M-415A

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 21, 1998
In reply refer to: M-98-42 through -57

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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 estimated total damage to the ship was $1.5 million.

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

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[1]For 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)*.

The *Universe Explorer* is typical of passenger vessels whose steel structure results in "dead spots" where UHF radios become ineffective. In an emergency situation, it is absolutely essential that personnel who may be going into harm's way be able to receive and transmit messages. 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, the safety of the crew, or the safety of the passengers, he could not have transmitted it to the bridge. In this accident case, the National Transportation Safety Board concluded 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 the passengers and the crew. The Board determined that had the *Universe Explorer* been equipped with an internal radio antenna network, which eliminates dead spots, radio communications would have been more effective during the emergency.

During this emergency, when the second officer received no response to his transmissions, he did not initiate measures to determine what had happened to the fire watch. For his part, the fire watch did not advise the bridge about his status or the conditions on the Main deck and left his fire patrol post without first communicating with and obtaining permission from the watch officer. The Safety Board determined that internal communication procedures used during shipboard emergency responses, particularly the communication between the bridge watch and fire watch when the latter is sent to investigate a fire alarm, need to be improved.

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.

Fire conditions prevented the medical staff from accessing the medical supplies stored in the hospital. The bridge maintained an emergency medical kit, but it did not contain oxygen to treat the crewmembers who sustained smoke inhalation injuries. The Safety Board determined that the circumstances of this accident point out that the *Universe Explorer* should have an auxiliary store of medical equipment and medicine for use in emergencies should the hospital become inaccessible.

Smoke from the main laundry fire on the *Universe Explorer* probably began spreading upward to the crew accommodations area before the bridge received the first fire alarm. Because of the delay in the bridge watch's closing the magnetic fire doors and because crewmembers compromised the effectiveness of some fire doors by tying them open, a massive, lethal amount of smoke quickly accumulated in the crew accommodations area, trapping a number of crewmen.

The method I construction used in building the *Universe Explorer* is designed to confine a fire to its compartment of origin by the use of structural fire boundaries. Fire screen doors are

an important feature of these fire boundaries because they maintain the fire integrity when closed. In the Board's view, closing the fire doors ought to be the first action taken on a method I ship when a fire alarm activates. To do otherwise allows more time for the heat and smoke of a fire to escape from its compartment of origin and to spread to other parts of the vessel. In this instance, the first alarm sounded at 0259, and the doors were not closed until 0305. If the watch officer had immediately closed the fire doors when the bridge received the first fire alarm, the amount of smoke that ultimately reached the crew berthing area may have been significantly reduced. The Safety Board concluded that the *Universe Explorer*'s operating procedures that the watch officer is supposed to follow when a fire alarm activates are less than adequate to ensure the timely establishment of fire boundaries restricting the spread of heat and smoke.

However, in this case, even if the bridge watch had closed all doors when he received the first alarm, conditions still might have been perilous because the main laundry was fitted with heat detectors instead of smoke detectors, the fire was next to the stairwell, and the doors to the crew berthing corridors were tied open. Together, these factors contributed to a rapid spread of smoke before the first heat detector actuated. Therefore, the nature of this fire demonstrates that 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.

Had the fire doors leading from the main laundry to the stairways automatically closed when the fire started, the smoke and heat of the fire would probably 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 of the *Universe Explorer*, the doors near the fire would have shut immediately when nearby detectors activated, thereby restricting the spread of lethal amounts of smoke to the crew berthing areas.

The crew 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 steel construction of the vessel, noises either migrated or were not audible, making it difficult for rescuers to accurately determine where trapped crewmembers were located. Rescuers did not locate 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. However, had they had a means, such as an emergency call system similar to the flight attendant call system used on commercial airlines, by which they could signal their location, rescuers could have determined that location and helped them sooner, thereby reducing the number and severity of injuries to the trapped crewmen and exposing the search teams to fewer risks.

Other factors adversely affected fire detection and control on the *Universe Explorer*. At the time of this accident, the main laundry on the *Universe Explorer* was not equipped with, and was not required by the *Safety of Life at Sea* (SOLAS) Convention to have, an automatic fire sprinkler system. In this fire a tremendous, lethal amount of smoke was produced when the many layers of paint on the stairwell bulkheads ignited. If the main laundry of the *Universe Explorer*

had been equipped with automatic sprinklers, they probably would have activated and extinguished the fire during its early development, preventing or at least mitigating the spread of smoke and flames into the spiral stairway. The Safety Board concluded that if the *Universe Explorer* had been equipped with an automatic sprinkler system, the large quantities of smoke and resulting loss of life may have been avoided.

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. Based on its findings, the Safety Board concluded that greater fire protection can be attained in laundry facilities by using a combination of different types of detection devices, as well as an automatic suppression system.

