

GAO

March 1993

# COAST GUARD

## Additional Actions Needed to Improve Cruise Ship Safety



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**Resources, Community, and  
Economic Development Division**

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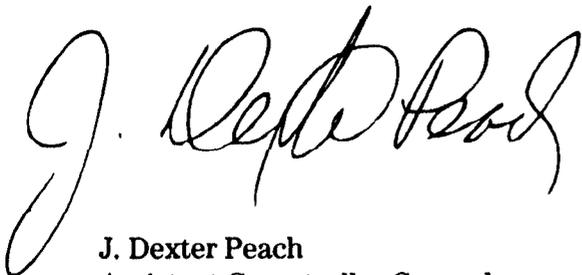
**The Honorable Jack Fields  
Ranking Minority Member  
Committee on Merchant  
Marine and Fisheries  
House of Representatives**

**The Honorable W. J. (Billy) Tauzin  
Chairman  
Subcommittee on Coast Guard  
and Navigation  
Committee on Merchant  
Marine and Fisheries  
House of Representatives**

This report, prepared at your request, provides information on the Coast Guard's program for examining safety conditions aboard foreign cruise ships calling in U.S. ports and international standards pertaining to passenger safety.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days after the date of this letter. We will then send copies to the Secretary of Transportation; the Commandant, U.S. Coast Guard; and other interested parties. We will also send copies to others upon request.

This work was performed under the direction of Kenneth M. Mead, Director, Transportation Issues, who can be reached at (202) 512-2834. Other major contributors are listed in appendix I.



J. Dexter Peach  
Assistant Comptroller General

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# Executive Summary

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## Purpose

In 1990 a fire aboard the Scandinavian Star off the coast of Norway killed 158 persons. This accident served as a catalyst to strengthen international standards for ship fire safety and design and also raised questions about the adequacy of other passenger safety standards. The accident investigation criticized the failure of international inspections to detect and correct safety deficiencies, the fire fighting response, and inadequate shipboard emergency information.

The Ranking Minority Member, House Committee on Merchant Marine and Fisheries, and the Chairman of its Subcommittee on Coast Guard and Navigation asked GAO to determine actions the Coast Guard is taking, or may need to take, to ensure (1) that flag nations adequately perform cruise ship safety oversight and (2) the adequacy of international standards for shipboard fire fighting training and emergency information.

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## Background

Nearly all (137 out of 139) cruise ships operating in U.S. ports are registered (or "flagged") with foreign countries. International safety standards for such ships are set through the International Maritime Organization (IMO), a United Nations agency. A ship's flag nation is responsible for certifying the ship's compliance with safety standards, although many nations delegate this task to classification societies, which perform safety inspections under contract. The country where the ship calls (the "port state") can conduct its own ship examinations to verify compliance with international standards and can detain a ship if it finds significant noncompliance. The Coast Guard performs these examinations and enforces standards in U.S. ports.

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## Results in Brief

Through its safety examinations, the Coast Guard continues to find safety problems on cruise ships, including inoperable fire doors and improperly designed escape routes. Key reasons for these problems include inadequate inspections by flag nations or classification societies and differing interpretations of some key international safety standards. IMO has begun efforts to identify needed reforms. However, the Coast Guard has not adequately assessed information, nor shared it with IMO, on the extent of substandard safety oversight by flag nations and classification societies.

The Coast Guard's own examination program can be improved in two respects. First, the Coast Guard needs to more effectively collect and analyze its cruise ship examination results, because its current automated

system does not routinely track repeated deficiencies or detect deficiency trends by individual companies, flag nations, or classification societies. Second, the Coast Guard needs to provide additional training on international safety standards for its inspectors; some inspectors told GAO they lack sufficient knowledge to uniformly enforce these standards.

International standards contain limited training requirements for crew members responsible for fighting shipboard fires. Since 1979 IMO has recommended, but not required, that fire squad members receive additional training in fighting shipboard fires. Few of the eight cruise ship companies GAO reviewed had implemented all of IMO's recommendations, and they varied greatly in the training they required.

International standards for emergency information aboard cruise ships are limited and unclear. Emergency information to facilitate safe passenger evacuation is often confusing and incomplete. The Coast Guard has considered taking a more comprehensive approach to improving emergency standards but has not obtained the consensus of Coast Guard groups working separately on U.S. positions on such standards.

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## Principal Findings

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### Coast Guard Examinations Point to Need for Improved International Oversight

Inspections by flag nations or surveys by classification societies are the primary check to ensure that international safety standards are met. However, the Coast Guard's port state examinations have identified instances in which flag nations or classification societies did not consistently identify or resolve problems that affect a ship's safety. For example, a Coast Guard examination aboard a cruise ship in October 1990 found inoperable fire doors and a possible leak in the hull, among other problems. The ship had received a classification society's approval just 6 days before. Open-ended language in the standards results in some key safety requirements being left open to the flag nation's interpretation, such as the design of emergency escape routes.

The Coast Guard has held maritime workshops and promoted initiatives at IMO to strengthen flag nations' and classification societies' oversight. GAO believes additional Coast Guard actions are needed to assist IMO in strengthening certain flag nation inspection requirements, such as the personnel and training needed to perform effective safety oversight.

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## Coast Guard Examination Program Can Be Further Improved

Until international inspections are strengthened, the Coast Guard will need to maintain its heightened safety oversight to ensure that cruise ships comply with safety standards. However, Coast Guard inspectors do not consistently record safety deficiencies they identify in their automated system, nor does the Coast Guard consolidate or analyze deficiency information among its offices. For example, during a November 1991 cruise ship safety examination, inspectors identified 116 deficiencies but recorded none of them, because all were corrected when the examination was done or soon thereafter. The absence of complete and consolidated information has hampered the Coast Guard in identifying patterns of safety deficiencies on ships operated by one company or substandard oversight by a single flag nation or classification society.

In the past Coast Guard inspectors received only 1 hour of formal training on international safety standards. Inspectors GAO contacted said additional training would provide more consistent enforcement of safety standards. The Coast Guard plans to add more training in 1993.

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## Improvements Needed in Fire Fighting Training

Fire investigations and routine Coast Guard examinations have both questioned crew members' ability to respond to shipboard fires. For example, the National Transportation Safety Board has issued six reports on foreign cruise ship fires since 1980, five of which concluded that the incidents were marked by poor crew fire fighting, ineffective responses, or both. Under current international standards, most crew assigned to fire squads are not required to receive training other than to participate in periodic drills and shipboard instruction. Repeated Coast Guard examinations suggest that these drills and instruction have not been sufficient, because fire squad members were repeatedly incapable of performing satisfactory fire drills. Crew members who are required to receive formal training are not required to update it, even though shipboard fire fighting techniques have changed in recent years.

Between 1979 and 1990 IMO adopted a series of nonmandatory recommendations calling for additional formal training courses and certifications of proficiency. The eight companies GAO reviewed had all taken some steps that exceed IMO requirements, but only one had implemented all of the recommendations. For example, five companies did not require formal training of all fire squad members. Coast Guard representatives to IMO are not currently considering formal proposals to improve mandatory standards related to crew fire fighting training.

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## Improved Emergency Information Needed

International standards do not ensure that emergency information to assist in passenger evacuation is clear and readily available. GAO found that emergency symbols and terms were often unclear, emergency information presented in passenger cabins was not always adequate, and effective escape route diagrams were not routinely used. For example, none of the eight companies provided emergency diagrams in dining halls and lounges showing the passengers' location in relation to emergency stations or showing more than one route of escape to such stations.

In 1991 IMO recognized that current standards need improvement, but it has not addressed several problem areas, such as use of confusing emergency terminology and inadequate use of emergency diagrams. A Coast Guard group has considered a new "system" approach to emergency escape by addressing several related safety standards, including those on emergency information, design of escape routes, and emergency lighting, in a single proposal. However, the Coast Guard has not decided whether to submit this approach to IMO, because it has not yet obtained internal consensus on key elements, such as emergency lighting requirements.

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## Recommendations

GAO recommends that the Secretary of Transportation direct the Coast Guard to (1) petition IMO to amend international cruise ship safety standards to require strengthened safety oversight by flag nations and classification societies and improved fire fighting training and emergency escape information and (2) develop a better system for collecting and analyzing cruise ship safety examination results.

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## Agency Comments

GAO discussed this report with the Chief of the Coast Guard's Merchant Vessel Inspection and Documentation Division and the Executive Director, International Council of Cruise Lines. The Coast Guard generally agreed with GAO's findings; however, it requested that GAO clarify the status of its proposals to IMO regarding crew training and emergency information. The cruise industry official believed that GAO's report understated the cruise ship industry's safety record. GAO acknowledges the overall safety record of the industry but also identified significant or important areas where safety could be enhanced, most notably in the areas of stronger safety oversight and improved standards for crew fire fighting training and emergency escape information.

