



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 21, 1998

In reply refer to: M-98-31 through -41

Admiral Robert Kramek
Commandant
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Washington, D.C. 20593-0001

Early on July 27, 1996, while the Panamanian cruise ship *Universe Explorer* was en route from Juneau, Alaska, to Glacier Bay, Alaska, with 1,006 people aboard, a fire started in the main laundry near an open fire door next to a stairway. Dense smoke and heat spread upward to a deck on which crew accommodation quarters were located. Five crewmembers died from smoke inhalation and 55 crewmembers and 1 passenger sustained minor or serious injuries. Sixty-nine people were transported to area hospitals, where 13 of the injured were admitted for further treatment.¹ The total estimated damage to the vessel was \$1.5 million. As a result of its investigation of this fire, the National Transportation Safety Board identified several safety deficiencies, which are listed below. The analysis also raised questions about the toxicological testing criteria, namely the lack of specificity in the *Code of Federal Regulations* (CFR).

The major safety issues identified in this accident were, in part, the following:

- Adequacy of shipboard communications;
- Adequacy of fire prevention, detection, and control measures;
- Adequacy of company emergency procedures; and
- Adequacy of oversight, including the control verification examination (CVE) procedures of the Coast Guard.

In this accident, when the watch officer on the bridge received the first fire alarm, he immediately instructed the fire watch to verify the presence of a fire as required by company procedures. After the fire watch was below deck, the bridge watch officer radioed him a second time via UHF radio but heard no response, although the fire watch did receive and acknowledge the transmission using his UHF radio. When the fire watch realized that his radio transmissions were ineffective from his location, he tried to telephone the bridge with a report of smoke conditions, but the telephone line was busy. Upon hearing the announcement to report to emergency stations, the fire watch then went to his muster station, never reporting his observations to the watch officer on the bridge. Thus, the *Universe Explorer* suffered a

¹For additional information, refer to Marine Accident Report—*Fire On Board the Panamanian Passenger Ship Universe Explorer in the Lynn Canal Near Juneau, Alaska, July 27, 1996* (NTSB/MAR-98/02)

communications breakdown during the early phase of this emergency, not only because the type of instrument used was ineffective, but also because the fire watch did not follow effective procedures, failing to pass on essential information to the bridge.

The *Universe Explorer* is typical of passenger vessels whose steel structure results in "dead spots" where UHF radios become ineffective. Had the fire watch, who was acting alone, been seriously injured or trapped and in need of assistance, he could not have notified the bridge. Additionally, had he had vital information about the progress of the smoke, the fire, or the safety of people on board, he could not have transmitted it to the bridge. The Safety Board therefore found that the UHF radio did not provide the communications capability to ensure the safety of the fire watch, which, in turn, was needed to ensure the safety of passengers and crewmembers.

The Safety Board is aware that the U.S. Navy has addressed the problem of effective internal shipboard radio communications by installing an internal radio antenna network throughout its vessels. This type of system eliminates dead spots, enabling crewmembers to carry out communications with no interruptions. In the Board's opinion, it is absolutely essential that personnel who may be going into harm's way be able to receive and transmit messages from anywhere inside a vessel during an emergency.

The fire occurred immediately below the hospital, forcing the ship's doctor and nurses to evacuate immediately. The *Universe Explorer* medical staff had only one radio, which meant that the nurses repeatedly had to go to the doctor to determine where their assistance was most needed. The lack of effective communications interfered with the medical staff's ability to render treatment to injured passengers and crewmembers. Had each member of the medical staff had a radio and a separate frequency on which to communicate so as not to interrupt other emergency transmissions, the doctor and nurses could have conferred over the radio without having to leave patients; as a result, many injury victims could have been treated sooner.

