ANSI/NFPA 1405 An American National Standard February 5, 1990

NFPA 1405
Land-Based Fire Fighters Who Respond to Marine Vessel Fires
1990 Edition

NFPA

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101

NOTICE

All questions or other communications relating to this document should be sent only to NFPA Headquarters, addressed to the attention of the Committee responsible for the document.

For information on the procedures for requesting Technical Committees to issue Formal Interpretations, proposing Tentative Interim Amendments, proposing amendments for Committee consideration, and appeals on matters relating to the content of the document, write to the Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

A statement, written or oral, that is not processed in accordance with Section 16 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Users of this document should consult applicable Federal, State and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action which is not in compliance with applicable laws and this document may not be construed as doing so.

Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Licensing Provision

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

NFPA has no power or authority to police or enforce compliance with the contents of this document and any certification of products stating compliance with requirements of this document is made at the peril of the certifier.

NFPA 1405

Guide for

Land-Based Fire Fighters Who Respond to Marine Vessel Fires

1990 Edition

This edition of NFPA 1405, *Guide for Land-Based Fire Fighters Who Respond to Marine Vessel Fires*, was prepared by the Technical Committee on Fire Service Training, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 13-15, 1989 in Seattle, WA. It was issued by the Standards Council on January 12, 1990, with an effective date of February 5, 1990.

The 1990 edition of this document has been approved by the American National Standards Institute.

Origin and Development of NFPA 1405

This Guide was developed in response to a recognized need in the area of fire fighter training. Marine vessel fires constitute one of the greatest challenges that structural fire fighters can face. The Fire Service Training Committee helped to establish a subcommittee of experts on the subject of shipboard fire fighting. The results of the subcommittee's efforts are contained in this first edition of NFPA 1405. All of the members of both the technical committee and subcommittee are to be commended, together with those who participated in the process by submitting comments.

Technical Committee on Fire Service Training

John Hoglund, *Chairman*
Maryland Fire & Rescue Institute
University of Maryland

Edward W. Bent, Sacramento, CA
Thomas E. Brown Jr., DeKalb County Public Safety, GA
Rep. IAFC
Ronald L. Callahan, Speedway, IN
Rep. Indianapolis Fire Dept
Gene P. Carlson, (IFSTA), OK
W. Rolland Connelly Jr., Rohm & Haas Delaware Valley Inc., PA
John Lee Cook Jr., Denton Fire Department, TX
Rep. NFPA FSS
Nicholas J. Cricenti Jr., Cowen & Cricenti Engineering Associates, NH
Vincent K. Elmore, Palm Beach Fire-Rescue Dept., FL
David W. England, University of California, Davis Fire Dept., CA
Michael V. Franchini, Marine Safety School, USCG Reserve Training Center, VA
R. B. Gibson, Fort Worth Fire Dept., TX
David C. Grupp, Kemper Corp., IL
Rep. AAI
P. Gerald Haag, Syntex (USA) Inc., CA
Frank D. Harrisson, Professional Loss Control Inc., PA
James G. Kellam Jr., Virginia Beach Fire Dept., VA
Rep. ISFSI
Robert A. Lincoln Jr., Nassau County Fire Service Academy, NY
John B. Lockwood, Bowie, MD
Rep. IAFF
John M. Loverin, Lawrence Livermore Natl Laboratory, CA
George E. Luther, Connecticut State Fire Admin., CT
Charles L. Page, Texas A & M University, TX
William Peterson, Plano Fire Dept., TX
Rep. FMANA
Thomas C. Quillin, Skokie Fire Department, IL
Garnet E. Schenk, Ontario Fire College, Canada
Austin R. Sennett, Fire Safety Services, MA
Robert L. Smith Jr., Tennessee Valley Authority (TVA), TN
James B. Straseske, Illinois Fire Service Institute, IL

Alternates

Jack A. Bennett, Menlo Park Fire Protection District, CA
Rep. IFSTA
(Alternate to G. Carlson)
David E. Best, Intl Assn. of Fire Fighters, FL
(Alternate to J. B. Lockwood)
Doyle E. Frazier, Palm Beach Fire-Rescue Dept., FL
(Alternate to V. K. Elmore)
Jack K. McElfish, Wallingford Fire Dept., CT
(Alternate to T. Brown)

Subcommittee for Land-Based Fire Fighters Who Fight Marine Vessel Fires

George E. Luther, *Chairman*
Commission on Fire Prevention, CT

Frank Bateman, Minnesota Mining and Mfg. Co., CA
Mike Bishansky, Military Sea Lift Command/Atlantic, NJ
John R. Burns, Jr., Texas A & M University, TX
Nicholas Cricenti, Jr., Cowan & Cricenti Engineering Associates, Inc., NH
John Donovan, Texas A & M University, TX
Michael Franchini, Marine Safety School, US Coast Guard, VA
Bob Hansen, Seattle Fire Dept., WA
Frank D. Harrisson, Professional Loss Control Inc., PA
Jose Hernandez, Military Sealift Command/Atlantic, NJ
Forest Herndon, Jr., MarAd Firefighting School, NJ

John Hoglund, Maryland Fire & Rescue Institute, MD
Robert Lincoln, Nassau County Fire Academy, NY
John Manganaro, U.S. Coast Guard H.Q., Washington, D.C.
Michael McDermott, Santa Barbara Fire Dept., CA

Martin F. Henry, NFPA Staff Liaison

David Moskoff, Maretech, NH
Les Omans, San Jose Fire Dept., CA
Charles L. Page, Texas A & M University, TX
Steve Souder, U.S. Coast Guard H.Q., D.C.
Gene Spinazola, Maine Maritime Academy, ME

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

Contents

NFPA 1405

A Guide for

Land-Based Fire Fighters

Who Respond to Marine Vessel Fires

1990 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates a reference to explanatory information contained in Appendix A.

Chapter 1 Introduction

1-1 Scope.

1-1.1 This guide identifies the elements of a comprehensive marine fire fighting response program, including, but not limited to, vessel familiarization, training considerations, and pre-fire planning and special hazards, that will enable land-based fire fighters to safely and efficiently extinguish vessel fires. In general, the practices recommended in this publication apply to vessels that may call at United States ports, or are signatory to the Safety of Life at Sea (SOLAS) agreement.

1-1.2 This document does not consider offshore terminals or vessels on the high sea.

1-2 General Information.

1-2.1 The tactics and strategies utilized in the attack of a fire aboard a vessel are in many ways similar to those used daily in attacking structure fires. However, there are many aspects of marine fire fighting that warrant special attention because of the unique environment encountered aboard a vessel. Ships are often compared to high-rise buildings. This is not altogether false. However, ventilation of a vessel fire may be more difficult to achieve and the spread of a fire more difficult to check. The fire fighter's natural response when confronted with a structure fire is one of immediate action. This is because most structure fires possess similar conditions that have been encountered before and thus form a knowledge and experience resource from which to draw. However, a major fire aboard ship seldom occurs, and very few fire fighters have experienced them. Because of this fires aboard ship must be approached in a quick but safe and prudent manner. Firefighters have come to realize that in approaching hazardous material incidents, it is much better to proceed slowly and to be right than to react too quickly, thus increasing risks and jeopardizing success. So it is with vessel fires.

1-2.2 Unlike structure fires, hazardous material incidents, and many other fireground operations for which there is extensive written material available for fire service personnel to study, there is relatively little information available to land-based fire fighters concerning the management of a fire aboard a vessel. The absence of this type of information often leads fire fighters to apply strategies and tactics associated with structure fires to fires aboard vessels. Although those strategies and tactics are similar, it must be recognized that there are distinct differences.

1-2.3 To address this major void in knowledge and understanding of vessel fire fighting procedures, the NFPA, at the request of, and in cooperation with the United States Coast Guard (USCG) and with the assistance of the fire service and maritime communities, has undertaken the task of developing this guide for use by local fire fighting organizations that may be confronted with a fire aboard a vessel.

1-2.4 Because there is extensive written material available concerning structure fires, hazardous material incidents, and other fireground operations, the discussion of those aspects of vessel fire fighting procedures that are similar will be minimized. On the other hand, those aspects that are different will be emphasized and highlighted throughout this document.

1-3 Definitions.

Accommodation Spaces. Spaces designed for living purposes for people aboard a vessel.

Admiralty Law – Maritime Law. A court exercising jurisdiction over maritime cases.

Aft. Toward the stern of the vessel.

Anchorage. An area identified for safe anchoring. (*See 2-6.*)

Athwartship. Side to side, at right angles to fore and aft centerline of a ship.

Ballast. Weight, liquid or solid, added to a ship to ensure stability.

Ballast Tank. A watertight compartment to hold liquid ballast.

Barge. A long large vessel, usually flat-bottomed, self-propelled, towed, or pushed by another vessel, used for transporting materials.

Beam. The breadth, width, of a ship at the widest point.

Berth. 1. Mooring of a boat alongside a bulkhead, pier, or between piles. 2. A sleeping space.

Berthing Area. 1. Bed or bunk space on a ship. 2. A space at a wharf for a ship to dock.

Bilge. The lowest inner part of a ship's hull.

Bitts. A pair of heavy metal posts, fastened on a deck to which mooring lines are secured.

Boom. 1. A long pole extending upward at an angle from the mast of a derrick to support or guide objects lifted or suspended. 2. A floating barrier used to contain materials upon the surface of the water. such as oil.

Bow. Front end of boat or vessel.

Break Bulk Terminal. Terminal where commodities packaged in bags, drums, cartons, crates, etc., are commonly but not always palletized and loaded and unloaded.

Bulk Terminal. Terminal where unpackaged commodities carried in holds and tanks of cargo vessels and tankers and generally transferred by such means as conveyors, clamshells, pipeline, etc. are handled.

Bulkhead. 1. One of the upright, vertical partitions dividing a ship into compartments and serving to retard the spread of leakage or fire. 2. A fixed pier or wall back-filled to be continuous with the land.

Buoyancy. 1. The tendency or capacity to remain afloat in a liquid. 2. The upward force of a fluid upon a floating object.

Car Terminal. Terminal where the commodity handled is automobiles.

Centerline. Also known as the "lubber's line"; a line that runs from the bow to the stern of the vessel and is equidistant from the port and starboard sides of the vessel.

Chief Mate. Deck officer immediately responsible to the vessel's master; commonly referred to as "mate."

Coaming. Name given to any raised framework around deck or bulkhead openings to prevent entry of water.

Cofferdam. A void between compartments or tanks of a ship for purposes of isolation.

Companionway. Interior stair-ladder used to travel from deck to deck, usually enclosed.

Container Terminal. Terminal that is designed to handle containers that are carried by truck or rail car when transported over land.

COTP. United States Coast Guard Captain of the Port. The Captain of the Port has broad powers over all vessels in the area.

Damage Control Locker/Emergency Gear Locker. A locker used for the storage of emergency equipment.

Deck. A platform (floor) extending horizontally from one side of a ship to the other.

Dewatering. Process of removing water from a vessel.

Double Bottom. Void or tank space between the outer hull of the vessel and the floor of the vessel.

Draft. The depth of a vessel's keel below the water line.

Drafting. The act of acquiring water for fire pumps from a static water supply by creating a negative pressure on the vacuum side of the fire pump.

Dry Bulk Terminal. Terminal equipped to handle dry goods that are stored in tanks and holds about the vessel.

Dunnage. Loose packing (usually wood) material protecting a ship's cargo from damage or movement during transport.

Escape Trunk. A vertical trunk fitted with a ladder to permit personnel to escape if trapped.

Fantail. The stern overhang of a ship.

Fire Control Plan. A set of general arrangement plans showing for each deck the fire control stations, fire-resisting and fire-retarding bulkheads, together with particulars of the fire detecting, manual alarm, and fire extinguishing systems, fire doors, means of access to different compartments, and ventilating systems including locations of dampers and fan controls. It is required to be stored in a prominently marked weathertight enclosure outside the deckhouse for the assistance of shoreside fire fighting personnel.

Fire Station. A location for the fire fighting water supply outlet, hose, and equipment on board ship.

Fire Warp. Wire rope or other fire proof materials of sufficient strength to tow the vessel in event of fire. It should be hung from the forward and after end of the vessel at a position that would allow for easy retrieval by a vessel for towing; the other end of the fire warp is attached securely to the vessel.

Force Majeure. *(See 15-4.)*

Forecastle. (fo'c's'le) The section of the upper deck of a ship located at the bow, forward of the foremast. A superstructure at the bow of a ship where maintenance shops, rope lockers, and paint lockers may be located.

Forward. Toward the bow of the vessel.

Frame. Structural members of a vessel that attach perpendicularly to the keel to form the ribs of the vessel.

Freeboard. The vertical distance between water line and main deck.

Gangway. Opening through bulwarks (sides) of a ship or a ship's rail to which an accommodation ladder used for normal boarding of the ship is attached.

Gunwale. The upper edge of a side of a vessel or boat designed to prevent items from being washed overboard.

Heeling. To tip to one side. To cause a ship to list.

Hogging. Straining of the ship that tends to make the bow and stern lower than the middle portion.

House. Superstructure that is above the main deck.

International Shore Connection. A universal connection to the vessel's firemain to which shoreside fire fighting water may be connected. This allows use of the vessel's fire stations and associated hoses. Required on all vessels over 500 gross tons subject to SOLAS, and on U.S. inspected vessels over 1000 gross tons. *(See 2-13.)*

Jacob's Ladder. A rope or chain ladder with rigid rungs.

Keel. The principal structural member of a ship, running fore and aft on the centerline. Extending from bow to stern, forming the backbone of the vessel to which the frames are attached.

Ladder. All staircases, often almost vertical, onboard vessels.

List. An inclination to one side, a tilt.

Main Deck. The upper most continuous deck of a ship, which runs from bow to stern.

Master. The captain of a merchant ship.

Mate. A deck officer on a merchant ship ranking below the master.

Mooring. 1. Equipment, such as anchors, chains, or lines, for holding fast a vessel. 2. The act of securing a vessel. 3. A place at which a vessel can be moored. 4. Any place where a boat is wet stored or berthed. Locally, may be used to differentiate between permanent anchored moorings and slips.

Overhead. A vessel's equivalent to a ceiling.

Passageway. A corridor or hallway.

Platforms. 1. Any flat top vessel, such as a barge, capable of providing a working area for personnel or vehicles. 2. A partial deck in the machinery space.

Port Side. The left-hand side of a ship as one faces forward.

Riser. A pipe leading from the firemain to firestation (hydrants) on upper deck levels.

Roll-On/Roll-Off (ro/ro). A form of cargo handling utilizing a vessel designed to load or unload cargo that "roll-on" or "roll-off," such as automobiles or tractor trailer units.

Sagging. Straining of the ship that tends to make the middle portion lower than the bow and stern.

Sail Area. The area of the ship that is above the water line and that is subject to the effects of wind, particularly a crosswind on the broad side of a ship.

Scupper. An opening in the side of a vessel through which rain, sea, or fire fighting water is discharged.

Shaft Alley. A narrow, watertight compartment through which the propeller shaft passes from the aft engine room bulkhead to the propeller.

Shaftway. A tunnel or alleyway through which the drive shaft or rudder shaft passes.

SOLAS. The International Convention for the Safety of Life at Sea, 1974.

Starboard Side. The right-hand side of a ship as one faces forward.

Stern. After end of boat or vessel.

Stevedore. A person employed in the loading and unloading of ships, sometimes called a longshoreman.

Superstructure. Enclosed structure above the main deck, which goes from one side of the vessel to the other side.

Tank Top. Lowest deck, top plate of the bottom tanks.

Tides. The periodic variation in the surface level of the oceans and of bays, gulfs, inlets, and tidal regions of rivers, caused by the gravitational attraction of the sun and moon.

Towboat. A powerful small vessel designed for pushing larger vessels.

Tug. A powerful small vessel designed for towing larger vessels.

Tween Decks. Cargo decks between main deck and lower hold.

Ullage Hole. An opening in a tank hatch to allow measure of liquid cargo.

USCG. United States Coast Guard.

Vertical Zone. The area of a vessel between adjacent bulkheads.

Watertight Bulkhead. A bulkhead (wall) strengthened and sealed to form a barrier against flooding in the event that the area on one side of it fills with liquid.

Watertight Door. A door that is designed to keep water out.

Watertight Transverse Bulkhead. A bulkhead that has no openings through it and extends from tank top up to the main deck, built to control flooding.

Winches. A stationary motor-driven hoisting machine having a drum around which a rope or chain winds as the load is lifted.

Chapter 2 Marine Environment

2-1 Introduction. This chapter describes the elements of the physical marine environment that may be encountered by those involved in managing a fire aboard a vessel. An understanding of the following items is necessary to plan for the changing conditions that occur during a vessel fire. Local sources of expertise that may be available to provide specific information on the marine environment should be identified during the planning stages.

2-2 Tides and Currents. Tides and currents are critical to the fire officer as they will produce vertical and horizontal movement of the vessel; equipment, such as hoses and ladders, that are attached to the vessel, as well as "drafting" operations from docks and piers may be adversely affected.

Tides are the daily changes in the depth of the water. Depending upon location, this change can vary from an unnoticeable amount more than 30 feet. Changes in the tide need to be considered when mooring or anchoring a vessel and during fire suppression activity. The vessel may become grounded, which in turn may cause listing or capsizing.

Currents can result from tide changes and river flow. Tidal currents change direction at predictable intervals. River flow will increase or decrease the tidal current. The river flow rate usually increases during spring run-off and decreases during summer and fall droughts.

Currents affect the movements of vessels and boats. They put additional strain on the mooring system of a vessel and can even compromise a weakened system. When currents hit obstructions in the water, such as piers, they often change direction and form whirlpools and eddies. Fireboats and rescue boats maneuvering around piers may find it very difficult to maintain their position in these swirling waters. People who go overboard into strong currents may be pulled under piers, barges, or vessels by these currents. They may become trapped underneath them.

The coast guard, the vessel's crew, and others who work in the port can estimate tides and tidal currents from Tide Tables and Current Tables produced by the National Oceanic and Atmospheric Administration. For local conditions around piers and in channels, consult with docking pilots and channel pilots.

2-3 Weather. Observing and reporting the actual weather conditions at the site of an incident is of critical importance to planning and executing an effective response. Observations of the on-scene weather conditions should be reported to the Command Post at regular intervals. Changes in on-scene weather conditions must also be reported as soon as they are recognized.

A variety of weather forecasting information sources may be available to the Incident Commander for planning and modifying fire fighting strategies. Local National Weather Service (NWS) offices may be able to provide weather forecasts that are specific to the location and nature of the incident. Continuous weather forecasts are broadcast by the National Oceanic and Atmospheric Administration (NOAA) on VHF-FM channels. The USCG has maritime weather observations and forecasts available for use by the Incident Commander. Local airport FAA offices may make aviation weather observations and forecasts available.

Weather conditions over the water are often different from the weather experienced over the land. Rapid changes of the weather occur frequently in coastal areas and may take incident responders by surprise. Weather observations and forecasts for offshore conditions may be less accurate as the distance from shore increases.

Wind speed and temperature over water can be expected to be different from conditions observed over land. Temperatures over the water can be a few degrees warmer during the winter but cooler during the summer. A breeze may exist along the coast even when it is calm inland because of this temperature difference. Winds can be stronger along the coast or in harbors where there are few obstructions.

2-4 Vessel Traffic. The amount and type of vessel traffic varies from port to port, within the port, and along waterways. Fishing vessels, sailboats, pleasure boats, naval vessels, deep-draft vessels, etc., all present different traffic problems. The Coast Guard Captain of the Port has the authority and resources to control vessel traffic in the harbor. (*See Chapter 12, U.S. Coast Guard Role, for more information.*)

2-5 Channels and Navigation. Nautical charts are maps of the harbor that show the channels used by vessels to enter and leave the port. They also show the projected depth of the channels and the buoys and beacons that mark the channel.

Vessel movements are governed by the Rules of the Road (Navigation Regulations) and harbor regulations where applicable. Many larger vessels are under the guidance of local professional pilots who have extensive knowledge of local conditions.

2-6 Designated Fire Fighting Anchorage and Piers. The USCG determines the locations of fire fighting anchorages in the port and along waterways. They also enforce the anchorage regulations. Moving a burning vessel to an anchorage often will reduce exposure problems but could increase access and pollution problems. Even if a sufficient number of vessels or platforms can be obtained to gain access to the vessel, fighting a fire from a platform, exposed to the weather and currents, is much more difficult than fighting a fire from a pier. An anchorage can be an excellent temporary location for the vessel while fire fighting resources are being mustered and a more advantageous location is being found.

Designated piers and anchorages should be, and usually are, listed in the Coast Guard Firefighting Contingency Plan for the area, see Chapter 12.

2-7 Bottom Conditions. Bottom conditions should be evaluated when a vessel is anchored or moored. An anchor may not hold on a rocky bottom while it may hold too well on a muddy bottom, making it difficult to pull up. The nautical chart of the area identifies the bottom conditions (mud, sand, rock, wrecks, etc.). When a vessel is moored to a pier and in danger of settling to the bottom due to an excess of fire fighting water, the slope of the bottom will determine how the vessel comes to rest. At some piers the bottom is sloped steeply toward a deeper channel. A vessel settling on this bottom may slide out toward the channel or capsize.

2-8 Marine Terminal Types. Marine terminals vary in type, size, age, construction, cargo handling and fire fighting equipment, etc.

The different types of marine terminals are:

Liquid Bulk
Dry Bulk
Container
Break Bulk
Motor Vehicle Terminal
Roll-On/Roll-Off (Ro/Ro)
Rail
Ferry/Passenger

2-8.1 Liquid Bulk Terminal – transfers oils, chemicals, liquefied gases, etc., from tank vessels, through a fixed pipeline, and to large storage tanks onshore.

2-8.2 Dry Bulk Terminal – transfers cement, grain, coal, salt, fertilizer, etc. in bulk quantities usually using bucket cranes and conveyor belts. Storage is in piles on the ground or in large warehouses.

2-8.3 Container Terminal – transfers containers (8.5 – 9.5 feet high, 8 feet wide, and 20 – 40 feet long) from vessels to ground storage, chassis, or rail cars using specialized movable cranes.

2-8.4 Break Bulk Terminal – transfers non-bulk cargo, such as a raw rubber, lumber, bags of cocoa and coffee beans, steel coils, heavy machinery, etc., to large transit sheds and warehouses using ship's equipment or cranes. It is very labor intensive.

2-8.5 Motor Vehicle Terminal – transfers vehicles that are driven from large car carriers to large storage parking lots on the terminal.

2-8.6 Roll-On/Roll-Off Terminal – transfers freight containers on chassis, trailers, motor vehicles, etc., that are driven on or off the vessel using special piers and/or vessel ramps.

2-8.7 Rail Terminal – transfers railcars that are driven on or off the vessel on tracks located on the vessel and terminal and connecting the vessel and terminal.

2-8.8 Ferry/Passenger Terminal – transfers passengers, their vehicles, their baggage, etc. The operations at a large cruise ship terminal are similar to those at an airport.

2-9 Piers and Wharves. Piers and wharves are constructed from materials that vary from concrete pilings and surfacing to wooden pilings with wooden or concrete decking. Ideally, vessel fires should be fought from concrete piers or wharves. The construction of buildings on piers and wharves also varies considerably. (*See NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves, for the requirements for the construction of piers and wharves.*)

2-10 Shipyards and Drydocks. Because of the nature of the work, i.e., welding, burning (cutting), grinding, etc., many vessel fires have occurred in shipyards and drydocks. They are typically crowded with people and machinery. Ship systems, including fire fighting systems, may be inoperable due to repair. Access to the pier or drydock is difficult. A vessel in a drydock may stand a hundred feet out of the water with only one gangway leading into the ship from the top of the drydock. Openings may be cut in the vessel, which will contribute to the spread of smoke and fire. Refer to NFPA 312, *Fire Protection of Vessels During Construction, Repair and Lay-up*.

2-11 Moorings. Vessels are moored to piers and wharves using wire or rope lines. Efforts must be made to protect mooring lines so that they do not burn through or break, setting the vessel adrift. On deck, mooring lines usually are handled on large power winches. Without power to these winches, mooring a vessel becomes very difficult. Operate clear of any monitor mooring lines during vessel incidents. If vessel stability changes, mooring lines can be strained to the point of parting or separation, causing a hazard for emergency personnel.

2-12 Cranes. Vessels often have their own cargo handling gear (cranes and booms), which may be usable during a fire. At terminals, cargo handling cranes come in various shapes, sizes, and capacities. They range from large container and derrick cranes to small mobile cranes. Marine construction companies usually operate cranes on barges that can be towed throughout the port. They can be useful if ship or terminal cranes have been damaged or cannot be used.

2-13 Shoreside Fixed Fire Fighting Equipment. Some piers and wharves are equipped with fixed fire main and potable water systems. The connections to these systems need to be examined to ensure that fire fighting equipment can be connected to them. There is a way to connect a shore fire main system to a vessel fire main system by connecting two "international shore connections." (*See Figure 2-13.*) The ship's "international shore connection" connects to the ship's fire main and presents a standard international flange, while the shore "international shore connection" connects to the shore fire main and presents another standard international flange. These flanges can be bolted together to connect the two systems. The ship's "international shore connection" is required on all commercial vessels; however, there is no requirement to have a shore "international shore connection." Therefore, each responding fire department should have their own "international shore connection" to adapt to the fire department thread. The "international shore connection" is only tested to 150 psi. Take care not to over pressurize this device or the ship's fire main system. Therefore, it is strongly encouraged that the ship's flange be connected directly to the vessel's firemain, if possible, and not to the vessel's fire hose. For specific technical information for the International Shore Connection, refer to ASTM F1121.

2-14 Shore Connections. Vessels sometimes take on potable water and fuel, and sometimes are connected to shoreside electricity, sanitary, bilge water, telephone, and other services while at a pier. These connections may need to be disconnected during fire fighting efforts. (*See Figure 2-14.*)

Chapter 3 Vessel Familiarization

3-1 Ship Construction. Modern ships are mainly constructed of steel plates that are welded together. This includes the decks and vertical framing. The interior bulkheads may be made of steel or other materials provided that they meet the fire resistive requirements of the bulkhead.

Aluminum and other alloys are sometimes used in noncritical areas. Structural aluminum is normally found only above the main deck. The heat of a shipboard fire causes aluminum structures to sag or melt much sooner than steel structures.