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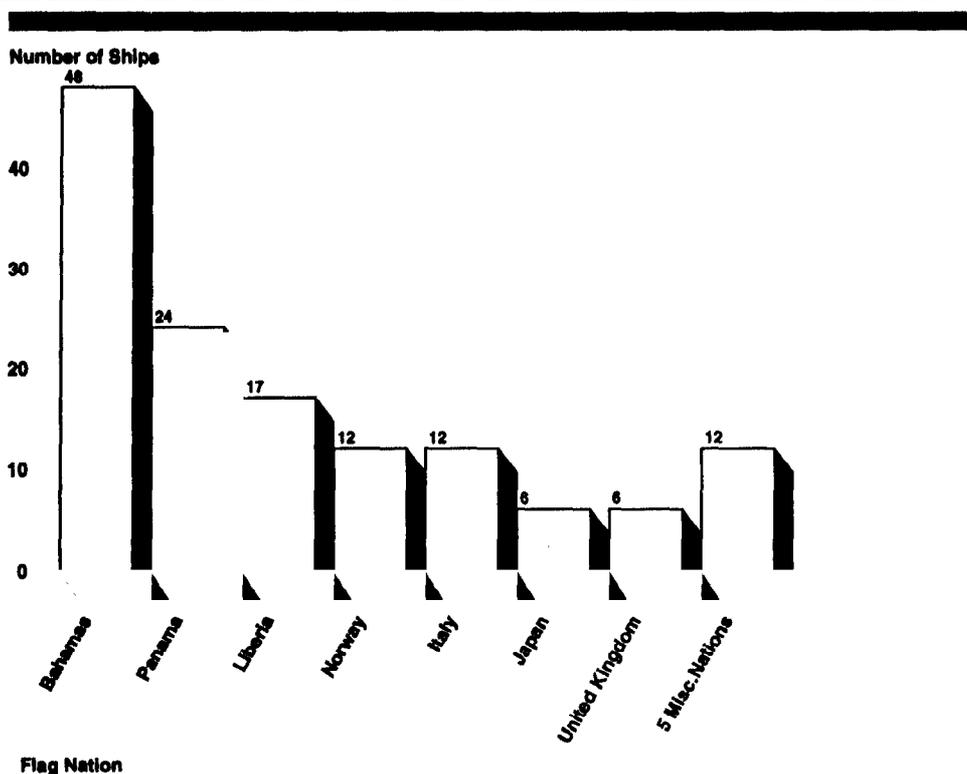
**Abbreviations**

<b>GAO</b>	<b>U.S. General Accounting Office</b>
<b>IMO</b>	<b>International Maritime Organization</b>
<b>MSIS</b>	<b>Marine Safety Information System</b>
<b>MSN</b>	<b>Marine Safety Network</b>
<b>NTSB</b>	<b>National Transportation Safety Board</b>
<b>SOLAS</b>	<b>International Convention on Safety of Life at Sea</b>
<b>STCW</b>	<b>International Convention on Standards on Training, Certification, and Watchkeeping for Seafarers</b>

# Introduction

Setting and enforcing safety standards aboard cruise ships operating in U.S. ports is a complex process reaching far beyond the United States. This is the case because, under international agreements, the basic responsibility for ensuring the safety of a cruise ship's design and operation rests with the ship's "flag nation"—the country in which the ship is registered. As of October 1992 only 2 of the 139 cruise ships operating in U.S. ports were registered in the United States.<sup>1</sup> The remaining 137 ships were registered in 12 countries; the Bahamas was the most common country of registration (see fig 1.1). Safety aboard these ships involves international standards and multiple inspection responsibilities.

**Figure 1.1: Flag Nations of Foreign Cruise Ships Using U.S. Ports, October 1992**



Note: Miscellaneous flag nations are Greece, Netherlands Antilles, Germany, Russia, and Denmark. Each nation has fewer than 5 vessels operating from U.S. ports.

Source: GAO's analysis of U.S. Coast Guard data.

<sup>1</sup>The two U.S.-flagged vessels sail exclusively within the Hawaiian Islands. Because they make no international voyages, they are not subject to the design and safety standards that this report addresses.

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## Safety Standards Are Set by International Conventions

Two international conventions govern design and safety standards for foreign-flagged cruise ships. Established through the International Maritime Organization (IMO), an agency of the United Nations, the conventions apply to all cruise ships making international voyages under flags of the 136 member nations. The conventions include both mandatory standards, or “amendments,” and nonmandatory recommendations, known as “resolutions.” The two conventions are as follows:

- The Safety of Life at Sea (SOLAS) convention. First established in 1914 and amended many times since, SOLAS covers such matters as fire safety requirements in ship design and construction, fire detection and drills, lifesaving appliances, and lifeboat drills.
- Standards on Training, Certification, and Watchkeeping (STCW). Created in 1978, STCW establishes training, certification, and watchkeeping standards for masters, officers, and crews of seagoing merchant ships. Among other things, it specifies the extent of initial formal fire fighting training required of crews.

Since 1990, as a result of recent maritime disasters involving passenger vessels, IMO has significantly amended a number of fire safety equipment and ship design SOLAS standards. STCW is currently being reviewed by IMO members but has not yet been upgraded to improve international crew training standards.

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## Verification of Compliance With Standards Involves Multiple Inspection Responsibilities

Three different parties are generally involved in ensuring that cruise ships comply with applicable standards of SOLAS and STCW—the flag nation, organizations called classification societies, and the country or countries where the ship calls (the “port state”).

- Flag nation. For vessels of its registry, the flag nation must annually certify compliance with appropriate SOLAS and STCW requirements. Flag Nations are also responsible for issuing qualification certificates to those crew covered by STCW requirements.
- Classification society. While a flag nation can conduct its own inspections for certifying compliance with SOLAS requirements, most flag nations delegate this responsibility to classification societies. These organizations generally use naval architects or marine surveyors for periodic inspections (called surveys) designed to determine whether ships are built and maintained in accordance with SOLAS safety standards. According to Coast

Guard data, nine classification societies<sup>2</sup> had conducted surveys or issued safety certificates on foreign-flagged cruise ships calling in U.S. ports in October 1992.

- **Port state.** Port states have the authority to verify the validity of the flag nation's or classification society's certification of compliance with SOLAS safety regulations. The IMO recommends that port states also assess the crew's ability to perform operational requirements for their duties. Under international agreements the port state may detain a vessel when it finds noncompliance affecting the vessel's safety and seaworthiness.

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## Coast Guard's Port State Role

The Coast Guard has port state authority for cruise ships calling in U.S. ports. It exercises this authority by conducting cruise ship safety examinations called control verification examinations. In general, safety examinations involve such activities as checking the ship's certificates and other paperwork, observing a crew fire drill, judging the crew's ability to work cooperatively in the event of an emergency (see fig. 1.2), checking fire fighting equipment and protective gear, and looking for adequate ventilation and means of escape.<sup>3</sup>

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<sup>2</sup>These classification societies were the American Bureau of Shipping, Bureau Veritas, Det Norske Veritas, Germanischer Lloyd, Lloyd's Register, Nippon Kaiji Kyokai, Panamanian Bureau of Shipping, Hellenic Register of Shipping, and Registro Italiano Navale.

<sup>3</sup>Examinations are guided by a 1981 Coast Guard booklet, "Control Verification or Examination of Foreign Vessel," which acts as an examination checklist. Other guidance includes Navigation and Vessel Inspection Circulars, updates to the Marine Safety Manual, and numerous policy letters and directives.

**Figure 1.2: Coast Guard Inspector Questioning Crew on Emergency Duties During Cruise Ship Safety Examination**



The most detailed cruise ship safety examination is conducted when a cruise ship initially calls in a U.S. port, at which time the Coast Guard reviews the ship's construction plans and conducts a 2-to 4-day in-depth examination of the ship and crew. Thereafter, it conducts an annual safety examination that results in a certificate of compliance if safety requirements are still met. On a quarterly basis the Coast Guard also conducts a more abbreviated examination.

SOLAS gives the Coast Guard enforcement authority to require corrective action if safety deficiencies are found. In practice, vessel operators often correct minor deficiencies as soon as the Coast Guard identifies them. If major deficiencies are found that are not likely to be corrected before a vessel's departure, or if the Coast Guard judges the response to be insufficient, it can prevent the vessel from leaving port with passengers until corrective action is completed.

The Coast Guard maintains most records on examinations at the field office level. Some of the information from the examination is also entered into the Coast Guard's computerized Marine Safety Information System (MSIS). MSIS was established in 1984 mainly to track vessel histories. Over time, however, it was modified and expanded and now serves as the primary information system for marine safety programs, including the foreign cruise ship safety examination program. However, a 1989 Coast Guard report found that MSIS was difficult for field personnel to use and did not eliminate the inspectors' need to rely on manual records to carry out their jobs. The status of this concern was discussed in a recent GAO report.<sup>4</sup>

## Recent Cruise Ship Accidents and Fires Affecting Passenger Safety

According to the Coast Guard, since U.S. citizens make up approximately 80 percent of cruise ship passengers worldwide, it is critical that the effectiveness of cruise ship safety standards be addressed at the international level. While comprehensive information about cruise ship accidents worldwide does not exist,<sup>5</sup> the following examples demonstrate the potential for disastrous consequences which exists worldwide.

- In 1990 a fire started aboard the Scandinavian Star while the ship was en route from Oslo, Norway, to Frederikshavn, Denmark. Within 45 minutes, 158 people died. Most were found in their cabins, where they apparently did not hear alarm bells or were not wakened by the crew. Others were found in hallways, where thick smoke apparently confused their efforts to escape. An investigation by several Scandinavian nations found, among other things, that the crew was unprepared to deal with the fire and that fire and safety equipment was missing, inoperable, or poorly maintained.

<sup>4</sup>Coast Guard: Progress in the Marine Safety Network, but Many Uncertainties Remain (GAO/RCED-92-206, Aug. 28, 1992).

<sup>5</sup>IMO has established a system for reporting passenger and other vessel accidents, but requests for casualty reports have met with limited response from member nations. Of the 1,239 casualty reports requested by IMO since 1978, only 701 have been submitted.

Just weeks before, the same vessel had been operating on cruises between Florida and the Caribbean.

- In 1991 the Oceanos sank in heavy seas off the coast of South Africa after a machinery explosion tore a hole in her side during a cruise. While all passengers and crew were rescued, passenger accounts pointed to possible serious breakdowns in safety procedures. Passengers reported that the ship's officers and crew offered little assistance and actually abandoned ship first. This ship had been carrying American passengers from Florida ports less than a year before it sank.
- In 1992 the Royal Pacific was hit by a fishing trawler while traveling between West Malaysia and Sumatra. The ship sank in less than an hour, resulting in three deaths and six passengers reported as missing. Accounts by passengers, including some U.S. citizens, were mixed, but many said the crew provided little help. This ship had been chartered for temporary service in Indonesia, but previously it had regularly operated on cruises from California to Mexico.