Because the first fire alarm was triggered by a heat detector, smoke from the main laundry fire on the *Universe Explorer* probably began spreading upward to the crew berthing area before the bridge received the first alarm. The delay in the bridge watch's closing the magnetic fire doors in combination with the crew's compromising the effectiveness of some fire doors by tying them open allowed a massive, lethal amount of smoke to quickly accumulate in the crew accommodations area, trapping a number of crewmen in their quarters. Their cabins lacked telephones or other means of communication with which they could signal their location or call for help. Crewmen tried to signal their need for assistance by waving a towel out of a porthole, by banging on walls, and by yelling for help; however, their efforts were ineffective. Because of the vessel's steel construction, noises either migrated or were not audible, making it difficult for rescuers to accurately determine where the trapped crewmen were located. Rescuers did not find several trapped crewmen until more than 2 ½ hours after the fire started. Had some stranded crewmen not found a room with a porthole, the number of fatalities would have been higher.

The Safety Board has been a proponent of emergency call systems in passenger staterooms on cruise ships for several years; in a 1993 special investigation report² concerning passenger ship accidents, the Board issued Safety Recommendation M-93-39 asking that the Coast Guard “analyze the desirability and feasibility of equipping passenger staterooms with an emergency call system by which trapped passengers can signal their plight.” The Coast Guard ultimately advised the Safety Board on August 6, 1996, that it had discussed the desirability and feasibility of installing emergency call systems in passenger staterooms with the U.S. Safety of Life At Sea (SOLAS) Working Group on Fire Protection and, based upon that discussion, determined that “an additional emergency call system would not improve passenger-to-crew communications and would require additional maintenance.” The Safety Board then classified Safety Recommendation M-93-39 “Closed—Unacceptable Action” because the Coast Guard did not perform the requested analysis.

As mentioned earlier, when the fire watch tried to contact the bridge by telephone, he got a busy signal. The Safety Board notes that the *Universe Explorer* had telephones in passenger staterooms. Had passengers been trapped and tried to use their telephones, they likely would have had similar difficulties. As this accident demonstrates, all accommodation areas should have a means by which individuals can signal their locations during a fire emergency to facilitate rescue operations. Even a simple system, such as the flight attendant call button system used on commercial airlines, would probably be sufficient to signal a location.

A number of factors adversely affected survivability on this ship. During the Safety Board’s postaccident examination of the laundry, investigators observed that a bulkhead isolating the laundry area from the stair towers had been removed. The presence of the bulkhead would not have prevented a fire from starting; however, it would have mitigated the propagation of smoke, thereby affording the crew a better chance for survival.

Records show that the vessel now known as the *Universe Explorer* was built in 1958 as a combination passenger/cargo ship, has been owned by a number of companies, and has undergone a number of major modifications. The present vessel operator indicated that the main laundry bulkhead was removed with the approval of the American Bureau of Shipping (ABS) during a conversion completed in the early 1970s while the vessel was being operated by another company. However, classification and inspection authorities have no record of granting approval for removal of this bulkhead.

This accident therefore raises questions about the adequacy of the ABS survey and Coast Guard control verification procedures and the resulting thoroughness of their inspections. According to Coast Guard documents, its inspectors currently check a foreign-registered passenger vessel’s approved plans when the vessel first enters service in the United States or when it undergoes a major structural modification. In the case of the *Universe Explorer*, the vessel happened to first enter U.S. service as a foreign passenger ship during a 5-year period when the Coast Guard did not require a plan review as part of the initial CVE.

²For additional information, read Special Investigation Report—*Accidents Involving Foreign Passenger Ships Operating from U.S. Ports 1990-1991* (NTSB/SIR-93/01)

Since the late 1980s, the Coast Guard regularly conducted annual and quarterly CVEs of the *Universe Explorer*. The Coast Guard's *Navigation and Vessel Inspection Circular No 1-93* does not specifically describe how and to what extent inspectors should check fire boundaries. For example, instructions for the quarterly CVE state that the extent of the vessel examination is "at the discretion of the attending inspectors" and is determined by the observed condition of the ship. Instructions for a general walk-through stipulate only that the inspectors should check the engine room, machinery spaces, and accommodation spaces.