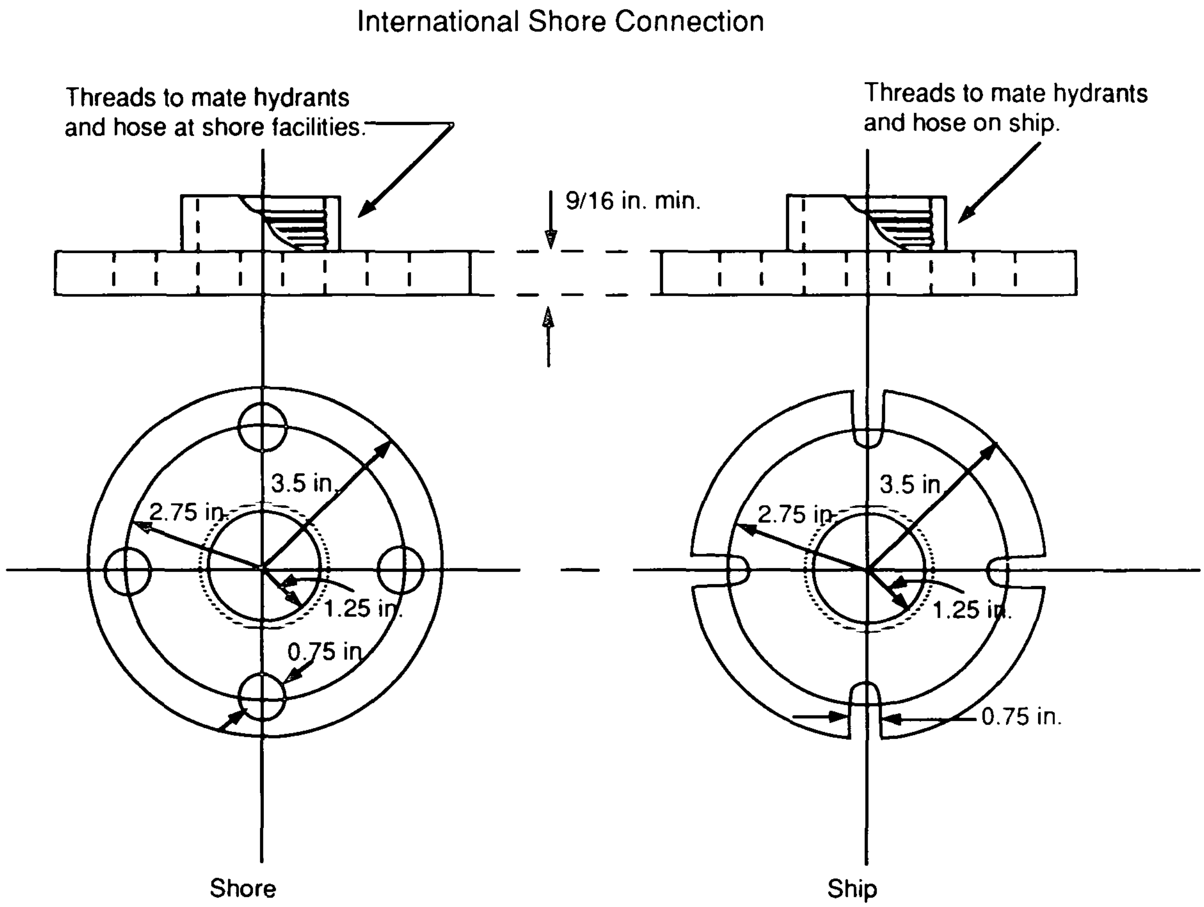
Composite materials, metal cored laminated panels, are often used for bulkheads in accommodation and berthing areas.

Bulkheads may be rated in a manner similar to partitions in buildings.

BULKHEAD RATING*

Classification	Rating
A-60	one hour
B-30	30 minutes
C	No rating

* See 46 CFR 72.05-10 for additional information.



Material: Any suitable for 150 P.S.I service (shore)
Flange Surface: Flat face
Gasket Material: Any suitable for 150 P.S.I service
Bolts: Four 5/8 in. diameter, 2 in. long (min.), threaded to within 1 in. of bolt head
Nuts: Four, to fit bolts
Washers: Four, to fit bolts

Material: Brass or bronze suitable for 150 P.S.I service (ship)

Figure 2-13 International ship shore fire connection.

3-1.1 Ship Structure. Ships are framed in a manner similar to buildings. The outer shell or plating and the decks provide the main frame of the ship. The main girder of the vessel is called the keel. (*See Figure 3-1.1A for Pre-1949 Convention Compartment Identification System and Figure 3-1.1B for Post-1949 Convention Compartment Identification System.*)

Frames, similar to ribs, provide the internal structure to support the decks and outer shell. Frames are numbered sequentially but vary as to point of reference. They begin from the bow, stern, or amidships. The compartments also are numbered. The starboard side compartments are odd numbered, and the port side compartments are even numbered.

On a military ship decks are usually numbered. Decks may be named or numbered aboard merchant vessels.

On a military ship decks above the main deck will be numbered 01, 02, 03, etc. The higher the number, the higher the deck in the superstructure. Decks below the main decks will be numbered the lst deck, 2nd deck, 3rd deck, etc. The larger the number, the lower the deck will be within the hull.

Aboard merchant vessels the decks may be named or numbered, or both. Names vary from vessel to vessel and even within the same vessel. It is important for fire fighters to refer to the vessel's general arrangement plan to determine the correct deck name or number for a specific vessel. (*See Figure 3-1.1.B.*)

Ships are divided into zones by fire resistive bulkheads and decks. The location of bulkheads and decks may be found by referring to the ship's fire control plan.

The doors separating the vertical zones are required to have the same rating as the bulkhead.

Below the main deck the doors may be remote controlled or manually operated watertight doors, or they may be standard fire doors.

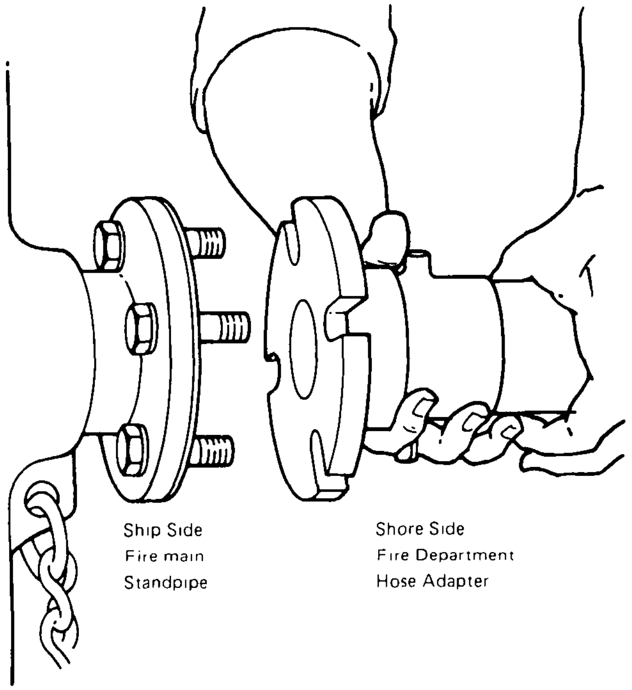


Figure 2-14 International shore connection.

3-1.2 Construction. During construction, US flagged vessels are rigidly inspected by the Coast Guard. Penetrations are sealed or protected by dampers at vertical zones.

Between the vertical zones, penetrations in bulkheads, framing, and decking are permitted. These penetrations may cause hidden spaces to be created.

Other concealed spaces may exist because of cofferdams, shaftways, double bottoms and intakes, or discharges.

As ships age, the integrity of the vertical zones tends to diminish.

3-2 Interior Arrangements. The size of a ship's interior spaces, ladders, companionways, and passageways are much smaller than those found in a building. It is difficult for two people to pass in some passageways.

The cabins or berths are usually smaller than those found in a hotel.

Stairs are called companionways or ladders. They are often steep and narrow, as well as open backed.

The machinery spaces on a ship may be very large since they commonly contain the equipment used to produce the ship's electrical and propulsive power.

Each self-propelled vessel must have at least two electric generating sets. Additionally, an emergency source of power (battery and/or generator) must be provided.

On most U.S. flag vessels, lighting for engine rooms, boiler rooms, and auxiliary machinery spaces is supplied by two or more electrical feeders.

Because of the oils and fuels used in the machinery spaces everything in the space should be considered to have a coating of oil upon it and therefore may be slippery, especially when wet.

Much of the decking in the machinery spaces is open webbed grating to reduce the chance of slipping. If the fire is underneath the open webbed or expanded metal decking (grating), the flames and heat pass through and can cause injury and early structural failure.

Because of the critical nature of these spaces, they are usually protected by manually activated extinguishing systems.

All the separate compartments in the main machinery spaces require at least two exits. One of these exits is usually an escape scuttle to the deck above.

Cargo storage areas (holds) are large spaces in which the cargo is carried. These spaces usually have hatch covers at the main deck level through which cargo is handled. There may also be covers on the decks below. If the ship is in port these covers may be open, posing considerable risk to people on deck, particularly in a smoke environment. Generally, these spaces are required to be equipped with manually operated suppression systems. Holds may have mezzanines called 'tween decks to increase storage capacity.

Tanks are holds designed to contain liquids. The tanks are emptied by the use of pumps that are aboard ship.

Ships are equipped with fire pumps that supply fire mains, which are similar to standpipes in buildings. At least one of these pumps must have an alternate or emergency source of power.

Self-propelled vessels and some barges are equipped with fire pumps that supply fire mains that are similar to standpipes in buildings. Where two or more fire pumps are required, the pumps must be arranged with separate sea connections and sources of power so that a fire in any one space will not put all of the fire pumps out of operation.

3-3 Types of Ships. There are many variations of ships that utilize the ports in the United States, but they can be classified into several main types. The vessels that are flagged/registered as American Vessels must comply with a slightly different set of rules than do vessels that are flagged by foreign countries. With those countries participating in the Safety of Life at Sea (SOLAS) convention, all of their applicable vessels should comply with the SOLAS standards. Some vessel categories to which SOLAS does not apply include: cargo vessels under 500 gross tons (most offshore supply vessels) and vessels not propelled by mechanical means (barges and sail training ships).

The major types of vessels are as follows:

1. Dry Bulk Carriers
2. Break Bulk Carriers
3. Ro/Ro
4. Container
5. Liquid Bulk Carriers (Tankers)
6. Passenger Carriers
7. Ferries
8. Barges
9. Tugs and Tow Boats
10. Multi-Purpose
11. Lighter-on-Board

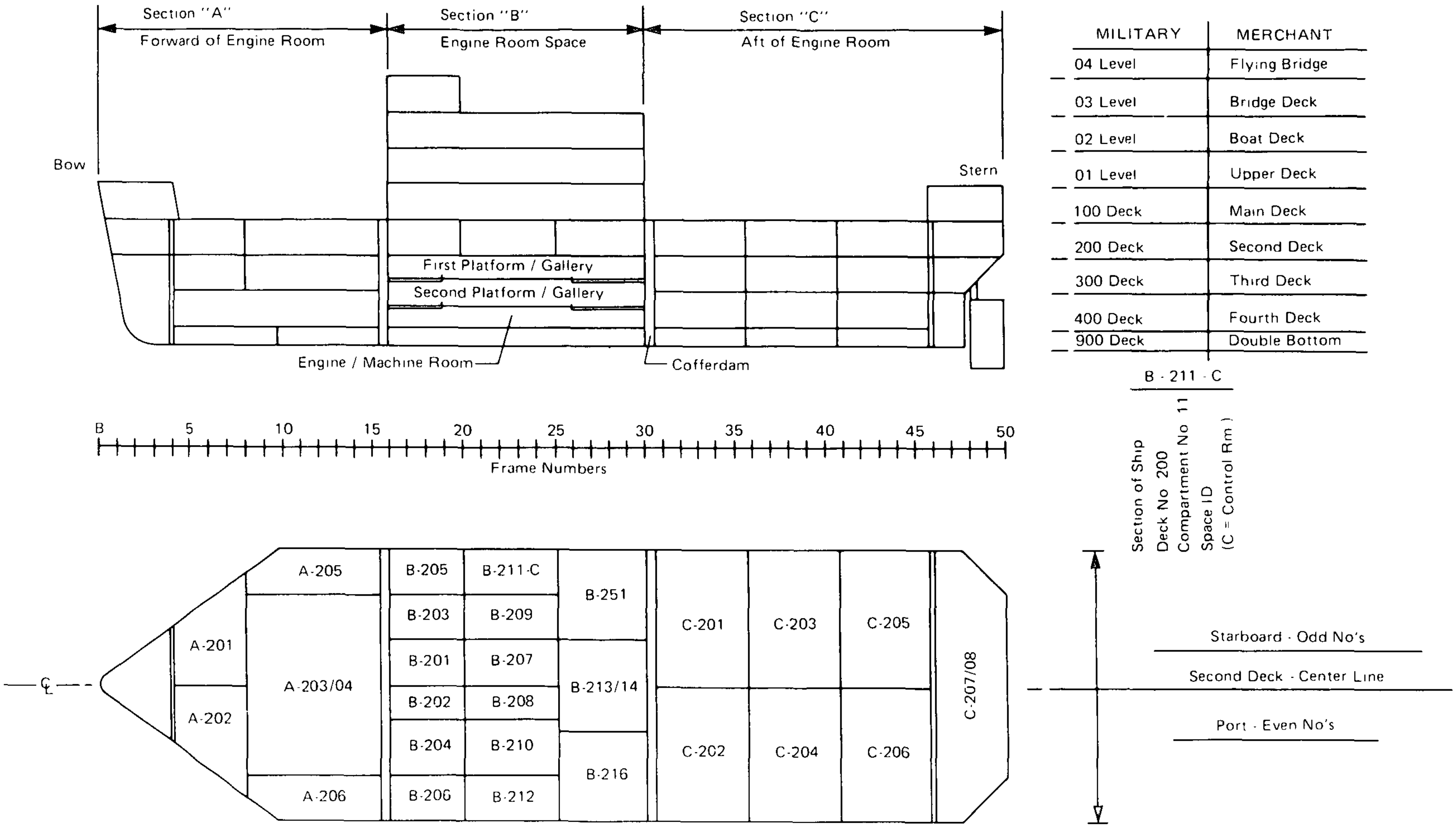


Figure 3-1.1A Pre-1949 Convention

04	Level	Flying Bridge
03	Level	Bridge Deck
02	Level	Boat Deck
01	Level	Upper Deck
100	Deck	Main Deck
200	Deck	Second Deck
300	Deck	Third Deck
400	Deck	Fourth Deck
900	Deck	Double Bottom

2 - 20 - 3 - E

Deck No. 200
Frame No.
Forward
Compartment from Center
Space ID (E=Engineering)

Space Code	
A	Ship Stores
AA	Cargo Dry
C	Control Center
E	Engineering
L	Accomodation
Q	Support
M	Munitions--Arms
F	Fuel Oil--Ships
FF	Fuel Oil--Cargo
G	Gasoline--Ship
GG	Gasoline--Cargo
K	Chemicals--Cargo
F/K	Fuel or Chemicals

Starboard--Odd No.s
Second Deck--Center Line
Port--Even No.s

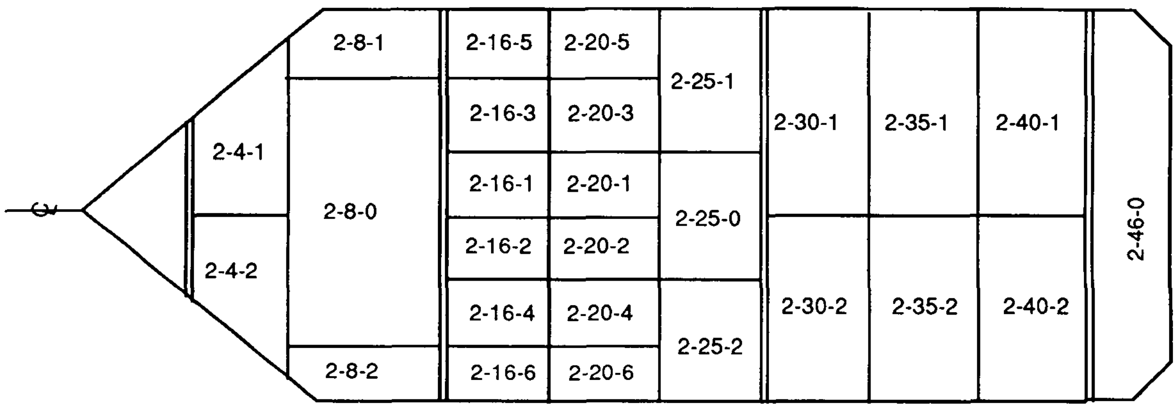


Figure 3-1.1B Post-1949 Convention

3-3.1 Dry bulk carriers typically carry goods such as grain, coal, iron ore, and scrap steel in large cargo holds. (*See Figure 3-3.1.*) The hazards associated with fires on these types of vessels can be likened to the hazards of grain silos, such as spontaneous combustion, dust explosions, and expansion of product due to the adding of water, with the added problem of stability. Additional care must be taken because of the large deck openings into the holds.

3-3.2 Break bulk carriers are ships that carry dry cargo in smaller parcels, such as crates, bags, or barrels. (*See Figure 3-3.2.*) Break bulk carriers may also contain dunnage (usually wood) used to support and separate cargo. Break bulk carriers can carry hazardous materials in the holds.

3-3.3 Ro/ro (roll-on/roll-off) ships are ships that carry automobiles and other vehicles. They are designed specially to carry as many vehicles as possible. These vessels may have low overheads, many decks, and sometimes straight flat sides.

3-3.4 Container ships are specialized carriers that carry break bulk goods in steel or aluminum containers. (*See Figure 3-3.3.*) Large container ships carry as many as 4000 20-ft containers in holds and above deck.

3-3.5 Liquid bulk carriers are called tankers and are capable of carrying tremendous quantities of liquids in specially designed holds called tanks. (*See Figure 3-3.4.*) Tankers are sized according to volume, the smallest being called a handy size tanker and the largest being called an ultra-large crude carrier (ULCC). The fire officer should become familiar with the size and type of tankers that call at the port. Some tankers will carry different liquids in different tanks. Some carry forty or more different liquids and are known as "Drugstores." A tanker also will have the ability to pump off its own cargo during the offloading process. Because of the pumps, there often will be a great deal of piping on the main deck of the tanker. Care should be taken to preserve the integrity of the piping.

3-3.6 Passenger vessels may carry several thousand people. Although the passenger spaces are similar to those in a hotel, there are several differences that should be noted. The corridors (passageways) will be considerably more narrow than in a hotel. The rooms also are smaller. The areas to which people can be evacuated on a ship are limited.

3-3.7 Ferries are usually a combination of automobile carriers and passenger vessels that traverse smaller bodies of water, such as harbors, lakes, and rivers. Ferries usually resemble floating parking garages with large undivided spaces.

3-3.8 Barges can contain any material that is carried by a larger ship. Barges often are used where deep draft vessels cannot travel. Many barges may be tied together to form a "tow," which resembles a raft floating on the water.

3-3.9 Multi-purpose ships are designed to carry a variety of cargoes at the same time. Special systems are available to transport break bulk, refrigerated (frozen), and liquid cargoes. (*See Figure 3-3.5.*)

3-3.10 Lighter-on-board ships carry smaller barge-like craft called lighters, which ferry cargo from a ship anchored in deep water to shallow water ports. The lighters usually are loaded aboard the ship through openings in the stern or are lifted aboard by large ship-mounted cranes.

3-4 Ship Personnel.

3-4.1 Captain. The captain or master of the ship is ultimately responsible for everything that happens to and upon the ship. The captain has final control over the safety of the vessel. However, the safety of the port is the responsibility of the COTP.

Liaison with the captain must be established as a priority item at the outset of any incident. A measure of courtesy and cooperation with the captain will greatly enhance any operations aboard the ship. The captain will have knowledge of the sequence of events and the actions taken prior to the fire department's arrival. The captain also should know which systems aboard ship are available and can be used.

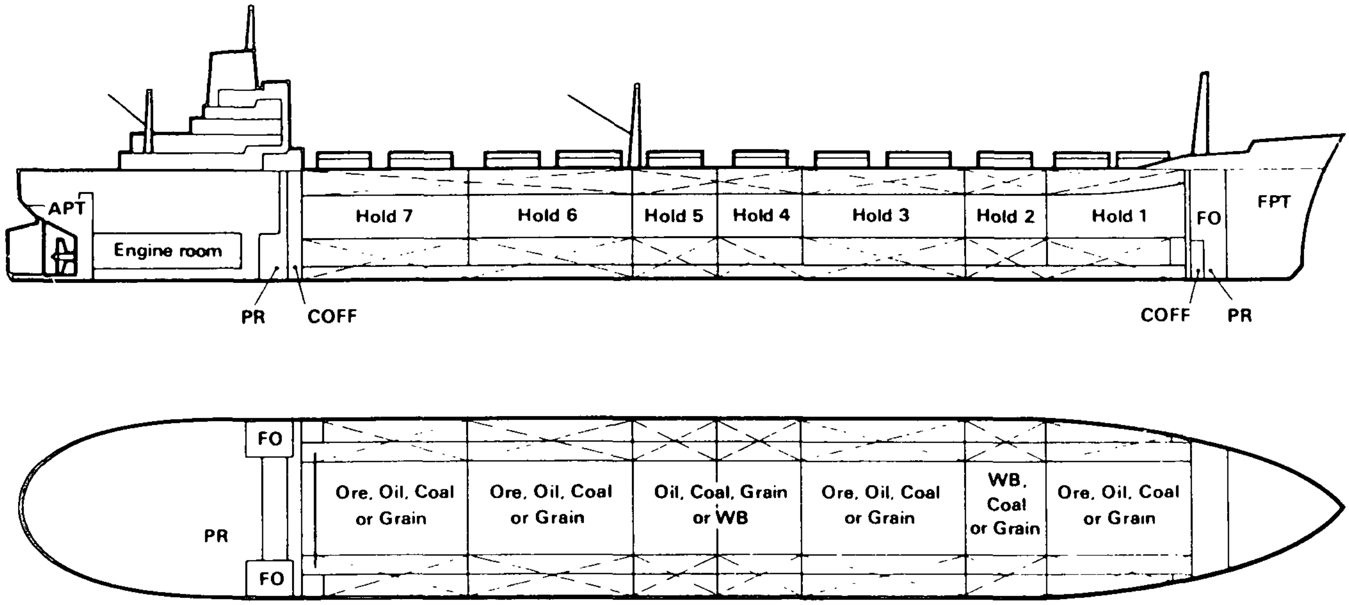


Figure 3-3.1 Dry bulk carrier.

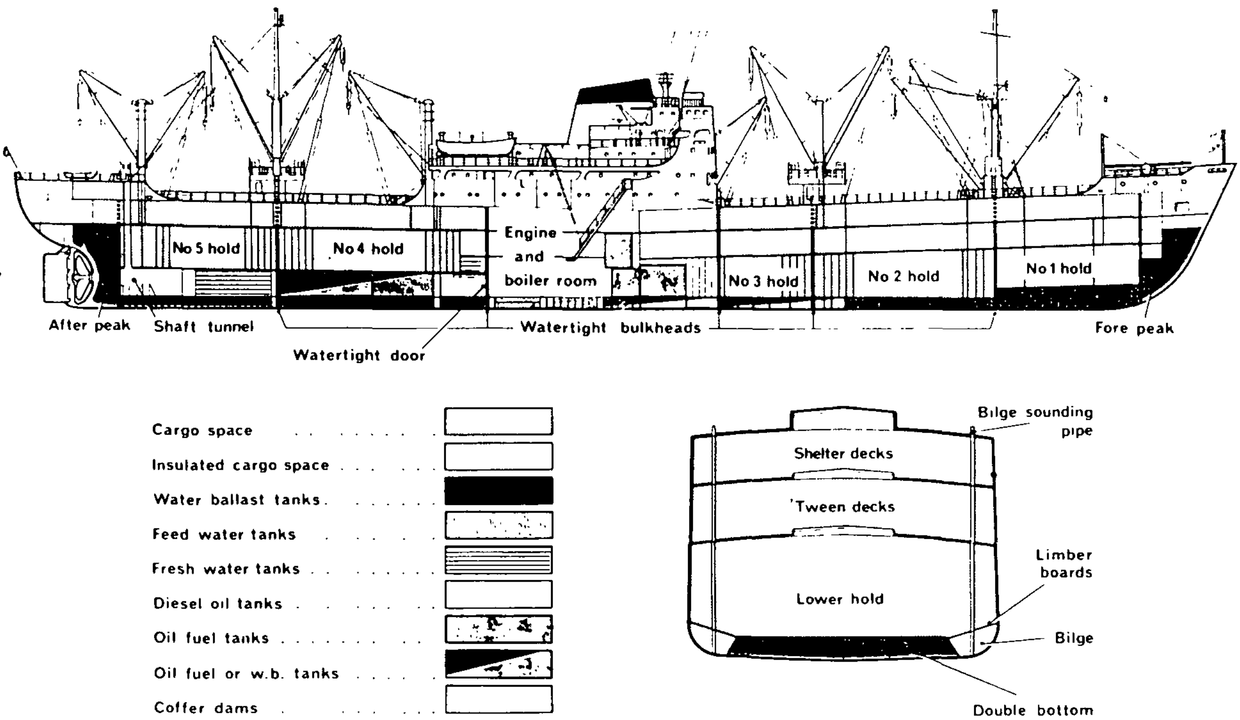


Figure 3-3.2 Break bulk carrier.

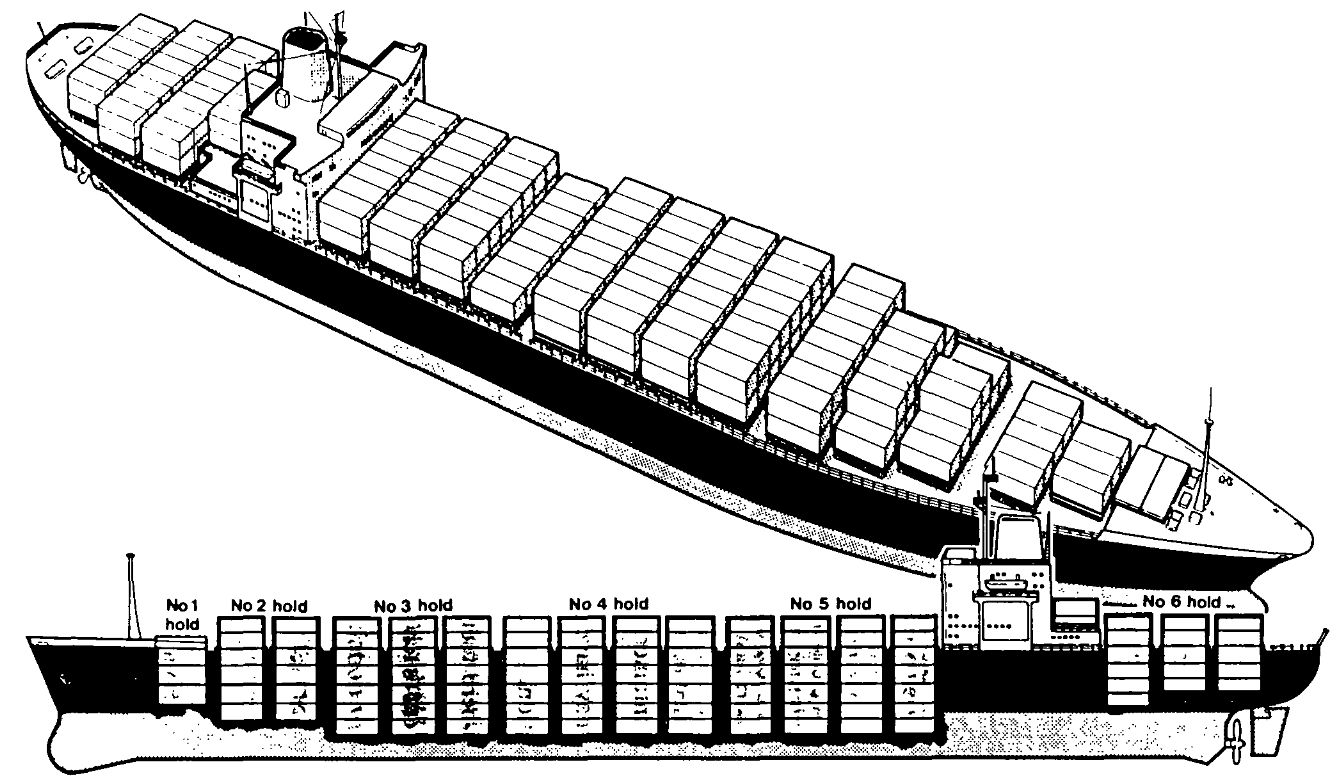


Figure 3-3.3 Container carrier.