These examples all involved cruise ships that were calling in foreign ports, but all had operated regularly from U.S. ports shortly before and/or were carrying U.S. citizens at the time that these accidents occurred. For cruise ships operating in U.S. ports, no recent accident of comparable magnitude in terms of loss of life has occurred. Between 1980 and 1991 the Coast Guard investigated 73 accidents involving large cruise ships operating in U.S. waters, including 22 groundings, 16 fires, 22 equipment or material failures, and 13 collisions. In these accidents, 1 passenger and a crew member were killed in a fire, 2 crew members were killed by a falling lifeboat, and 68 passengers or crew were injured by a variety of causes.

The continued potential for accidents has raised concern about whether additional actions are needed to strengthen international safety regulation governing cruise ships. For example, in an October 1989 report on cruise ship safety, the National Transportation Safety Board (NTSB) stated that it was "concerned that there is serious potential for a high loss of life." Despite the relatively favorable safety record for cruise ships calling in U.S. ports, the incidence and extent of accidents occurring worldwide raises concern about the adequacy of international standards for ensuring the safety of cruise ship passengers.

Another reason for concern about the adequacy of international safety regulation is the continued growth anticipated in the number of Americans taking cruises. Since the early 1980s the number of cruise ship passengers embarking in U.S. ports grew 8 to 15 percent a year, and additional

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increases are anticipated in the future. Cruise ship companies expect to place 26 new and renovated ships into service by 1996, most of which will be capable of carrying at least 1,000 passengers; the largest will carry 5,600.

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## Objectives, Scope, and Methodology

In an October 31, 1991, letter and in subsequent discussions, the Ranking Minority Member, House Committee on Merchant Marine and Fisheries, and the Chairman of its Subcommittee on Coast Guard and Navigation asked us to determine actions the Coast Guard is taking, or may need to take, to ensure that (1) flag nations and classification societies adequately perform their cruise ship safety functions and (2) the adequacy of international standards for shipboard fire fighting training and emergency information. As agreed, we limited the scope of our review to foreign-flagged cruise ships over 100 gross tons calling in U.S. ports.

Our review involved work at Coast Guard headquarters and at 6 of its 47 marine safety offices in Juneau; Los Angeles/Long Beach; Miami; San Diego; San Juan, Puerto Rico; and Seattle. At Coast Guard headquarters we interviewed officials, reviewed laws and regulations, and obtained other documents related to cruise ship safety and the foreign cruise ship safety examination program. At each marine safety office, we interviewed officials in charge of the marine inspection program and four or five inspectors who regularly perform foreign cruise ship safety examinations. We also accompanied inspectors on several cruise ship safety examinations at marine safety offices in Miami, San Diego, and Juneau—offices that accounted for 41 percent of Coast Guard's annual foreign cruise ship safety examinations in 1991.

To assess the type and frequency of safety deficiencies the Coast Guard finds during cruise ship safety examinations, we reviewed 18 of 48 initial examinations completed between 1990 and October 1992. We chose initial cruise ship safety examinations because, unlike annual or quarterly examinations, they require extensive review of plans and involve a 2- to 4-day in-depth examination of key fire and safety systems. These 48 examinations were completed with technical assistance from the Coast Guard cruise ship safety examination augmentation team. Initial examination cases we reviewed were selected to reflect a variety of cruise ship companies and flag nations.

We supplemented our direct review of Coast Guard actions with additional information collected from flag nations, classification societies, and cruise

ship companies. The four flag nations from which we obtained information (Bahamas, Liberia, Panama, and Norway) collectively registered about 74 percent of the foreign-flagged cruise ships operating in U.S. ports as of October 1992, and the three classification societies from which we obtained information (Lloyds Registry of Shipping, Bureau Veritas, and Det Norske Veritas) collectively conducted surveys on about 61 percent of the foreign-flagged cruise ships. We obtained information about these flag nations' and classification societies' inspection programs but did not attempt to conduct a detailed analysis of their relative effectiveness. We obtained information on fire fighting training, emergency information, and other matters from nine cruise ship companies (Carnival Cruise Lines; Chandris Cruises, Inc.; Discovery Cruises; Holland America Line-Westours, Inc.; Kloster Cruises Ltd.; P & O/Princess Cruise Lines; Premier Cruise Lines; Royal Caribbean Cruise Lines; and Renaissance Cruises). Seven companies provided us with both fire fighting training and emergency information; one company provided us with only with fire fighting training information and another provided us with only emergency information. These nine companies, which vary in size and operate throughout the United States, own or operate about 64 ships (or 47 percent) of all foreign-flagged cruise ships calling in U.S. ports, as of January 1992.

To assess actions internationally to reform safety oversight by flag nations and classification societies, we discussed SOLAS and STCW conventions with representatives from IMO's Maritime Safety Committee.

To assist us in evaluating technical issues associated with our review, we worked with experts from six agencies that provide training in shipboard fire fighting. To assist us in evaluating the sufficiency of passenger emergency information and signs aboard cruise ships, we contracted with a consultant, Mr. Jerry Miller, who is an expert in such matters within the maritime industry. Mr. Miller assisted GAO in analyzing emergency evacuation information obtained from eight cruise ship companies and accompanied GAO on shipboard assessments of emergency evacuation information aboard several cruise ships.

We discussed the information in the report with the Chief, Merchant Vessel Inspection and Documentation Division, U.S. Coast Guard, and other responsible Coast Guard officials who generally agreed with our presentation of the facts and our conclusions and recommendations. The Coast Guard officials suggested that we clarify or more fully explain the status of Coast Guard proposals to IMO regarding passenger vessel crew fire fighting training and emergency information and escape standards. We

incorporated the Coast Guard's comments, where appropriate. However, as agreed with the requester, we did not obtain written agency comments.

We also discussed the information in this report with the Executive Director, International Council of Cruise Lines, who stated that the Council's members did not feel that the report made a fair and reasonable representation of the safety record of the foreign cruise ship industry operating in U.S. waters. The purpose of the report was not to assess the relative safety of the cruise ship industry, but rather to identify steps the Coast Guard should take to improve international standards pertaining to safety oversight, fire fighting training, and emergency evacuation information. We recognize that accidents on cruise ships calling in U.S. ports have been relatively infrequent. However, as discussed in chapter 1, cruise ship accidents worldwide suggest that potentially catastrophic consequences can result, as in the Scandinavian Star accident, if ships are not properly inspected or lack sufficient passenger safety information or crew fire fighting training.

The Executive Director also stated that IMO has required numerous improvements to ship architectural safety design and fire detection and extinguishing systems standards that were not addressed in detail in the report. We are aware of recent changes to SOLAS standards concerning fire safety equipment and design and, where appropriate, have addressed them in the report.

We conducted our work between December 1991 and December 1992 in accordance with generally accepted government auditing standards.

# Actions Needed to Strengthen Enforcement of International Cruise Ship Safety Standards

Cruise ship inspections by flag nations, or the classification societies they designate, are the primary check to ensure compliance with international safety standards. Coast Guard examinations of foreign-flagged cruise ships calling in U.S. ports show that flag nations or classification societies do not consistently identify or resolve problems that affect a ship's safe operation. Both IMO and the Coast Guard have proposed initiatives which could better ensure that flag nations or classification societies identify deviations from ship safety standards and more thoroughly enforce safety standards. However, additional Coast Guard actions are needed to ensure that flag nations and classification societies interpret and enforce safety standards more uniformly and that the Coast Guard's own cruise ship safety oversight program is managed effectively.

## Flag Nations' and Classification Societies' Safety Oversight Not Consistent

Coast Guard inspectors have found instances of potentially unsafe conditions aboard cruise ships after the flag nation or classification society certified a vessel's compliance with international safety standards. Ineffective enforcement of cruise ship safety standards is evident by Coast Guard examinations that find such potentially unsafe conditions as inoperable fire safety equipment or poorly executed fire or lifeboat drills. Such conditions have led Coast Guard officials at locations we visited to question the adequacy of some flag nations' safety inspections and the competence of work completed by some classification society surveyors. Here are examples from several initial cruise ship safety examinations:

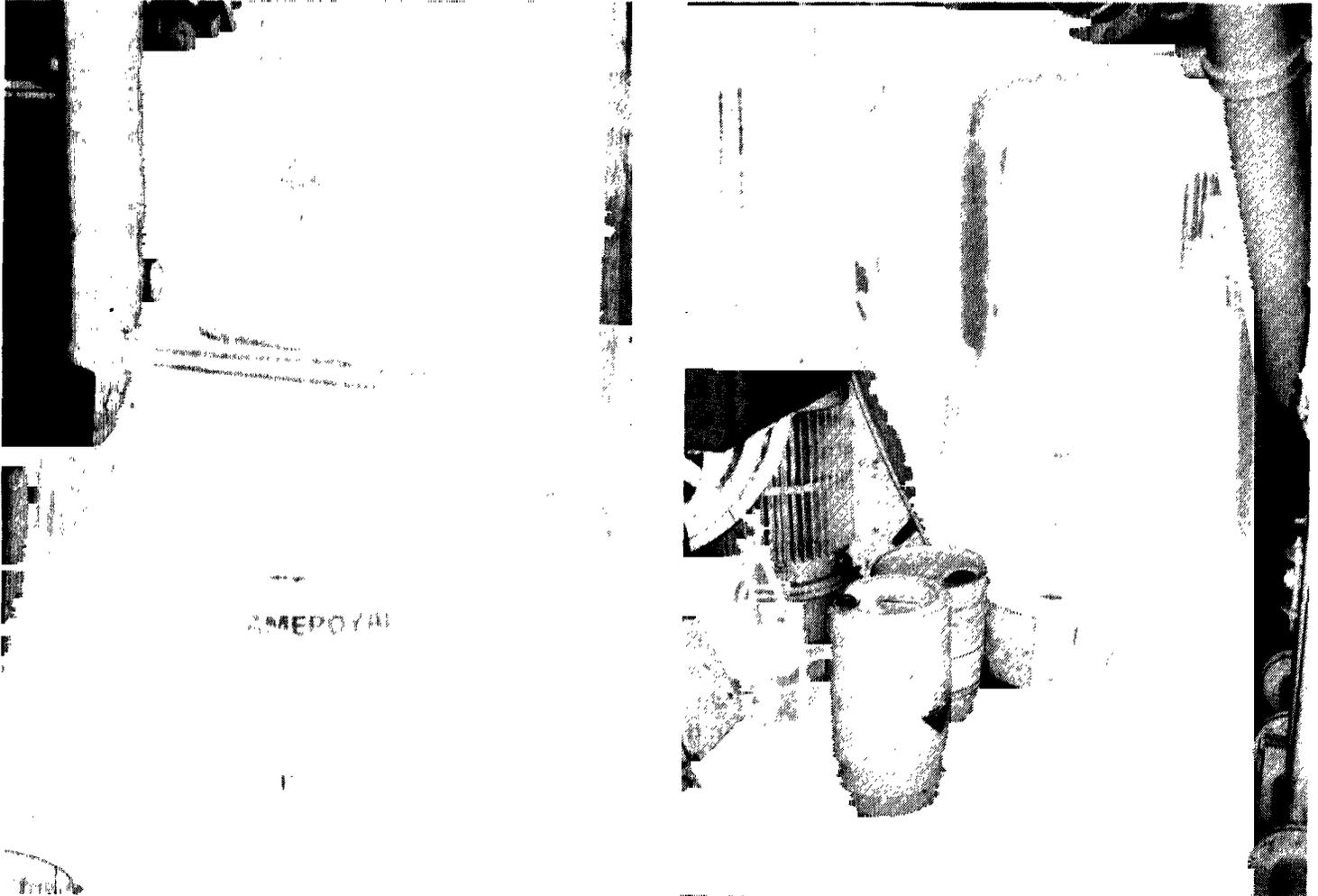
- In October 1990 the Coast Guard examined the Bahamian-flagged Vera Cruz I and found some fire screen doors that would not close, deteriorated lifeboat equipment, poor engine room maintenance, and a possible leak in the hull. Six days before, the classification society had issued a certificate of compliance.
- In November 1991 on the Bahamian-flagged Ocean Princess, the Coast Guard found problems with fire screen doors, numerous instances of combustibles being stored in stairtowers, and engine room, galley, and machinery spaces that lacked required fire safety boundaries. In a December 1991 memorandum to Coast Guard headquarters, the Chief of Marine Inspection in Miami said the deficiencies were "of such a fundamental nature that doubts exist as to the adequacy of flag administration/classification society oversight." In August 1991 the classification society had issued a certificate of compliance.
- In February 1992 on the German-flagged Berlin, the Coast Guard found that numerous fire screen doors were inoperable, combustibles were stored improperly, and some crew members lacked fire fighting training.

**Just 3 days earlier, the classification society had issued a certificate of compliance.**

**The extent to which such problems occur is not fully known, because the Coast Guard does not maintain summary data on deficiencies found during cruise ship safety examinations, according to Coast Guard officials contacted. We asked the Coast Guard for data on the number of deficiencies found on large, foreign-flagged cruise ships during calendar years 1987-91, but the Coast Guard said it could not readily provide this summary information because of higher priority data-processing activities.**

**To provide some indication of the type of safety deficiencies that occur, we analyzed 18 of 48 initial Coast Guard cruise ship safety examinations conducted between 1990 and October 1992. All 18 had at least one deficiency in three of the six safety-related categories: structural fire protection (such as impediments to passenger evacuation), improper storage of flammable materials (see fig. 2.1), inoperable fire safety equipment (for example, fire screen doors), poorly executed fire or lifeboat drills, improper documentation (logbooks or training manuals not updated), and missing or inoperable lifesaving equipment.**

**Figure 2.1: Improperly Stored Flammable Materials Observed During Coast Guard Safety Examination**



We identified two factors that contribute to inconsistent or ineffective flag nations' inspections and classification societies' surveys. First, the lack of clear definitions in many SOLAS standards makes the standards subject to varying interpretations. Second, flag nations vary considerably in such matters as the frequency of inspections and the number of inspectors conducting each inspection.

**SOLAS Standards Are  
Subject to Varied  
Interpretation**

The Coast Guard has analyzed all 56 SOLAS regulations pertaining to fire safety design and equipment (SOLAS ch. II-2) and found they contain phrases like "to the satisfaction of the administration" or "as deemed

practicable by the administration” a total of 229 times. While some degree of judgment is likely necessary, the degree of vagueness allows for substantially different interpretations, according to Coast Guard officials. SOLAS, chapter II-2, regulation 29, for example, states that, “In so far as it is practicable, stairway enclosures shall not give direct access to cabins, service lockers, or other enclosed spaces containing combustibles in which a fire is likely to originate.” [Underlining added.]

Nearly all the officials we contacted from classification societies and flag nations supported the Coast Guard’s position and said greater standardization and specificity in SOLAS regulations are needed to reduce varied interpretations of ship safety standards. For example, classification society surveyors we contacted said standards in need of further clarification included those related to the use of glass as fire protection in certain bulkheads; fire-resistant quality of materials used in emergency stairtowers; the width and angle of stairs used in emergency stairwells; and equipment items, such as the number of firemen’s outfits required.

Varying interpretations of safety standards have also occurred because new design features have been introduced since the mid-1980s, such as multistory atriums, large open stairtowers, and an increasing use of glass in ship bulkheads, which were not addressed or anticipated by SOLAS. For example, during a 1988 initial safety examination of one new cruise ship, the *Sovereign of the Seas*, the Coast Guard required installation of sprinklers in the 3-story atrium and required that numerous retail shops and other spaces opening into large stairtowers be closed off. The classification society that had certified the ship as safe had not thought such safeguards were necessary under the existing SOLAS standards. Until such modifications were completed, the Coast Guard required the captain to have roving fire patrols in those areas. Subsequently, the Coast Guard proposed and in June 1990 IMO approved new SOLAS design standards requiring sprinklers and fire detection equipment for new ships with atriums or multistory design features.

As of January 1993 the Coast Guard was finalizing work on a document to present at IMO explaining U.S. interpretations of key SOLAS fire safety design and equipment standards. These interpretations cover such matters as use of glass as fire protection in certain bulkheads, fire resistant quality of materials used in emergency stairtowers, and the design and arrangement of emergency stairwells. According to a Coast Guard official, the document should help form the basis for amending SOLAS to remove

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such vague phrases at the IMO Subcommittee on Fire Protection meeting in June 1993.

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**Flag Nation Inspection  
Activities Differ  
Extensively**

Concerns about the adequacy of flag nations' or classification societies' safety oversight have been raised in prior casualty investigations, such as the fire aboard the Scandinavian Star, which is described briefly in chapter 1 and is discussed in more detail in fig. 2.2.

**Figure 2.2: Fires Aboard the  
Scandinavian Star**

In January 1990 the *Scandinavian Star* was sold to new owners and moved from Florida to Norway where it was to provide overnight ferry service between Norway and Denmark. Early in the morning of April 7, 1990, while the vessel was en route from Oslo, Norway, to Frederikshavn, Denmark, two fires broke out. One was put out, but the second spread flames and toxic smoke rapidly through cabins and hallways, killing 158 people. The Scandinavian investigation revealed problems such as:

—Fire and safety equipment was missing, inoperable, or poorly maintained. For example, three alarm bells were missing, meaning that in about 90 of the 264 cabins the alarm probably could not be heard. Some fire screen doors failed to function or were missing altogether, allowing the fire to spread. More than half of the fire sprinklers on the car deck were inoperable. Lifeboats had patches of corrosion that had been painted over; many had motors that would not start or were missing altogether. Inspections conducted as recently as 1990 by the Bahamas (the flag nation) and Lloyd's Register (the classification society) either failed to detect the problems or to ensure that they were corrected.

—The crew was unprepared to deal with the fire. The report concluded, "No real attempts to fight the fire were made at any time. Under the emergency plan, fire on board was to be fought by the fire fighters, who were to assemble on the orders of the operational command (the captain). This did not happen." Neither the flag nation nor the classification society had verified that crew were proficient in carrying out fire and lifeboat drills. Each assumed that such verification was the other's responsibility.

An NTSB investigation of a 1988 fire aboard the same vessel found similar problems. While returning to Florida, a fire spread quickly from the engine room, cutting off nearly all electrical power. Although only three persons reported being injured, NTSB found that the crew's fire fighting response was inadequate and that several equipment-related problems went undetected. For example, the classification society survey failed to identify that the power source for the emergency generator was in the engine room, a violation of safety standards. With only limited emergency power, the captain had no way of communicating with passengers over the public address system.

IMO member nations have identified several weaknesses in the way flag nations or classification societies have carried out safety oversight. A discussion document submitted to IMO's Maritime Safety Committee by the Coast Guard and several European nations in February 1992 concluded that some flag nations may lack adequate numbers of skilled inspectors, organizational capacity to administer their programs effectively, or adequate procedures for delegating certain types of safety oversight to classification societies. Such problems can contribute to inadequate evaluation of safety equipment, crew proficiency in fire fighting, lifeboat drills, or other safety-related matters.

The four flag nations we contacted (Bahamas, Norway, Liberia, and Panama) showed substantial variation in at least three aspects of safety inspections: frequency of inspections, number of inspectors conducting the inspection, and qualifications of inspectors. For example:

- Only Liberia conducted safety inspections quarterly. The three other nations conducted inspections once a year, which is the minimum required by SOLAS.
- Only Norway conducted inspections with two inspectors. According to Coast Guard officials and several marine fire safety experts, at least two inspectors are needed to judge the adequacy of a shipboard fire drill on a large, multideck cruise ship—one to watch the operation of fire safety equipment and crew fire fighters and the other to monitor communication and coordination from the bridge. SOLAS requires that flag nations assess crew proficiency in conducting fire drills at least annually, but it does not specify how many personnel are needed to carry out such inspections.
- Only Norway uses exclusive inspectors (full-time employees who work only for the flag nation) to complete its inspections. The others use contracted inspectors who, according to some Coast Guard officials and a flag nation representative, may not be as familiar with a specific flag nation's inspection procedures or interpretation of safety regulations. SOLAS does not specify whether or not inspectors should be exclusive or contracted inspectors.