On July 20, 1996, one week before the fatal fire, Coast Guard inspectors conducted a quarterly CVE during which they held a fire drill in the main laundry, yet they did not notice that the bulkhead shown on the fire control plan was not in place. This raises the question of whether the inspectors even referred to the plan in the course of conducting the drill. The Safety Board concluded that the Coast Guard plan review and examination procedures of foreign passenger vessels do not adequately address the need to verify structural fire protection boundaries. What particularly disturbs the Safety Board about the missing bulkhead is that it was shown as being in place on the fire control plan, a document that is critical for firefighting. This case therefore highlights the need for the Coast Guard to periodically verify that vessels are maintained in accordance with approved plans as part of the agency's CVE program.

When Safety Board investigators examined the main laundry after the fire, they noted that the smoke detectors were not connected to the fire detection system. The only active fire detection devices in the area were heat detectors. Records do not indicate why the smoke detectors were disconnected. However, from discussions with people experienced in laundry operations, fire experts, and detector manufacturers, the Safety Board determined that moisture, dust, and lint in the air of a laundry facility can trigger smoke detector sensors, resulting in false alarms, unless the devices are maintained appropriately. Heat-actuated detectors require more time than smoke detectors to actuate because a minimum level or minimum rate of heating must occur in the area of the device's sensor before the detector activates. The limitations of each type of detector could be reduced by establishing systems using both types of devices. Moreover, combining the system of detection with an automatic sprinkler system would provide a greater measure of safety by limiting the spread of fire.

The Safety Board is aware of present methods for verifying the reliability of fire alarms, such as cross zoning, and of detection systems that are in development, such as infrared or ultraviolet detectors. Given the high fire risk of laundry spaces, it is essential that ship owners and operators be made aware of reliable ways for monitoring such areas.

Records indicate that on the morning of the accident, all fire doors were closed within a few minutes of the first fire alarm. Nevertheless, soot and debris patterns observed during the postaccident examination indicated that the fire doors, while open, had allowed the smoke and heat from the fire to enter the stairway, which then served as a flue, transmitting smoke and hot gases upward to other decks. At the top of the stairway, the open fire door allowed massive quantities of smoke to enter the break no. 1 passageway and migrate into the crew berthing area.

Had the doors leading from the main laundry to the stairways automatically closed when the fire started, the smoke and heat of the fire probably would have been contained within the boundaries of the main laundry long enough for crewmembers to have been warned of the fire and to have escaped from their berthing area. The Safety Board concluded that had automatic closure of the fire doors been incorporated in the fire detection system, the fire doors in the area where the fire broke out would have shut immediately when nearby detectors activated, thereby restricting the spread of lethal amounts of smoke to the crew berthing areas.

The Board identified the need for automatic closure of fire doors long before this incident. As a result of its investigation of the August 20, 1984, fire on board the Bahamian passenger ship *Scandinavian Sun*,³ the Safety Board issued safety recommendations asking that the Coast Guard propose to the International Maritime Organization (IMO) that SOLAS 74 be amended to require the integration of fire detectors with fire doors (M-85-60) and the fire control system (M-85-61). The Coast Guard concurred and submitted the proposals at the February 1986 meeting of the IMO Fire Protection Subcommittee, which took no action on them.

In a 1989 safety study,⁴ the Safety Board superseded Safety Recommendations M-85-60 and -61 with Safety Recommendations M-89-124 and -125, asking the Coast Guard to propose that the IMO, in part, require passenger ships operating from U.S. ports and embarking U.S. passengers to have a centralized automatic/manual fire control system integrating the fire detector, automatic fire door controls, ventilation systems controls, and general alarm into a unified system (M-89-124) and integrated heat and/or smoke detectors with automatic fire door release switches (M-89-125).