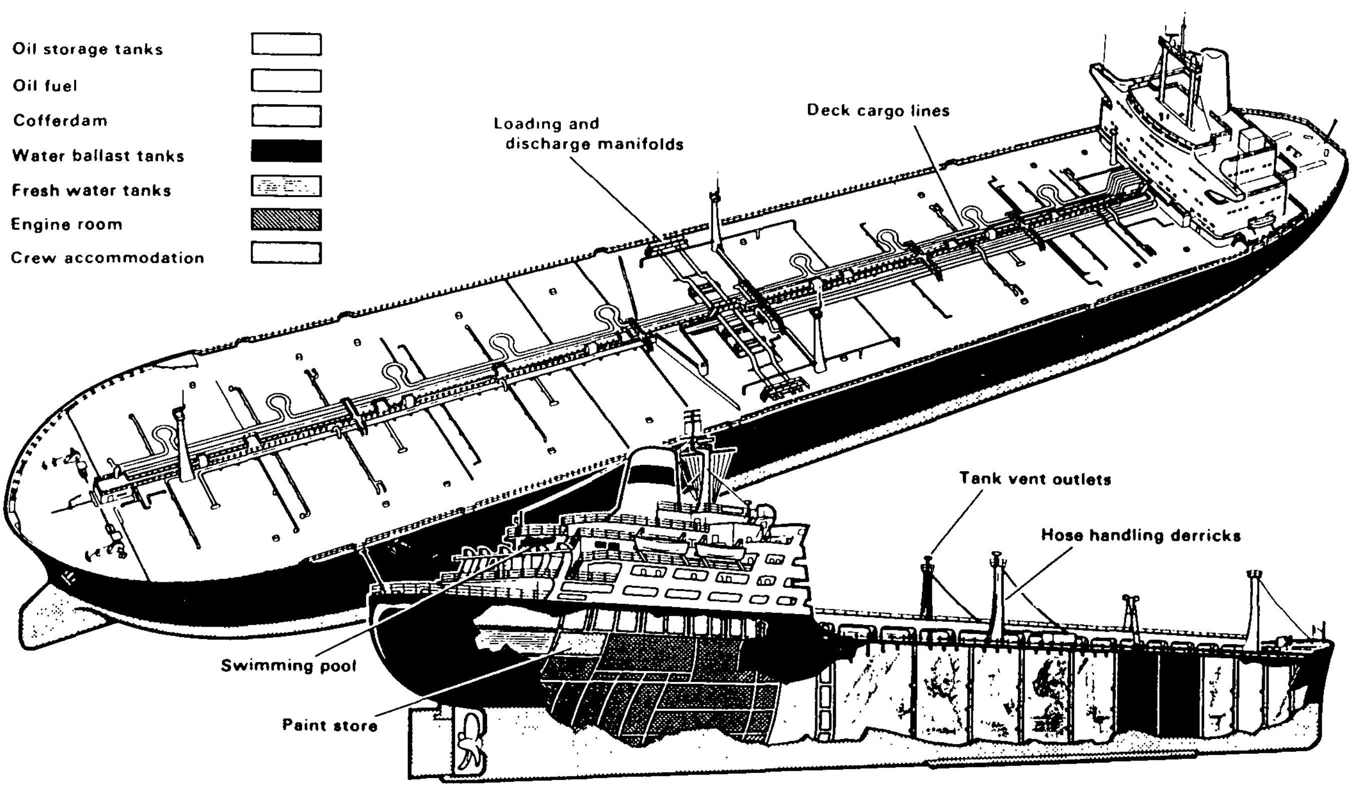


Figure 3-3.4 Liquid bulk carrier.

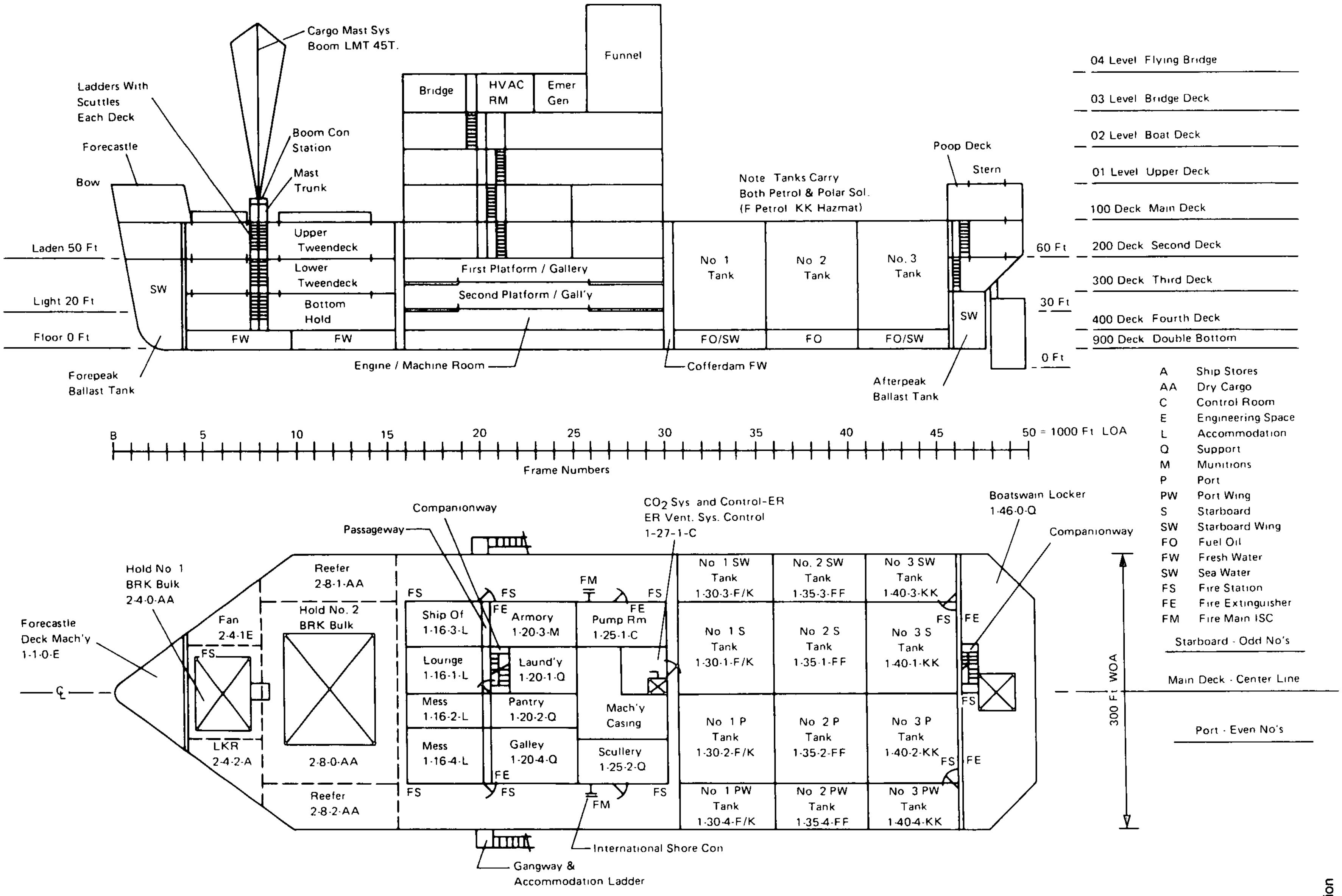


Figure 3-3.5 Multi-purpose ship.

3-4.2 Deck Department. The deck department will consist of one or more mates and other sailors. In port, the mates often are responsible for the cargo functions of the ship, including on and off loading.

The chain of command is from the captain to the chief mate (mate). (*See Figure 3-4.1.*)

The chief mate is responsible for stowage of the cargo and maintaining stability of the ship. The chief mate may have several assistant mates to assist in the performance of assigned duties.

3-4.3 Engineering Department. The engineering department on a ship is responsible for the ship's propulsion and steering, as well as all of the ship's mechanical and electrical systems.

The engineering department is led by a chief engineer who may have several assistants to assist in maintaining the ship's systems.

NOTE: The engineering and deck departments should have knowledge of the ship's extinguishing systems. This knowledge will include the type and location of the extinguishing agents and the location and operation of the activation systems.

When in port some ships are staffed by night mates or night engineers who may not be familiar with the vessel because they were hired specifically to perform night watch services.

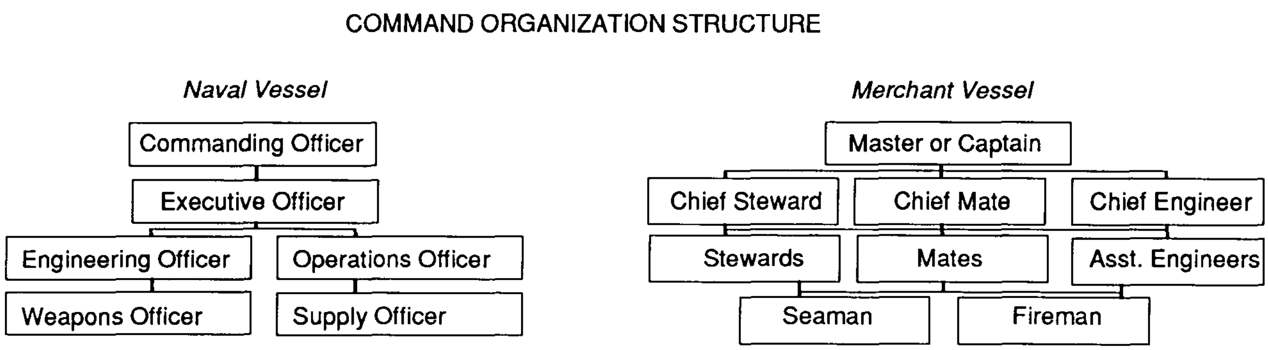


Figure 3-4.1 Command organizational structure.

3-4.4 Steward Department. A large steward department is found on ships that carry passengers. This department is similar, in function, to the staff at a hotel. They are responsible for passenger comfort.

Typically the department is led by a chief steward, who will have many people in the staff.

They will have the most knowledge about the passenger accommodations.

3-4.5 Ships' crews may be made up of various nationalities. As a result, there could be serious communication problems because of language barriers. Level of fire fighting expertise and willingness to get involved in incident mitigation will vary from vessel to vessel.

3-5 Shipboard Fixed Systems.

3-5.1 Introduction. Ships, unlike barges, have built-in fixed fire systems to extinguish shipboard fires. Experience has encouraged ship designers to improve these systems to a high degree of efficiency. Crews generally are trained to use these systems. However, the number of trained crew members aboard during a fire emergency and the initial damage done by the fire to the equipment or access to the fire system may render the condition of the system suspect. The system may or may not be operating properly. It may or may not have been used properly by the ship's crew and may be partially or fully expended.

3-5.2 Common Problems and Concerns.

3-5.2.1 Maintenance. While there is a need for the best of maintenance programs due to the marine environment, continuous changes in operating personnel can result in the ship's systems not being as well maintained as those that are land based.

3-5.2.2 Hardware Compatibility. With the exception of U.S. ships, components of shipboard systems are supplied by companies throughout the world in many configurations. Fittings, thread types and sizes, etc., are examples of equipment that could prevent a land-based fire fighter from connecting to a shipboard system.

3-5.3 Fire Main Systems. The primary intent in the design and construction of a fire main system is to provide the crew with protection for their ship. As such, they are designed for use by nontrained fire fighters. (Similar to the design intent of Class II standpipe systems as defined in NFPA 14, *Installation of Standpipe and Hose Systems.*)

3-5.3.1 Firemains. Firemains are configured either as loops, or as "dead-end" (riser) mains. The loop is obviously preferred because a break between the pump and the fire can be valved off and water pumped to the fire from an alternate route.

3-5.3.2 Branch Lines. Branch lines run from the fire main to the fire station. The pipe diameter is usually $1^1/_2$ in. – $2^1/_2$ in., or equivalent.

3-5.3.3 Fire Stations. Fire stations usually consist of a hydrant with required hose and nozzles. Stations may be located so all portions of a ship can be reached by streams from two separate fire stations.

3-5.3.4 Fire Pumps. Fire pumps aboard ships vary greatly in capacity but they usually are designed to provide much less water than their land-based counterparts. For this reason, augmenting or bypassing the ship's fire pump must be carefully considered. Over pressurization may cause rupture of the piping or result in the relief valve operating. Relief valves may be set as low as 125 psi. Some relief valves dump water into the engine room compartment presenting a flooding problem.

3-5.3.5 International Shore Connection. The international shore connection is a device that has the ship's coupling on one end and an adjustable flange on the other end. Shoreside fire departments must have the opposite connector, which consists of an adjustable flange on one end and a fire department's coupling on the other.

3-5.4 Water Sprinkler Systems. Sprinkler systems are not widely used aboard U.S. vessels due to construction methods employed. The most common use by U.S. vessels is for the protection of living quarters, ammunition lockers, public spaces and adjacent passageways, or vehicular decks on Roll-on/Roll-off vessels and ferries. Their primary function is to protect the vessel's structure and limit fire spread while providing escape routes.

3-5.4.1 Components. Sprinkler system components are similar to land-based systems of the country that constructs the vessel. Exceptions relate primarily to the system's connection to the water supply. The source of water for all shipboard water systems is through the sea suction (strainer), which must be kept free of debris if it is expected to remain effective.

3-5.4.2 System Types. Sprinkler systems are usually automatic (wet pipe) or manual (deluge type without detection) types. If the system is charged (wet pipe) there is a pressure tank installed to maintain required pressure. Piping and tanks are filled with fresh water. Dry pipe systems are common if the system is subject to freezing.

3-5.4.3 Stability. One of the greatest concerns for all water systems is the effects of the usage of water on the vessel's stability. The amount of time the system has been in operation and the system's flow rate should be obtained immediately upon the arrival of the fire department. The ship's fire plan should be consulted for the location of the system and/or the zone control valves.

3-5.5 Spray Systems (Exposure Protection). Spray systems are similar to manual sprinkler systems except that heads or spray nozzles are installed so that their stream is directed at the area to be protected/cooled.

3-5.6 Foam Systems. Foam systems usually are designed to protect engine rooms and/or cargo storage areas only. The duration of foam discharge is limited, and water usually continues to flow after the foam concentrate supply is exhausted. The ship's fire plan must be consulted for information regarding these factors.

3-5.6.1 Foam Proportioning. Ship systems use various methods of mixing water, foam concentrate, and air to produce foam. The ship's fire plan must be consulted to determine whether the system can be resupplied with foam concentrate or pressure can be augmented. For more information on foam systems refer to NFPA 11, *Low Expansion Foam and Combined Agent Systems.*

3-5.6.2 Low Expansion Foam Systems. Low expansion foam systems provide vapor suppression with foam blankets that are applied directly to flammable liquids. To be effective, coverage must be complete. The system is calculated according to the total surface area of the area protected. These systems are installed in engine rooms as well as cargo areas.

3-5.6.3 High Expansions Foam Systems. High expansion foam systems provide vapor suppression by completely filling the volume of the space protected. These systems are installed in enclosed spaces such as engine rooms. Flooding a compartment with high expansion foam will result in reduced visibility for fire fighters.

3-5.7 Carbon Dioxide ($C0_2$). Carbon dioxide systems are designed to protect enclosed spaces or portions thereof. They are used to protect cargo spaces, pump rooms, generator rooms, and engine rooms. Some smaller systems are used to protect areas such as paint lockers, galley ranges, and duct systems. (*See NFPA 12, Carbon Dioxide Extinguishing Systems, for additional information.*)

3-5.7.1 Life Hazard. Although $C0_2$ is a mildly toxic gas, it is extremely hazardous to humans when present in the concentrations sufficient to extinguish shipboard fires (upwards of 30% by volume in many cases). Also, visibility usually is obscured during discharge of CO_2. For these reasons, entry into spaces where CO_2 has been discharged should never be attempted without SCBA.

3-5.7.2 Predischarge Warning. Due to the life hazard, a predischarge warning alarm is installed in all spaces protected by CO_2 systems. Following evacuation, all doors, hatches, ventilation, and other openings must be closed or covered and all machinery shut down. Consult the ship's fire plan for instructions on these procedures.

3-5.7.3 Systems Operation. If the system has not been discharged prior to the arrival of the fire department, consult fire plan and carefully follow procedures for discharging agent. Assistance from the crew should be obtained when available. If the system has not been discharged and personnel will be working in the space, assure that the system cannot be inadvertently discharged. In addition to a predischarge warning, discharge delays are normally required for manned spaces to allow for escape. CO-systems, like other shipboard fixed fire protection systems, are difficult to support or augment from outside sources. It is critical that no agent be wasted. Once the involved space has been properly prepared and the system discharged, the on-scene personnel must not enter the space prematurely. Qualified personnel with appropriate testing equipment should be used to test involved areas to ensure the fire is out before opening the fire scene to outside oxygen sources. Cargo fires can take many days to extinguish with CO_2.

3-5.7.4 System Types.

3-5.7.4.1 Total Flooding. Total flooding systems are designed to protect entire spaces such as engine rooms, cargo holds, etc., (larger, manually activated type), or equipment storage areas (smaller, automatically activated type).

3-5.7.4.2 Local Application. Local application systems are designed to apply $C0_2$ directly to the hazard that is being protected (pumps, motors, electrical equipment).

3-5.7.5 Systems Storage.

3-5.7.5.1 Low Pressure. Low pressure systems are seldom used aboard ship. The advantage of the reduction in the required storage space is offset by the difficulties of servicing the system. These systems may be found on foreign vessels and ro/ro vessels.

3-5.7.5.2 High Pressure. High pressure systems may contain a large number of cylinders (often in excess of 100). They may be located in a designated storage area. Prior to the system's actuation, all cylinder fittings should be checked for tightness as they may not have been connected properly following servicing. Excessive leaks in system piping can result in the storage room atmosphere becoming unsafe. Precautions should be taken to protect the personnel in this area.

3-5.7.6 Delayed discharge. If all cylinders are not required on initial discharge, they can be discharged at appropriate intervals to maintain proper concentration levels. Engine rooms may require all available CO_2, while cargo spaces may require a partial discharge.

3-5.8 Halon Systems. Marine halon systems are used primarily to protect the same types of hazards for which land-based halon is used (electronics equipment, high value records, machinery spaces, pump rooms, etc.). These systems usually are smaller in size and use generally the same design criteria found in NFPA 12A, *Halon 1301 Fire Extinguishing Systems*.

"Pre-engineered" systems are smaller systems that protect areas such as unmanned engine spaces on small craft.

3-5.9 Dry Chemical Systems. Dry chemical systems are usually designed to protect galley ranges and duct systems. On liquefied gas carriers, fixed dry chemical systems are installed to protect cargo deck areas and loading station manifolds.

3-5.10 Twinned Agent Systems. Twinned agent systems are used on some ships to protect helidecks or other areas where flammable liquids might be handled. They contain PKP type dry chemical for knockdown and AFFF type foam for vapor coverage.

3-5.11 Steam Systems. Steam for smothering fires is usually generated by main or auxiliary boilers. To be effective, the steam pressure must be 100 psi or greater. The output of the steam generating equipment should be one pound of steam per hour for 12 cubic feet of volume protected. These systems are not common in the marine industry today but may be found on older vessels. Under no circumstances should steam systems be used on nitrates, sulfates, or explosives. The steam extinguishing systems should be operated only by the ship's crew.

3-6 Ship's Operating Systems.

3-6.1 Introduction. Because a ship is a self-contained unit, its operation is dependant upon and comprised of various internal systems and sources or power. These sources of power serve to provide the ship with movement, electrical power, heat/air conditioning/ventilation, water/sewage, cargo handling capability, etc.

The following brief descriptions are provided to give the land-based fire fighter a general understanding of these systems.

3-6.2 Generators. The vessel is equipped with its own electrical generating system. Electrical power is supplied throughout the ship by various distribution systems. Generators usually are driven by steam turbines or diesel engines. Most ships also will have a self-starting emergency generator that supplies vital equipment and emergency lighting; most small vessels (less than 500 gross tons) and barges have a manually connected emergency power source, or none at all. While in port, the vessel may take its electrical power from shore.

3-6.3 Ventilation. Most ships are a maze of enclosed metal spaces that must be provided with air exchanges on a regular basis. Exchanges usually are accomplished by mechanical systems that may be similar to those in structures.

Usually, the initial procedure during a ship fire is to shut down all ventilation systems during the containment phases of fire fighting.

3-6.4 Fuel Systems. Fuel oil systems aboard ships include tanks, piping, pumps, and associated equipment. The associated equipment is used for heating, straining, centrifuging, measuring, and burning fuel oil. The fuel oil transfer system can be used by the ship's personnel to affect vessel stability and trim by transferring fuel from tank to tank.

3-6.5 Communications Systems. Large ships are dependent on communication for their efficient operation. Systems may include electric and electronic telephones and "voice powered" telephones. "Voice tubes" are sometimes provided between a ship's wheel house and engine room for use in an emergency. Portable radios are commonly used by the ship's personnel throughout the vessel.

3-6.6 Cargo Handling. The main purpose of a merchant ship is to transport cargoes safely and quickly from one place to another. Types of cargoes are varied and require different types of ship and shore loading and discharging mechanisms. Some types of cargo handling gear are winches and booms, derricks, cranes, floating cranes, roll-on/roll-off ramps, shoreside gantries, and pumping systems. Trained personnel are required to handle ships' cargoes.

3-6.7 Mooring and Anchoring Systems. Vessels are secured to docks with various configurations of mooring lines and wires. These mooring systems must be monitored because of changes in the tide and current. Broken moorings can set the vessel adrift, resulting in personnel being stranded on the burning vessel and separated from their shoreside supply lines.

Anchors are connected to vessels by heavy chain or cable, which is manipulated through a device known as a wildcat/windlass. Anchoring is a specialized evolution of seamanship and requires proper training to be done safely and successfully.

3-6.8 Inert Gas Systems. The design and purpose of the Inert Gas System is to exclude oxygen or air from the void tank spaces of liquid bulk carriers. These gases usually are manufactured on board the ship. The inert gas may present a hazard to fire fighters.

Chapter 4 Vessel Stability

4-1 Introduction. In combating a fire aboard a vessel, attention must be given to the volume of water used for extinguishment and its effect on the stability of the vessel. Water applied to a vessel fire can jeopardize the stability of the vessel and the safety of the personnel on board. The application of water must be carefully monitored and removed in a timely and efficient manner. It is recommended that the Incident Commander have a basic understanding of this chapter. However, the Incident Commander is urged to consult the vessel's master, engineer, and other experts to determine how much water can safely be used. How and when water is added or removed from the vessel is critical information.

4-2 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, if it does not find a point of stable or neutral stability, continues to incline until it capsizes. Throughout an incident, it is desirable to maintain vessel stability and minimize list.

4-2.1 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.

4-3 Typical Vessel Conditions. This chapter will generally address stability matters concerning vessels in the following three conditions: (1) floating; (2) whose hulls are intact; (3) moored or in protected waters. Usually, these conditions will exist during the beginning stages of an incident. Stability and weight distribution considerations are relatively simple when these two criteria are met.

If, for instance, an explosion has ruptured the hull or the vessel has contacted the bottom, considerations will be more involved since they must also incorporate additional conditions. These more complex situations may occur singly or in combination and include vessels:

Aground
Damaged (holed) with free communication to the sea
Underway with extensive free surface
In dry dock, graving dock, synchrolift, etc.

Unquestionably, expert advice should be obtained any time 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 4-10 Stability Information*).

4-4 Center of Gravity. The center of gravity of an intact vessel is the location of the point where the sum of all the weights in the vessel is equal to zero with respect to any axis through this point. The vertical downward force of gravity acts through this point. The center of gravity and its relationship with the vessel's center of buoyancy and righting arm are key factors to understand when determining and controlling vessel stability.

The concept of center of gravity is essentially the same for a vessel or other mobile equipment, such as an aerial ladder. 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 fire fighting is accumulated above the original center of gravity. This is particularly significant in regard to vessels with large superstructures, such as 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 fire fighting efforts. It is an integral part of overall strategy.

4-4.1 Free Surface Effect. Free surface, for fire fighting 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 filled, 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.

4-4.2 Free Surface Critical Factors. If the vessel is listing or develops a list, the liquid will flow to the low side of the compartment and result in an athwartship shifting of weight. This movement causes the apparent height of the center of gravity to rise, impairing stability. The critical factors of free surface are the surface area of the liquid and the breadth of the compartment. The length of the compartment is much less a factor than its width. For fire fighting stability considerations, a liquid's free surface effect is not related to either the liquid's depth or its location within the vessel. Whether the liquid is high or low, on or off centerline, forward or aft, the reduction in stability due to free surface will be the same. However, the effect on the overall stability of the vessel MUST be kept in mind. A weight added high not only raises the center of gravity due to free surface but also raises it due to the height above the keel.

4-4.3 Free Surface Reduction. Pocketing is the effect of the liquid contacting the top of the compartment or exposing the bottom of the compartment. It will reduce the breadth of the free surface area and therefore will have a beneficial effect on stability. Similarly, solid fixed objects projecting through the surface (surface permeability) will impede the liquid's movement and be of some benefit. Since the positive effects of pocketing and surface permeability are difficult to determine, they should be considered an extra margin of safety in free surface assessments.

4-4.4 Combined Effects. The strongest threat to vessel stability from water-induced fire fighting 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 aggravated situation. These concerns will be addressed in the next section.

4-5 Center of Buoyancy. If the water that is displaced by the vessel were considered as one homogeneous unit, the center of the displaced volume of water would be considered the location of the vessel's center of buoyancy. It is the geometric center of the underwater form of the vessel. The vertical upward force of buoyancy acts through this point.

4-6 Righting Arm. The perpendicular distance between the force of gravity (through the center of gravity) and the force of buoyancy (through the center of buoyancy) is termed the righting arm or righting lever. It is generally calculated at 10-degree intervals of list for several different load conditions of the vessel.

4-7 Metacentric Height. The true measure of a vessel's initial stability is called the metacentric height or GM of the vessel (*Figure 4-7*). It is simply a geometric relationship between the center of gravity (G), the center of buoyancy (B), and the vessel's righting arm (GZ) for a given angle of inclination. After listing, (Bl) is the new center of buoyancy.