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## **Coast Guard Has Taken Actions to Address Inspection Deficiencies**

The Coast Guard has already taken several steps to ensure more uniform adherence to international safety standards for cruise ships:

- In 1991-92, the Coast Guard promoted three international initiatives to improve maritime safety: (1) an IMO resolution establishing the administrative and organizational requirements flag nations should follow

in carrying out their enforcement responsibilities; (2) a companion resolution establishing guidelines that flag nations should follow when delegating work to classification societies, including internal quality control systems and periodic external audits; and (3) an IMO amendment requiring that vessel owners establish ongoing safety management programs.

- In March and November 1991 it convened workshops with representatives from various flag nations, U.S. and foreign classification societies, marine insurers, and vessel owners and operators. Among other topics these workshops addressed ways to improve safety conditions aboard cruise ships and other vessels by establishing clearer roles, responsibilities, and performance standards for safety oversight performed by flag nations and classification societies.
- During 1990-92 the Coast Guard wrote letters to representatives from several flag nations and classification societies voicing strong concern about the quality of safety inspections and surveys and questioning their commitment to maritime safety.

In response to Coast Guard initiatives, IMO has taken some steps to address these concerns. In December 1992, for example, IMO formed a working group on flag nation compliance that drafted a 2-year, 14-point work program to, among other things, establish minimum standards for training, personnel, and organizational requirements for flag nations or classification societies acting on their behalf. Such changes are needed, the working group stated, if flag nations or classification societies are to consistently and effectively implement IMO conventions such as SOLAS. The U.S. Coast Guard will coordinate comments on the draft proposal by member nations and submit a revised resolution for approval by IMO's Maritime Safety Committee in May 1993.

Cruise ship lines and classification societies we contacted are also taking some steps to strengthen cruise ship safety. Four of the eight cruise lines we contacted said that they had recently initiated safety management programs to more clearly define and establish responsibility for safety objectives and to better track safety training. The three classification societies we contacted said they had increased their surveyors' training in safety standards and had implemented or were implementing quality assurance programs to monitor their surveyors' work more closely.

While these changes are encouraging, IMO has just recently begun efforts to specify the reforms needed if flag nations and classification societies are to carry out their safety oversight effectively. The December 1992

formation of the Working Group on Flag State Compliance, for example, is the first step toward identifying the personnel, organizational structure, and laws and regulations needed to perform effective safety oversight by these two groups. Limited information exists, according to IMO officials, about how frequently flag nations conduct inspections, the scope of these inspections, and the capabilities of flag nation personnel in conducting them.

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### **Coast Guard Can Take Steps to Strengthen Its Examination System**

Problems with flag nations' and classification societies' inspections or surveys place an added burden on the Coast Guard's port state cruise ship safety examination program. The Coast Guard's ability to use the safety examination program as an effective monitoring tool has been hampered by two problems. First, the Coast Guard is not consistently recording and analyzing deficiencies found during examinations. As a result, it cannot readily identify or track which cruise ship companies, flag nations, or classification societies are repeatedly missing significant safety deficiencies during inspections and/or surveys. Second, Coast Guard inspectors lack formal training in international safety standards, leading to possible inconsistent oversight during safety examinations.

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### **Collection and Analysis of Deficiency Information Insufficient for Identifying Patterns of Noncompliance**

The Coast Guard's Marine Safety Manual requires that all deficiencies found during initial or annual examinations be entered into MSIS, its computerized marine information data base, so that deficiencies can be tracked and trends noted when the vessel travels to other ports. Inspectors in most marine safety offices we visited entered only deficiencies that were not immediately corrected. For example, during a November 1991 initial safety examination of the Monarch of the Seas, inspectors identified 116 deficiencies but entered none of them in MSIS because they were all corrected when the examination was done or soon thereafter. Deficiencies not input into MSIS included missing fire or smoke detectors in 12 areas throughout the vessel, numerous instances of improperly stored combustibles, and inoperable fire screen doors.

Such incomplete entries into the MSIS do not provide the Coast Guard with sufficient data to monitor deficiency patterns on a given vessel. That is, a vessel may be consistently storing combustibles improperly and correcting the situation only as the Coast Guard happens to discover it, rather than making appropriate operational changes to ensure ongoing proper storage. If all deficiencies were entered into MSIS, the Coast Guard could routinely

determine if improper storage was a recurring problem and could take appropriate action to ensure compliance on that vessel.

A second limitation of cruise ship safety examination information is that the Coast Guard does not routinely analyze deficiency information to identify specific companies, flag nations, or classification societies that repeatedly fail to comply with SOLAS safety standards. Such information is available in the field office files, but Coast Guard headquarters does not routinely consolidate, analyze, or share information on trends in safety deficiencies in computerized form with other field offices and headquarters.

A recent incident illustrates the need for better consolidated information on safety deficiencies aboard cruise ships. According to the cruise ship safety program manager, in 1992 separate Coast Guard offices identified problems with several Bahamian-flagged cruise ships owned by the same company. The problems were identified through passenger complaint letters received by one office, casualty reports on the deaths of three crew members in two separate accidents completed or received by another office, and a report of an electrical fire and grounding aboard one ship by another office. One or more of these reports caught the attention of Coast Guard officials in headquarters, who in turn began checking with field offices about the incidents. Given the lack of readily accessible computerized information on these types of safety deficiencies, the Coast Guard took over 2 months to retrieve and analyze field office examination records on cruise ships owned by this company. In this particular case, the Coast Guard lost the opportunity to take timely action to ensure consistent compliance with international safety standards.

The Coast Guard has a new marine inspection information project underway, Marine Safety Network (MSN);<sup>1</sup> however, because the systems component pertaining to safety examinations has not been designed, it is too early to know how the problems mentioned above will be specifically addressed by MSN.

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**Lack of Training**  
**Contributes to Inconsistent**  
**Safety Oversight**

Formal training of Coast Guard inspectors in SOLAS has been limited. According to Coast Guard officials, during an 8-week introductory course, new marine inspectors receive only 1 hour of formal training on SOLAS conventions. Hence, inspector training in SOLAS has been provided on the

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<sup>1</sup>See GAO's report, Coast Guard: Progress in the Marine Safety Network, but Many Uncertainties Remain (GAO/RCED-92-206, Aug. 28, 1992).

job. According to inspectors at the six field offices we visited, which perform most cruise ship safety examinations, the Coast Guard cannot rely primarily upon on-the-job training to impart adequate knowledge of SOLAS conventions, because such training is only as good as the supervisor providing it; however, supervisors' knowledge of SOLAS can vary greatly according to their experience. For example, one supervisory inspector with whom we talked was assigned to head the inspection department at a field office conducting a high volume of cruise ship safety examinations, although before his assignment he had not participated in any cruise ship safety examinations and did not consider himself well versed in all aspects of SOLAS. Hence, relying on this person to train others in SOLAS is questionable.

The limited formal training in SOLAS standards has caused some Coast Guard and cruise industry officials to question the proficiency of Coast Guard inspectors. Several Coast Guard officials said the training provided to new marine inspectors, who often lack prior maritime experience, is not sufficient to prepare them to understand and interpret some of the provisions on international safety standards affecting large passenger vessels. In addition, representatives from several cruise ship companies said Coast Guard field inspectors do not always know complex sections of SOLAS standards. Coast Guard inspectors told us that formal training in the U.S. interpretation of SOLAS would make examinations more uniform and allow them to more consistently enforce safety standards.

Recognizing that field inspectors need increased expertise in SOLAS, the Coast Guard is in the process of revising marine-inspector qualification standards and in 1993 has developed a course on SOLAS conventions. A Coast Guard training official said that, of the 228 inspectors who conduct cruise ship safety examinations, about 15 to 20 inspectors are expected to complete this course by the end of fiscal year 1993. To help inspectors interpret safety standards, since early 1990 the Coast Guard has also made staff who are expert in SOLAS fire safety standards available to assist field inspectors in completing safety examinations of mostly new or renovated cruise ships. As of October 1992 these experts had provided assistance on 48 initial, 15 annual, and 3 quarterly cruise ship safety examinations.

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## Conclusions

Both IMO and the Coast Guard have acknowledged that deficiencies exist in the international system for enforcing cruise ship safety standards. Until such deficiencies are corrected, varying interpretations and selective enforcement of safety standards will continue, forcing the Coast Guard to

maintain its heightened port state oversight of cruise ships calling in U.S. ports. Initiatives by both IMO and the Coast Guard are positive first steps toward identifying the problems that need to be addressed to achieve more effective enforcement of safety standards.

To hasten IMO's development of solutions to these problems, however, will require that the Coast Guard take action in two areas. First, to achieve more consistent interpretations of existing safety standards, IMO must complete efforts now under way to clarify safety standards subject to frequent or recurring misinterpretation, such as improperly designed or constructed passenger escape routes. Completing the U.S. interpretation of standards subject to varied interpretations is an important first step to clarify key standards affecting passenger safety. Second, by collecting and sharing more information on flag nation inspection practices, including examples of recurring problems with flag nations' inspections or classification societies' surveys, the Coast Guard can help IMO accelerate work just getting under way to improve flag nations' and classification societies' safety oversight.

Until such reforms of the international safety system are in place, the Coast Guard will likely continue to shoulder the increased port state burden of enforcing safety standards on foreign flag vessels embarking passengers in U.S. ports. The Coast Guard has been hampered in successfully carrying out this role, however, in two respects. First, the Coast Guard does not routinely identify and track the numbers and types of deficiencies found during its cruise ship examinations. Such limited deficiency information has affected the ability of Coast Guard cruise ship safety program managers to identify recurring cruise ship safety problems or to single out cruise ship companies, flag nations, or classification societies in need of closer oversight. Second, some inspectors lack sufficient knowledge of international safety standards, which has limited their ability to enforce such standards uniformly.

