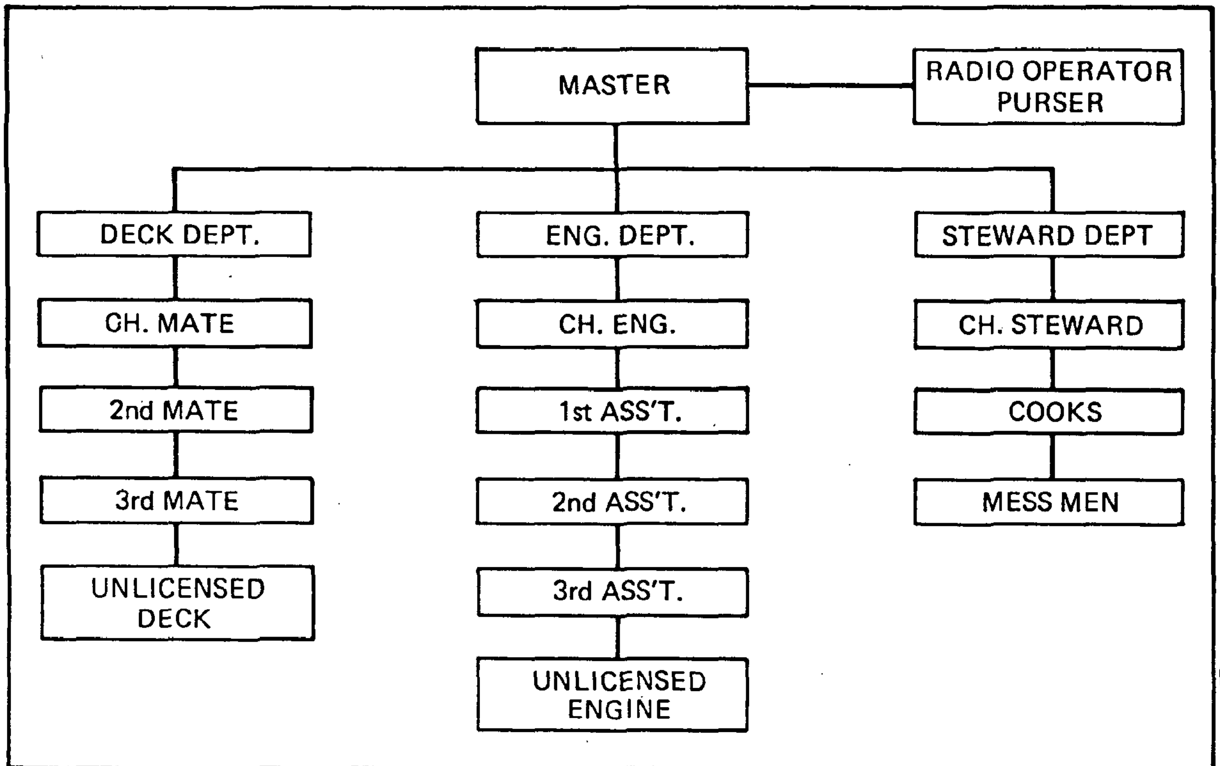




(Courtesy of Manual of
Fireboats, Ships and Pier Fires)

Vessel Personnel



The chain of command aboard ship. (Courtesy of the Maritime Administration)

Towards the smallest possible crew

15,000 ton cargo liner circa 1960

Master

Deck Department	*Engine Department*	*Catering Department*
Chief Officer	Chief Engineer	Ch Steward/Purser
2nd Officer	2nd Engineer	2nd Steward
3rd Officer	3rd Engineer	Chief Cook
4th Officer	4th Engineer	2nd Cook/Baker
2 Cadets (Deck)	5th Engineer	Butcher
Radio Officer	6th Engineer	3 Stewards
4 Quartermasters	C/Electrician	2 Catering Boys
1 Carpenter	2nd Electrician	
1 Bosun	2 Cadets (Engine)	
1 Bosun's Mate	1 ER Storekeeper	
8 Able Seamen	1 Donkeyman	
2 Ordinary Seamen	4 Greasers	
2 Boys	2 Boys	TOTAL 55

30,000 ton Containership circa 1987

Master
Deck Department
Chief Officer
2nd Officer
3rd Officer
Radio/Electronics Officer
Engine Department
Chief Engineer
2nd Engineer
3rd Engineer
6 General Purpose Ratings
Catering
1 Cook
1 Cook/Steward
TOTAL 16

30,000 ton Containership circa 1990

Master
Chief Watchkeeper } Deck or
2nd Watchkeeper } Engine
3rd Watchkeeper Communications
1 Electronics Specialist
4 Mechanics
1 Cook
TOTAL 10

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