If M is above G, the metacentric height (GM) is positive. If M is below G, then metacentric height (GM) is negative. A positive GM indicates the vessel will tend to float upright and will offer resistance to an applied outside force. A negative GM indicates the vessel to be initially unstable and will cease to float upright when even the smallest outside force is applied. An initially unstable vessel may only list at some angle and come to rest in a state of stable equilibrium. If the negative GM is large enough, the vessel will not come to rest before capsizing.

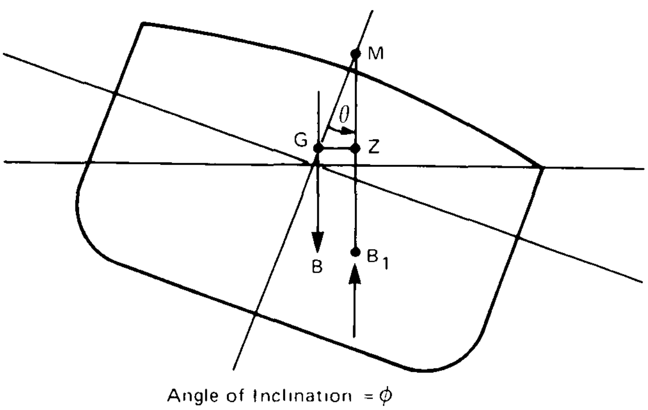


Figure 4-7.

This relationship of the vessel's stability and GM is only accurate at small angles of heel (below 10 degrees). As list increases, the overall stability of the vessel is the determining criteria. This is interpreted through the vessel's stability curves that are normally found in the vessel's Trim and Stability Booklet, generally obtained from the captain. During cargo loading and unloading, accurate values of the ship's stability are rarely maintained.

4-8 Stability Curves. Have the ship's officers identify the curve that most closely represents the ship's present condition of loading. If no curve is considered applicable, find the curve showing the minimum stability condition. If no curves exist at all the IC will have to depend upon the ship's officers, USCG, and others for guidance. The graphic curves depicting the vessel's calculated righting arms at incremental angles of heel are termed the vessel's stability curves. These curves reveal the overall stability characteristics of the vessel. They are extremely important since they quickly reveal the maximum righting arms for the vessel at different conditions of loading (different values of GM). The maximum righting arm, and more importantly, the angle of inclination at which it occurs, is the primary danger indicator when the stability of the vessel is in serious doubt. A fictitious example of a partially loaded vessel with a +2 ft. GM is depicted in the stability curve below (*Figure 4-8*).

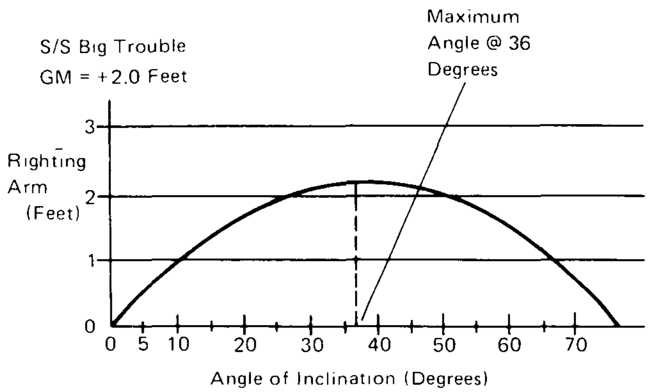


Figure 4-8.

Note that the maximum righting arm attained in this condition is at an approximate inclination angle of 36 degrees. Generally, this maximum angle indicates the point at which the edge of the weather deck becomes submerged. At this point stability drops off rapidly. A vessel suffering a permanent list would be in imminent danger of capsizing long before this angle was reached.

4-8.1 Critical Angle of List. The critical angle of list is the point at which it may be assumed that critical events will occur. It is not a point that remains constant in all cases. In some vessels it may be as much as one half of the maximum righting arm. In another case, it may be substantially less. The critical angle depends on the conditions that exist on the vessel at the time of the fire. It can only be determined by qualified personnel as a result of stability calculations combined with their professional judgement.

4-9 Vessel Stability Concerns. The most important concern regarding vessel stability is the control of the vessel's list. The inability to maintain the vessel at a reasonable degree of transverse levelness (side to side) will seriously impact all fire fighting operations.

4-9.1 Fire Fighting Factors Affecting Stability. The introduction of large amounts of water into the vessel as a result of fire fighting operations will probably be the most critical factor affecting vessel list. Other factors include:

–intentional flooding of compartments

–personnel/equipment movement through watertight doors

4-9.2 Stability Factors Affecting Fire Fighting. As a vessel's list increases, so do the concerns related to fire fighting activities. As the vessel heels poor footing on slippery decks can slow or stop fire attack teams. It may be difficult to apply and maintain a foam blanket. Other concerns include:

–increased chance of flammable liquids spilling

–possible closure problems with automatic fire doors

–strain and possible failure of mooring lines

–restriction and loss of vessel access/egress

–damage or injury from loose objects shifting

–problems with fixed dewatering drains and suctions

–loss of vessel machinery due to excessive sustained list

4-9.3 Vessel Factors Affecting Initial Stability. In 4-2.1, 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:

–the free surface status of all liquids aboard

–whether or not the hull is intact

–if contacting ground, flatness of hull bottom

–whether double bottoms are empty or full

–if flooding, integrity of watertight boundaries

4-9.4 Internal 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:

–shifting of loose objects, bulk dry cargo such as grain or coal

–flooding from unsecured hull openings like portholes

–movement of unsecured cargo, machinery, stores, etc.

4-9.5 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:

–steering system may function improperly

–vessel machinery may not function at large lists

–loss of maneuvering control due to proximity to bottom

–free surface may cause vessel to flop from side to side

4-9.6 External Factors Affecting Overall Stability. Planning for the impact of external factors may help to minimize their negative effects. Concurrently, planning for the positive effects may help to maximize some benefits. External factors would include:

–adjacent structures, such as piers and wharves

–mooring lines if vessel is listing away from structure

–range of tide may cause vessel to contact bottom

–contour of bottom beneath vessel if contact occurs

–bottom composition beneath vessel, such as mud or rock

–precipitation accumulations of snow or ice on high areas

–sea state of surrounding water

–action of passing vessels (wake, suction effect, etc.)

–unusually intense high winds if significant "sail" area

4-10 Basic Stability Information and Resources.

4-10.1 Stability Resources. An incident commander, possessing basic understanding of stability concepts and concerns, should be able to draw upon the available information resources prior to and during an incident. For purposes of this chapter, information resources are divided into consulting personnel and documents. Stability equipment resources are discussed under Section 4-11, Dewatering.

4-10.1.1 Consulting Personnel. Prior to an incident, a regional inventory of stability advisers should be compiled. These individuals or agencies will vary depending on locale except for the identification of the COTP. The USCG COTP offers assistance to all ports within their respective zones throughout the United States. The COTP or designee will normally be available during a large-scale incident to provide stability advice. The COTP can also help access and coordinate various federal resources and agencies should the ultimate scope of the situation require additional expertise and/or equipment. Stability advice may also be obtained from marine-related personnel including:

–vessel's officers – master, chief mate, and chief engineer

–vessel operator/owner representative, such as port captain

–pilots or docking masters

–harbormaster or port authority representative

–salvage masters

–officers from other vessels

–marine consultants

–naval architects

–maritime academies

–marine fire fighting schools

–National Cargo Bureau

4-10.1.2 Documents. It is prudent for response organizations to maintain vessel information. This should include information on regularly and occassionally visting vessels, since it may be difficult to gather information during an incident. The preferred approach is to be familiar with the vessel's onboard documentation prior to an event. 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. Documentation and other information that may be helpful with stability considerations include:

–vessel trim and stability booklet or similar document

–vessel tons per inch immersion factor (T.P.I.)

–vessel general arrangement plan

–vessel capacity plan

–vessel fire control plan

–vessel docking plan

–vessel cargo plan

–slide rule used to calculate trim and stress factors

–computer or loadmaster used for stability calculations

4-10.2 Primary Stability Information. Basic stability data should be gathered during the initial stages of an incident. The methods or sources utilized to obtain the data often will affect accuracy. Always endeavor to verify information.

4-10.2.1 Vessel Drafts. Most large vessels will have draft marks as vertical scales on both sides of the hull at the bow and the stern. They usually are incremented in either feet or meters with the bottom of the number being the increment (zero) line. Large ships and barges will also have draft marks midships on both sides. For example, on American ships, the numbers are 6 inches high with 6-inch spaces between them. The bottom of each number indicates an even foot of draft; if the water covered half of a number, the ship's draft would be equal to that number of feet plus 3 inches. (*See Figure 4-10.2.1.*) 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.

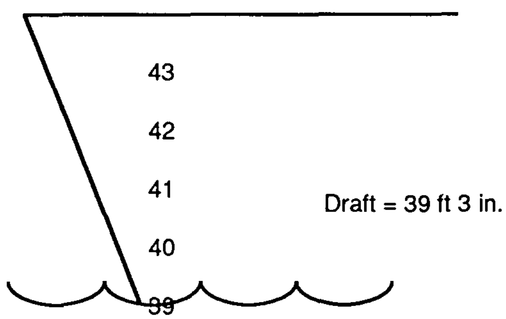


Figure 4-10.2.1.

4-10.2.2 Vessel List. The angle of transverse inclination normally is obtained aboard by reading the vessel's inclinometer. Most vessels will 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.

4-10.2.3 Vessel Status. Determine tank and cargo status. As mentioned previously, 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 also should be ascertained at this point.

4-10.2.4 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 also should be incorporated if applicable.

4-10.2.5 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. As above, determine this as soon as possible and ensure accuracy.

4-10.2.6 Water Flow. Calculate the amounts of water being put on board the vessel and the amount anticipated in the coming hours. It may be convenient to determine rates in 'tons per hour,' instead of gallons per minute (GPM), since stability calculations will probably be worked in tons (*see: 4-11.1 and 4-11.2*).

4-10.3 Secondary Stability Information. If the stability situation is in doubt, the initial assessment outlined above should be followed immediately by a secondary information flow.

4-10.3.1 Hull Openings. Assess all direct hull openings, such as portholes or cargo loading doors, that may allow water to pour aboard in the event a serious list occurs.

4-10.3.2 Dewatering Capacity. Determine the vessel's fixed dewatering capacity and power supply potentials. As above, it will probably be beneficial to convert all rates to 'tons per hour' (*see: 4-11.1 and 4-11.2*).

4-10.3.3 Watertight Potentials. Determine watertight areas and capabilities of vessel with regard to flooding resistance. Give special attention to watertight doors and closing mechanisms.

4-10.3.4 Mooring Potentials. Assess the possible dangers to personnel should mooring lines fail as a result of severe strain from the vessel listing away from the pier or wharf. Learn what alternatives may be available with the mooring system and be sure consequences are understood.

4-10.4 Vessel Aground. If the vessel is aground or is in danger of contacting the bottom, other information will be necessary and may include:

–slope of ground beneath vessel

–shape of vessel's hull bottom

–proximity of passing deep-draft traffic

–sea state forecasts

–hull stress considerations

4-11 Dewatering.

4-11.1 Water Weight. Aboard most large vessels weight is measured in long tons (2240 pounds). A gallon of salt water weighs about 8.5 pounds while fresh water weighs slightly less. This equates to about 264 gallons per long ton. Note that these figures apply to US gallons. Imperial gallons (1.1 US gallons) may be used aboard British, Canadian, or other vessels and should be adjusted accordingly.

4-11.2 Water Flow. A 2½ inch attack line delivering 250 GPM adds approximately 60 tons of weight to the vessel each hour. A 1½ inch line can be figured at roughly half or approximately 30 tons per hour.

4-11.3 Vessel Fixed Pumps. Vessels usually will 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

–forward machinery space

–thruster rooms

4-11.3.1 Fixed Pump Suctions. Vessel bilge pumps are usually attached to fixed piping and therefore will have no flexibility regarding movement and positioning of the pumps' suctions. However, these pumps often have the flexibility to "crossover" and draw from a varied number of fixed suctions. As a result, the fixed system is limited to pumping only water that settles into the lower areas of the vessel and is susceptible to clogging. The capacity of fixed pumps must be determined since they may be less than 500 GPM. Water that accumulates in upper spaces must be removed by some alternate means.

4-11.3.2 Fixed Pump Power. Some older steam vessels may have steam reciprocating bilge pumps, but most will have electric bilge pumps that are powered by the vessel's generators. If the vessel's main generators fail, the pumps probably will be useless. Emergency generators often are not able to supply sufficient power to operate both fire and bilge pumps simultaneously. If electrical power has been secured in the vicinity of fire fighting operations (due to shock hazards), the vessel's pumps may not be available for use.

4-11.4 Vessel Portable Pumps. Although some vessels may have a few small portable diaphragm pumps that run on compressed air, most vessels will provide limited portable pump capability.

4-11.5 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 often are 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 fire fighting efforts.

4-11.6 Swimming Pools. If the involved ship has swimming pools, remove water from pools beginning with the highest pool first.

4-11.7 Toilet. If there is a sanitary drain available at the floor level, remove the fixture (toilet, shower, or 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.

4-11.8 Portable Pumps Brought Onboard. Arrangements for vessel dewatering 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 would include:

–USCG COTP

–industrial pump suppliers

–salvage companies

–US Navy installations

–USCG Strike Teams

–pollution cleanup contractors

4-11.9 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 principle of a venturi and has no moving parts. These units are extremely lightweight and require minimum supervision once they are operational. However, hoses on the discharge site must remain clear or else water can back up into the space being dewatered.

4-11.10 Cutting of 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. Cutting holes in vessels can be extremely dangerous. Holes should never be cut without a thorough review of the consequences and obtaining permission from the appropriate authority; generally this will be the ship's master.

4-12 Stability Analysis and Monitoring.

4-12.1 Critical Angle of List. Once the vessel status is determined as part of the primary information (*see 4-10.2*), the vessel's GM should be computed for its present condition. The GM should be used in conjunction with the vessel's Trim and Stability Booklet to determine the critical angle of list for the vessel's current condition. (*See 4-8 and 4-8.1.*)

4-12.2 Vessel Drafts. Drafts should be monitored at least every half hour. If the vessel is listing the drafts on the low side of the vessel will be greater than those on the high side. For this reason, it would be prudent to take the average of the two sides. Also, the midship draft should be exactly halfway between the forward and after drafts. If it is more than 6 inches off of this halfway point, it may be an indication that the hull is being subjected to severe stress due to hogging and sagging. Continue to monitor and record the vessel's drafts for at least 4 hours after discontinuing waterflow into the vessel to ensure there is no change in vessel stability.

4-12.3 Tons per Inch Immersion. Large vessels' Trim and Stability Booklets generally include a hydrostatic table that describes the vessels' tons per inch immersion (T.P.I.) factors for various drafts. These figures represent the weight, in tons, necessary to sink the vessel one inch. Since this refers to the vessel's mean sinkage, each inch of sinkage will directly correspond with each inch of draft at the midships draft marks. This fact should be used to visually confirm the calculated weight of water being placed aboard the vessel.

4-12.4 Vessel Listing at Pier. Generally, it may be preferred to have the vessel list away from the pier or wharf so that list may be monitored as it progresses. This may require slacking the mooring lines and adjusting vessel access ramps. The alternative, to allow the vessel to lean against the structure, would not only interfere with the list monitoring, but could also lead to damage to both the vessel and the adjacent structure. The vessel's draft probably will increase on the side of the list. This fact, combined with the generally deeper water away from the shore-based structure, also suggests a list away from the pier as appropriate and safer than a list toward the pier.

4-12.5 Increase of Draft Due to List. Due to the relative flatness of most vessels' bottoms, the draft will increase as the vessel lists. An approximate value of the increase is equal to half the vessel's breadth times the sine of the angle of list. The formula is as follows:

increase in draft = beam/2 × sine angle of list

example:

Vessel with 92 ft beam listing at angle of 8 degrees

92/2 × sine 8 degrees =

46 × .1392 = 6.4 ft increase in draft

4-13 Stability Tactics

4-13.1 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.

4-13.2 Causes of List. The two basic causes of vessel list are: (1) a negative GM, or (2) an off center position of the vessel's center of gravity. The list may be the result of either one of the causes or both causes in combination. If negative GM is the cause, any transfers of weight within the vessel should be very carefully considered. It is possible that a transverse shifting of weight to correct list due to negative GM will result in a worse situation.

4-13.3 List Correction. If the list is due solely to the accumulation of water through fire fighting 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 outlines a sequence of general actions to limit and improve an impaired stability situation and the list that accompanies it:

(1) Determine and establish flooding boundaries.

(2) Remove water from partially flooded areas (remove free surface first).

(3) Jettison Topside Weight.

(4) Completely remove water from solidly flooded areas.

(5) Transfer weight as appropriate (usually liquids).

(6) Add weight as appropriate (counterflooding).

See Section 4-4.

4-13.3.1 Establish 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.

4-13.3.2 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 the list. Emptying the compartment is much more desirable.

4-13.3.3 Weight Removal. Removal of liquid and solid weights from higher locations onboard should lower the center of gravity, improve stability, and help improve the list.

4-13.3.4 Weight Transfer. Transfer of weight will normally be accomplished with liquids since the movement of large amounts of solid objects will probably not be practical. Methods of transfer may include pumping and gravitating. Weight transfer is not recommended if free surface is the cause or a significant factor in the list.

4-13.3.5 Weight Addition. Similar to transfer, weight addition of liquids usually will be most practical. This probably will be accomplished through counterflooding the compartment(s) with seawater. NEVER counterflood if free surface is the cause of the list. Always start with the lowest spaces available, such as double bottoms or low water tanks. The inherent problems of free surface effect, and the additional weight, make counterflooding or counterballasting a "last resort."

4-13.4 Scuttling or Beaching. If it becomes apparent that the vessel is going to be lost due to capsizing or simply from the fire being too extensive to control, the only alternative may be to sink (scuttle) the vessel. This decision would be made by the COTP in conjunction with involved parties. Under these two circumstances it may be necessary to sink the vessel at the pier by overall flooding. If time permits, it would be preferable to have the vessel towed 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.

Chapter 5 Organizational Resources

5-1 Vessel Owners and Operators. There are many different combinations of vessel owners and operators. Owners and operators range from individuals to small companies to large shipping lines. Sometimes there are many owners, and sometimes there is only one. Some owners are involved with the daily operation of the vessel; others are far removed from it. Some owners are also the operators, but usually they are different. Sometimes vessels are chartered or leased many times over, further complicating the situation. Most of the time, the owner or operator does not own the cargo, and there may be many different cargo owners. It can become very difficult to determine who owns or operates the vessel, who represents them, and who has the authority to make decisions concerning its protection and safety.

The master of the vessel usually represents the owner or operator, but sometimes does not have the authority to make all the decisions. Because most owners and operators do not have offices/agents in all of the vessel's ports of call, many large organizations will send owner or operator representatives to the fire scene. This representative, sometimes called the port engineer or port captain, usually has some technical training, experience in the particular trade of the vessel, and the authority to make decisions and spend money.

Besides decision-making and technical expertise, the owner or operator usually can provide funding. It is the owner or operator, and eventually their insurance companies, who usually bear much of the cost of the fire fighting operation, such as: fire fighting agents, tugs, pilots, cranes, barges, divers, pollution cleanup, etc.

5-2 Marine Terminal Owner or Operator. The owner of the marine terminal is sometimes also the operator of the terminal. However, many times the operator leases the property and equipment from the owner (the city, port authority, or private corporation), and the owner is removed from the daily operation. In either case, determining who owns or operates the marine terminal is usually not as much of a problem as it is on a vessel because the terminal owner/operator office usually is at the terminal.

Marine terminal owners and operators can often supply many resources to the fire fighting operation. They can provide security by keeping unwanted visitors off the terminal during a fire, and communications by using fixed and portable systems on the terminal. They can supply cargo handling equipment (such as forklifts, trucks, and cranes) that often are needed to move and protect threatened cargo. The owner or operator can also provide a location for a command post, fire fighting hoses and water, and sometimes foam, dry chemical, and a fire fighting brigade. The fire fighting equipment available on the terminal usually is listed in the Coast Guard Fire Fighting Contingency Plan.

5-3 Terminal Fire Brigades. Some large marine terminals, such as bulk oil terminals, and some large shipyards maintain private fire brigades on their properties. These brigades are trained specifically to fight the type of fires that could occur on their property. They can be a great source of specific information concerning the cargoes and hazards on their particular property. They also can be the source of additional fire equipment and extinguishing agents, such as foam and dry chemical.

5-4 Shipping Agents. Shipping agents are the commercial representatives of the vessel owner or operator in the port. As the representative, the agent schedules pilots, small repairs, vendors; notifies federal agents of the vessel arrival; makes arrangements for a berth, line handlers, fuel, water, electricity, etc.; and ensures that all the needs of the vessel and crew are met while in port.

Some vessel operators, such as large shipping lines, are their own shipping agents; but shipping agents are not vessel owners or operators. Shipping agents always know who the owners and operators are. They are in direct contact with the person or persons who control the operation and movement of the vessel and, therefore, can often obtain permission or get a decision from the appropriate person.

5-5 Pilots. Most major ports in the United States have docking pilots and channel pilots. Docking pilots normally moor and unmoor large vessels with the assistance of tugs. They sometimes work for, or are associated with, a tug company and navigate the vessel to or from an agreed upon location just off the dock and in the channel. The channel pilots navigate large vessels from and to the sea buoy at the offshore end of the channel usually without the assistance of tugs.

Pilots usually have very reliable information concerning the arrival and departure of vessels in the port. They also have a great deal of knowledge and experience of local weather and currents. Large vessels are normally moved within the port by pilots.

5-6 Port Authorities. Port authorities are federal and/or provincial, state, regional, or local government agencies that manage the operations of the ports under their jurisdiction. They often own or operate terminals in the port and in this respect can provide many of the same resources as do other terminal owners and operators. Because of their legal authority over the port, they play a large role in the overall planning and coordination for vessel fires.

5-7 Tug, Towing, and Barge Companies. Tug, towing, and barge companies can provide services that may be vital during a vessel fire. Some operate tugs that have the horsepower and equipment to move large vessels within the port. These tugs may be needed to move a burning vessel to a safer or more accessible area of the port. They also may be needed to tow a burning vessel from offshore to a safe harbor, or visa versa. Some operate deck and tank barges, which may be needed as a platform from which to fight a fire or transfer fuel from a burning vessel. Some of these companies may provide all of these services.

Another service some of these companies can provide is fire fighting support. Many, but not all, tugs are equipped with fire pumps and/or monitors to provide a waterstream from the waterside. The type of equipment that a company operates and its fire fighting capability is usually listed in the USCG Fire Fighting Contingency Plan.

5-8 Fire Fighting Agent Supplies. Beyond the usual and well-known commercial suppliers, military installations and other marine terminals often can be the source of fire fighting agents, especially foam and $C0_2$. Shipyards, ship chandlers, airports, and petrochemical facilities also may be able to supply some fire fighting agents.

5-9 Cargo Handlers. In many areas longshoremen load or unload much of the cargo entering or leaving the port on vessels. An exception is bulk liquid cargo, which usually is loaded or unloaded by the vessel's crew and marine terminal personnel. Some longshoremen work for a stevedoring company, while some work for the marine terminal. If containers or cargoes need to be offloaded, appropriate arrangements will have to be made.

5-10 Marine Construction Companies. Marine construction companies can provide expertise in the construction of piers, wharves, bridges, marinas, etc. They usually operate cranes on barges that can be towed throughout the port to provide lifting capability from the waterside. They could be used to clear damaged or undamaged structures and to construct temporary piers, wharves, or bridges. They usually are sources of underwater welding.

5-11 Marine Chemist. As a result of normal construction and design, vessels usually contain many enclosed, poorly ventilated spaces. The atmospheres in these spaces often are tested by a marine chemist to protect the people entering them. They test these atmospheres for the content of oxygen and harmful, explosive, and flammable vapors. This information would be very valuable during a vessel fire when deciding which vessel compartments must be protected. It would also be necessary during overhaul at regular intervals to protect the people working in the enclosed space. The vessel's crew also may have some limited gas detection equipment and ability. (*See NFPA 306, Control of Gas Hazards on Vessels.*)

5-12 Marine Surveyors. Marine surveyors are usually private consultants who survey damaged vessels and recommend needed repairs. They have a lot of technical expertise and local knowledge in vessel construction and repair. There are some large marine surveying companies, but most surveyors are independent and self-employed. They are hired by vessel owners and operators to ensure that the vessel gets the correct, most economical repair.

5-13 Marine Salvage Companies/Salvors. These companies salvage severely damaged or sunken vessels. They usually own or operate very sophisticated equipment, such as floating cranes, inflatable lifting bags, deep-diving equipment, and underwater welding and cutting equipment. If a vessel is sinking and needs to be kept afloat, or has sunk and needs to be raised, these companies have the expertise and equipment to accomplish the job. The U.S. Navy Supervisor of Salvage (who can be contacted through the COTP) also has this type of expertise and equipment.

5-14 Law Enforcement Agencies. Various government agencies have law enforcement duties in the port area. The Federal Bureau of Investigation investigates crimes that occur on U.S. vessels or involve U.S. citizens. The U.S. Marshals of the Department of Justice are empowered to detain or seize vessels and crews. All cargo imported into the United States is inspected and cleared for entry by the U.S. Customs. The Immigration and Naturalization Service examines crew lists and allows foreign crewmembers to enter the United States. The U.S. Coast Guard enforces many of the maritime laws of the United States. (*See Chapter 12, U.S. Coast Guard Role, for more information.*)

Some state and local governments also maintain specialized maritime law enforcement agencies. The existence and type of marine, environmental, and conservation police or agencies varies within each port and each state. These agencies usually share jurisdiction with their federal counterparts.

5-15 U.S. Army Corps of Engineers. The Army Corps of Engineers oversees the dredging of all navigable waters of the United States and operates a few dredges located throughout the country. These dredges could be used to do some emergency dredging to gain access to an area or to free a grounded vessel. The Corps also operates smaller boats that clear flotsam (debris) from channels. They could be used to clear floating combustible material from areas threatened by fire.

5-16 Military Installations. Military installations usually are good sources of fire fighting agents and personnel. Fire stations on these installations usually are well equipped and can often provide compressed air to refill air bottles, foam, pumps, tankers, fire fighters, etc. In addition to the above equipment, Navy bases usually have tugs equipped with fire monitors. Lists of the equipment available at these installations usually are found in the USCG Fire Fighting Contingency Plan.

5-17 Divers. In most major ports there are diving companies that specialize in commercial marine work. They inspect and do minor repairs to vessels, docks, bridges, etc. They usually are equipped to perform underwater welding, cleaning, sawing, drilling, etc. Divers may be needed to make emergency investigations or repairs. In some areas public agencies may provide divers.

5-18 Launch Services. Launch services provide transportation for passengers and equipment from a pier to vessels at anchor or in the channel. They are used to transport crews, federal agents, spare parts, food, etc. to vessels without a berth. Their boats usually are very maneuverable and relatively fast. They may be needed during a vessel fire to provide additional transportation to the burning vessel.

5-19 Ship Chandler. Most things that a vessel needs to remain in operation can be purchased through a ship chandler/marine supplier. If the chandler doesn't stock a certain item, he or she knows where it can be purchased. A chandler usually can supply fire fighting agents and equipment and spare parts for fire fighting equipment and machinery found on vessels.