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## **Recommendations**

We recommend that the Secretary of Transportation direct the Commandant of the Coast Guard to:

- Petition IMO to require flag nations to submit information on inspection practices and provide IMO with examples of recurring problems it has identified with flag nation or classification society inspection or survey practices.

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- **Develop a cruise ship safety program management component, as part of the inspector module of the Marine Safety Network project, to allow the Coast Guard to consistently document and analyze the results of cruise ship safety examinations. The system should also allow the Coast Guard to monitor the effectiveness of flag nations' and classification societies' enforcement of cruise ship safety standards.**
- **Require that inspectors performing cruise ship safety examinations receive formal SOLAS training.**

# Improvements Needed in Crew Fire Fighting Proficiency

Accident investigations and safety examinations have shown that some cruise ship personnel are not proficient in responding to shipboard fires. Limited training requirements under current international standards are a major contributor to the problem. Under current standards, most crew members assigned to fire squads are not required to receive training in shipboard fire fighting other than to participate in shipboard instruction and periodic drills. The few crew members who are required to receive formal shipboard fire fighting training are not required to update it. Since 1979 IMO has recommended guidelines for improving training and extending it to all crew members with fire fighting responsibilities, but these training recommendations are not mandatory and have not been consistently implemented within the cruise ship industry.

## Inadequate Fire Fighting Response Is a Commonly Cited Problem

Crew members who are adequately trained in fire fighting and effective in responding to shipboard fires are an important component of passenger safety. Shipboard fires carry the potential for creating considerable confusion and panic. Cruise ship fires almost always produce large amounts of smoke because of the furnishings and other materials commonly used in passenger accommodations and public areas. This smoke can spread rapidly if the ship's ventilation system is not immediately shut down, causing passenger and crew disorientation, obscuring signs, and making passenger escape difficult.

Investigations of fires on ships operating in U.S. ports have repeatedly shown that crews were inadequately prepared to respond to the situation. We reviewed six NTSB investigations of cruise ship fires issued since 1980 and found that five were marked by poor crew training in fire fighting techniques and/or ineffective fire fighting response. Deficiencies in responding included the following:

- Inadequate supervisory oversight and control of fire fighting efforts, including confusion over who was in charge of fire fighting.
- Failure to take organized and effective action to prevent or mitigate the spread of fire and smoke.
- Failure of crew members to assist and systematically evacuate passengers in a timely manner.

Poorly executed fire drills and a lack of crew proficiency in fire fighting are also among the most frequently identified problems found during cruise ship safety examinations, according to Coast Guard officials. Problems include confusion over who is in charge of fire fighting efforts,

failure to shut doors and close off ventilation to the fire area, and improper techniques for approaching the fire and attempting search and rescue efforts. Here are some of the recent examples cited by Coast Guard officials:

- In December 1988 a Coast Guard examination aboard the Tropicana in Miami found the crew's inability to communicate and its lack of knowledge of fire fighting techniques "particularly distressing." Because of the numerous safety problems identified, the Coast Guard restricted the number of passengers aboard and required the ship to have additional lifesaving and smoke detection equipment.
- In November 1990 Coast Guard inspectors in the Virgin Islands identified inadequate crew proficiency aboard the Renaissance II during two attempts by the crew to perform a fire drill. Only after Coast Guard inspectors and the ship's officers worked for several hours to improve the crew's shipboard fire fighting skills did crew members satisfactorily perform a third drill.
- In February 1991 the Coast Guard delayed the Rotterdam in the Virgin Islands when during a fire drill the crew failed to wear protective breathing apparatus, lacked effective communication, and did not shut fire doors or close off ventilation to the fire area.

## **Standards Do Not Ensure That Training Is Adequate**

Under current international training standards, officers in the deck, engine, and radio departments are required to have knowledge or a formal training course in shipboard fire fighting. Nonofficers assigned to safety watches are also required to have experience or training in shipboard fire fighting, but this can be provided while on the job by officers aboard their ship. Through shipboard instruction and regularly scheduled drills, officers are expected to train the remainder of the ship's nonofficer crew assigned to fire fighting teams.

These requirements do not appear adequate to ensure that cruise ship personnel are properly trained to respond to fires. The requirement for formal training courses covers relatively few members of the crew with fire fighting responsibilities and does not specify what such training should include. On average, this requirement covered fewer than 20 percent of all crew members assigned to fire fighting squads, according to most cruise ship companies we contacted. Furthermore, officers do not have to update their formal training, even though it is their responsibility to ensure the ongoing training and drilling of the remaining crew members

who serve on fire fighting teams.<sup>1</sup> For the remaining nonofficers assigned to fire fighting teams, the standards contain no provision for certifying their proficiency and no requirements that they receive any formal training. By contrast, as a way of ensuring more consistent training and a standard level of proficiency, international standards call for certification of all crew members who operate lifeboats.<sup>2</sup>

Since 1979 IMO has recognized that existing standards are deficient, but it has not instituted stricter requirements. Instead, it has issued a series of nonmandatory recommendations that attempt to deal with the deficiencies. These recommendations, issued in 1979, 1985, 1989, and 1990, call for basic and advanced formal fire fighting training courses for all crew members assigned to fire fighting squads, provide guidelines on the specific content of these courses, and suggest that certificates be issued to indicate completion of such training. In 1990 IMO required that shipboard fire drills and emergency instruction for all crew members cover a few specific areas, such as use of the ship's fire extinguishing appliances. However, IMO only recommended and did not require additional guidelines to assist companies in implementing these minimum standards.

IMO's approach of recommending improvements rather than requiring them has not produced a consistent upgrading of fire fighting proficiency. Some cruise ship companies we contacted said they do not always adopt IMO recommendations. One company stated that because IMO recommendations are often unclear, they do not want to incur the costs to implement them until required to do so. All eight companies we contacted had taken some steps beyond basic IMO requirements, but only one had implemented the nonmandatory training recommendations in their entirety. We found that:

- The content of the training instituted by the eight companies varied considerably. For example, three companies said they had instituted some degree of formal fire fighting training for all members of fire fighting squads; five said they had not. Also, with regard to experience in putting out actual fires (a practice IMO recommended), five companies said their training included it for some crew assigned to fire squads, while three companies said their training did not.

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<sup>1</sup>Current international training standards do not ensure training updates because flag nations are allowed to accept continued sea service as a substitute for any refresher courses required to maintain an officer's license.

<sup>2</sup>This certification, which is granted by the flag nation, usually involves completing a training course and passing a final examination on (1) the use of lifeboats or liferafts and emergency equipment and (2) actions to take in case of abandon-ship situations such as fire, collision, or sinking. Crew who receive this certification are not required to update this training.

- Four companies said they required ships' officers to attend regular training updates; three currently do not. Only one company said it extended this requirement to all members of fire fighting squads.
- Two companies stated that two flag nations (Great Britain and the Philippines) require that some crew members have a certificate indicating attendance in a one-time formal shipboard fire fighting course. None of the other six companies required any certification of crew members' fire fighting proficiency, although five said they supported such certification as a way to ensure a more standardized and adequate level of proficiency.

Experts from five of the six agencies providing marine fire fighting training that we contacted said greater uniformity in training requirements was needed to ensure a consistent level of safety and fire fighter proficiency. Experts from all six agencies also said training updates were important, because tactics, equipment, and technology can change dramatically. For example, one expert stated that improved technologies such as fixed fire extinguishing systems<sup>3</sup> require that crews have the knowledge and proficiency to ensure that proper precautions are taken when toxic chemicals are dispensed within any area of the ship. Experts from five of the six agencies also said training should include experience extinguishing actual fires because it clearly imparts to all shipboard fire fighters the physical limitations of crew and equipment, the importance of always wearing protective gear, and the need to keep equipment in good working condition.

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## **U.S. Efforts to Improve Standards Do Not Address Crew Fire Fighting Training**

Within the last year U.S. representatives at IMO have promoted a more comprehensive review of international training standards, but they have not focused attention on the need for improved crew fire fighting training standards. As a result of a U.S. proposal in 1992, the IMO Subcommittee on Standards of Training and Watchkeeping has agreed to expand the original agenda for its March 1993 meeting, which was to focus on incorporation of modern training and certification issues primarily related to navigation into the Standards on Training, Certification, and Watchkeeping (STCW) convention. The subcommittee's agenda has now been broadened to make a more comprehensive review of the entire STCW convention and proposed amendments to it and to extend the target completion date of this review to 1996. Under this proposal all subcommittee representatives, including the U.S. group headed by Coast Guard personnel, are working to develop a

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<sup>3</sup>Fixed fire fighting systems can dispense extinguishing chemicals, such as carbon dioxide, within the space in which the system is located.

comprehensive list of items that will be presented in March 1993 for discussion of proposed standards to be added to the STCW convention.

In 1992 the United States submitted proposals to the IMO subcommittee concerning training of crew members on various types of vessels, including passenger ships. These positions were discussed at the January 1993 meeting of the U.S. Working Group on Standards of Training and Watchkeeping. However, the U.S. submission on training of passenger vessel crews focused on providing more specific provisions on the ability of crew members to communicate with passengers during emergencies; it did not address any other aspects of passenger vessel crew emergency training.

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## Conclusions

Fires aboard crowded cruise ships can pose a serious threat to the safety of both passengers and crew members. Unless crew members have adequate training and experience to take precautionary measures and use appropriate fire fighting tactics, lack of immediate and effective shipboard fire fighting response can have disastrous consequences. Recent casualty investigations and numerous Coast Guard cruise ship safety examinations have demonstrated numerous instances of inadequate fire fighting preparedness. Cruise ship officers and nonofficer crew members lacked both the proficiency and skill to respond quickly and effectively to shipboard fires, did not know how to or failed to use proper equipment and protective gear, lacked knowledge of effective fire fighting techniques, or displayed inadequate communications and supervisory control.