In 1992, the IMO enacted amendments to the SOLAS 74 fire safety regulations that included improved measures for fire doors. Requirements contained in Chapter II-2 stipulate that new passenger ships must have fire doors capable of remote and automatic release from a continuously staffed central control station, as well as from a position at both sides of each individual door. Further, SOLAS Regulation 41-2 requires that the stairway enclosures, main vertical zone bulkheads, and galley boundaries on existing passenger vessels be fitted with self-closing fire doors capable of being released from a central control station and from each door.

The Safety Board reviewed the amendments to SOLAS 74, considered the measure requiring remote release from a centrally manned location to be in compliance with the intent of the recommendations, and classified Safety Recommendations M-89-124 and -125 "Closed—Acceptable Alternate Action." Following its investigation of the *Universe Explorer* fire, the Board has reconsidered its opinion. As this accident demonstrates, having a central station initiate the closure of fire doors does not afford the maximum measure of safety and can result in delays that prove fatal.

³For additional information, read Marine Accident Report *Fire Onboard the Bahamian Passenger Ship M/V Scandinavian Sun, Port of Miami, Miami, Florida, August 20, 1984* (NTSB/MAR-85/08).

⁴For additional information, read Safety Study—*Passenger Vessels Operating from U S Ports* (NTSB/SS-89/01)

Based upon interviews with crewmembers, the Safety Board identified several deficiencies in the on-board emergency procedures, including the adequacy of the crew emergency drills and the methods used to locate the fire and trapped crewmembers.

The *Universe Explorer* conducted weekly crew emergency drills as required by SOLAS. The drills did not include, and were not required to include, identifying alternate escape routes from cabins and work sites. The berthing area where the fatalities occurred was forward of the crew galley and most work areas. Consequently, when crewmembers were alerted to the fire, they reacted according to habit in attempting to escape. They first tried to walk aft but could not continue because the increasing intensity of the heat and smoke forced them to turn around to find alternative escape routes. Although they had several other means of escape 50 to 60 feet away, locating an exit quickly in the dense smoke conditions was difficult. The position of the deceased crewmen's bodies in the passageways indicates that they probably were overcome by the heavy, toxic smoke while trying to find an escape route.

The 1995 amendments to the Standards for Training Certification and Watchkeeping Convention that became effective February 1, 1997, recognize the need for improved survival training. The amendments require that before being assigned to shipboard duties, crewmembers who are new to a seagoing ship must receive familiarization training in survival techniques or receive sufficient information and instructions to be able to perform certain tasks, including identifying emergency escape routes and muster and embarkation stations. Although the Safety Board is pleased by the training requirements for new employees, it is concerned that individuals newly assigned to a ship, who have to familiarize themselves with numerous other vessel operations, may not assimilate all or may forget some of the information provided to them. Based on its findings from this accident, the Safety Board determined that crewmembers need periodic training in survivability that includes information and/or drills about alternate routes of escape.

Following the emergency broadcast to the crew, the ship's two fire teams assembled, donned protective gear, and marshaled firefighting equipment. The safety officer took charge of the search for the fire while the staff captain directed efforts to search the crew berthing area. Despite the prompt action, the searches did not result in timely location of either the fire or the trapped crewmen.

The search for the trapped crewmembers was disorganized and ineffective. The staff captain initially directed one fire team member to don breathing equipment and to search the crew area alone, which was ill-advised and dangerous. The lone searcher encountered fallen crewmen whom he could not aid and heard calls for help from people whom he could not locate. He reported his findings to the staff captain, who, along with another team member, went below deck with the first searcher to remove the fallen crewmen. However, the staff captain did not immediately order other fire team members to find the trapped crewmen. The lack of systematic effort and the delay in rescuing trapped crewmembers demonstrate that the *Universe Explorer* crew was not adequately prepared to conduct rescue operations. The Safety Board concluded that if the vessel had had a properly equipped rescue team that was trained in locating and recovering people trapped in smoke-filled areas, the crewmen probably would have been rescued sooner and would have sustained less severe injuries; moreover, fewer crewmen may have died.