5-20 Foreign Consulates and Language Schools. Most vessels entering U.S. ports carry foreign crews speaking many different languages. If the vessel's English-speaking senior officers are injured and translators are needed, foreign consulates and language schools in the area are good sources of translators. A list of translators is usually found in the USCG Fire Fighting Contingency Plan.

5-21 Other Organizational Resources.

The following is a list of other organizations that may be able to assist or provide resources during a vessel fire:

–Federal and state fire agencies

–State/county fire marshal

–Emergency Management Agencies/Civil Defense

–Bridge and tunnel authorities

–Red Cross/relief organizations

–Utility service companies

–News media representatives

–Self-contained breathing apparatus refilling sources

–Hospital supply companies

–Fast food restaurants

–Welding companies

–Oil and hazardous materials cleanup companies

–Private fire fighting services

–Aircraft reconnaissance sources

–Railroads

Chapter 6 Special Resource Considerations

6-1 Introduction. The unique nature of shipboard fire fighting points to the need to consider the use of methods and resources beyond those normally employed on the fire ground. A good preplan identifies not only target hazards, but also special personnel and resources available to provide assistance. Because most responders involved are likely to be unfamiliar with shipboard fire incidents, it is essential to smooth emergency management that realistic drills be held to train responders and assess operations before the real emergency occurs. A pre-fire plan should include a check-off list that is specific to the area. Some of the special resources that might be listed are:

6-2 Support Vessels. With the exception of drydock fires, most ships will be accessible by water. In some cases that will be the only means of access. A vessel at anchor may need to be moved or a burning vessel may need to be stopped from drifting. Vessels providing towing assistance may be able to provide fire fighting streams. This can be helpful in extinguishing the fire, but may endanger the stability of the vessel that is on fire.

6-2.1 Fireboats. A fireboat is a vessel designed for fire fighting and is staffed by trained fire fighters. For the safety of vessel personnel, vessels should be able to safely and adequately function in their anticipated operating environment. Fireboats are made in many sizes and designs. Design features such as noncombustible construction, spray protection, and on-board air supply should be considered for the protection of the fire fighting personnel. Fireboats serve three basic functions:

6-2.1.1 Rescue. Fireboats provide rescue of personnel and transportation of fire crews and equipment from incidents not accessible from shore. A fireboat may often be the primary escape route for fire crews.

6-2.1.2 Platforms. Fireboats provide a fire fighting platform for delivery of agent through monitors or through hoselines from fireboat to fire crew on board the vessel. It may function as a mobile command, staging, and pumping base.

6-2.1.3 Water Supply. Fireboats provide water supply for shoreside operations. Remote pumping may be as simple as hooking up to a dockside manifold or hose lay, or may involve anchoring in deeper water off a beach and sending supply lines ashore via a boat drag. Some fire departments equip fireboats with large diameter hose so as to have a secondary water supply should the underground mains be broken in an earthquake, explosion, pier collapse, or insufficient shoreside capacity.

6-2.2 Auxiliary Vessels. Many commercial vessels may be pressed into service in an emergency, either by preplanned agreement or as vessels of opportunity.

6-2.2.1 Tug Boats. Tug boats come in many sizes and configurations. Develop a list of those that are available and their capabilities.

6-2.2.2 Barges. Barges can provide large, flat, stable working areas that are mobile. They have the potential to store debris and contaminated product and runoff. They have been used as platforms from which land-based fire engines can draft and pump.

6-2.2.3 Offshore Supply Boats. Offshore supply boats carry heavy equipment and supplies and often have cargo handling equipment.

6-2.2.4 Pollution Response Vessels. Pollution response vessels carry booms and skimmers for oil containment and cleanup. These vessels and their equipment are rarely fire resistant.

6-2.2.5 Crewboats and Launches. Crewboats and launches can carry personnel and limited supplies.

6-2.3 Military Vessels. Military assistance is available in a wide variety of ways: regular, reserve, National Guard, and auxiliary units.

6-2.3.1 USCG. USCG vessels have limited fire fighting capabilities. Many vessels, small and large, are equipped with monitors/nozzles. They have water rescue equipment and some fire fighting training. The Captain of the Port has broad powers over all vessels in the area. USCG helicopters may be used for transportation, reconnaissance, and rescue.

6-2.3.2 Navy. The navy also may assist on the sea and in the air. Local commanders or the COTP should be listed in the Coast Guard Fire Fighting Contingency Plan.

6-2.3.3 Army Corps of Engineers. The Army Corps of Engineers is responsible for dredging and channel maintenance. They can often provide assistance.

6-3 Special Equipment Resources. Shipboard fires require special types of equipment and quantities that exceed normal needs.

6-3.1 Pumps and dewatering equipment. There are many marine pumps/eductors capable of dewatering vessels. It may be necessary to work pumps in tandem, sending smaller ones into tight quarters and relaying through larger ones on deck. Specialized pumps/eductors and dewatering eductors should be listed in the Fire Fighting Contingency Plan.

6-3.2 Patching, Salvage, and Shoring Equipment. Patching, salvage, and shoring equipment will be needed to control leaks and seal breeches.

6-3.3 Fire Fighting Equipment. The fire department should bring its own hose and appliances as there is no way to guarantee the condition of ship's equipment or its compatibility with fire department equipment. The fire department should depend on its own water supply for attack operations.

Fog applicators that come in 4 ft, 10 ft, and 12 ft extensions fit on "Navy All-purpose" nozzles. They are basically an open sprinkler head at the end of a curved pipe. They allow penetration of small openings such as open port holes. Piercing applicators may be used to penetrate certain materials and shipping containers.

Heat and flame detectors (thermal imagers) are valuable in smoky confined spaces on ships.

Monitoring equipment for temperatures, gases, oxygen, and hazardous materials may be needed in some situations.

Special communications equipment may be needed for interior use. In some cases, the vessel's communications systems may supplement portable radios. On-scene support equipment includes lighting, ventilation, air supply, recording equipment (video/audio...), office supplies and copiers, food, shelter, transportation, and sundry supplies, such as fuel and batteries for extended operations.

Special cargo-handling equipment may be necessary for manipulating cargo and bringing supplies aboard. If available on the ship or at the dock, this should be coordinated through the stevedore.

Chapter 7 Planning

7-1 Introduction. Experience has shown that in incidents where shoreside fire fighters fight the fire, one of the most valuable assets on the ship is the fire control plan. Most of the information an incident commander would need to fight a fire on the ship, such as general layout and dimensions, fire fighting systems, and other systems that have a direct impact on fire fighting, is included in the fire control plan. Its primary purpose is to assist shoreside fire fighting personnel. It is ideal for fire fighters to use as a guide when taking tours of ships, since it contains the location of most the items they will be looking for and it also will allow them to become familiar with fire control plans.

7-2 Contents. The fire control plan is a set of general arrangement plans for each deck of the ship that also contains information that will be of use to land-based fire fighters. The plans will be in the official language of the flag state with translation into English or French. The plans may be a rolled set of drawings or a booklet combining such drawings. The plans are required by SOLAS to indicate, when installed:

–fire control stations (continuously manned spaces where controls and alarm panels for fire detection and suppression systems are located)

–means of access/escape from different compartments

–fire resistant bulkheads with their fire rating, e.g. "A" class divins and "B" class divisions

–hose stations, which should include arrangement of the fire main system withcations of fire pumps and their controls, the location of isolation valvin the system

–location and extinguishing agent of portable and semi-portable fire extinguishers

–fixed carbon dioxide and halon systems, locations of releases, and locan of closing appliances for exterior ventilation openings

–automatic sprinkler systems and location of controls

–foam system showing the monitors and controls

–fire detection systems showing location of indicator panels and spaces protected

–alarm systems (carbon dioxide, halon, automatic sprinkler, fire deteon, watertight doors, general)

–ventilation systems including dampers and fan controls.

In addition, the following items should be clearly marked:

–fire door locations and their rating, e.g. "A" or "B" class

–location of international shore connection

7-3 Location. The fire control plan is required to be permanently stowed in a prominently marked weathertight enclosure outside the deckhouse. Investigations have shown that, in the past, even when shoreside fire fighters were aware that the fire control plan existed, they had trouble finding it. In response to this problem, the International Maritime Organization (IMO) published specific guidance on locating and marking the fire control plan enclosure.

The enclosure should be red and the contents of the enclosure should be indicated by a red ship silhouette on white background. Dimensions of the location sign should not be less than 297 × 400 mm (*see Figure 7-1*).

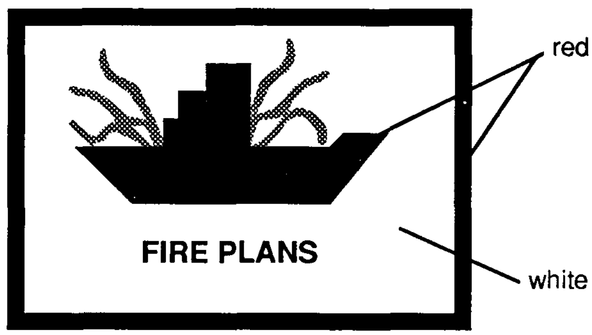


Figure 7-1 Location Sign.

If the enclosure is not adjacent to the gangway, there should be guide signs to help shoreside fire fighting personnel find the enclosure containing the fire control plans. The guide sign should be the location sign shown in Figure 7-1 with the addition of a red arrow (*see Figures 7-2 and 7-3*) showing the direction where the fire control plan enclosure can be found.

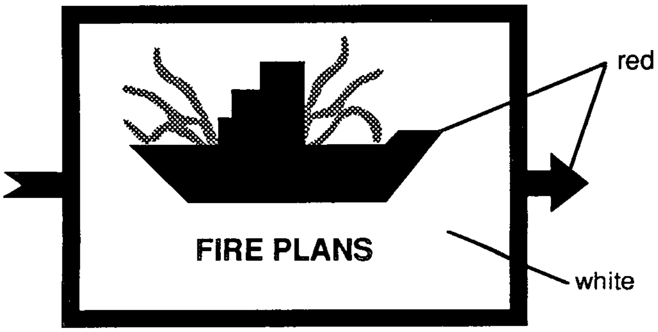


Figure 7-2.

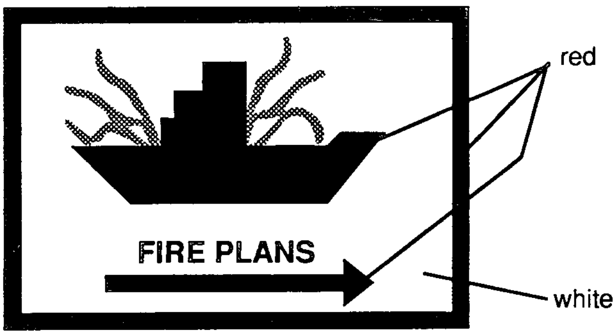


Figure 7-3. Guide Signs.

The arrows show the direction
in which the fire control plan
enclosure can be found

7-4 Requirements. Fire control plans are required by both SOLAS (Chaper II-2, Regulation 20) and the *Code of Federal Regulations* (46 CFR 78.45-1(a)(1) and 97.36-1(a)). Therefore, all new and existing ships that are either U.S. flagged or foreign flagged and entering U.S. ports should have one.

7-5 Pre-fire Planning. Shipboard fires are among the most difficult of all fires to extinguish. They have the capability to tax the resources of entire regions. Realistic and effective pre-fire planning is crucial to successfully deal with such emergencies. Without pre-fire planning and drills, the wide variety of resources and specialists needed at a shipboard fire can rapidly turn a command post into chaos.

Incident Commanders who are unfamiliar with the maritime industry must know how to acquire and to utilize special help before an incident occurs. Pre-fire planning also will help put problems in perspective by defining the larger picture at a time when it can be studied at leisure.

General pre-fire plans focus on areas and environments. They set a hierarchy of goals in the mitigation process and give a sense of general direction to efforts. All responders must understand their roles and responsibilities and the scope of their authority.

A general pre-fire plan looks at factors such as: human and environmental protection, scope of authority of responders, preferred locations for operations, and major hazards to the port and its inhabitants.

Specific pre-fire plans focus on target hazards and provide a guide to the ship's systems and facilities. They look at characteristics of vessels and terminals and help identify aids and hazards, as well as strategy and tactics. They may be tailored to individual ships or general classes of vessels.

Response plans should be part of standard dispatch procedure and should provide for notification of affected parties.

7-6 Purpose of Pre-Fire Plan. In addition to its use during fire operations, a pre-fire plan is useful as a training aid. By using the pre-fire plan during training, fire personnel can keep themselves familiar with the ship's vital systems even though they may not have the opportunity to board the vessel for frequent familiarization tours.

7-7 Format. The pre-fire plan is intended to be made available for the review and use of each lst alarm responding unit. In addition a copy should be provided to the masters of ships that regularly visit the port. The plan may be divided into several major sections, with each section divided into specific areas pertaining to that subject. Numerous pictures can be utilized to emphasize an important point or to clarify the text.

7-7.1 General Information, Section I. The first portion of this section gives the name of the vessel, general use, owner, operator or representatives, number of crewmen, number of passengers/cadets carried, and any other pertinent information, such as languages spoken by the officers.

The second part of this section references the physical properties of the vessel: length, breadth, depth, freeboard, overall height above water (empty and loaded), draft, propulsion, fuel used, and fuel capacity.

The next portion contains the telephone numbers to call in case of an emergency, i.e., ship's agent, insurance company. The manning practices of the vessel are also noted (how many crewmen are aboard during the day and at night).

7-7.2 Construction, Section II. The first part of Section II contains a drawing, not necessarily to scale, showing the general location and names of the decks, holds, compartments, and machinery spaces. This drawing is intended to be a quick and simple guide to general arrangement. It may be obtained from the Vessel Fire Control Plan.

Part two of Section II gives the specific name and location of each deck. The general types of compartments on each deck also are given. This portion also notes how the compartments are identified (either by name or number). The frame numbering system is explained as well, and all locations are specified by frame number.

The third area covered under Section II includes the cargo hold numbering system, gives the type of hatches used, outlines the means of access to the cargo holds, and tells the capacity of each hold. The locations of machinery spaces and other compartments are given, and the means of access are described.

7-7.3 Location Lists, Section III. The normal storage place for specific information is included in the first part of Section III. These include the stability plans, cargo manifest, dangerous cargo manifest, ship's blueprints, safety plans, and similar data that would be helpful in an emergency.

The second part of this section lists all spaces in the ship having escape trunks, such as the shaft alley, holds, and machinery spaces.

The locations of the instruments and controls are given under part three of Section III. The operating instructions are not given here, but are addressed in a later section.

The last part of Section III gives the exact location of every compartment on the vessel in alphabetical order. These pages give the frame number, deck location, and whether the compartment is on the port or starboard side of the center line. In addition, primary access to the space is listed.

7-7.4 Systems Information, Section IV. Communication systems are included in the first part of Section IV. This section describes the vessel's intercommunication systems and gives instructions for the operation of each one. The location of all stations within the system are identified and listed.

The second part of Section IV discusses the electrical systems within the vessel. The method for generating electricity is stated, as well as the type of current generated and the voltage. The emergency power unit is described, including which system it powers. Some primary control switches are located and their function is explained (i.e., main ventilation switches). The voltage and maximum current carrying capability of shore power connections, if any, are identified.

The vessel's fire protection systems are summarized on one page and the area the system protects indicated. No specific operating information on the systems is given at this time. This page is intended as a quick reference to determine what type of systems are available on the vessel (i.e., watertight doors, fire doors, fire walls, $C0_2$ systems, foam systems, etc.).

In the fourth part of Section IV the fire protection systems are discussed in detail. Directions are given for the operation of each system. For example, the CO_2 system is explained in detail. A drawing of the system is included and instructions are given for the operation of the system. Independent systems are also noted and explained. All instructions may be keyed to photographs of the systems controls.

The general alarm system is discussed and the areas protected by the system are listed.

The sixth part of Section IV contains information on the watertight doors. They are explained in detail and, if remote controls can be used, these are also discussed. Controls are explained and instructions are usually accompanied by a picture.

The ventilation systems are discussed in the seventh portion of Section IV. All emergency controls are noted and located. Natural ventilation, to the holds and some compartments, is discussed. Pictures are used to show key features or controls of the system.

The eighth portion of Section IV discusses emergency controls for the fuel system. Remote emergency controls are located and instructions given for their operation. If manual controls are used for a backup system, they also are located and an explanation is given for their operation.

7-7.5 Tactics, Section V. General information items are discussed in the first part of this section. The location of the master keys for the various compartments is given. If no master keys are available, vessel personnel with keys for gaining access to the compartments are listed. If safety plans or fire plans are posted on the vessel, their location is given. The emergency gear/damage control locker is identified, and hazardous cargo stowage is located (as well as the hazardous cargo manifest).

The second part of Section V discusses items to be given special consideration. The international shore connection is identified and located. Instructions for supplementing the CO_2 system from a shoreside supply are contained in this portion. In addition, special safety precautions are recommended at this point.

Fire exposures are listed under the third part of Section V. Exposures include flammable liquid tanks, flammable gas tanks, explosives, open stairways, non-protected laundry chutes, or any substance or material aboard the vessel that would help to spread or accelerate a fire.

In the fourth part of Section V the length of fire hose and accompanying type nozzle at each onboard fire station is noted, as well as the minimum length of hose required to reach a given area. Location of appropriate adaptors and fire department international shore connections are clearly marked and accessible for shore hook-up. The maximum operating pressure of the fire main system should be identified during pre-fire planning.

The last portion of Section V is the "Action Check Off List." This list assists personnel in making certain nothing is overlooked. The list provides a check for nine categories of information.

1. Nature of emergency
2. Life hazard
3. Data acquisition, which includes obtaining information that is available aboard the vessel (such as a pre-fire plan, ship plans, dangerous cargo manifest, cargo manifest, etc.).
4. Locating the fire or emergency
5. Checking on the exposures
6. Access to the fire or emergency
7. Vessel systems/equipment that may be utilized
8. Stability/Dewatering
9. Ventilation

7-7.6 General Arrangement, Section VI. These plans have general measurements and show the arrangement of decks, compartments, and holds. Each deck usually is on a separate page. Smaller decks, such as the bridge deck, boat deck, etc., may be grouped together on one page.

7-8* Conducting Pre-Fire Surveys. In order to conduct a survey properly, the surveyor must have the right equipment. The following have been found to be helpful:

A. Clipboard, pencils, note pads

B. Pre-fire survey guide

C. Ship arrangement plans

D. Audio, video, and photographic equipment

E. Sample pre-fire plan (if available)

F. Tape measure

The survey should be conducted with the master or his designee. The individual doing the survey should contact the master of the vessel for an introduction and explain the purpose for boarding. Then, utilizing the survey guide, the surveyor completes as many of those items as possible from a review of the vessel's general specifications, or from information obtained from the master, before beginning any walk-over of the ship. A sample survey guide is found in Appendix A.

7-8.1 Bridge. After entering on the guide the available preliminary information, the surveyor begins the survey on the navigation bridge, noting the general layout and documenting and photographing the following equipment:

A. Inclinometer

B. Fire protection systems controls and instruments

C. Emergency shut-offs

D. Communication systems

E. Watertight door controls

7-8.2 Upper Decks. Proceeding downward, the surveyor should tour the upper decks, documenting:

A. Deck arrangement

B. Compartmentation, vertical fire zones, and ratings

C. Access emergency egress to other spaces (machinery)

D. Special controls for systems

E. General use of area

F. Special features

G. Safety hazards

7-8.3 Engine Room and Machinery Spaces. After gathering the necessary information from the area above the main deck, the surveyor proceeds to the engine room and machinery spaces, noting:

A. Access (regular and emergency)

B. Type of machinery encountered

C. Type of fire protection systems

D. Location of controls

E. Fire pump controls

F. Ventilation shutdowns

G. Emergency shutdown

H. Watertight doors

I. Location of flammable liquid tanks

J. Shaft alley escape trunk

K. Safety hazards

7-8.4 Cargo Spaces. After completing the survey of the engine room and machinery spaces, the next area visited should be the cargo spaces. On some vessels it may not be possible to enter all the cargo spaces because of hazards or their being full. However, when possible they should be entered and the following information recorded:

A. Access (regular and emergency)

B. Type of fire protection systems

C. Deck and hold arrangement

D. Special use areas (cargo tanks, reefer boxes)

E. Storage practices (locking off spaces, status of controls for systems)

F. Safety hazards

G. Types of hatch covers and their controls

7-8.5 Bow and Stern Areas. The surveyor should then visit the bow and stern areas of the ship. Since these are areas where machinery and combustible storage often may be found, the surveyor must take note of such items as:

A. Access to spaces

B. Type of fire protection systems

C. Hazardous storage

D. Machinery in use

E. Flammable liquid tanks

F. Housekeeping

G. Safety hazards

7-8.6 Weather Decks. After these areas are completed, the surveyor finishes his survey on the weather decks, including the forecastle, the poop deck or fantail, and the main deck. Items to be checked in these areas are:

A. Access to holds and other interior areas of the vessel

B. Deck houses and their contents

C. Winch controls (determine operating procedures)

D. Hazardous cargo storage

E. Connections to the fire main

F. Deck fitting, piping, and obstructions

G. Type of fire protection systems

H. Safety hazards

I. Fire control plan location

J. International shore connection

7-8.7 Photographs. Photographs are an essential component of the pre-fire survey. They should be taken, if allowed. Much of the data contained in the survey is of a technical nature and would be easier to understand if appropriate photographs or drawings with identity symbols superimposed are used. In general, anything that would help make the text of the manual easier to understand should be photographed. This might include:

A. Systems controls

B. Systems components

C. Instruments

D. Arrangement features

E. General ship views

7-8.8 Summary. A problem encountered in conducting surveys is the failure to gather all the necessary information on the initial visit.

The pre-fire plan worksheet must be used properly or not used at all. The gathering of pre-fire information on any vessel cannot be committed to memory. Extensive notes must be taken and the pre-fire plan worksheet must be used as a guide.

It will not always be possible to devise a pre-fire plan for a vessel in one visit, but a well planned, systematic survey will reduce the actual survey time to a minimum.

Chapter 8 Training

8-1 Introduction. Once the pre-fire plan has been completed, a fire department can establish drills and training sessions on board the vessel. The pre-fire plan locates and identifies important aspects of the vessel that shoreside fire fighters will need to know in an emergency situation.

Tours and drills must be scheduled through the appropriate authorities to minimize interference with the vessel and terminal operations. The appropriate size of the touring group should be determined prior to going onboard the vessel. Generally it is difficult to effectively tour a vessel with large groups. For that reason several tours may need to be scheduled in order to familiarize as many personnel as possible.

8-2 Training Exercises. The function of a training exercise is to ensure that the plans, systems, and procedures that have been formulated in theory and on paper can be implemented practically.

Because most land-based fire fighters infrequently fight shipboard fires, the value of a marine fire fighting exercise is immeasurable. The exercises that have been conducted by fire departments throughout the United States have shown significant benefit when the department was later required to respond to a shipboard fire.

Arrangements should be made with the terminal management people and ship's owner/operator for the purpose of conducting a full dress rehearsal of an incident. This would include search and rescue, deployment of water supplies on a massive scale, deployment of water curtains, master streams and attack lines, and deployment of fire department ladders for boarding a ship at locations other than the gangway.

Before an operation of this size can be conducted, extensive planning is necessary. It is wise to involve the COTP and ship's master with all fire company officers who would be a party to the operations. Include mutual aid personnel. Conduct on site visits and discussions to familiarize the participants with the intended operation.

Coordination for drills/exercises is essential. Agencies involved in the drills may not be able to suspend work during the exercise.

The ship and terminal personnel will not stop work during your visit. There may be days or nights when work is not in progress. This is particularly true at liquid bulk transfer facilities. Often, especially on a Sunday or waiting on a favorable tide, a ship will be berthed and not transferring product. This may be the time to conduct a drill.

Often a local towboat and tankbarge company will provide the towboat and barge with their crews for a full scale drill. Again, very close cooperation is required among the COTP, towboat company, and marine terminal.

If the drill evolutions are properly planned and conducted, the fire chief will have the support and cooperation from the port community.

It cannot be emphasized enough that the fire chief must include the COTP in all planning and field evolutions. The COTP has broad powers and is held in high esteem in the port community. Cooperation can almost be guaranteed if the COTP supports the training exercise.

In order for an exercise to occur there must first be a plan of operation. This plan is only legitimate when it has been realistically exercised. Some of the characteristics of a functional plan are the following:

8-2.1. Coordination. Any plan should be written and reviewed with the input of the agencies required to participate in the plan. Only with this cooperative effort can a training exercise using this plan be truly beneficial. The coordination for a full-scale shipboard fire fighting drill may take weeks or months after a draft of the plan is written.

8-2.2 Validation. Plan validation occurs when the plan is tested by real or simulated situations that assist the planner in determining the functional validity of the plan. Ship-board fire fighting training exercises should be constructed of multiple, small, previously validated elements that are then brought together to form a large-scale drill.

8-2.3 Updating. The plan should be reviewed at least annually or as changes occur. Training exercises should be conducted on a recurring basis and especially after major alterations in the plan have occurred.

8-2.4 Authoritative Recognition. Before a plan is finalized it should be submitted to recognized individuals or agencies who have experience in tasks called for in the plan. These authorities should be invited to observe large-scale training exercises and invited to provide independent comment or critical analyses of the drill, plan, and training exercise.

8-2.5 Qualitative Analysis. The quality of the plan is a function of its ability to accomplish the mission for which it was designed and the perception of all the users as to its "user friendliness." A plan that is not easy for the user to understand and to implement will not be used and will, therefore, have no value. If the training exercise does not accomplish the tasks for which it was designed, then the plan must be reevaluated.

8-2.6 Critique. After every exercise of the plan or a drill that incorporates the plan, formal and informal critiques should be held. It is neither sufficient nor beneficial to test or critique the plan in small sections and assume that a large-scale exercise will work if all components have not been tested simultaneously. The plan must be exercised in its entirety and the critique must include all facets of the exercise and plan.

8-2.7 Incorporation. After each exercise, drills or test of the plan, the lessons learned should be incorporated into the revised plan.

8-2.8 Debriefing. After each actual emergency, a debriefing should occur at which accurate notes are taken. The lessons learned should then be incorporated into the plan. Debriefings should include discussions of the following areas:

8-2.8.1 Tactical. Actual strategic, tactical, and task accomplishments should be compared to the goals set forth in the plan, and inconsistencies between the plan and tactical necessities should be the primary focus of tactical debriefings. Everyone from the chief to the driver should be debriefed.

8-2.8.2 Critical Incident Stress (CIS). The focus of CIS debriefings is the mitigation of the effects of the incident and their by-products. It may be useful to revise the plan in an attempt to reduce stress on the fire/rescue personnel, if possible.

8-2.9 Video Review. It is extremely useful to have these records for review and analysis.

8-2.10 Audio Review. As above.

8-2.11 Log Review. It is essential to have these records to document the changes of the plan.