Moreover, because IMO has not established minimum or continuing qualifications to certify shipboard fire fighter proficiency, there will continue to be variations in the effectiveness of crew fire fighting aboard passenger vessels. Although IMO has recommended additional and more realistic initial training for all crew fire fighters, we believe cruise companies will continue to implement IMO's recommendations inconsistently, if at all, because the training is not mandatory. Past Coast Guard efforts to improve international safety standards through IMO have resulted in a number of significant upgrades in passenger vessel equipment and design standards. Because these efforts succeeded, we believe that the Coast Guard should continue to vigorously promote needed improvements in international cruise ship safety standards through IMO. However, because of the potential consequences of continued inadequate fire fighting preparedness aboard cruise ships, we believe that the Coast Guard

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should consider independent actions to enforce more stringent crew fire fighting training standards if IMO is slow to respond.

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## **Recommendations**

To improve passenger vessel crews' preparedness in fighting shipboard fires, we recommend that the Secretary of Transportation direct the U.S. representatives to IMO to propose that international conventions be amended to

- require that IMO-recommended basic and advanced shipboard fire fighting courses be made mandatory for all crew members assigned to fire squads;
- require that these courses be regularly updated and include experience extinguishing actual fires; and
- establish qualifications for certifying crew members responsible for shipboard fire fighting, similar to certifications currently required of lifeboat operators.

# Improvements Needed in Emergency Instructions to Passengers

Emergency information aboard cruise ships operating in U.S. ports is not always clear or sufficient to assist passengers during an emergency evacuation. Current international standards on emergency escape are limited and do not provide adequate guidance for ensuring that emergency information is clear and readily available. Both IMO and the Coast Guard have developed limited proposals to address the deficiencies in emergency information provided aboard passenger ships, but many of the problems we identified continue to go unaddressed.

## Emergency Information Is Inconsistent and Sometimes Inadequate

Because of the confusion and chaos that can often occur during shipboard fires, passengers need clear, conspicuously displayed emergency information to allow for rapid and orderly evacuation from cabins and common areas. However, existing international standards for emergency information aboard cruise ships provide few specifics on the amount or the content of emergency information required and contain no requirements for sign-posting of escape routes. These standards, contained in SOLAS, require that

illustrations and instructions in appropriate languages shall be posted in passenger cabins and be conspicuously displayed at muster stations and other passenger spaces to inform passengers of: (1) their muster station;<sup>1</sup> (2) the essential actions they must take in an emergency; and (3) the method of donning lifejackets.

SOLAS also requires that emergency information be “clear” and “exhibited in conspicuous places throughout the ship including the navigating bridge, engine-room and crew accommodation spaces.” Beyond this guidance, however, SOLAS provides no other specifications to assist in standardizing the content, amount, or format of emergency information provided aboard cruise ships.

We found that ship owners and operators often had to use their own judgment in deciding what constitutes adequate emergency information. With the help of a human-factors engineering consultant, our examination of the emergency information provided by the eight cruise ship companies we contacted found three problems that could inhibit safe passenger evacuation:

- Emergency symbols and terms used were often inconsistent and unclear.

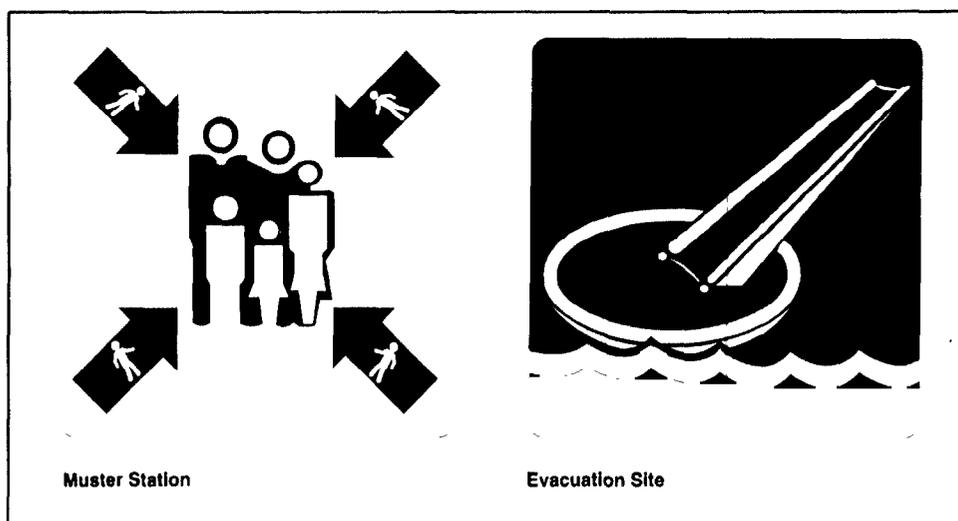
<sup>1</sup>An emergency gathering area for passengers, which is often away from the lifeboat boarding areas, designed to allow the crew to account for the presence of all passengers and to prepare and lower lifeboats unhindered.

- Evacuation and other emergency information presented in passenger cabins was not always conspicuous or clear.
- Effective signs and escape route diagrams were not routinely used in public areas and stairwells.

### **Symbols and Terms Are Inconsistent and Unclear**

Consistent, easily understood symbols may be more important than any other aspect of emergency information on a cruise ship, because passengers may come from a variety of cultural backgrounds and speak several different languages. In 1987 IMO recommended a set of emergency symbols for such items as muster stations or evacuation slides but did not require their use. Some of the companies had responded by adopting these symbols, while others had not. We found that three of the eight companies used only some of the recommended symbols along with nonrecommended symbols, while three others did not use IMO-recommended symbols for such things as muster stations and lifeboat boarding areas.

**Figure 4.1: Examples of IMO-Recommended Emergency Symbols**



Source: IMO Resolution A.603(15) on Emergency Symbols.

A 1990 study of emergency information and practices aboard British ferries, conducted after an at-sea accident killed over 190 persons, underscored the importance of using symbols consistently. The study

found that only 55 percent of ferry passengers surveyed could correctly identify the IMO symbol for a muster station and only 30 percent could correctly identify the symbol for an evacuation slide (see fig. 4.1). The study concluded that to increase passengers' knowledge, the use of IMO's emergency symbols should be required rather than recommended.

Like symbols, emergency terms need to be consistently used and should clearly depict the emergency function they represent. IMO has not recommended the use of standard emergency terms, but current international standards use nautical terms such as "muster station" and "embarkation station" to identify emergency gathering and lifeboat boarding areas. However, the companies we contacted often used a variety of terms interchangeably on the same ship to indicate emergency gathering areas and locations for boarding lifeboats:

- Five companies used several different terms, including "assembly station," "emergency station," or "lifeboat embarkation station," sometimes interchangeably, to identify an emergency gathering and/or lifeboat boarding area.
- Five companies used emergency terms in the signs posted throughout the ship that were inconsistent with or not used in the emergency information posted inside cabins. For example, one cruise line used the single term "muster station" in the emergency information provided in passenger cabins but used several different terms in signs posted elsewhere on the ship, including "emergency assembly stations" and "lifeboat stations."
- Three of the eight companies acknowledged that the use of multiple or nautical terms to refer to emergency assembly locations may be confusing to passengers. One company, for example, said it now uses the term "lifeboat station" to indicate both an emergency gathering area and a lifeboat boarding area, primarily because it felt "muster station" and "embarkation station" were not commonly understood terms for most passengers.

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**Cabin Information Is**  
**Sometimes Inconspicuous**  
**or Unclear**

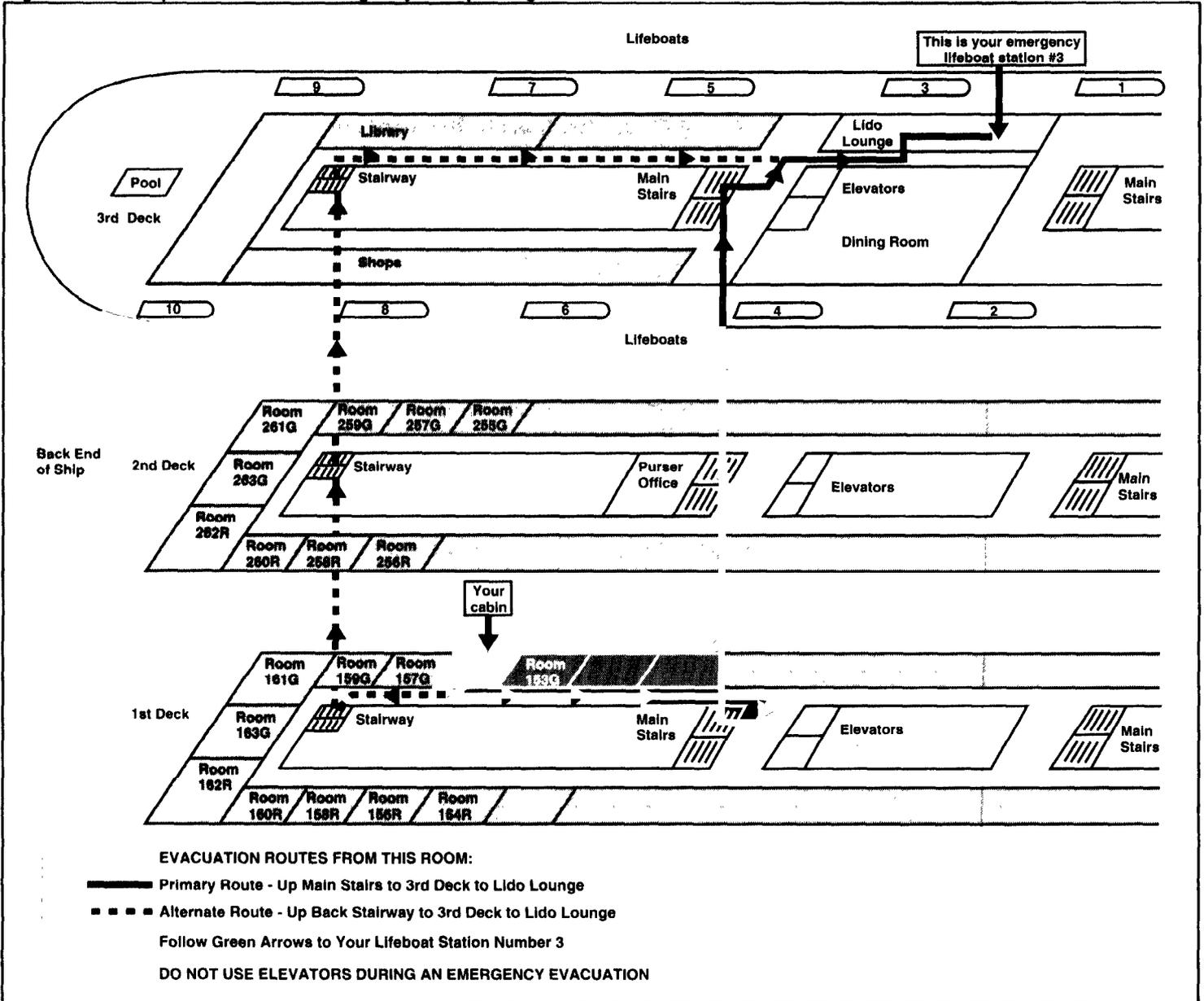
Conspicuous emergency information in passengers' cabins is critical because, according to our consultant, cabins are the only location on many cruise ships where information about a passenger's assigned emergency stations and/or lifejacket is provided. While all eight companies provided emergency instructions inside passenger cabins, these instructions were sometimes inconspicuously displayed. For example, emergency instructions provided aboard two ships we visited were posted inside a closet or on the inside of a bathroom door. According to our consultant,