In addition to the major safety issues discussed above, the Safety Board had concerns about the toxicological testing that warrant discussion. Following this accident, company officials did not designate any crewmember for testing until late July 27, 1996, and only then at the request of Safety Board investigators. Specimens were not collected from the individuals designated for testing until at least 34 hours after the accident. Crewmembers who were tested showed no indication of having used drugs or alcohol. In this case, however, the fire watch, who was known to have been in the main laundry within 20 minutes of a fire detector activating in the area, was not tested for either drugs or alcohol.

In reviewing the regulatory requirements for testing, the Safety Board found that the wording in the CFR regarding who should undergo postaccident toxicological testing is not specific. The regulations at 46 CFR Subpart 4.06 state that following a serious marine incident "the marine employer shall take all practicable steps to have each individual engaged or employed on board a vessel who is directly involved in the incident chemically tested for evidence of drug and alcohol use" and to ensure that specimens are collected "as soon as practicable." The term *individual directly involved in a serious marine incident* is defined at 46 CFR subpart 4.03-4 as "an individual whose order, action or failure to act is determined to be, or cannot be ruled out as, a causative factor in the events leading to or causing a serious marine incident." The Safety Board found that, in the absence of specific criteria, an immediate determination of the individual(s) directly involved in a serious marine incident who should be considered for drug and alcohol testing is sometimes difficult and that procedures are needed to ensure that such identification and subsequent testing is conducted in a timely manner.

Therefore, the National Transportation Safety Board recommends that the U.S. Coast Guard:

Propose to the International Maritime Organization that passenger ships be required to institute procedures, upgrade equipment, or do both to establish reliable internal radio communications from anywhere inside a vessel during an emergency. (M-98-31)

Recommend to the International Maritime Organization that passenger and crew cabins on cruise ships be required to be equipped with an emergency call system so that people trapped during a fire emergency may have a means of signaling their location. (M-98-32)

Conduct research with the passenger ship industry and the National Fire Protection Association on the adequacy of heat and smoke detectors for use in high-fire-risk areas, including laundry spaces, of passenger ships and, based upon your findings, propose to the International Maritime Organization equipment or procedural guidelines for improving the reliability of fire alarms. (M-98-33)

Propose to the International Maritime Organization that passenger ships be required to integrate heat and/or smoke detectors with automatic fire door release switches so that the doors in the immediate area of the fire will close automatically when the detectors are activated. (M-98-34)

Propose to the International Maritime Organization that periodic instruction or drills on alternate escape routes be provided to all crewmembers on passenger ships to reinforce the familiarization training required of new seafarers by the 1995 Amendments to the Standards for Training Certification and Watchkeeping Convention. (M-98-35)

Propose to the International Maritime Organization that specially trained and suitably equipped rescue teams be required on board all passenger ships. (M-98-36)

Recommend to the International Maritime Organization that passenger ship companies be required to equip each on-board medical staff member with a portable radio with a dedicated frequency for use during an emergency. (M-98-37)

Revise your control verification examination procedures to include a more detailed review of structural fire protection features on board foreign passenger ships. (M-98-38)

Require that each foreign passenger vessel operating from U.S. ports periodically undergo a complete plan review and vessel examination to verify that it is being maintained in accordance with approved plans. (M-98-39)

In cooperation with maritime industry representatives, establish criteria for identifying those individuals who should undergo drug and alcohol testing after a serious marine incident, and establish procedures to ensure that such identification and subsequent testing is conducted in a timely manner. (M-98-40)

Submit a copy of the National Transportation Safety Board's report of the fire on board the *Universe Explorer* to the International Maritime Organization for distribution and discussion. (M-98-41)

Also, the Safety Board issued Safety Recommendations M-98-42 through -57 to New Commodore Cruise Line, Ltd., and to V. Ships Marine, Ltd., M-98-58 through -67 to the International Council of Cruise Lines, and M-98-68 to the American Bureau of Shipping.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By 
Jim Hall
Chairman