8-3 Advanced Fire Fighting – Marine Training. Training of land-based fire fighters in the unique aspects of combating vessel fires should include:

–Vessel types

–Vessel construction pertaining to fire fighting

–Stability and dewatering

–Strategy

–Command

–Suppression and ventilation

–Resources available to assist

There are several established schools that provide training in vessel fire fighting for ship crews.

Every port community should develop a comprehensive program and implement a system of support for marine fire training. This program could also provide for specialized equipment for marine fire fighting.

Each jurisdiction should have the ability, knowledge, and resources to use and to obtain this specialized training within their region.

Some of the resources that should be utilized to develop this program may include fire chiefs' associations, port authorities, USCG, federal, provincial and state governments, insurance industry, maritime academies and associations.

Local training programs could include table top exercises, review of past ship fires, and simulation exercises. Training exercises should address water supply problems, particularly drafting, access ladder use, air supply problems, and personnel rescue problems.

The types of simulations that could be exercised for the marine fire fighter are as follows:

1. Engine Room	Fuel line break and fire Electrical fire Victim extrication lower level
2. Pump Room	Broken pump seals and fire Electric pump motor fire Victim extrication lower level
3. Dry Cargo Areas	Tank top fire and/or rupture Bottom hold cargo fire, access to tween deck cargo fire and access to upper deck or shelter deck fire Weather or main deck fire Man in the hold extrication
4. Tank Ship Hold	Interior tank fire Weather deck fire Product pipe system on deck Rupture and/or fire Product cascade hose Connections and valves rupture and/or fire Person in the tank extrication
5. Accommodation Spaces	Personnel berthing quarters fire Galley fire Laundry room fire Mess room fire Electrical fire Cooking gas fire Ventilation system fire Multiple victim extrication from various spaces

8-4 Personnel Safety. Marine fire fighting requires the use of full protective clothing and equipment as required in Chapter 5, in NFPA 1500, *Fire Department Occupational Safety and Health Program*. Marine fire fighting presents the hazard of falling into the water. Provision should be made for locating and rescuing the victim immediately. The use of personal flotation devices is encouraged but not at the expense of wearing full protective clothing and self-contained breathing apparatus. Provisions should be made for adequate access and egress for emergency personnel by providing additional gangways, ladders, or other devices. When conditions permit provisions should be made for the potential of water rescue.

In some areas hypothermia may be a concern; therefore, the time spent in the water awaiting rescue is critical.

Ice or snow is a hazard on the decks of pier facilities and on board ships.

Ship ladders may be very steep with a narrow step. One should face the ladder at all times.

Hot steel surfaces and structural members may be harmful to personnel and equipment.

Utilizing a Jacob's ladder for boarding vessels may be hazardous. Alternate means should be used if possible. Prior familiarization with the use of these ladders is essential.

A ship has its own utilities. Lighting and power systems usually are completely independent from any shore connection. Below deck there is little if any light available when something happens to the main or emergency electrical system. Fire departments must provide portable lighting systems with generators. If the incident may involve flammable vapors, the portable electrical equipment should be intrinsically safe. Portable battery units should also be suitable for use in hazardous locations (i.e., intrinsically safe).

Special consideration should be given to maintaining adequate air supplies. The standard fire fighting 30 min. SCBA has frequently proven insufficient in vessel fire fighting.

It is recommended that an evacuation procedure and signal be established in case of the need to "abandon ship." Care must be taken to ensure the safe and systematic withdrawal of all personnel.

Vessels have large, deep, undivided spaces and areas, such as cargo holds and engine rooms, with many fixed obstructions, such as machinery. Fire personnel should move about the vessel with extreme caution.

Prior to entering vessel spaces, fire personnel should review diagrams for the area and consult with the vessel's crew.

Chapter 9 Communications

9-1 Introduction. In any fire suppression, rescue, or hazardous material operation, effective, disciplined, and established communications procedures are necessary for safe mitigation of the incident. These requirements are even greater in a shipboard fire, since the uniqueness of the environment (ship's construction and size and the possible involvement of numerous personnel and various agencies) require that the Incident Commander be provided with adequate and reliable communications systems and procedures.

It should not be presumed that because a fire department's radio procedures and systems meet their everyday needs that they will automatically meet their needs during a shipboard fire. However, as with any major incident/disaster, a department's operations should be an extension, by degree, of its day-to-day operations.

This chapter identifies various communications considerations, practices, procedures, and systems. When applied in conjunction with Chapter 7 (Planning) and Chapter 11 (Incident Command System) this information will assist personnel involved in combating a fire aboard ship to establish effective communications.

9-2 Pre-Fire Planning. Pre-fire planning for shipboard fireground communications is a significant issue because of the many unique aspects of a shipboard fire.

The following considerations regarding shipboard fireground communication should be given careful and thoughtful consideration when pre-fire planning for a fire aboard ship:

–The possibility of many fire fighting units from various departments/agencies operating at the same incident.

–Is there a common radio frequency or frequency on which to communicate?

–Are there established and recognized radio procedures and call signs thatll be utilized by all agencies involved?

–What existing shipboard communications systems may be utilized by fire suppsion personnel to supplement radio communications?

–Have drills been conducted to identify the effectiveness/limitation of all types of communications systems that may be utilized?

The preceding questions are simply intended as mind joggers to assist those involved in pre-fire planning for shipboard fires.

9-3 National Mutual Aid Frequencies. One source of frequencies that should be given careful consideration are those in the Fire Mutual Aid Radio System (FMARS). These frequencies are in the VHF spectrum and are:

154.265, 154.280, and 154.290 MHz

The Federal Communications Commission (FCC) has specifically allocated these frequencies to provide a means of common communication between units from different agencies operating at a common incident. Licensing of these channels is similar to that followed for other frequencies. The FCC also has authorized five 800 MHz frequencies for use in mutual aid operations.

These frequencies are:

National Calling Channel #1, Base Unit	866.0125 MHz
National Calling Channel #1, Mobile Units	821.0125 MHz
Tactical Channel #2, Base Unit	866.5125 MHz
Tactical Channel #2, Mobile Units	821.5125 MHz
Tactical Channel #3, Base Unit	867.0125 MHz
Tactical Channel #3, Mobile Units	822.0125 MHz
Tactical Channel #4, Base Unit	867.5125 MHz
Tactical Channel #4, Mobile Units	822.5125 MHz
Tactical Channel #5, Base Unit	868.0125 MHz
Tactical Channel #5, Mobile Units	823.0125 MHz

9-4 Terminology. It is important that the radio terminology used is similar to terminology that is used on a daily basis. Firefighters must be familiar with the nautical terminology used on board ships to better communicate with marine personnel.

Effective fireground radio communications should:

–Identify who is calling whom.

–Obtain acknowledgment before continuing. Keep messages short and to the point.

–Use ships terms only when they will enhance clarity.

9-5 Procedures. The pre-fire planning process should include adoption of procedures that, when employed, will serve to effectively manage radio traffic. Those who need to communicate via radio must do so in a manner that will not have an overall negative effect on the operation. This should include:

–Development of a radio resource list that will include an inventory of how many portable radios may be available at a given incident; and,

–With what frequencies, channels (simplex, low output, tactical, FMARS), and scanning capability are radios equipped.

This inventory will allow for consideration of how the available radios, given their operational features, can best be utilized. Reallocation of radios may be desirable to place the proper equipment in the hands of those who need it.

An example would be the unit (company) leader assigned to a suppression operation; he/she may need tactical channel capability but might not need scanning capability. Conversely, sector commanders might need scanning capability but not a tactical channel. The Incident Commander might need to communicate with sector commanders, as well as have the ability to communicate with other involved agencies. All of this should be thought out in advance; and, if done properly, will greatly facilitate efficient fireground operations.

9-6 Ships' Fixed Communications Systems. All large ships are equipped with internal telephone systems. These systems can be very effective. The ship's master can identify the type of on-board telephone system and how it may be utilized during a fire.

Likewise, most larger ships utilize low output portable radios to allow the ship's crew to communicate with key personnel. These radios can be a big asset.

Marine radio frequencies are an ideal means to communicate from ship to ship during a marine fire fighting operation. Typical use of these frequencies would be for an Incident Commander to give direction to or receive reports from tug boats, pilot boats, coast guard boats, etc. Coordinate the use of these frequencies with the COTP.

9-7 Communications Logistics. There are three (3) principal communication logistical needs that must be considered. They are: extra portable radio batteries, battery charging capability, and additional portable radios.

Radio Batteries. Given the long duration that can be expected in a shipboard fire incident and the considerable radio traffic that will occur, portable radio batteries will need replacement and recharging. Pre-fire planning must provide for these needs by having extra batteries available and by ensuring that there is a means to recharge batteries on the scene.

Additional Portable Radios. The need for portable radios by other involved agencies (Coast Guard, tug boats, etc.) may require loaning these agencies a fire department portable radio to achieve effective communications. Considering the large size of many ships, there may be a larger deployment of personnel who are totally dependent upon portable radio communications. This increased deployment may exceed the number of portable radios available. Plans should include the acquisition of extra portable radios from elsewhere in a department's organization (fire prevention, training, personnel, administration, etc.).

9-8 Communications Inhibitors. The very nature of a ship's construction, mostly steel, creates an immediate negative impact on good, clear communications. During ship's tours conduct radio tests between portable radios and mobile radios to identify any limitations.

Whenever operating on the decks or in the holds that are below the water line, communication into or out of a ship will most likely be impossible to achieve. Below deck radio communication may be improved if transmissions are made near port holes; or if radios were used "in relay" to transfer messages.

9-9 Miscellaneous Considerations. During the changing environment of a major shipboard fire, one of the simplest steps that can be taken to minimize radio communications traffic is to not communicate every message by radio. Whenever possible, assign a person to serve as a messenger to deliver the message to its intended recipient.

Utilize mobile communication units where available. Cellular telephones, both mobile and portable, can be utilized as part of an effective communication plan.

Computers can be used to store a complete pre-plan, including all aspects of communication capability and availability data. They can be used in conjunction with the CHEMTREC "HIT" program and other HAZMAT data bases.

Because portable radios are susceptible to humidity and water damage, provisions should be made to dry, replace, and/or repair radios at the scene.

Chapter 10 Strategy and Tactics

10-1 Introduction. Vessel fire fighting strategy requires that the Incident Commander choose between an offensive or defensive strategy. The danger to fire fighting personnel and exposures must be weighed against the dangers to the vessel and cargo.

10-2 Offensive Strategy. When resources are adequate and the vessel's environment is tenable, an offensive strategy may be appropriate. The Incident Commander can choose from an aggressive handline attack, to remote agent application or smothering.

Strategy is goal oriented. The Incident Commander should develop a list of desired outcomes. Tactics should be continually evaluated against the desired outcomes. The ability to achieve tactical objectives will serve as a guide to the feasibility of the strategic goals.

10-3 Defensive Strategy. When resources are insufficient for extinguishment or the danger to personnel, environment, or exposures outweighs other considerations, a defensive strategy may be appropriate. The Incident Commander's options are containment and exposure protection or removal of the vessel to an approved location.

10-4 General Tactics. There are many different types of fires that can occur aboard vessels. As with any fire incident, initial fire department actions should address rescue of endangered persons, protection of exposures, confinement, and prevention of fire spread. Other tactics, strategies, and their order of precedence will vary depending on the type of fire situation and location on the vessel. As is the case in some structure fires, incorrectly ventilating a vessel space can cause a backdraft explosion. Any use of ventilation as mentioned in 10-5 through 10-16 and throughout this document should be carefully considered before application as a strategy. Usually it is essential that ventilation not be established until a coordinated attack can be made.

10-4.1 Watertight Doors. Watertight doors can be found throughout a large ship. The operation of the doors should be noted during the pre-fire planning process. They are vital to the containment of fire, smoke, and water. By their very nature, watertight doors can be under pressure from water or hot gases. Opening watertight doors must be done with extreme caution.

10-4.1.1 Nonquick Acting Watertight Doors. Nonquick acting watertight doors are manual and are held in place by slip hinges and, usually, six locking dogs. Because the door may have pressure behind it, it is advisable to first open the dogs on the hinged side of the door. The slip hinges will allow the pressure to be released without the door being uncontrollably blown open. The unhinged side can be unlocked when it is safe to do so.

10-4.1.2 Quick Acting Watertight Doors. Quick acting Watertight doors are manual and are locked with the rotation of a single lever or wheel. The lever or wheel passes through two stages as it is rotated. The first stage partially opens the door to release pressure while keeping the door secured to the door jambs. It cannot blow open in this stage. After the pressure has dissipated continue rotating the lever or wheel to open the door.

10-4.1.3 Power Driven Watertight Doors. Power driven watertight doors are doors that are operated by means of electric motors. Each door usually can be operated by an electric switch or a hand crank. Operating stations usually are both nearby and remote from the door. Remote electric control stations may be provided with an auto close mode that will automatically reclose the door upon the releae of the local switch.

10-5 Forward Compartments. The compartments in the bow contain machinery, storage, flammable and combustible liquids, and seawater ballast tanks.

Rescue of personnel in these compartments is very difficult due to the vertical access and vertical ladders that service each deck. It may be necessary to establish a "man-hole"/confined space rescue operation on each deck above the victim.

Electrical power to these compartments can be disconnected within the compartments or from the motor control center (MCC) in the electrical room or machinery space. Control of the electrical distribution system should be accomplished by the ship's crew.

Some ships are provided with fixed extinguishing systems for these compartments. Determine if the fire department can support or supplement the fixed systems.

Fire fighting in these compartments may be limited to smothering the fire by sealing off the compartment or applying water through cellar or revolving nozzles.

10-6 Aft Compartments. The aft compartments are located in the stern of the vessel. Each level or deck presents problems of access. In some cases there is only one access point to these compartments. The decks below the main deck compartments may have two access points. These compartments generally are larger than the forward compartments.

The compartments contain machinery, storage, combustible liquids, and seawater ballast tanks.

The aft compartments are essential to the operation of the ship because they contain the steering system for the vessel.

Rescue on levels below the main deck can sometimes be accomplished by the use of companionways and ladders. Access to the lowest levels may require a vertical descent.

Electrical power to these compartments can be disconnected within the compartments or from the motor control center (MCC) in the electrical room or machinery space. Control of the electrical distribution system should be acomplished by the ship's crew.

Because there may be two access points to the upper decks, it may be possible to make a direct attack on fire in these compartments. Ventilation may be possible also. Where a direct attack is not possible, the use of cellar or distributor nozzles or the sealing of the compartments may be required.

Pump Room Fires. Pump room fires usually are the result of a mechanical failure, i.e., ruptured pipe, pump failure, ruptured stuffing tube seals.

Items to consider in order to extinguish a pump room fire:

A. Shut off source of fuel to pump room.

B. Utilize portable extinguishers, $1\frac{1}{2}$ in. hose lines, foam.

C. Activate ship's fixed fire fighting system for pump room.

Caution:The fire fighter must know how to do this or seek assistance from the ship's engineering officer.

D. Extinguishing a pump room fire by smothering (securing all ventilation and closing pump room doors) requires extreme precautions. This may extinguish the fire, but the possibility of a reflash or explosion is a real danger. It may take several hours or days for the pump room to cool down sufficiently to prevent a reflash when the room is opened up.

E. In many instances a ship's crew will automatically activate the ships pump room fire protection system when there is a pump room fire. They may have the fire out or contained when the shoreside fire fighters arrive. Fire fighters must take appropriate precautions, such as those listed above, when approaching a pump room fire under these conditions.

10-7 Tanker Deck Fires. A deck fire is a common type of incident aboard tank vessels. They generally result from the spillage of product on deck from a leaking or burst pipe.

Often the spill will be contained on deck due to the common practice of plugging the scuppers. This will result in product pooling in low areas until there is enough to flow overboard.

The first consideration in dealing with these fires is to shut off the flow of product feeding the fire. This may require stopping the ship's cargo pumps or having the shoreside terminal cease loading operations. Care should be taken not to arbitrarily close valves without a thorough understanding of the effects of such actions, as this may produce a water hammer effect with even worse consequences. Product flowing into navigable waters causes environmental pollution as well as spreading the fire. Oil booms or absorbent pads generally are not fire resistive.

Most spill fires contained on deck can be treated as a static flammable liquid spill fire. Extinguish with foam or dry chemical.

As part of initial size up, the I.C. (Incident Commander) should evaluate the vessel's fixed systems. Many tankers have deck foam monitors, which may be pre-aimed or remotely controlled. If the crew has previously activated them, it may not be possible to replenish the system during the incident. The I.C. must evaluate the on-scene resources and foam supply in relation to the size of the incident.

Should fire spread into waters alongside the vessel, escape and supply routes may be cut off. The fire may burn the mooring lines causing the vessel to drift, possibly with fire crews still aboard. The use of hose streams to sweep away or emulsify product on the surface should be considered.

10-8 Tank Fires. During the size up of a tank fire, the Incident Commander must consider several items that will be critical to a successful operation:

A. The status of the tanks involved must be determined. The type of product in the tank and how long it has been burning are important. Determine what the level of tank was at the time of ignition. Is the tank accessible? Obstructions will influence the type of attack.

B. Determine the status of the ship's fire protection systems. Is the ship's foam system operational? It may or may not serve the area involved in fire. The ship's crew may have charged the foam system prior to the arrival of the fire department. If so, it will be necessary to verify how much foam concentrate remains. The ship's plan may indicate whether or not the ship's foam concentrate supply can be augmented from shoreside supplies. Lastly, the ship's crew may be very helpful in operating the system.

C. Consider the operational condition of the ship's fire main system.

10-8.1 Fire Attack with Foam. When using foam as an extinguishing agent it is imperative to postpone the application of the foam until sufficient quantities are available to effect complete extinguishment.

The required rate of application must be calculated. NFPA 11, *Low Expansion Foam and Combined Agents*, will assist in identifying the application rate. The shipboard fixed system can be included in the calculations provided the system is reliable and charged. Pumping capacity calculations should include foam flow requirements plus flow required to operate cooling streams. Cooling streams include lines used to protect personnel and to cool exposures and hot surfaces.

If possible, turn the ship so that foam can be applied from the upwind direction.

Hoseline access to tank fires may be gained through ullage holes, vent lines, ruptures, and manholes.

Ignition of adjacent tanks must be prevented.

During attack:

–Keep water from cooling lines away from foam.

–Begin only after sufficient resources are in place to sustain the attack.

When the fire is out:

–Cool heated surface without disturbing foam blanket.

–Maintain foam blanket until ignition sources are removed.

–Inert the tanks if possible. Carbon dioxide may produce static electricity; therefore, it should not be used.

10-8.2 Fire Attack with Water. If water is the only available extinguishing agent, consider the following:

–All areas involved must be accessible to water fog streams.

–Water vapor suppression is possible only when water is applied continuously. Personnel should be kept away from the extinguished area because reflash or rekindle is a distinct possibility.

–Larger volumes of water will be required; as a result, larger dewatering capability may be needed.

10-9 Engine Room Fires. The main engine room provides propulsion power, electrical power, and steam to the entire ship. Since this is the power center of the ship, a fire here will render all but emergency systems ineffective. Emergency systems may not operate due to fire damage, disrepair, or being in manual mode.

Some engine spaces are separated by watertight bulkheads. If proper closures are made systems located in the noninvolved spaces may remain operational.

Ships generally are provided with emergency power to supply critical systems, such as emergency lighting.

A main engine room fire probably will be an oil fire, either at a flange or in the bilge, or it could be an electrical fire.

An electrical fire in the main engine room would be handled as an electrical room fire.

The following is a list of some of the equipment that may be found in an engine room: propulsion boilers, auxiliary boilers, steam turbines, diesel engines, pumps, generators, electric motors, hydraulic motors, electrical distribution centers, electronic control consoles, pressure vessels, evaporators, heat exchangers, sewage treatment plants, etc.

10-9.1 Personnel Rescue. Due to varied arrangements and the equipment found in main engine room spaces, search and rescue operations will be extremely difficult and hazardous.

Assistance from the ship's crew may be necessary to safely overcome hazards such as high pressure steam leaks, electrical shock, rotating equipment, and difficult accesses.

10-9.2 Confinement. To prevent the spread of fire and smoke to other areas of the ship all closures and ventilation to the affected area should be initially shut off. The effectiveness of closure procedures should be verified to identify any open or damaged dampers.

Making proper closures is also necessary to prevent the flow of water from one compartment to another, thus affecting the stability of the ship.

Shut down all main engine room systems from their remote emergency shut-down stations. This usually will not include the emergency lighting as it is powered from a different area of the ship.

Establish and cool the six fire boundaries (fore, aft, port, starboard, above, and below.)

Determine dewatering requirements and availability of the necessary equipment to accomplish immediate dewatering procedures.

10-9.3 Attack. Identify and establish the secondary fire boundaries for staging of personnel and equipment.

Identify and evaluate the status of the ship's fixed systems (CO_2, halon, foam).

If the ship's fixed systems are available and operational, they should be used as soon as evacuation and closure of the space is completed. Entry into a space where fixed CO_2 or halon has been released should be delayed to allow the agent to perform its function.

Entry into the engine room should be made wearing full protective equipment through an access at the lowest point possible.

Before entry is made it must be determined that adequate fire fighting equipment, personnel, and agents are available to not only extinguish the fire but protect the fire fighters. This becomes especially important when considering tight spaces and a possibly complex escape route.

Fire fighting equipment that may be available aboard the ship and be of assistance to the fire fighter includes; $C0_2$, halon, foam, and dry chemical portable extinguishers, $C0_2$ and dry chemical hose reel extinguishers, foam applicators, fog applicators, piercing applicators, fire hose, and nozzles.

The preferred agent for fighting a main engine room fire is foam. The amount of foam necessary and the amount available will have to be determined. In addition, the compatibility of the available foam and foam generating equipment will have to be verified (refer to: NFPA 11, *Low Expansion Foam and Combined Agent Systems*).

Before making entries through power actuated watertight doors, it should be determined that they are in the manual mode and will not automatically close on release of the actuating device.

Entry into all machinery spaces should be made with extreme caution as deck plates and gratings are routinely removed for equipment maintenance, creating trip and fall hazards.

When entry into the involved space can be made at or below the fire deck, ventilation can be established through the uptakes or natural vents to the outside atmosphere. This will reduce heat and improve visibility, but care must be taken as this will also introduce fresh air to the fire.

When entry to the involved space has to be made from above the fire deck, ventilation will have to remain secured until extinguishment and cooling are complete. Ventilating before extinguishment pulls the flames up to the fire fighters as they attempt to descend down into the space.

Areas of an engine room where fire is most likely to occur are, bilges, diesel engines, boiler fronts, boiler casings, fuel strainers, centrifuge, and stack areas.

A fire in the stack area of a ship may be further complicated by soot deposits. If soot is aerated it could quickly ignite. When mixed with water it will form sulphuric acid.

10-9.4 Overhaul/Salvage. When the fire is declared out, a "reflash watch" should be established until all cooling and overhaul functions are complete.

A blanket of foam must be maintained in the bilge until it is cooled and pumped out.

Oil leaks will have to be repaired and oily surfaces cleaned to eliminate the fire hazard.

Throughout the fire fighting and overhaul/salvage operations, water conservation procedures and dewatering operations must be maintained.

10-10 Electrical Room Fires. Electrical power is generated aboard the ship and is supplied throughout the ship by wires running through cableway/wireways. Starting at the main generator board these cableways interconnect electrical distribution centers that supply electrical power to the equipment in that sector.

Some areas in which electrical fires may occur are winch control centers, motor controllers, motors, generator boards, generators, distribution boards, galley equipment, lighting panels, pump control centers, computers, automation control centers, wireways, transformers, propulsion motors, and propulsion control consoles.

A ship in port may be hooked up to shore power. The ship may not be generating its own electrical power. The source of electrical power must be verified with the ship's crew.

10-10.1 Personnel Rescue. Due to the varied arrangements and the equipment found aboard ships, search and rescue operations will be extremely difficult and hazardous.

Assistance from the ship's crew may be necessary to safely overcome hazards, such as electrical shock, rotating equipment, and difficult accesses. Special rigging also may be necessary to affect the safe removal of a casualty.

10-10.2 Confinement. To prevent the spread of fire and smoke to other areas of the ship, all closures and ventilation to the affected area should be initially shut off. The effectiveness of closure procedures should be verified to identify any open or damaged dampers.

Power to the involved equipment must be disconnected to reduce the intensity of the fire and possible shock hazard. The ship's crew should be consulted as to location and method of deenergizing circuits as there may be alternate power supplies and live wires that traverse the space.

Identify, establish, and cool as necessary all six primary fire boundaries. (fore, aft, port, starboard, above, and below). If cooling of the bulkheads is required, establish dewatering procedures.

10-10.3 Attack. Identify and establish the secondary fire boundaries for staging of personnel and equipment.

Identify and evaluate the status of the ship's fixed systems (CO_2, halon). Note that propulsion motors may have fixed systems that discharge into the motor housing.

If there is an operational fixed system for the space involved, it should be used as soon as evacuation and closure have been completed. Entry into a space where fixed $C0_2$ or halon has been released should be delayed to allow the agent to perform its function.

Entry into the involved space should be made wearing full protective clothing.

Transformers aboard the ship may contain oil. If the integrity of the transformer is breached, the fire may become a combination electrical and oil fire. The transformer oil may contain a carcinogen and release highly toxic fumes.

Before entry is made it must be determined that adequate fire fighting equipment, personnel, and agents are available to not only extinguish the fire but protect the fire fighters. This becomes especially important when considering tight spaces and the possibly complex escape route.

Fire fighting equipment that may be available aboard the ship and be of assistance to the fire fighter include: CO_2, halon, and dry chemical hose reel extinguishers; $C0_2$ and dry chemical semi-portable extinguishers; fire hoses; and nozzles.

When the fire fighters are ready to make entry into the involved space, ventilation should be established to the outside atmosphere to reduce heat and improve visibility.

10-10.4 Overhaul/Salvage. When the fire is declared out, a "re-flash watch" should be established until all cooling and overhaul functions are completed.

Take appropriate action to prevent further damage to adjacent electrical equipment.

Special care must be taken when dealing with wireways. They can be difficult to access, and they can easily spread fire from one compartment to another compartment.

10-11 Chemical Tanker Fires. Chemical tankers are vessels that carry flammable and toxic chemicals in tanks on and below decks. They usually carry a variety of different chemicals. Multi-product tankers are commonly referred to as "drug stores."

Even though the tanks may be segregated by cofferdams, during an incident the tanks may leak and result in the mixing of the chemicals, creating an unknown reaction or hazard. By identifying the chemicals that are on board, a proper strategy can be executed. The chemicals may be violently or mildly reactive with water.

While attacking a fire on a chemical tanker, the following should be considered:

–Ensure that the cargo transfer operations have been stopped and pumps are shut off;

–If needed, some cargo may be able to be heated or cooled in the tank by onboard heating or refrigeration systems;

–Due to the possibility of electrical shock and the presence of explosive vapors, secure the power to the area and ensure that there is no source of ignition within or added to the area (i.e., static discharge from CO_2 extinguishing systems);

–To maximize tank integrity, cool adjacent tanks; cool the piping on deck and in the area to prevent explosion and vapor ignition; cargo piping on deck is usually empty but may contain vapors of the last cargo.

–Consider the use of fixed systems, such as inert gas.

–Be prepared for downwind evacuation due to plume development.