such information (1) should be immediately visible to a passenger preparing to leave the cabin in case of emergency and (2) should not force the passenger to enter or open another compartment. Six companies provided additional emergency information through in-cabin brochures or booklets, but this information was sometimes included along with miscellaneous information on shipboard entertainment or other activities not related to safety and was not easily distinguishable from the non-safety-related information. Again, our consultant noted that emergency information should be immediately accessible to a passenger, and distinguishable from all other information, to facilitate a quick and effective response.

Graphics such as diagrams of emergency routes are particularly important in presenting emergency information clearly, because most people can understand and remember them more easily than explanations in words. To be effective as part of an emergency information system, graphics need to indicate the passenger's location in relation to emergency stations and provide more than one route of escape, as shown in figure 4.2. Only three of the eight companies included a diagram of the ship's layout in their cabin instructions, and none of these showed the cabin's location in relation to emergency stations or routes of escape.

**Chapter 4  
Improvements Needed in Emergency  
Instructions to Passengers**

**Figure 4.2: Example of Effective Emergency Escape Diagrams**



**Instructions in Public  
Areas and Stairwells Are  
Limited**

To help passengers reach safety from locations other than their cabins, it is important that stairwells, lounges, dining rooms, and other public areas of a ship have signs that are displayed at frequent intervals and are easily discernable from other types of information. If diagrams are used, they

need to show the routes of escape in correct relation to the particular location on the ship. However, most of the eight companies we contacted did not meet these criteria. On the basis of our discussions with cruise company officials, our review of emergency information they provided, and physical observations made during visits to cruise ships, we identified the following problems:

- Only one of the eight companies posted directional and other emergency information in all stairwells and near elevators at every deck level. Missing, for example, on several ships we visited were warnings against using elevators during an emergency and instructions on how to open or close heavy fire screen doors, which are designed to impede the spread of fire and smoke, but which may also block routes of escape. None of the eight companies we contacted displayed site-specific diagrams in all stairwells to provide passengers with a clear orientation of their location and escape routes.
- Only two of the eight companies displayed written emergency instructions in passenger lounges, casinos, or other common areas of the ship. One of these two companies, however, posted the same information that was in passenger cabins in dining halls and lounges—information that instructed passengers to put on the life jackets located in their cabins. Sending passengers from a public space on an upper deck to cabins on a lower deck may place them in danger, or may be impossible due to narrow stairwells crowded with passengers going in opposite directions.
- None of the eight companies provided site-specific diagrams in public areas showing escape routes to emergency stations.

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## **More Comprehensive Approach Needed by Coast Guard**

While IMO has recognized that current standards pertaining to emergency information need improvement, its response has been limited. In 1991 IMO circulated a proposed new standard among member nations, "Safety Instructions to Passengers," in an effort to provide more specific recommendations on emergency information provided to passengers in broadcasts, notices, and signs. However, these proposed recommendations fail to address many of the problems we identified in emergency information provided aboard cruise ships. For example, while the proposal recognizes that "the majority of passengers will have very little knowledge of the layout of the ship on which they are travelling or of the purpose or location of the Muster stations," it still allows the use of nautical terms for these essential stations. Furthermore, the proposal acknowledges that "the display of simple plans showing 'you are here' positions and decks to which passengers have access, will also be of

assistance to passengers in identifying decks," but it provides no specific requirements about which areas of the ship such diagrams should be displayed in and whether or not escape routes should also be shown. This lack of specificity increases the possibility that emergency information on some ships will continue to be inconsistent and inadequate. In addition, IMO's proposal is limited solely to emergency signs and instructions provided to passengers and does not address several other critical factors affecting emergency escape, such as crew assistance and access to multiple escape routes.

In response to some of the weaknesses in IMO's Safety Instructions proposal, the U.S. Coast Guard presented a proposal for improving these emergency information standards at the February 1993 meeting of the IMO Subcommittee on Life-Saving, Search and Rescue. The Coast Guard's proposal improves on IMO's earlier proposal by identifying the need to provide emergency instructions geared to different situations, such as discovering a fire or abandoning the ship, and by providing samples of such instructions to help standardize their format and contents. However, the Coast Guard proposal contains many of the same weaknesses of current and proposed IMO emergency information standards, including the following:

- The proposal retains the nautical terms "muster station" and "embarkation station" for emergency stations. According to our consultant, replacing these terms with a single, more easily understood term, such as "lifeboat station," may help passengers' understanding.
- The proposal contains the same vague guidance currently provided by IMO standards for many emergency signs, but it gives much more specific measurements for other types of shipboard information. For example, the proposal states that muster station signs "should be of such size and so located at the muster station that they are readily apparent to passengers and the muster stations themselves clearly identifiable." Yet, the proposal provides exact size specifications for cabin numbers, stating they "should be at least 20 mm high and posted on the door approximately 1.2 meters above the deck."
- The proposal calls for a conspicuously posted emergency diagram showing passenger position and routes of escape in cabins and on every deck, but it does not call for such diagrams to show location of emergency stations and be posted in all public areas and stairwells. Given the evacuation difficulties encountered in previous fires, this additional step appears warranted.

In September 1992 a Coast Guard official presented a draft paper entitled "Emergency Escape Arrangements for Passenger Ships" for discussion by the Coast Guard working group on Lifesaving, Search and Rescue standards. This paper, described by Coast Guard officials as a "very rough draft," supports taking a more comprehensive approach to emergency instructions within the context of the ship's entire emergency escape "system." This system includes several interrelated subjects, including crew assistance in emergency situations, ship equipment and layout, and emergency information. For example, it provides specifications and design standards on visibility, legibility, readability, contrast, and other critical features of effective emergency signs and information. Although the paper does not address some of the deficiencies noted in other proposals, such as requiring nonnautical emergency terms, it takes a much more comprehensive approach to many shipboard emergency standards that are currently being developed by separate IMO subcommittees. However, as of February 1993 the paper had not been submitted to IMO because it was still under review by the Coast Guard Headquarters Human Factors Coordination Committee, according to Coast Guard officials. The officials stated that the paper was still being reviewed because of concerns that its contents might conflict with proposals related to emergency escape issues being developed by other Coast Guard groups, such as a proposal on low-level lighting that the Fire Protection standards working group submitted to IMO in February 1993.

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## Conclusions

Conditions associated with shipboard fires and other major emergencies make it imperative that emergency information is adequate to allow quick and independent passenger evacuation from cabins and other common areas. Emergency evacuation information that does not use clear and consistent symbols and terminology, that is not clearly and conspicuously displayed in passenger cabins, and that fails to use adequate amounts of graphics and signs throughout the public areas and escape routes on the ship, may confuse passengers and make it more difficult for them to independently find their way to safety.

Since IMO standards on passenger information and other aspects of emergency evacuation systems are often limited or vague, emergency information provided aboard cruise ships is inconsistent and not always adequate. IMO and the Coast Guard have recommended additional standards on passenger safety instructions and signs, but they have not adequately addressed emergency information as one factor within the

broader context of an effective emergency evacuation system. The Coast Guard has developed a more comprehensive approach to improving inadequate standards by proposing clear and more specific requirements on emergency information to passengers, as well as several other factors that make up an effective emergency evacuation system. We believe the Coast Guard's draft proposal on "Emergency Escape Arrangements for Passenger Ships" represents a significant improvement over those currently being considered. However, additional work among the various Coast Guard groups working on the international safety standards addressed in this proposal is needed before this "system" approach to emergency information and escape can be promoted at IMO. Further development and support for the Coast Guard's "Emergency Escape Arrangements for Passenger Ships" proposal can significantly improve the adequacy of emergency information and evacuation procedures provided aboard cruise ships.

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## **Recommendations**

We recommend that the Secretary of Transportation direct the U.S. Coast Guard to

- develop a coordinated position that incorporates the efforts of the various Coast Guard groups working on emergency escape standards and promote this more comprehensive "system" approach at IMO and
- ensure that the Coast Guard's "Emergency Escape Arrangements for Passenger Ships" proposal addresses deficiencies identified in other proposals by requiring the use of (1) a single standard of emergency symbols and nonnautical emergency terminology, (2) more specific measurements to assist in the standardization of emergency escape requirements, and (3) emergency diagrams in all public areas, stairwells, and emergency stations.



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