The Safety Board is aware of other fire detection systems that are in development, including infrared and ultraviolet flame detectors and carbon monoxide detection systems. Some of these systems are currently available, and others are still being tested. Investigative research at the National Fire Academy has shown that using an alarm verification reset feature and cross zoning of fire detectors significantly reduce random false alarms and increase the reliability of fire detectors.

Given the high fire risk in laundry operations, improvements in the methods used to monitor such areas are essential. Conventional fire surveillance consists mainly of smoke and heat detectors. However, other methods are available that could augment passive sensory devices. Safety aboard the *Universe Explorer* could also be improved by instituting improved surveillance measures, such as installing video cameras in high-fire-risk areas.

One of the specific duties assigned to the fire watch was to ensure that all fire screen doors were not blocked or lashed open. Soot deposits and remnants of twine indicated that some fire screen doors were lashed open during the fire. The Safety Board therefore determined that the fire watch's execution of assigned duties and the safety officer's oversight of the fire watch were less than adequate and need to be improved.

Based on surveys of passengers and interviews with crewmembers, the Safety Board identified some deficiencies in on-board emergency procedures.

Some survey respondents stated that the passenger fire drill consisted of providing them with instructions on how to don a life preserver and on how to locate their muster stations. A large majority of those responding indicated that passengers were not told what to do should they

see a fire or smell smoke. Passengers were particularly critical of the lack of information provided about the fire doors. About one-fourth of the responders characterized the drill as unrealistic because many passengers who knew the scheduled time of the drill went in advance to their lifeboats, using the elevators to reach their stations. One passenger complained that the drill did not prepare him to locate his life preserver because it had been placed on his bunk for the drill when he first arrived at his stateroom, whereas it was stowed in his room when he needed it during the actual emergency.

To have the maximum effectiveness, fire drills should be as realistic as possible. The content of the drill on the *Universe Explorer* left many passengers unprepared to meet the demands of the actual fire emergency. Allowing passengers to use elevators to reach their assembly stations during a drill does not prepare them to identify a safe route of escape. Further, not requiring passengers to observe approved safety procedures during drills may lead them to attempt the same shortcuts during the actual emergency, perhaps with tragic results. When dealing with a large group—in this case, 732 passengers—undoubtedly some individuals will become agitated or frightened during an actual emergency. When events occur for which passengers are not prepared, such as magnetic doors suddenly slamming shut, the likelihood increases that they will panic. Such reactions clearly support the need for passenger fire drills and for placards in staterooms that contain adequate instructions about fire emergencies. To be effective, a drill must provide passengers with the basic information, including:

- how to report a fire;
- what to expect if a fire occurs, such as typical announcements, actions of the crew, operation of the emergency lights, and operation of fire doors;
- the location and meaning of emergency signs;
- the description of emergency signals;
- if incapacitated, how to call for assistance; and
- the route to take from their stateroom to their assembly area.

Passengers indicated that they were not adequately informed about the progress of the emergency while they were at their muster stations, although announcements were made over the public address system asking them to remain calm. They said they were never told how long they might have to remain at the assembly areas. Further, they felt that someone in authority, such as the master or another officer, should have given them status updates. One passenger stated, "There was no communication from the ship's captain or any officer of the crew until several passengers challenged an official from the cruise line to inform us of the situation, 4 to 5 hours after the initial fire."

During an emergency, it is vital to passengers' peace of mind to receive periodic information about the status of the situation, particularly any progress in overcoming a threat to safety. Further, receiving such reports from a recognized authority figure, such as the ship's master, is more reassuring. Understandably, the master's and officers' primary concern was to

extinguish the fire. Nonetheless, providing periodic assurances to passengers during prolonged emergencies is important so that order and discipline can be maintained.

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. They said the heavy smoke stung their eyes and severely limited their visibility, requiring that they feel their way along the corridors until they found an exit. Although they had several other means of escape 50 to 60 feet away, locating an exit quickly 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 safety officer used a trial-and-error method, first alone and then with a fire team leader, to locate the fire. On the *Universe Explorer*, even the most stoutly constructed fire boundary is designed to prevent the passage of heat and smoke for only 60 minutes; therefore, timely location of a fire is paramount. Although ultimately successful, the men did not find the fire for 30 to 45 minutes. During this time, the fire continued to burn freely, producing increasing amounts of toxic smoke. Had the safety officer organized a more methodical approach, assigning one or more search teams to check out possible avenues simultaneously, the fire probably would have been located sooner.

The search effort to find the trapped crewmembers was also disorganized and ineffective. The staff captain directed one fire team member to don breathing equipment and search the crew area. The lone searcher said that he encountered intense and blinding smoke, saw the fallen

crewmembers, and heard people calling for help but saw nothing but smoke. He returned to the staging area, whereupon the staff captain directed a second team member to join the first searcher and return to remove the fallen crewmen. However, they did not immediately initiate follow-up actions to find the trapped crewmen.