Since fires involving chemicals can be extremely hot, personnel protection by water streams is a viable tactic. Rescue of personnel and movement of hose teams can be hampered by the presence of much fixed piping on the decks of these vessels. Due to high volatility and inhalation risk of the chemical vapors, adequate personnel protection procedures and equipment must be utilized. Always be aware that heat, water, and mixing of chemicals can produce dangerous products; personnel protection is a must.

10-12 Fires in Holds. The holds of a vessel are large areas below the main deck in which cargo is stored for transport. Although holds are most often associated with cargo vessels (bulk and break bulk carriers), many vessels contain holds.

To protect the cargo holds have hatches that cover the hold at the main deck and the tween deck openings. Hatches are usually removed by mechanical means. When the hatches are closed cargo may be lashed onto them. Surrounding the hold is a hatch combing that prevents deck runoff from entering the hold and helps prevent personnel on deck from falling into the hold. There are no combings around the tween deck openings. Access to a hold may be accomplished through large openings in the side of the vessel. Scuttles and ladders, which are closed when vessel is underway, provide access to the hole.

While attacking a fire in the hold, the following should be considered:

–Determine what is burning;

–determine fixed fire fighting systems for that hold;

–plan an attack: side opening vs. attacking from the hatch;

–close side opening if attacking from the hatch;

–consider smothering the fire by closing the hatch and, if possible, adding inert gas.

–Continually monitor and protect exposures and adjoining holds;

–distributor nozzles and fog nozzles may be placed into the hold; (Note: excessive cargo damage and/or stability problems may result.)

–Deck operations can be dangerous because of open hatches and cargo handling equipment;

–the freeboard of the vessel may have to be cooled; and,

–consider removal of some cargo.

–Fire in a hold can be difficult to attack because of the large area involved, difficult means of accessing, and poor visibility.

10-13 Machinery Room Fires.

10-13.1 Fire Fighting Systems in Machinery Spaces:

A. Water – (fire-main, stand-pipe)

B. CO_2 – Hose reels are used to extinguish electrical fires in large switchboards, some of these hose reels have nozzles that may be locked in the open position, which will allow flooding of the area.

C. Installed $C0_2$ svstems are found in these spaces, but successful operation requires the space to be secured (watertight doors and ventilation).

D. AFFF or Other Types of Foam – One example of fixed foam systems found on board ship is a bilge sprinkling type. It is designed to permit the extinguishment of Class B fires in ship's bilges. This system is sometimes found in conjunction with halon.

E. Halon – Fixed flooding systems.

10-13.2 Mechanical Systems Found in Machinery Spaces:

A. Hydraulic systems

B. Air compressors

C. Fuel transfer, service and stripping pumps, centrifugal purifiers, and fuel heaters

D. Fuel systems, storage and service tanks

E. Lube oil tanks

F. Steam systems

G. High pressure, low pressure, and bleed air systems

H. Air-conditioning systems

I. Sewage treatment holding tanks

J. Electrical

10-13.3 Common Causes of Fire in Machinery Spaces

Oil spray. These fires often occur during maintenance of flanges and valves

Major oil leak

Electrical systems

Improper storage of combustible materials

10-13.4 Personnel Rescue. Due to varied arrangements and the equipment found in main engine room spaces, search and rescue operations will be extremely difficult and hazardous.

Assistance from the ship's crew may be necessary to safely overcome hazards such as high pressure steam leaks, electrical shock, rotating equipment, and difficult accesses.

10-13.5 Fire Confinement.

Electrical Power. Complete electrical power isolation will be difficult due to the number of cables within the affected space. All electrical equipment should be secured prior to entry of the affected area. This can be done at the ship's emergency switchboard, load center, or distribution panel.

Isolate the mechanical systems, tanks, and machinery that may contribute to the fire.

Cool the boundaries. Check the surrounding areas (hot spots, discoloration of paint, combustible and flammable materials.)

Working with the ship's master, establish ventilation.

In unaffected machinery spaces, establish positive ventilation (supply on high, exhaust off). This is intended to prevent smoke from entering unaffected spaces.

The extension of fire in the overhead generally is faster on board ship. Therefore, entry into machinery spaces should be made at the lowest point possible. (Escape trunk, shaft alleys, etc.)

Entry into affected area most likely will require the use of foam. Once in the space the primary purpose of entry is to extinguish the fire, to ensure that fire sources are secured (fuel oil, lube oil systems), and to cool spaces. Cover ALL flammable liquids with foam. Cool fuel oil and lube oil tanks. Care should be taken that water from the cooling lines does not destroy the foam blanket.

10-13.6 Dewatering. While fire fighting procedures are in progress, efforts should be made to establish dewatering in operations. Use the ship's systems.

Consider the use of a barge into which fire fighting waste water can be discharged.

10-13.7 Points to Consider when Combating Machinery Space Fires:

Low Pressure Air. Some of the shipboard's low pressure air line joints may be assembled with soft solder. They will separate in a major fire. This will result in a blow torch effect that can enhance the fire.

Cables. Because of the large number of cables that transit a compartment aboard ship, there is a very good possibility that the fire fighters will have to combat the cableway fire also.

Steam. Because of the inability to ventilate, the temperatures in the space can be extremely high. If the attack team does encounter this situation, it is recommended that the handlines be used at the absolute minimum. Large volumes of water will result in high production of steam.

Thermal Imager. If available, this piece of equipment could prove to be extremely valuable while dealing with any shipboard fire.

Sheared Metal/Metal Turnings. Can result in a Class D fire. This possibility should be kept in mind.

10-14 Accommodation and Berthing Space Fires.

10-14.1 Rescue. In areas where people live or sleep the primary concern must be the location and rescue of victims. Vessel passenger areas closely resemble a pre-fabricated housing lay-out. Some of the similarities are compactness, built-in furnishings, thin walls, low ceilings, narrow hallways, and small doors.

10-14.2 Electrical Power. The electrical power to accommodation spaces must be shut off prior to fire fighting efforts. It should be noted that the removable overhead ceilings contain cableways that may provide power to adjacent spaces. Therefore, the power to the spaces on all six sides of the involved area may have to be shut off. Emergency power is usually of the same voltage on a separate circuit feeding the same fixtures.

10-14.3 Ventilation. It is difficult to ventilate heated fire gases from living quarters below decks without using a combination of horizontal and vertical ventilation. These spaces are not air tight on merchant vessels. However, they may be on military vessels. It is essential that ventilation not be established until a coordinated attack can be made. These spaces will retain high heat because of their insulation and, therefore, must be ventilated if the fire fighters are to be protected from heat injuries.

10-14.4 Direct Attack. In the early stages of the fire, a quick attack by the ship's crew or land-based fire fighters has proven effective. However, if the fire has been allowed a significant pre-burn time, a sustained effort probably will be required.

10-14.5 Indirect Attack. Because of the high synthetic fire-loading of these spaces, the flashover potential of passenger cabins is normally higher than the average house. For this reason fire fighters should use extreme caution when entering these closed spaces. The use of piercing nozzles should be considered.

10-14.6 Overhaul. The possibility of fire extension in concealed spaces surrounding passenger cabins is usually very high. A thorough overhaul is essential and must include penetration of the bulkheads.

10-15 Gas Tanker Fires.

Gas tankers referred to in this section are vessels that are specifically designed to transport flammable gas in bulk liquid form at very low temperature. Nonflammable and essentially nonflammable liquefied gases transported in bulk, such as anhydrous ammonia (ignition temperature -1204 °F), may share similar tactics for control as unignited releases. The two most common liquefied flammable gases are liquefied natural gas (LNG) and liquefied petroleum gas (LPG). LNG is mostly methane, liquifies at -260 °F, and is reduced in volume 600 times during the gas-to-liquid change. LPG is primarily propane or butane, liquefies at -44 °F and is reduced in volume 270 times when liquefied.

Although many of the physical characteristics of LNG and LPG differ substantially, fire fighting strategies and tactics will be similar. Both gases are nontoxic but are asphyxiates. They are often similarly stored aboard in large, insulated spherical containers (usually 5 spheres per vessel). The spheres or tanks are usually individually isolated within the hull by a "secondary barrier" designed to temporarily contain low volume leakage from the tank or "primary barrier" (*see NFPA 306, Control of Gas Hazards on Vessels*). These enclosed spaces, like others that exist aboard the vessel, may provide an environment that could promote explosion and/or fire hazards from either gas. If escaping into open air, however, both gases are similarly subject to fire, but generally only LPG is subject to explosion. An open air LPG explosion usually would require a large liquid-phase release and may also depend upon such environmental factors as wind conditions, humidity, terrain, and ignition sources.

Ships that carry LNG or LPG usually have water spray systems throughout critical cargo areas on deck. Although the water spray normally is not used to directly extinguish the fire, it may prove effective in:

–Dissipating unignited flammable vapors

–Protecting metal surfaces subject to brittleness and fracture from cryogenic liquids

–Confining a fire to a limited area

–Protecting exposures from radiant heat

Most ships also will be fitted with sufficient dry chemical units to extinguish a cargo fire onboard. Units may include large fixed systems with fixed monitors, smaller skid-type stations, and semi-portable wheeled tanks. Generally, crew members are specifically trained to combat liquefied flammable gas fires.

United States ports that regularly handle these gases in bulk will be controlled by the USCG Captain of the Port LNG/LPG Vessel Management Plan and the LNG/LPG Emergency Contingency Plan. These plans usually categorize gas vessel incidents into two separate areas: those incidents that occur while the vessel is in transit to the facility and those that occur while the vessel is moored at the facility. Generally, no matter what the nature of the emergency, the plans require that the response always be the same and to respond anticipating the worst situation. Various factors, including resource response time and high hazard potential, dictate this approach. The following general quidelines will apply to most liquefied flammable gas vessel fires whether they are ships or barges:

1. All personnel should remain upwind of the release.

2. High velocity fog should be used on the vapor of unignited releases. This will assist in the dispersion of gas vapors. This also can be employed to direct vapors away from an ignition source or toward a more windy area. NEVER APPLY HIGH VELOCITY FOG TO THE LIQUID. THIS WILL MERELY ACCELERATE THE FORMATION OF VAPOR.

3. In the event of ignition water should be used to cool down surrounding tanks, piping, equipment, and structures. It also should be used to cool down the tank involved in the fire. Water spray should be used to protect personnel involved in shutting down the source or protecting exposures.

4. Normally, gas fires should not be extinguished unless the source can be shut off. A controlled burn generally is preferable to an uncontrolled, unignited leak. Factors for consideration may include failure of structural metal from extreme cold (unignited) or extreme heat (ignited).

5. If it is necessary and practical to move the vessel away from the facility, a delay of at least 30 minutes should be expected depending on the type of hose connection(s) that are connected to the shoreside facility.

Chapter 11 Incident Command System

11-1 Introduction. As the complexity of the incident increases, additional positions with the incident command system (ICS) will need to be activated. The Incident Commander (IC) will have to determine which position will be activated. They may include planning, logistics, safety officer, information officer, etc.

The incident command system (ICS) provides a method for different agencies, organizations, and individuals to work together toward a common goal, in an organized, productive, efficient, and effective manner. ICS consists of procedures for controlling personnel, facilities, equipment, and communications during all phases of an incident. ICS is designed to evolve from the time an incident begins, through initial attack and stabilization, to long-term control, and, finally, to the resolution of the incident.

The incident command system is adaptable to any type of vessel incident whether fire, explosion, hazardous material, etc. It can be utilized for a small fire aboard a vessel, involving a single agency such as the local fire department. It can also be used on the large complex incident involving vessel(s) and/or a terminal.

The structure of ICS can be established and rapidly expanded depending on the changing conditions of the incident. The person in charge of the incident could be a company officer, who might be the first on the scene, or it could be the chief of the fire department, depending on the magnitude of the situation.

Solving any problem, especially one as complex as a major vessel emergency, is easier to do if broken down into parts. Under ICS the incident organizational structure develops in a modular fashion, based on the size of the incident. The incident's staff builds from the top down, and additional sections or functions are added as the incident requires it. One person usually can manage small incidents whereas larger operations require independent management of the various command responsibilities.

ICS allows response agencies to operate within a common, consistent, and preestablished organizational structure and with standard operating procedures. Predesignated standard names and terminology are used for organizational elements. Plain english is used instead of complicated codes for radio communications. Incident communications are planned, controlled, and managed using several functional radio networks.

ICS provides for the rapid activation, utilization, and control of resources.

11-2 Size-up. Any incident begins with the notification that an emergency exists. This sets in motion the beginning of the ICS.

A predetermined amount of emergency equipment and personnel are dispatched to the incident scene. Responding fire officials immediately begin an analysis process called "size-up." This is the gathering of the facts, data, and information on what has occurred or is occurring, forecasting what will happen, and developing a plan of action. This size-up process is continual throughout the incident and subject to constant revision.

Enroute to the incident scene, fire officers mentally consider their familiarity of the location and possibly involved vessel, scene conditions, time of day, their personnel situation, and possible resources available. They may consult fire plans of the vessel and the terminal facility or a preestablished response plan for vessel incidents.

Upon arrival, the first fire official will observe the scene and give input on conditions, such as type of incident, vessel type, vessel name, incident location. Based on what is observed, the call for more assistance in the form of additional alarms or specialized resources may be required. It can save time if this is preestablished.

Some special size-up considerations should be: the location, status, and condition of the vessel; gathering of the ship's documents and plans; locating pre-fire plans; identifying special equipment needed and the level of fire fighting experience of the crew.

Size-up Considerations:

Availability of pre-fire plan

Exact location on vessel

Vessel construction

Locate master, mates, engineer, crew-personnel

Gather ship's plans and documents

Status of fuel and ballast tanks

Flooding and stability problems

11-3 Staging. Staging areas should be predetermined for every marine terminal during the pre-fire planning process. The Incident Commander should designate a Staging Officer who should establish the staging area, maintain a log, and maintain communication with the Incident Commander.

11-4 Command Post. The first arriving fire officer will take command of the incident and name the command, usually after the name of the vessel, terminal, or location of incident. This officer will establish a command post (CP) and announce its location.

Its location should be accessible but safe to prevent from having to relocate it later in the incident. It should be upwind and have an overall view of the incident if possible. It should be large enough to accommodate all key personnel who will be involved in the command function. Communication equipment and sanitary facilities are desirable. A nearby terminal or office building will work well. The command post is where all incident operations are directed. There will be only one command post.

The Incident Commander has the responsibility for overall management of the incident. This includes staff functions such as information, safety, and liaison to support the command function. The IC will prepare incident objectives that in turn will be the foundation of subsequent action planning. The IC will approve the final action plan and all requests for ending and releasing primary resources.

Command will keep track of what has been ordered, what's in progress, and what's completed.

11-5 Operations. The operations section will supervise the actual control of the emergency. Operations will implement the action plan. The operations section can set up in the vessel, in the terminal, or adjacent to the command post.

The coast guard and/or harbor patrol will establish and enforce a waterside safety zone.

Fire personnel will obtain information concerning vessel's cargo and fire load.

Obtain general cargo management and stowage plan.

Consider offloading or transferring cargo.

Obtain Dangerous Cargo Manifest on or near bridge or terminal office, determine hazards present, and take necessary actions.

Determine fire situation and exact location. Methods include: heat scanners (infrared), temperature sensors, observing red hot or warped plates, and determining the areas served by smoking vents.

Determine which compartment or deck is involved. Determine life hazard and steps to minimize or neutralize.

Crew –have them account for:
- Personnel on board
- Crew list
- Condition/location

Passengers
- Passenger list
- Condition/location
- Others

Determine evacuation needs.

Evaluate exposures
- shoreside
- waterside
- other parts/areas of involved vessel other vessels
- port facilities, piers, structures
- cargo
- vehicles
- people
- environmental/pollution
- other exposures

Determine ship's systems status and condition.

Evaluate access and egress problems on the shore and the watersides of the vessel.

Water supply
- drafting sites
- fire boats and apparatus
- floating platforms

Lay supply hose lines from shore to vessel

Use aerial apparatus as stand pipes

Notify Coast Guard Captain of the Port – obtain assistance.

Due to the numerous aspects of a vessel fire that require special consideration by the Incident Commander, it is suggested that a check list be developed to assist the Incident Commander to manage the incident. A sample vessel fire check list is provided as Appendix B of this document.

When managing a shipboard fire under ICS, a number of key individuals should be included.

The vessel's master or master's representative should be present to give particulars of the vessel and its cargo and condition of loading.

The Coast Guard Captain of the Port has authority over marine disasters, and is primarily concerned with safety and effects on navigable waters.

Port and terminal representatives can help identify exposures to port facilities as well as provide equipment and crews for assistance.

Passenger vessel pursers and shoreside company officials can assist in accounting for passengers before they leave the scene. An area should be immediately designated for passengers to report. Comparisons of this information with those taken to hospitals may reduce unnecessary entries for search and rescue purposes.

Naval architect/salvage expert. Fire and extinguishment operations can rapidly render a vessel unstable and unsafe to work on. There is a continuous need to monitor the vessel's condition.

A certified marine chemist helps to monitor gas concentrations, interior fire area conditions, and may help in smothering operations.

A communications officer will be needed to coordinate groups who do not share frequencies or systems. There also may be a need to have access to translators for foreign crews.

11-6 Logistics. The logistics section should be developed and expanded to provide, maintain, and move the necessary personnel, equipment, and supplies (equipment maintenance: fuel, food and refreshments, communications, sanitation, etc.) to areas needed in the incident. The initial staging area may now be designated as a base where the primary support or logistical activities will be performed.

A logistics officer will be needed for large incidents, which present great supply problems.

A staging area or equipment resource pool used to stockpile air cylinders, hose, and appliances can be established on the vessel or adjacent to the vessel on the dock for personnel and equipment ready to be assigned to the incident as other personnel are rotated out. It is critical that once the fire attack has begun that it continue uninterrupted until the tactical objectives are attained. If extinguishment operations are interrupted temporarily to mobilize fresh personnel, the fire can gain additional headway and overtake gains previously made.

Hose attack teams in breathing apparatus under high heat and difficult access conditions aboard vessels will be effective for approximately fifteen (15) minutes. Because of this a minimum of three (3) teams of personnel should be dedicated for each fire attack hose line: one operating the hose line, one team ready to relieve the attack team, and a third team changing their air cylinders and getting ready to be operational again. Each attack team should have a minimum of two (2) 1½ in. or 1¾ in. hose lines. This allows one for fire attack and the second hose line for personnel heat protection (wide fog).

Logistics should develop a system to mechanically transfer equipment and supplies (hose, appliances, air cylinders, foam, etc.) from the dock to the vessel using the vessel cargo handling gear, winches or cranes, and transfer lines from the dock. Logistics is responsible for maintaining the incident radio communication systems. A minimum of three radio networks should be utilized. A command network for the incident commander, command staff (safety liaison, information), general staff (operations, logistics, and planning) and branch, divisions, and group supervisors should be established. A tactical network for operations and the various divisions and groups communicating with each other is also needed. Lastly, provide a support network for logistics to utilize to control the supply of resources and other non-tactical functions. There also may be a marine channel for control of waterside activities involving coast guard and fire boats and an air operations channel for helicopter activities.

A rehabilitation area should be established close to the incident but in a safe area so fire crews can be rotated out for rest and refreshments. Relief agencies often can assist with this. This area, along with staging and base, should provide personnel with some protection from the weather, such as heat and rain. Logistics may want to assign specific officers to manage key areas, such as water supply, foam, air, and cylinders.

11-7 Manageable Units. Operations must divide the incident into manageable units that may be called divisions, groups, branches, or sectors.

Divisions split the incident into geographical areas of operations. For example, each involved deck could be a division with two to three fire companies performing all needed activities in that area under the direction of a division supervisor. They would be designated 'main deck division,' 'second deck division,' etc. The incident could be divided by fire boundaries such as forward division, aft division, and deck division. Divisions are used to split the incident into manageable geographic areas and are assigned personnel, equipment, and a supervisor to perform activities needed in that area.

Operations also can divide the incident functionally into units called groups. Tactical objectives or tasks can be assigned to several fire companies under the direction of a group supervisor. Some examples would be rescue, evacuation, triage, ventilation, dewatering, salvage, exposure protection, etc.

If the number of divisions and groups exceed the officers' span-of-control, branches can be utilized to further organizationally divide the incident into manageable areas. Divisions and groups can be assigned to various branch commanders. An example would be a vessel branch for all activities aboard the vessel, a dock branch for all tactical activities on the dock, and a marine branch for the waterside activities.

11-8 Planning. A planning section will be established near the command post to collect, evaluate, and disseminate tactical information about the incident. It is here where the ship's blueprints, plans, and pre-fire surveys will be used by technical specialists who will prepare primary and secondary action plans. This section also will maintain accurate records and documentation on resources and how the incident progresses chronologically.

11-9 Emergency Medical System. An emergency medical system will need to be established if there are victims. Fire personnel can provide immediate first aid and removal from dangerous areas. An organization under the ICS should be established to conduct triage and transportation of the injured. This can be handled and staffed by fire, EMS, public health officials, or a combination.

11-10 Miscellaneous. Once the rescue of injured or endangered persons has been addressed, the ICS will protect exposures and set up fire boundaries to contain the fire. This will involve utilizing personnel and equipment to:

Position water streams on all sides of the fire to cool the hull, bulkheads, overheads, and decks.

Secure all ventilation systems ducts, fans, and dampers to fire area.

Isolate, secure, and stop all fuel flow to machinery located in fire area or threatened by spread of fire. However, exceptions may exist, such as emergency generators and emergency diesel fire pumps.

Close all vertical and horizontal openings, such as watertight doors, fire doors, ports, and hatches to the fire area.

Move all combustibles away from bulkheads and decks adjacent to the fire area.

There should be primary fire boundaries identified that will be the nearest complete bulkhead on the deck of the fire. Secondary boundaries should be identified in case the fire situation escalates and compels suppression forces to retreat.

Control and secure electrical power to fire area.

Identify and continually investigate all concealed spaces and avenues of fire spread through fire boundaries.

Make frequent inspections of all sides of fire to make sure primary fire boundaries are holding.

Make arrangements for portable mechanical ventilation and portable lights, if necessary.

Monitor vessel stability early in the incident.

Determine critical list and note inclinometer reading on bridge. Calculate amount of water going in and coming out of vessel.

Begin salvage operations if necessary.

Chapter 12 U.S. Coast Guard Role

12-1 Coast Guard's Legal Responsibility. In discussing fires aboard vessels, one of the most often asked questions is, "What is the Coast Guard's fire fighting responsibility?" It is beneficial for all agencies to know and understand this policy. To do so allows for a greater understanding of what type of Coast Guard support is available and under what circumstances it may be obtained. The following is the Coast Guard's marine fire fighting legal responsibility and enforcement policy, as stated in the Coast Guard Marine Safety Manual, Volume VI, Chapter 8:

"**AUTHORITY.** Among the provisions of the Ports and Waterways Safety Act of 1972 (PWSA) (33 U.S.C. 1221 et seq.) is an acknowledgment 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. This statute, along with the traditional functions and powers of the Coast Guard to render aid and save property (14 U.S.C. 88(b)), is the basis of Coast Guard fire fighting activities. 42 U.S.C. 1856-1856d provide that an agency charged with providing fire protection for any property of the United States may enter into reciprocal agreements with state and local fire fighting organizations to provide for mutual aid. This statute further provides that emergency assistance may be rendered in the absence of a reciprocal agreement, when it is determined by the head of that agency to be in the best interest of the United States.

"POLICY The Coast Guard has traditionally provided fire fighting equipment and training to protect its vessels and property. Captains of the Port (COTP's) are also called upon to provide assistance at major fires on board other vessels and waterfront facilities. [NOTE: COTP's are Coast Guard Officers, authorized by Congress (14 U.S.C. 634(a) to be designated by the Commandant of the Coast Guard, to facilitate execution of Coast Guard duties prescribed by law.] Although the Coast Guard clearly has an interest in fighting fires involving vessels or waterfront facilities, local authorities are principally responsible for maintaining necessary fire fighting capabilities in U.S. ports and harbors. The Coast Guard renders assistance as available, based on the level of training and adequacy of equipment (i.e. Coast Guard personnel and equipment). The Commandant intends to maintain this traditional "assistance as available" posture without conveying the impression that the Coast Guard is prepared to relieve local fire departments of their responsibilities. Paramount in preparing for vessel or waterfront fires is the need to integrate Coast Guard planning and training efforts with those of other responsible agencies, particularly local fire departments and port authorities. COTP's shall work closely with municipal fire departments, vessel and facility owners and operators, mutual aid groups, and other interested organizations. The COTP shall develop a fire fighting contingency plan which addresses fire fighting in each port within the COTP zone. This plan should be organized in a format similar to the federal local pollution plan as required by the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) (40 CFR 300.43)."

12-2 Available Resources. The Coast Guard's "assistance as available" policy is in keeping with long-standing policies of the Coast Guard and should not be construed as providing less assistance than in the past. The Coast Guard is an important resource available to fire fighting organizations because of its fire fighting contingency plans that are developed for each port and their maritime authority within each port area. The contingency plans are vital to the effective coordination of fire fighting efforts on vessels in port. In this regard the Coast Guard is in fact providing greater assistance than in the past. These contingency plans will be discussed in more detail later.

Personnel. Coast Guard personnel who would be helpful to local fire fighting agencies are:

Marine inspectors
National Strike Teams
Coast Guard Reserve Fire & Safety Technicians (FS)
Marine Firefighting Coordinators
the COTP or a representative thereof.

Marine Inspectors are Coast Guard personnel assigned to the inspection department of a Marine Safety Office (MSO) who are familiar with construction, equipment, and operating procedures for various types of vessels.

The National Strike Force is composed of the Pacific Area Strike Team and the Atlantic Area Strike Team (which includes the Gulf of Mexico). They have expertise in oil and hazardous substance removal and vessels' damage control.

The FS is a Coast Guard reservist who is a specialist fully qualified in the fields of marine fire protection, prevention, and fire suppression; hazardous material storage and transfer; and pollution incident monitoring, supervision, and investigation.

The Marine Firefighting Coordinator, usually a Coast Guard FS, provides the COTP with expertise and advice during a fire fighting situation. This individual, due to the requirements of this Coast Guard Reserve rating, is usually a local civilian fire fighter.

The COTP is the coast guard officer responsible for administering and enforcing the Port Safety and Security, Marine Environmental Response, and Waterways Management programs within the boundaries of a specific COTP zone. He has the authority (based in the Ports and Waterways Safety Act, 33 USC 1221) to order a vessel to operate or anchor in a specific manner, in the interest of safety, due to a temporary hazardous circumstance or the condition of the vessel itself.

12-3 Equipment and Supplies. The Coast Guard does not stock large amounts of fire fighting supplies at either their offices or on board their vessels. They rely upon local agencies and vendors for this support. Coast Guard vessels that have fire fighting support capability that may be available to fire response agencies are: various size utility boats with outboard motors, 32 ft Ports and Waterways Boat (PWB), 41 ft Patrol Boat (UTB), and the 44 ft Motor Life Boat (MLB).

Equipment Limitations. Coast Guard boats operate within the inland and coastal waters. Cutters (larger than boats) operate on the coastal waters and high seas. Their fire fighting capabilities generally are more substantial, but due to their operational commitments, they cannot always be made available. If they are available their fire fighting systems are designed for combating fires on board and are limited.

12-4 Training. The Coast Guard training available to local fire fighting agencies is limited, and varies from zone to zone. Within each zone, the COTP is encouraged to conduct training in marine fire fighting for Coast Guard and other personnel. The Marine Firefighting Coordinator is usually tasked with this program, which may involve exercising of the Contingency Plan. Due to resource limitations, formal training is generally limited to Coast Guard personnel. The Coast Guard does not approve marine fire fighting courses for the land-based fire fighter. There are, however, Coast Guard-approved marine fire fighting courses for the merchant mariner. These courses may be made available to land-based fire fighters so that they may become familiar with marine fire fighting.

12-5 Contingency Plan. The Coast Guard has the role and responsibility to develop the fire fighting contingency plans for the ports in the geographical area for which the COTP is responsible. This process usually begins with the COTP organizing a task group comprised of all interested and involved members of the port community. The Coast Guard then provides the coordination and direction for the development of the contingency plan. The task group will usually set the parameters that they intend the plan to cover but are guided by the basics as outlined by the Coast Guard. Some of the best plans are those that have allowed for task group members to exercise imagination and thoroughness. The following is the sample outline for a contingency plan found in the *Coast Guard Marine Safety Manual*, Vol. 6, Chpt. 8:

- Letter of Promulgation
- Record of Amendments
- Table of Contents
- List of Effective Pages
- Introduction
  - Authority
  - Purpose and Objective
  - Scope
  - Abbreviations
  - Definitions
- Policy and Responsibility
  - Federal Policy
  - Related State Policy
  - Multinational Policy
  - COTP Responsibility
  - Nonfederal Responsibility
- Planning and Response Considerations
  - Transportation Patterns
  - Waterfront Facilities
  - Historical Considerations
  - Hydrological and Climatic Considerations
  - Local Geography
  - Highly Vulnerable Areas
  - Local Response Resources
  - Political Considerations
- Response Organization
  - Predesignation of Responsibilities for Various Scenarios
  - Organization Charts
- Operational Response Actions
  - Command, Control, and Communications
- Coordination Instructions
  - Delegations of Authority
  - Notifications
  - Coordination with Special Forces
  - Termination of Response Activities
  - Resolution of Disputes
- Procedures for Reviewing, Updating, and Exercising
  - Responsibility
  - Exercises
- Annexes
  - Distribution
  - Response Personnel Assignments
  - Geographical Boundaries
  - Notifications and Communications
  - Public Information
  - Documentation
  - Funding
  - Response Techniques and Policies
  - Arrangements for Volunteer Groups
  - Interagency Support
  - Geographical/Action Directory
  - Response/Assistance Directory

Because of the interdependency of the involved personnel in a contingency plan, these plans need to contain the signatures of the appropriate authority from each agency. To produce a thorough contingency plan is a major undertaking that takes much time and effort. The plan must be then tested to see if it works. A plan should be tested often enough for those currently involved in its execution to be familiar with their own role and responsibility.

12-6 Fire Fighters and the Vessel's Master. The relationship between local fire fighters and the master of a vessel is critical for the successful extinguishment of a vessel fire. It is the Coast Guard's policy that the presence of local fire fighters does not relieve the master of command or transfer the master's responsibility for overall safety on the vessel. However, the master should not countermand any orders given by the local fire fighters in the performance of fire fighting activities unless the action taken or planned clearly endangers the safety of the vessel or crew.

12-7 Fire Fighters and the Coast Guard. The Coast Guard COTP is responsible for the safety and security of the port; the COTP is interested in any incident that may endanger this. As such, the COTP's role at a vessel fire is not to direct the fire fighting efforts, but to ensure that efforts do not threaten port safety and security. Due to authority based in law, the COTP may direct the movement of a vessel. This authority may be very helpful to the fire fighter to assist fire fighting efforts.

12-8 Marine Safety Office. Most Coast Guard captains of the port are located within a field organization called the Marine Safety Office (MSO). The Commanding Officer of the MSO is the COTP and the officer in Charge of Marine Inspections (OCMI). The chief of the Port Operations Department at the MSO is the local C.G. liaison for port fire fighting efforts and contingency planning.

Jurisdiction. The fire fighting activities of the Coast Guard are based in the Ports and Waterways Safety Act of 1972. This authorizes the Coast Guard to prevent damage to structures in, on, or adjacent to the navigable waters of the U.S. As defined in 33 CFR 2.05-25, the navigable waters means:

(1) Territorial seas of the U.S. (*see below*);

(2) Internal waters of the U.S. that are subject to tidal influence; and

(3) Internal waters of the U.S. not subject to tidal influence that:

(a) are or have been used for interstate or foreign commerce, or

(b) are capable of improvement to be used for interstate or foreign commerce.

The territorial seas are those waters within the belt, 3 nautical miles wide, that is adjacent to the U.S. coast and seaward of the territorial sea baseline (depicted on most charts).

The USCG's authority on the Great Lakes ends at the Canadian border.

Chapter 13 Problems Associated with Marine Fire Fighting

13-1 Press and Media Relations. As with any incident command system (ICS) the fire officer involved with a marine fire or emergency should assign a press relations officer. However, with marine fires there is a strong international interest. Astute marine fire incident commanders will arrange for their own interpreter to be available to reduce the possibility of translation errors.

13-2 Hazardous Materials. Hazardous materials officers preparing plans for maritime incidents should be aware of the locations of the cargo stowage plans for the vessels that enter their port. They should also be aware that there are many different hazardous material container marking systems in the world. They should become familiar with the systems that may impact them during a marine incident in their response area. Refer to:

Safety of Life at Sea 1974, Chapter VII (SOLAS, 1974);

International Maritime Dangerous Goods (IMDG) Code;

Title 49, Code of Federal Regulations, Parts 100177;

International Conference on Marine Pollution, 1973 Annex II, Appendix I through IV. Resolutions 12, 13, 14 and 15

Though hazardous materials are required by law to be marked, placarded, or documented, there are times when they are not. Be aware of this when reviewing cargo.

13-3 Pollution Considerations. The risk of water pollution in marine fires usually is significant. Fire officers should consult Coast Guard representatives to ensure that fire fighting actions do not unnecessarily aggravate the problem.

13-4 Language Barriers. Most of the vessels sailing to and from U.S. ports are foreign flag ships. In many cases the crew may not speak English. Firefighting plans for marine areas should have lists of interpreters who are available at all times to respond to assist with communications.

13-5 Vessel Movement. The movement of any vessel that is on fire must be undertaken with great caution. It should not be assumed that the vessel can move safely under its own power. Tugs should be present to assist the vessel even if the ship's engines are functional. If required, a pilot should direct the vessel's movement. Regardless of the risk to shore facilities, vessels should not be cast free to drift with the current. Any fire vessel movement should be coordinated between the ship's master, COTP, port authority, pilot, and incident commander.

Chapter 14 Post-Incident Activities

14-1 Vessel Disposition.

14-1.1 Fire Out. Once the fire is out the chief fire officer involved in a marine incident may be asked to certify that the danger has passed. A complete overhaul of a vessel may take many hours or even days. Incident commanders are cautioned to avoid a hasty decision to declare the fire out.

14-1.2 Safe Entry. Frequently, after the fire is out, fire officers involved in marine fires are asked if the fire area is safe for entry by non-fire fighters, civilians, or crew. The marine industry has had numerous fatalities resulting from entry into toxic or oxygen-deficient atmospheres after a fire. As a result, the industry has developed certifications for "marine chemists" who are recognized and accepted by courts as being competent to test and certify spaces as being safe for human entry. Fire officers are strongly advised to leave "safe entry" decisions to marine chemists.

14-1.3 Vessel/Scene Control. If the master and/or crew remain on the vessel, they remain in control of the vessel. The chief fire officer involved in a marine fire or incident may think that a vessel presents a continued hazard and he has no authority to act. These reservations should be voiced to the master in front of documented witnesses, and if mitigating action is not taken they should be referred to the COTP for appropriate action.

14-2 Fire Watch. It is a common practice in marine fire fighting to post fire watches on vessels that have experienced fires. This is usually done during and after the overhaul. Normally, these individuals are positioned on the fire deck as well as on the deck above and below. Fire watches are rotated in shifts and may be maintained for 48 hours or longer. Additionally, the ship's hoselines are laid out (and charged), ready for use in case the overhaul effort was insufficient.

Chapter 15 Legal Issues

15-1 Admiralty Law.

15-1.1 Court Authority. Questions of admiralty law are not within the province of local courts. State courts may adjudicate admiralty matters if the Congress has not and if the body of water or shoreline falls entirely within that state. Under Article I, Section 8, and Article III, Section 2 of the Constitution, Congress was given the power to legislate admiralty and maritime matters and the Federal Courts were given the judicial power, respectively. The U.S. Congress has vested admiralty jurisdiction completely in the federal district courts. (Amer. Juris. 2d., 1962)

15-1.2 Repercussions. Many fires on ships result in a high dollar loss and sometimes a loss of life. As a result, court actions are brought in admiralty court to relieve interests who have suffered a loss. In many cases fire departments, volunteer and career, as well as mutual aid departments have been the defendants in these cases. An understanding of the dangers inherent in marine fire fighting must include an understanding of the consequences of the failure to provide an equal standard of training, planning, response, and action that a department may provide on the land portions of its response area.

15-2 Legislation. The following are examples of legislation that are applicable to marine incidents.

York-Antwerp Rules (1864). Provides for uniform international procedures in adjusting liability.

Harter Act (1893). Concerned with U.S. domestic water common carrier liability.

Hague Rules (1924). Concerned with international water common carrier liability.

Carriage of Goods by Sea Act (1936). COGSA is the U.S. law that was written as a result of the *Hague Rules* and is concerned with the international water common carrier liability in U.S. courts.

Oil Pollution Act (1961). A revision of the 1924 Act that prohibits the discharge of oil or the by-products in the navigable waters of the U.S. or within 50 miles of the coastline.

Ports and Waterways Safety Act, 33 CFR 10; 33 USC 1221. Refer to 12-8.

15-3 Jurisdiction. The admiralty court jurisdiction may be determined by two important considerations: the wrong must have occurred on navigable waters and the wrong must have occurred on a "vessel" in those navigable waters. A "vessel" is anything that has the characteristic of mobility rather than being fixed. (Amer. Juris., 1962)

15-4 Force Majeure. A concept of International Customary Law that provides that a vessel in distress may enter a port and may claim "as a right an entire immunity" from local jurisdiction (Jessup, 1927). It should be noted that admiralty courts have upheld this concept as long as the distress was real and valid. Some foreign admiralty laws hold that "force majeure" makes exception of all rules.

15-5 Negligence. Most cases reaching court accuse some form of neglect. In other forms of law the doctrine of contributory negligence is used. However, in admiralty court "the doctrine of comparative negligence prevails." The Rule of Divided Damages is a specialty in admiralty law. (Amer. Juris., 1962) Normally, "gross negligence" or "willful misconduct" results in an award of damages. (Gilmore, 1975)

15-6 Salvage. In admiralty law salvage is the award of compensation to a salvor for services rendered to a vessel in distress. These services normally substantially improve the distressed vessel's condition. When considering an award of salvage, admiralty courts look at the status of the salvor, if amateur or professional, and if the aid was requested or self-initiated. (Mankabady, 1978)

15-7 Salvors. Under admiralty law anyone who renders assistance to a vessel in distress on navigable waters may be called a salvor. A salvor is not always entitled to an award of salvage. (Shon, 1984)

15-8 Duty to Act. A true salvor's acts must be voluntary; therefore, a person or persons under a duty to render assistance may not be awarded claim for salvage in admiralty court. (Gilmore, 1975)

15-9 Salvage and Fire Fighters. "Municipal or other public employees, such as firemen, are not entitled to an award for saving property if they were merely performing their regular duties." (Fireman's Charitable Assn. vs. Ross, 60F. 456; 5th. Cir. 1893)

15-10 Port Authority Documents.

15-10.1 Port Regulations. Many U.S. ports have regulations that govern the activities of foreign vessels in their port. It is usually understood that vessels wishing to enter these ports must conform to these regulations. Fire officers should ensure that their marine fire fighting plan does not contradict these regulations. It is extremely advantageous if the port regulations support or reiterate the command activities outlined in the plan and delineate the authority of the incident commander.

15-10.2 Port Tariffs. Some port tariffs also put forth regulations to be followed by visiting vessels. They may be employed in the same manner as port regulations. Also, port tariffs provide a source of income for port authorities. This source of income may be used to offset the high cost of providing marine fire protection to vessels using the port.

15-10.3 Contracts for Fire Protection. Some ports contract with local fire departments for fire protection services. These contractual arrangements take many forms and may stipulate actions or prohibitions for the fire department. Chief fire officers should ensure that these contracts do not contradict existing laws, regulations, rules, or customary practices in admiralty law. Contradictions have occurred that resulted in confusion for the fire departments involved. (Burns, 1984)

15-10.4 Memoranda of Understanding (MOU). MOU should be used between agencies whose responsibilities are not otherwise defined in regulation or law. Mutual aid agreements may fall into this category. These documents should define the expected actions of the agencies involved and stipulate a desired level of response to marine fires.

15-10.5 Lloyd's Open Form (LOF). This is a standard form document used in the shipping industry to cover salvage agreements between vessels and salvors. It is approved and published by The Committee of Lloyd's. The LOF has as a primary consideration the concept of "NO CURE - NO PAY." This salvage agreement stipulates arbitration, appeals, maritime liens, cargo disposition, interest rates, liability, and remuneration. (LOF, 1980)

15-10.6 Legal Support. It is recommended that a chief fire officer concerned with the preparation of or reaction to plans having to do with maritime fire and emergency response have those plans reviewed by an attorney who is familiar with (and preferably admitted to practice) admiralty law. Ports usually retain attorneys that can provide these services.

15-10.7 Fire Cause Investigation. Fire officers concerned with a cause and origin investigation on a vessel (especially foreign flag vessels) should be prepared to place their personnel or federal officers on fire watch, if they intend to maintain scene control to preserve a chain of custody. If the Master or crew reject an investigation, non-federal fire officers should consult federal authorities (USCG COTP) for direction. Local fire officers should not assume they have the same control of the post-fire scene that they may have on land. The U.S. Marshal, insurance carrier, or flag country may wish to assume control of any or all investigations.

15-11 Insurance. Marine insurance began about 800 years ago, long before fire or life insurance. Modern underwriting insurance had its origins centered around the coffehouse of Edward Lloyd in London in the middle 1700s. It wasn't until the 18th century that marine insurance was written in America. Generally, insurance allows the price of commodities and services to be less expensive because it allows the shipowner or shipper to spread the burden of losses to a larger group of people called underwriters.

15-12 Fire Chief's Relationship with Ship's Master. Many COTP Marine Firefighting Contingency Plans may contain the following or similar paragraphs:

15-12.1 Fire Department. Within the limits of the fire department's jurisdiction it will respond to all notifications of fire as manpower, equipment, and training allows. This includes marine facilities located within its boundaries and vessels moored alongside those facilities. Further, it may involve fighting a vessel fire occurring in portions of the harbor within their jurisdiction." (COTP Contingency Plan, Jacksonville, FL, 1985)

15-12.2 Master. This plan does not intend to relieve the Master of his command nor restrict his authority concerning normal shipboard operations. However, it must be recognized that the local Fire Chief normally has more experience in the art of fire fighting. In addition, the Chief has the responsibility for the safety of his men and equipment, and to the community, to contain and extinguish any fires. The success of the operation is contingent on one person being in overall charge of the fire fighting aspects. In the case of shipboard fires, the local Fire Chief will be the person in charge of the fire fighting operation. The Master plays a very important role in lending his experience and assisting the Fire Chief, which will greatly enhance the successful operation. The presence of the Fire Chief in no way relieves the Master of command of his vessel. However, the Master shall not countermand any orders made by the Fire Chief in the performance of fire fighting activities. The Master, officers, and crew of the vessel shall assist in the fire fighting operation. The Master shall be the liaison between the Fire Chief and his crew. He shall furnish, if possible, the Fire Chief with any and all information requested and should provide members of his crew to act as guides. The Master is at all times in charge of and shall control the actions of his crew. In the absence of the Master, the senior deck officer present will act for the Master." (COTP Contingency Plan, Jacksonville, FL, 1985)

Chapter 16 Referenced Publications

16-1 The following documents or portions thereof are referenced within this guide and shall be considered part of the recommendations of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

16-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 11-1988, *Standard for Low Expansion Foam and Combined Agent Systems*

NFPA 12-1989, *Standard on Carbon Dioxide Extinguishing Systems*

NFPA 12A-1989, *Standard on Halon 1301 Fire Extinguishing Systems*

NFPA 14-1990, *Standard for the Installation of Standpipe and Hose Systems*

NFPA 306-1988, *Standard for the Control of Gas Hazards on Vessels*

NFPA 307-1985, *Standard for the Construction and Protection of Marine Terminals, Piers, and Wharves*

NFPA 312-1984, *Standard for Fire Protection of Vessels During Construction Repair, and Lay-Up*

NFPA 1500-1987, *Standard on Fire Department Occupational Safety and Health Program*

Appendix A

This Appendix is not a part of the recommendations of this NFPA document, but is included for information purposes only.

PREFIRE SURVEY GUIDE (EXAMPLE)

PREFIRE SURVEY GUIDE

I. GENERAL INFORMATION

A. Ship Name: M/V Batterymarch Park

B. General Use - What is the general use of the vessel?
Container, Bulk, Grain, Tank, etc.

C. Ship Line - What company owns the vessel?
NFPA Lines, Quincy, MA

D. Flag - List the flag of the operator (owner).
USA

E. Language - What is the language normally spoken by the Officers (Captain, Mates, Engineers)?
English

F. Crew Number - List the number of crew normally assigned.
28

G. Passengers - List the number of passengers for which the vessel has accommodations.
Crew + 16

H. General Specifications: Length: 900 ft. **Beam:** 110 ft.
Freeboard (Empty and Loaded): 37/20 ft.
Height Above the Water (Empty and Loaded): 97/80 ft.
Draft (Empty and Loaded): 18/35 ft.

(If all specifications cannot be found on the ship's plans, obtain them from the Chief Engineer or Mate.)

I. Propulsion - What type of propulsion is used?
Slow speed, 8-cylinder diesel

J. Fuels/Capacity - List the types of fuels used and the amount of storage for each.
Diesel fuel bottom tanks and wing tanks - 53,000 Bbls.

PREFIRE SURVEY GUIDE

I. GENERAL INFORMATION (Continued)

K. Names and Emergency Telephone Numbers of Owner or Agent - List the name and phone number of the person who should be contacted in case of emergency, when the Master of the vessel is not aboard, and cannot be reached.

Capt. Steve Gooblatz 123 555-4141

L. Night Manning Practice - List the normal day and night manning practices. (Does the crew remain aboard and are the night mates used?)

0800-1600 Usually full crew aboard
1600-0800 1 night mate, 1 night engineer
(Hired for local union hall, not regular crew members)

II. CONSTRUCTION INFORMATION

A. General Layout - Make a full page side view drawing showing all deck levels and cargo space locations. This should be a reduction in size (to letter size) of the side view from the ship's plans. It is to be used as a quick reference in this section.

B. Deck Arrangement - Identify the location of the superstructure(s). Also, describe the deck arrangement, both in the superstructure(s) and the rest of the vessel. List the name and location of all decks in the vessel. Identify the general compartmentation on each.

Upper deck - Engineer Officers' state rooms, linen locker, ship's office.

C. Compartment Identification System - Describe the method used to identify compartments.

Vessel will use names, numbers, letters, or combination of these.

(Explain if compartment numbering or lettering has any significance as to its location or contents)

D. Frame Numbering System - Describe the frame numbering system used. Explain the direction of numbering.

Bow to stern, stern to bow, center to both ends.

(If sections have been added to the ship to lengthen it, note where the break in the numbering system is and what system is used on the modified section.)

E. Fire Resistive Separations - List the location of all fire resistive separations. Identify their location by frame number, deck, and state whether or not they extend the width of the ship or are partial.

(Be careful to gather complete information)

F. Cargo Spaces - List the following information (Include other information that would be useful with regard to cargo spaces):

PREFIRE SURVEY GUIDE

II. CONSTRUCTION INFORMATION (Continued)

1. The type of space (container, bulk, tank).
Break bulk & dry bulk upper & lower tween deck, bottom hold.
Liquid bulk in deep tanks - No. 2 & No. 4 holds.
Refrigeration - No. 5 hold, upper tween deck.

2. Arrangement (show how many spaces, how they are located, numbering system).
5 cargo holds forward of main house and 1 cargo hold aft of main house.
Cargo holds are numbered from fore to aft.

3. Identify access to all cargo spaces.
Scuttles and ladders P & S of mast trunk.

4. Describe interconnection between spaces. (Are any cargo spaces connected directly?)
Watertight bulkheads between holds 1 & 2, 3 & 4, and 5 & cofferdam.
Holds 2 & 3 and 4 & 5 are double holds without divisions.

5. Identify the capacity and volume of each cargo space.
Between frames 118 & 149, double hatch, upper and lower hold No. 4 tween decks, dry cargo (grain 141,022 cu.ft.; bale 840,080 cu.ft.), refrigerated cargo 9,488 cu.ft. (-)5^{O}F, liquid ballast 5000 barrels.

6. List the vessel's fuel tanks, location, and capacity.

HOLD/LOCATION	CAPACITY (BARRELS)
1F Center Deep	4000
1A Center Deep	6000
4F Starboard Deep	4000
4A Starboard Deep	4000
4F Port Deep	2000
4A Port Deep	2000
1 Double Bottom Stbd	600
1 Double Bottom Port	600
2 Double Bottom Stbd	1000
2 Double Bottom Center	2000
2 Double Bottom Port	1000
3 Double Bottom Stbd	2000
3 Double Bottom Center	2500
3 Double Bottom Port	2000
4 Double Bottom Stbd	2000
4 Double Bottom Center	1500
4 Double Bottom Port	2000

PREFIRE SURVEY GUIDE

II. CONSTRUCTION INFORMATION (Continued)
F.6. (Continued)

HOLD/LOCATION	CAPACITY (BARRELS)
5 Double Bottom Stbd	2000
5 Double Bottom Center	1500
5 Double Bottom Port	2000
6 Double Bottom Stbd	900
6 Double Bottom Center	1200
6 Double Bottom Port	900
7 Double Bottom Center	1500
5P Deep Tank Stbd	2000
5 S Deep Tank Stbd	2000
	TOTAL 53200

7. Describe how to remove hatches.
Ship has the equipment on board. Folding accordian on rails - Boom hoist cables and controls - pull open or close hatch covers.

G. Machinery Spaces - List the following information pertaining to the engine room/machinery spaces.

1. Location - The forward and after limits by frame number, upper and lower limits by deck.
FR 95/115, Floor to Upper Deck (02 Level)

2. Access - possible accesses and where they are located.
The doors on the port and starboard sides in the passageway on the upper deck.

3. A brief description of what the space contains.
Oil fired boiler, turbines, generators, etc.

4. Fire Pumps - the location of all fire pumps by frame numbers, deck, and compartment.
FR100 Starboard, 3rd deck, Machinery Room.

5. Switchboards — the location of switchboards.
FR100 Center, 2nd deck, Machinery Room

6. The location of "day" or "service" tanks.
Port, 3rd deck, Machinery Room below companionway

PREFIRE SURVEY GUIDE

II. CONSTRUCTION INFORMATION (Continued)

7. The location and nature of significant hazards to firefighting operations.
Steep ladders and narrow galleries with expanded metal decking four levels deep.

H. Accommodations - Describe briefly the general arrangement of all accommodations.

DECK	ACCOMMODATIONS	# STATE ROOMS
Bridge Deck	Emergency generator, swimming pool, Radioman, Wheelhouse	
Upper Deck	Engineer Officers	11
Boat Deck	Passengers	8
Main Deck	Crews' Quarters, Talley Clerk's Office	20
2nd Deck	Galley and Stores	
3rd Deck	Machinery Space and Holds (Refrig.)	

I. Other spaces - Describe only additional spaces (other than the previously mentioned) that need special instructions.

III. LOCATION LISTS

A. Data Location - List the exact location of all documents that would be useful during an emergency. (Example: hazardous cargo manifest, cargo manifest, ship's blueprints)
Purser's Office - Manifests
Bulkhead, Main Passageway - Blueprints
Copies are available on bridge

B. Escape Trunks - List all escape trunks, including location by frame number and compartment at which they originate and end.
From shaft alley at frame 204 at the center line up the second deck.

PREFIRE SURVEY GUIDE

III. LOCATION LISTS (Continued)

C. Instruments and Controls - For Detailed Information on Controls, Refer to the Systems Information Section - List the exact location of all controls and instruments that might be beneficial during an incident.

Inclinometer - Pilot House on Bridge, Engineering Control Room

Communications System - Wireless radio, Telephone, Sound Power Telephone main controls on bridge.

CO2 Systems - Main Deck

Smoke detection cabinet and annunciators - on bridge

Steam smothering - None

Remote Emergency Controls
- CO2 Systems - Manual System CO2 room
- Windlass motor room CO2 - Manual System Forecastle
- Ventilation - Motor Control Center 2nd Deck
- Fuel shutoff - Engineers Control Room 2nd Deck

D. Space Location List - List all spaces on the ship in alphabetical order. Include the name as it is shown on the ship's plans, the center, starboard side of center, and primary access (a brief description of the main access).

Space Name	Deck	Frame #	Side	Primary Access
Baggage Room	Boat	114	s	Forecastle frame #21
Cargo Office	Main		p	Midship House
Capstan Machy	Second	217	p	Fantail Booby Hatch
Chief Engineer's Office	Boat		p	After House
Chief Mate's Office	Upper		s	Midship House
Laundry, Crews	Main	113	s	Stairs, Main Superstructure

PREFIRE SURVEY GUIDE

III. LOCATION LISTS (Continued)

Space Name	Deck	Frame #	Side	Primary Access
State Room Pass. C-4	Boat	112	p	Stairs, Main Superstructure
Wheelhouse	Bridge			
Windlass Motor & Pump Room	Main	15	s	Forecastle frame #21

IV. SYSTEMS INFORMATION

A. Communication Systems - List all communication systems on the vessel, where the main station is, where remote stations are, and how to operate them.

Public address - on bridge

Sound Powered Telephone - on bridge & throughout ship

Dial Telephone - On bridge & throughout accommodation and engineering spaces

B. Electrical System - Describe the electrical system.

Electrical power is provided by two steam turbine generators located in the engine room on the starboard side of the throttle level.

Describe procedures to secure ventilation.

Describe and locate any alternate electrical systems.

Emergency generator, bridge deck aft of stack.

Identify the type of electrical power used and the voltage.

1000 KVA, 440/220 VAC, 3 phase, 60 Hz.

C. Fire Protection Systems - Summary Page - List all fire protection systems on the vessel.

Built-in Detection Systems:

Smoke - XYZ Company	Manual Box - General Alarm
Heat - None	Other - None

Built-in Extinguishing System:

CO2 - KIDDE	Steam - To Boilers only
Foam - None	Sprinklers - None