Again, having a lone individual—in this case the fire team member—search an area of a vessel during a fire was ill-advised and dangerous. The searcher could have needed help himself or could have encountered people who needed assistance that was beyond the ability of one person to provide. The delay and lack of systematic effort in rescuing trapped crewmembers demonstrates that the *Universe Explorer* crew was not adequately prepared to conduct rescue operations. The Safety Board concluded that if the *Universe Explorer* 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.

As described in greater detail earlier in this letter, company policies and procedures were less than adequate in a number of areas, including emergency response procedures, employee oversight, communications equipment and procedures, fire drills, fire locating procedures, and search and rescue.

Company representatives indicated that shoreside officials periodically visit the ship to confer with vessel officers and attend classification society surveys and U.S. Coast Guard examinations. In the Board's opinion, these actions alone are not sufficient to provide adequate management oversight and to ensure effective fire safety aboard the vessel. These meetings typically exclude personnel who are not in upper shipboard management. Effective management oversight must extend beyond upper shipboard managers to include personnel from all levels in the shipboard organization. Only through inclusion may commitment to safety be attained at all levels of the shipboard organization. If more effective management oversight of safety had been exercised on the *Universe Explorer*, crewmembers would not have compromised the effectiveness of the fire doors by tying them open, the fire watch would have been more mindful that he needed to report his findings to the watch officer, and the watch officer would have been more concerned about the safety of the fire watch. The company needs to foster the attitude among crewmembers that fire safety is preeminent in vessel operations and that their actions directly affect the safe operation of the ship. Moreover, better oversight measures are needed to improve the level of fire safety on the *Universe Explorer*.

Therefore, the National Transportation Safety Board recommends that the New Commodore Cruise Lines, Ltd., and V. Ships Marine, Ltd.:

> Improve the means of radio communications between shipboard command and emergency responders and among emergency response groups on board your passenger ships. (M-98-42)

> Review and, if necessary, revise shipboard communication procedures to ensure that watch officers and the fire watch maintain effective communications at all times, especially when the fire watch enters a suspected fire area. (M-98-43)

Equip crew cabins on company passenger ships with an emergency call system so that people trapped in their cabins during a fire emergency can signal their location. (M-98-44)

Modify the fire control systems on company passenger vessels, integrating heat and/or smoke detectors with automatic fire door release switches. (M-98-45)

Provide each member of the medical staff on board company passenger ships with a portable radio for use in shipboard emergencies. (M-98-46)

Review the adequacy of the fire detection systems presently protecting high-fire-risk areas, including laundry spaces, on board company passenger ships, and, based on that review, install improved detection systems or institute improved surveillance procedures to improve fire detection capability. (M-98-47)

Implement procedures to improve the oversight of the fire watch on board company passenger ships. (M-98-48)

Review and revise as necessary the operating procedures followed by the navigation watch officer to ensure that fire screen doors are closed immediately upon receipt of a fire alarm. (M-98-49)

Revise passenger fire drills and stateroom placards to advise passengers what to expect in a fire emergency. Include an explanation that fire doors shut automatically and instructions for opening them. (M-98-50)

Revise procedures for announcing emergency status updates to passengers assembled at muster stations so as to assuage their concerns. (M-98-51)

Provide periodic instruction or drills on alternate escape routes to all crewmembers on company passenger vessels to reinforce the familiarization training required of new seafarers by the 1995 Amendments to the Standards for Training Certification and Watchkeeping Convention. (M-98-52)

Establish improved procedures for crewmembers to follow in locating fires on board company passenger ships. (M-98-53)

Establish for each company vessel a rescue team dedicated to locating trapped passengers and crew during a fire emergency, and provide the team members with recurrent search and rescue training. (M-98-54)

Review the contents of passenger vessel emergency medical kits to ensure they contain adequate medical supplies to meet an emergency, such as the fire on board the *Universe Explorer*. (M-98-55)

Address the safety issues identified in this report in the safety program that you are developing for compliance with the International Safety Management Code. Further, increase the shoreside management's oversight of fire safety conditions on board your vessels by initiating the following measures, at a minimum, periodic fire safety vessel examinations and periodic instruction for the ships' crews on maintaining a fire-safe vessel. (M-98-56)

Immediately install automatic sprinkler systems in accommodation areas, service areas, stairway enclosures, and corridors on company ships. (M-98-57)

Also, the Safety Board issued Safety Recommendations M-98-31 through -41 to the U.S. Coast Guard, M-98-58 through -67 to the International Council of Cruise Lines, and M-98-68 to the American Bureau of Shipping.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-42 through -57 in your reply. If you have any questions, you may call (202) 314-6455.

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

By: Jim Hall
Chairman